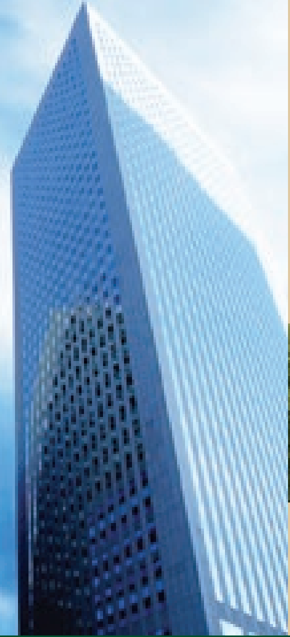

ICCREM 2015

Environment and the Sustainable Building

Edited by
Yaowu Wang, Ph.D.
Thomas Olofsson, Ph.D.
Geoffrey Qiping Shen, Ph.D.
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ENVIRONMENT AND THE SUSTAINABLE BUILDING

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Preface

We would like to welcome you to the 2015 International Conference on Construction and Real Estate Management (ICCREM 2015). The Conference is jointly organized by the Harbin Institute of Technology, Luleå University of Technology, North Dakota State University, Hong Kong Polytechnic University, China Construction Fourth Engineering Division Corp, Ltd, Queensland University of Technology, Louisiana State University, Heriot-Watt University, University of Alberta, National Central University and Karlsruhe Institute of Technology. The Construction Institute (CI) of the American Society of Civil Engineers (ASCE) and the Modernization of Management Committee (MMC) of the China Construction Industry Association (CCIA) are co-sponsors of the ICCREM 2015. The 2015 Conference is a continuation of the ICCREM series which have been held annually since 2003.

The ICCREM 2015 aims to create an international platform for researchers, educators, and practitioners from colleges and universities, research institutes, government agencies, consulting firms, construction companies, financial institutions and other related organizations to exchange ideas, share knowledge, build networks, and explore future potentials in construction and real estate industries. The conference proceedings include 132 peer-review papers covered nine important subjects. These subjects are: Global Construction Management; Information Technology Application in Construction; Sustainable Construction and Innovation; Land Use and Urban Management; Project Management; Risk Management; Real Estate Investment, Finance and Management; Construction Enterprise Management; and Facility Management, Infrastructure Construction and Management. We believe that the ICCREM 2015 will be invaluable to construction professionals in advancing their career.

It was a pleasure and an honour to organize and host ICCREM 2015 and we want to emphasize that the success of the conference would have not been possible without the contributions of members of the Organizing Committee, the Scientific Committees, and the Conference Secretariat. We also want to express our gratitude to all authors and reviewers for their contributions. In closing, we hope that you enjoy the conference and catch up with old friends and colleagues and make new ones.

Professor Yaowu Wang
Harbin Institute of Technology
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Professor Thomas Olofsson
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Towards a Knowledge-Based Engineering Methodology for Construction

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Abstract

The increasing industrialization and standardization of construction opens up for the field of design automation, and possibilities to work with several what-if-conditions and several product candidates instead of just one or two during design. Design automation applications for building component and infrastructural part design are starting to appear using software from the manufacturing industry. A challenge is however to develop such construction design automation applications since comprehensive methodologies are missing. MOKA is a methodology for developing knowledge-based engineering (KBE) applications originating from the aerospace and automotive industries. KBE is a label for computer-based automation of routine design tasks. This paper describes methodologies for developing design automation applications in construction, compares these with the MOKA methodology, and discusses the opportunities and challenges of having a KBE methodology for construction.

INTRODUCTION

Some of the most important decisions are taken during construction design as these decisions directly impact producibility or buildability. These decisions depend extensively on design team experience, an experience that too seldom is available to other engineers, as experienced people are busy with little time to share their knowledge or these engineers get promoted and change positions or project. Design automation applications can show the design change impact on e.g. cost, equipment availability, staff capabilities and buildability and also help designers reuse successful solutions from earlier work instead of reinventing the wheel for every project. Thanks to automation it becomes easier to generate several solutions and trying different what-if-conditions than when done manually. An issue is that many construction companies are not aware of the potential of design automation. Within the manufacturing industry a lot of work has been done to develop design automation applications see e.g. Verhagen et al. (2012). The term knowledge-based engineering (KBE), has become a label for automating routine design work within the manufacturing industry. It is named “knowledge-based” because knowledge from engineers is captured, formalized and implemented into a computer-based design automation application. Typically design automation applications feature both fully automated tasks as well as semi-automated tasks that require user-interaction and often feature computer aided design and engineering systems. Stokes (2001) defines KBE as ‘the use of advanced software techniques to capture and re-use product and process knowledge in an integrated way’. Automating chains of engineering activities is not new; this has been used by engineers since the early developments of computer-aided modelling and simulation (Dixon 1995; Begg 1984). Examples of KBE applications from the latest decades are e.g. (Chapman and Pinfold 1999; Sandberg et al. 2005; La-Rocca 2012).

Examples of KBE-like design automation applications have started to emerge within construction e.g. (Jensen et al. 2012; Sandberg et al. 2008), but a comprehensive methodology for design automation application development is absent within construction. Such methodology should be hands-on and describe how to choose tasks to automate, how to capture knowledge, formalize knowledge and implement the knowledge in computer software. This makes it hard for companies to know what tool to develop and how to develop it, especially for companies with little or no experience in design automation, apart from the usual hinder for change which is that most companies are too busy with their everyday tasks. Additionally for researchers it is hard to reproduce research and build on ideas due to lack of details in the papers regarding how the design automation application was created.

For KBE applications development, MOKA (Methodology and software tools Oriented to Knowledge based engineering Applications) is one of the more comprehensive methodologies (Stokes 2001). A related methodology is Common KADS that focus knowledge-based systems development which is more general and sometimes more artificial intelligence related applications. KBE applications usually have geometry, configuration and engineering knowledge (Lovett et al. 2000).

Since there are differences between the construction industry and the manufacturing industry in terms of e.g. less process focus, less level of digitalization, less standardization, MOKA cannot directly be adopted since this methodology focuses how to support repetitive and routine design work which requires high level of industrialization and standardization. This paper describes methodologies and approaches for KBE and design automation within the manufacturing industry and the construction industry, analyses these approaches and discusses opportunities and challenges for increased use of KBE within the construction industry.

METHODOLOGIES AND APPROACHES FOR DEVELOPING KNOWLEDGE-BASED ENGINEERING AND DESIGN AUTOMATION APPLICATIONS

MOKA. MOKA is the most comprehensive methodology for KBE application development although other less detailed methodologies exist, e.g. (Lovett et al. 2000). The focus of MOKA is to describe how to capture engineering knowledge and implement it into a KBE application (Stokes 2001). It was developed to aid Europe to catch up with the USA and the Far East regarding KBE applications for mechanical design. MOKA contains six phases which are shown in Figure 1. CAPTURE and FORMALIZE are the most elaborated phases although the other phases also are explained.

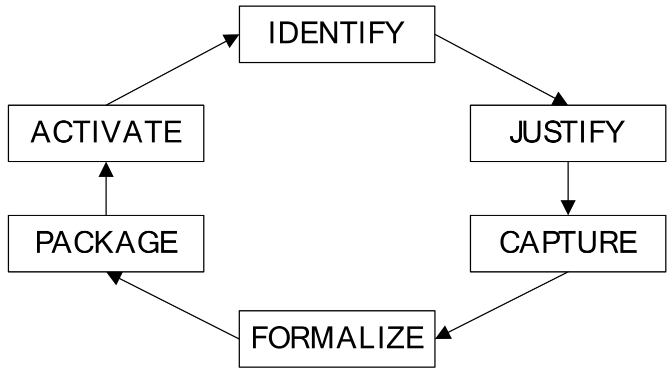

Figure 1.The MOKA phases, adapted from Stokes (2001).

IDENTIFY determines objectives, scope and a concept level technical specification for the design automation application. JUSTIFY examines commercial, cultural and technical risks. CAPTURE collects the raw knowledge and structures it into the Informal Model. FORMALIZE translates the Informal Model into the Formal Model. PACKAGE involves translating the MOKA Formal Model into code for a KBE application. ACTIVATE involves distribution, installation and use. In the CAPTURE part ICARE (Illustration, Constraint, Activity, Rule, Entity) forms are used to document engineering knowledge. A special developed modeling language, the MOKA Modeling Language is used to FORMALIZE the captured knowledge.

Approaches used in construction. Here the approaches used to develop a number of design automation applications in construction are described.

Jensen et al. (2012) have developed a floor-slab application and argue that manufacturing CAD software can be used for design automation within the construction industry. The approach used for the application development is described as: Firstly a multi-skilled engineering team was assembled that together with a building manufacturer defined constraints and requirements for the building system. Secondly a modular system was developed based on the constraints and requirements. Design rules was defined and implemented into a floor-slab application. Lastly the application was evaluated by undergraduate students.

Sandberg et al. (2008) presented a support tool for stair and structural floor design and used a development approach that started with choosing a design scenario and tool functionality, acquiring knowledge, formalizing the knowledge into rules and implementing the rules into an application.

A decision support system for concrete building design method selection has been reported by Chen et al. (2010). The support system was developed according to the following approach: Firstly interviews with clients, developers, engineers, contractors and precasters were done to collect data about how they make decisions. Secondly this data was verified and formalized into relationships that could be used to select method for concrete building design.

Artificial intelligence has also been used to develop decision support in construction, e.g. Kaklauskas et al. (2007) who presented an application for choice of windows. Firstly other decision support systems were analyzed which guided the development of the presented decision support system that consists of a database, database management system, model-base, and model-base management system and user interface. The system was then tested for usefulness.

Cheng et al. (2008) report on a tool for decision-making and assessment of high-rise building systems. Firstly the implicit decision-making procedure was documented and therefore made more explicit. Secondly the procedure was assessed and verified.

Attia et al. (2012) present a support tool for early design of zero-energy buildings. First barriers, requirements and expectations were identified and then a tool was developed to meet these. The tool was then tested twice for validity and usability respectively.

Semper II is an internet-based performance simulation tool for early building design (Lam et al. 2004). The tool is described extensively but the approach or methodology used for its development is neglected rather saying that it was developed using a bottom-up approach.

Overarching methods and principles for construction. Some papers suggest more overarching frameworks for IT (information technology) implementation. As part of their change management, Henderson and Ruikar (2010) suggest how to overcome construction-specific factors that influence technology implementation in construction. They suggest, among others, being clearer about expected outcomes of the IT implementations as well as having continuous communication, training and education in the organization.

Miozzo et al. (1998) presents an IT-enabled process strategy for construction. In their framework they analyze a generic construction process and couples design process problems with suitable IT support.

Stewart et al. (2002) presents a strategic implementation framework for information technology and information systems (IS) projects to increase the digitalization of construction. The framework contains of a six step process: 1) SWOT factors, 2) SWOT analysis, 3) IT/IS (IS-information system) diffusion strategy 'story telling', 4) operational strategy, 5) implementation strategy 'action plans', 6) monitoring plan.

Li (1997) outline success factors for knowledge-based support tools namely: User involvement (e.g. support tool project initiation, user interface design), problem difficulty (e.g. availability of expertise for the construction problem), developer's skill (e.g. ability to extract knowledge from construction experts), shell characteristics (e.g. flexibility, usefulness) and management support (e.g. commitment, encouragement from management to use support tools, appropriate financial resources).

COMPARISON WITH MOKA

As seen in the previous section design automation application papers rather focus on the resulting tool rather than the approach used during the application development. The approach is often mentioned too briefly to be of any use for repetition of the research or for guidance of industries that need applications to be developed. The reviewed design automation papers from construction are compared with each MOKA phase.

Identify. Parts of this phase are mentioned by Attia et al. (2012), Jensen et al. (2012) and Stewart et al. (2002) although it is unclear how much focus lies on stating clear business objectives, checking whether knowledge, needed for the application, already exist and briefly how it could be captured, checking what software and hardware that exist for the possible application and evaluating if design automation is suitable at all. Sometimes the knowledge changes rapidly, domain experts disagree on key points, experts are unable or unwilling to describe their product or process knowledge, knowledge is vague and decision are made in a subjective way why design automation is not suitable (Stokes 2001). This is particularly important for construction since the activities can be unstructured and done in different ways for each project.

Justify. The Justify phase cannot be found at all in the cited references although estimating the resources needed for implementation as well as creating a plan probably have been done. One important part of Justify is to gain managerial acceptance for the design automation application as well as defining criteria for how to assess success or failure of the application. This can imply measuring the current time it takes to perform the design task manually.

Capture. Acquiring knowledge for the application is described, although briefly, by several. Chen et al. (2010) mention interviews, Cheng et al. (2008) documentation of procedures, and Sandberg et al. (2008) knowledge acquisition. More details than that are not mentioned. Here MOKA offers ICARE forms to collect your knowledge into what represents a so called informal model. Here more forms or modification to the forms could be needed to work better for construction. However, using the five current forms may be enough time-demanding.

Formalize. Tasks that relate to the Formalize phase is formalization into relationships (Cheng et al. 2008), development of modular system (Jensen et al. 2012) and rule definition (Sandberg et al. 2008) but no further details are described in the papers. This part is supported by the MOKA modeling language which is used to transform the informal model into the formal model.

Package. Jensen et al. (2012) and Sandberg et al. (2008) implemented the design rules into an application. But then again, the details are not described. This phase is also very dependent on the chosen software and hardware system.

Activate. This phase includes finding debugs and enhancements of the application. Attia et al. (2012), Jensen et al. (2012) and Kaklauskas et al. (2007) briefly mention test or evaluation as part of their application development process.

CHALLENGES AND OPPORTUNITIES FOR A KBE METHODOLOGY FOR CONSTRUCTION

The papers that were compared to MOKA partly had some similarities although the papers had little details regarding method used to develop the applications. Experienced researchers in the KBE and design automation field usually have developed their own more or less systematic approaches to create applications. A first step is for them and every researcher in this field to shift focus slightly from the structure and performance of the applications to start describing more details about how the applications were developed. This could create input to a bottom-up development of a methodology. The research field would also benefit from more details because this would make reuse and building on previous research much easier. Reuse is seldom described in literature but techniques and methods of the presented applications often seem to overlap. Also sharing code is important for making reuse easier.

Since KBE is most suitable for standardized routine work, MOKA probably works for construction design tasks that fulfill that plus the other requirements such as knowledge availability, organizational readiness, hardware and software availability. But before this can be stated, MOKA needs to be tested for several design automation application development within construction. Also doing a larger literature survey listing current approaches used, is needed.

Will a generic methodology be used by researchers and companies? This is an important issue, especially since the construction industry is known for being slow to embrace innovative IT/IS applications (Stewart et al. 2002). However there are ideas to overcome obstacles related to IT changes in construction (Miozzo et al. 1998). One important part is to involve the future users in the development and implementation phase of the application. This could mitigate the fear of uncertainty and the resistance to change (Henderson and Ruikar 2010).

It is hard to create a generic and detailed methodology that works for everything. One idea is to enable every field of construction to have their own specialization; buildings, roads, bridges etc. Also the level of standardization and industrialization may need different specializations. A methodology could have overarching parts that are shared between the specializations. The overarching parts could help companies to start develop their own design automation applications and the more experienced they become, the higher is the possibility for companies to create their own specializations.

CONCLUSION

There is a need for a comprehensive methodology for developing KBE (design automation) applications for construction. This would help companies to create KBE applications but also help researchers to reuse other researcher's results. Current design automation research focus too much on the application itself rather than describing the way the application was developed. Approaches used are for a number of design automation research papers within construction are compared with MOKA, which is a methodology for KBE application development from the manufacturing industry. Results show that there are similarities although it is hard to compare due to the lack of details in the papers. This paper suggests trying MOKA for a several design automation projects in construction to find out how well this methodology works. Also all future researchers writing about design automation applications in construction are encouraged to write more about how their applications were developed. Then we can start collect approaches and modify MOKA into a useful methodology for construction.

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Maintenance Management: A Case Study of the Obstetrics and Gynecology Building in Al-Shifa Hospital in the Gaza Strip

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Abstract

The existing health buildings in the Gaza Strip hospitals lack of adequate maintenance. This is due to several reasons, such as lack of funding, lack of qualified well trained staff, and lack of staff motivation. Most public hospital buildings are in poor conditions. The aim of this paper is to present a case study regarding the maintenance of the obstetrics and gynecology building in Al-Shifa hospital in the Gaza Strip. It was observed that the old age building, high occupancy of patients, and lack of periodic maintenance resulted in many problems in the building, such as water leakages through cracks, corrosion of pipes, wet areas in walls and ceilings, and medical gases installation. Corrective maintenance action was used in this case such as removing the existing network pipes and install new one, painting pipes, construct internal walls and ceilings. Several advantages were resulted from the maintenance of this building such as providing healthier place for patients, changing many rooms' functions for better use, and increasing the capacity of building to receive more patients. This has led to a better health care services and improved patients' recovery.

INTRODUCTION

The Ministry of Health (MoH) in Gaza Strip is considered the main provider of health services (primary and secondary health care). MoH believes that the Palestinian people deserve the best health services and its sustainability in all health facilities which can be achieved by improving the quality of the medical staff, maintain the health facilities buildings in good status and expanding the capacity of health facilities. Gaza Strip is located at the southwestern part of Palestine with a total area of $360\,km^2$. According to Palestinian Central Bureau of Statistics, Gaza Strip has a total population of 1,588,691 capita and natural increase of population rate (3.3%). These numbers indicates that health sector must cover all the patients in Gaza Strip governorates (North, Gaza, Middle, Khanyonis and Rafah). Ministries of health care facilities are classified as follows: primary health care (clinics), and secondary health care (hospitals).

There are five main health care providers in Palestine: Ministry of health

(MoH), United Nations Refugee Works Agency (UNRWA), Non-Governmental Organizations (NGOs), Palestinian Military Medical Services (PMMS) and Private sector. According to the Ministry of health report, MoH bears the heaviest burden, as it has the main responsibility. In the West Bank there are (669) primary health centers operated by four main providers, while in the Gaza Strip there are (147) primary health centers distributed as follow: MoH operates (54) primary health care centers, UNRWA operates (20) primary health care centers scattered in eight refugee camps in the Gaza Strip. The NGOs sector operates (66) primary health care centers and general clinics in Gaza Strip, where PMMS operate (7) primary health care centers and clinics in Gaza Strip. The hospital services are operated by the government and non-government organization. There are (81) hospitals in Palestine; (51) in West Bank and (30) in Gaza Strip.

There are 30 hospitals in Gaza Strip, 13 of them are public hospitals which are administrated by the Ministry of Health. The 13 hospitals are distributed into 5 governorates in the Gaza Strip, these are: North, Gaza, Middle, Khanyonis and Rafah. The hospitals are grouped into three types: general, specialized and maternity. The hospitals are categorized into small size, big size and complex according to the MoH. Small means hospital capacity in beds equal or smaller than 100 beds, big means hospital capacity in beds equal greater than 101 bed, while complex indicates that there are more than specialized hospitals. The maintenance departments are centered in the five main governorates, each center are responsible for the maintenance services in the nearby geographic location hospitals and primary health care centers in the governorates.

LITERATURE REVIEW

Hospital represents perhaps the most difficult group of largely public sector buildings to maintain, because of their complex engineering services (Zawawi et al. 2010). It is recognized that since poor maintenance practices lead to more frequent breakdowns, which may cause anything from inconvenience to catastrophe, maintenance has to be more reliable, more efficient, and more cost effective (Ikhwan and Burney 1999). In the past few decades, researchers had realized the importance of maintainability of buildings in achieving cost savings and better functioning of facilities (Silva et al. 2004). Management of any process involves assessing performance, and maintenance management of buildings is no exception (Adenuga et al. 2007). A prime aim of building maintenance is to preserve a building in its initial effective state, as far as practicable, so that it serves its purpose effectively. The best way to achieve excellent maintenance is to have a maintenance management that matches as closely as possible the expected requirements of the user (Zawawi et al. 2011).

Maintenance is defined as the combination of all the technical and administrative actions, including supervision, intended to retain an item, or restore it to a state in which it can perform a required function. Horner et al. (1997) defined building maintenance as “work undertaken in order to keep, restore or improve every part of a building, its services and surrounds, to a currently accepted standard, and to sustain the utility and value of the building. Lam et al. (2010) said that in Britain, building maintenance activities have reached a level of

50% of all annual construction activities. Afolarin (2012) showed that historically, in both public and the private sectors, the maintenance is seen as an avoidable task which is perceived as adding little to the quality of the working environment, and expending scarce resources which would be better utilized. Dhillon (2002) mentioned that since the industrial revolution, maintenance of engineering equipment in the field has been a challenge.

Cooper and Jones (2008) defined the key factors that contributed to high levels of dissatisfaction of the approach to maintenance programs poor specification of initial requirements, unclear aims and objectives and inappropriate frameworks, an inability to predict long term cost requirements, variations in levels of experience of those conducting surveys, unrealistic claims by consultants selling survey services, inappropriate or unusable data, poor links to organizational objectives, and a lack of fit of survey data. Shah-Ali et al. (2010) concluded the most dominant factors affecting maintenance cost were building materials, building services, building age and failure to execute maintenance at the right time. Cobbinah (2010) reported factors as being responsible for the poor maintenance of public buildings: the age of the buildings, lack of maintenance culture, inadequate funds and high maintenance cost, pressure on building facilities by number of users and poor construction work and maintenance work done by maintenance personnel of the institution.

Maintenance is now recognized as tool to promote sustainability in buildings. Common types of building defects include: structural defects resulting in cracks or collapse, defective or faulty electrical wiring and/or lighting, defective or faulty plumbing; inadequate or faulty drainage systems, inadequate or faulty ventilation, cooling or heating systems, inadequate insulation or sound proofing, and inadequate fire protection/suppression systems. Additionally, dry rot, wood rot, mold, fungus, or termite or vermin infestation may also be the result of a building defect (Ahzahar et al. 2011). Humidity is a major source of problems in buildings worldwide. Moisture can damage the building structure, the finishing and furnishing materials, besides being a direct cause of human discomfort, high indoor humidity promotes mold growth, which can have adverse health impacts on the occupants (Lourenco et al. 2006). Building maintenance prepared through an accurate program of repeated maintenance plays a major role in preventing building defects.

Hospital buildings can be described as sophisticated public areas due to their functional organizations complexity and architectural configuration (Graip 2011). The increase in sophistication and complexity of medical services within the health service is reflected in the sophistication and complexity of buildings, their finishes, fittings, contents and services (Al-Zubaidi 1997). De-Ching et al. (2011) reported that there are several factors such as an increase in patient numbers, demands for more hospital beds, and expansion of hospital divisions, make the original hospital configuration inadequate, and additions or alterations must be added to the building in order to meet both current and future needs. Because hospitals cannot suspend all medical practices or reject patients, the reconstruction of hospital building must coincide with its normal hospital hours. According to Kennett (2006) hospitals are constantly renovating, whether they are just adding electrical outlets or communications cables, or engaging in more complex projects that involve moving functions and building additions to the existing structures.

OBSTETRICS AND GYNECOLOGY BUILDING IN AL-SHIFA HOSPITAL: A CASE STUDY

Introduction. Al-Shifa hospital is the biggest public medical institution in the Gaza Strip-Palestine. It is considered secondary health care delivery system and provides some tertiary care services for Gaza Strip population. It's located in the west part of Gaza. The hospital was established in 1946 on an area of over 45.000 m. sq. and it was developed over the years. Many new buildings were built in the hospital like radiotherapy department, burn department, and special surgery department. Till 2012 the hospital contained 590 hospitalization beds, distributed to internal medicine, general and specific surgeries, burn intensive care, obstetrics and gynecology and neonatal department. AL-Shifa hospital is comprised of 3 main buildings: surgical buildings, medical building and obstetrics and gynecology building beside paramedical services such as laboratory, radiotherapy, pharmacy, and physiotherapy. Each building has its own administrative team and each manager refer to his general director of hospital.

Project description. The description of the project is showed in Table 1.

Table 1.The Description of the Project.

Item	Content
Project name	Maintenance of second floor in obstetrics and gynecology hospital building
Location	Shifa hospital- Gaza city
Project value	$ 100,000.000
Owner	Ministry of Health (MoH)
Donor	Islamic Bank for development

Problem identification. Obstetrics and gynecology building is considered as one of the most important buildings in Shifa complex for its heavy daily services for Palestinian women. According to MOH report (92010) more than 21,000 babies have been born by the end of 2011 in Gaza city only. This number indicated the increase of demand on obstetric medical services in Shifa hospital. The old age building, high occupancy of patients and lack of periodic maintenance resulted in many problems in this building. Figures 1 and 2 illustrate a wide range of wet areas in walls and ceilings.

Staff in engineering and maintenance department have examined the building and reported the main problems, these were: Staining of tiles; Staining of ceiling boards; Water leakages through cracks; Water leakages through pipe penetration; Water leakages through joints; Corrosion of exposed drainage pipes; Paint peeling; Unevenness of tile surface; Bad plumping.

Then staffs in engineering and maintenance department have discussed with the medical staff the process of building rehabilitation and the following steps were taken into consideration: (1) Repair all damaged area; (2) Change functions of certain sections of the floor; (3) Build a new floor to have additional capacity of 6 operating rooms.

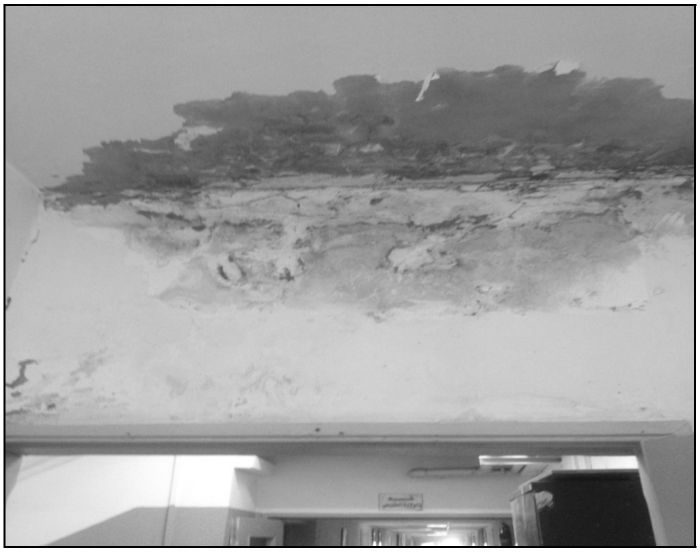

Figure 1.Wet areas in walls and ceilings.

Figure 2.Wet areas in floors and walls.

Corrective maintenance solution. The following actions were taken by maintenance staff as a corrective maintenance solution:

Removing existing paint from walls, columns and damaged ceiling areas till reaching plaster and preparing walls and ceiling for new painting (Figure 3).

Enlarging existing doors and windows openings.

Install and test electrically operated heavy duty elevator (1600kg, 21 passenger and speed $1\, m/s$), Figure 4 shows the preparation for the new elevator installation.

Removing existing tiles, skirting, cement and sand layers.

Add protection concrete around sleeves and pipes of electrical, sanitary and mechanical pipes and windows sills, external and internal lintels, parapets, canopies.


Figure 3.Preparing walls for maintenance.

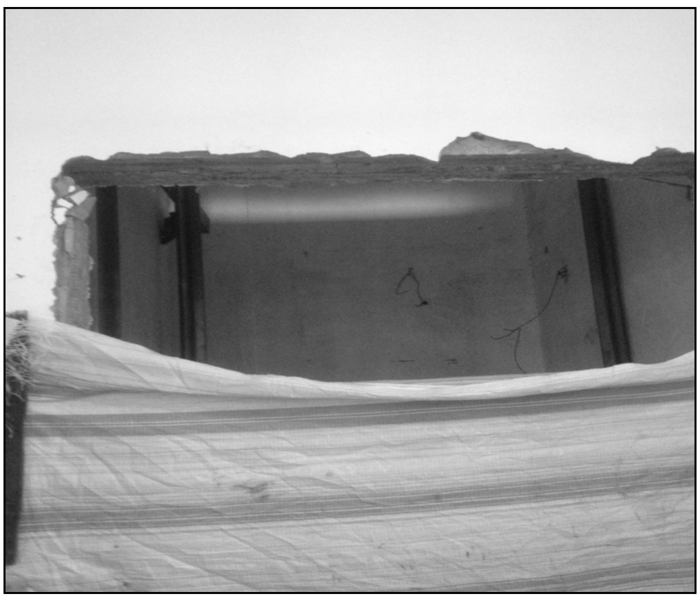
Figure 4.Installing new elevator.

All hardware for doors shall be original Italian. Doors should be fitted with handles.

Steel frames should be filled with fine aggregate mortar concrete, for fixation. Price of doors should include fixing two (Norista) kick plates and door stoppers.

Supply and install solid internal wooden double swing.

The door is priming and painting with Anti-Bacteria Painting type.

The steel works should include painting with priming and two layers of oil paint.

Repair any cracks using sec flex material.

Install drainage for rain water on all external sills.

Paint banderol primer coat and three coats palisade for the ceiling and internal walls height range (120-220cm) for corridors, stairs and rooms including a banderol layer, two layers of putty as minimum, one layer of primer undercoat and two layer of oil paint.

Install non slip porcelain floor tiles.

Change water network pipes with new pipes in the ceiling. Figure 5 shows the changed pipes.

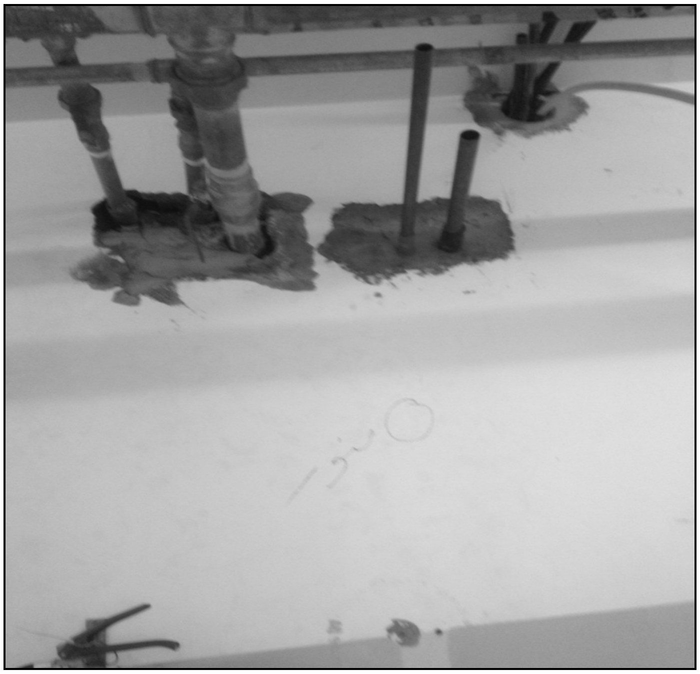

Figure 5.Changing water networks.

Lay antibacterial PVC sheet walls 1.6 mm for the rooms of operations

Lay antistatic PVC roll tiles 2mm for the rooms of operations

Anti-humidity and Anti-bacteria false ceiling (magnesium oxide silicate) 60x60cm should be fixed for the rooms of operation and recovery

Copper pipe should be installed for medical gases pipes (Figure 6).

CONCLUDING REMARKS

Maintenance of obstetrics and gynecology building (second floor) in Al-Shifa hospital in the Gaza Strip is considered an important step for improving health services. The most common building defects results from insufficient water and sewage network and the high occupancy of the building. After the building is maintained, many advantages have resulted: provide healthier place for patients, change many rooms' functions for better use and increasing of the capacity of building to receive more patients. This has led to a better health care services and improved patients' recovery. Corrective maintenance in obstetric hospital in Shifa complex was outsourced funding with local experience supervision from ministry of health. The finding of this practical case study which was conducted in the largest hospital in the Gaza Strip is crucial to other existing health buildings in Palestine and other developing countries in order to improve the maintenance management. The Ministry of Health (MoH) is advised to consider the main maintenance problems that were identified in this case study and to adapt the corrective maintenance solution that was successfully used in obstetrics and gynecology health building. The maintenance departments in the MoH are advised to consider proactive approach to reduce the occurrences of defects which will eventually improve the physical and functional public hospital services.

Figure 6.Medical gazes installation in ceilings.

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Embedding Corporate Social Responsibility into the Construction Process: A Preliminary Study

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Abstract

The environmentally and socially sensitive nature of construction activities calls for properly implementing corporate social responsibility (CSR) industry wide. Although CSR maps out the scope that business can contribute to the welfare of a wider community, few efforts have been put to its fulfillment on a construction site. The study presented in this paper proposes a framework for embedding CSR in the construction process with the intention of contributing to the attainment of sustainability. Research methods including case study and literature review were employed to interpret the suitability of embedding CSR in the construction process. Interview with professionals were thereafter conducted and based on the interview results, a conceptual framework for embedding CSR in the construction process was given. It is found that the connection between CSR and the construction process has not been aware of popularly in the industry. Although recent years have witnessed the widening popularity of CSR in construction, little attention has been drawn to CSR fulfillment on a construction site. The research findings shed some lights on CSR implementation in the area of sustainable construction.

INTRODUCTION

Subject to the distinctive impacts of construction activities on the physical environment and society, sustainable construction has been put highly on agenda since the Rio Earth Summit of 1992. It was reported that the built environment shares approximately 40 percent of total energy consumption, 40 percent of global material deployment and 25 percent of global waste (Mokhlesian and Holmén 2012). The Environmental Protection Agency (EPA) in the U.S. revealed that the construction industry generates the third highest Greenhouse Gas (GHG) emission among various industrial sectors. Such negative impacts of the built environment have unavoidably confronted construction firms with overwhelming pressure to pursue sustainable development as much as possible. For instance, MWH, a global construction contractor, employs cost-effective construction methods to meet clients' needs while do its best to preserve resources and to control pollution simultaneously. While contractors have taken some actions, it seems that they have not many ideas of how to attain sustainability in the construction process.

Sustainable construction process. A construction process consumes considerable energy and resources compared to other production processes (Sjöström and Bakens 1999). Most of the resources consumed on construction sites are non-renewable and some of them may even generate negative environmental effects at the early stages (Griffith 2011). A number of approaches have been proposed to improve the sustainability performance of the construction process. Koo and Ariaratnam (2008) devised a sustainability assessment model to determine the most sustainable option for a water main replacement project, and highlighted the importance of exploring all factors affecting sustainable construction process through its long life cycle. Ogwu et al. (2006a; 2006b) established a mathematic model for evaluating the sustainability of infrastructure projects in Hong Kong, and shed light on the pedagogical dimensions (e.g. knowledge, problem analysis, and application) of designing and constructing for better sustainability). Dasgupta and Tam (2005) synthesized the sustainability indicators of civil infrastructure system by using a multi-objective decision approach to facilitate the choice of practical alternatives. Furthermore, the work by Shen et al. (2002) demonstrates that a good concession time period underpinning infrastructure sustainability must deal well with the benefits, authorities and responsibilities between various project parties.

CSR in construction. The notion of CSR kicked off evolution in the 1950s, proliferated in the 1970s, and flourished in the 1990s (Golob and Bartlett 2007; Asif et al. 2011). This evolutionary process gained a stimulus of an ontological debate on what purposes business runs for. Along this trajectory, recent years have seen some increasing calls for corporate social responsibilities (CSR) and the growth of CSR research. The bulk of CSR studies mostly revolves around the impact of CSR on financial performance (Peloza 2006), measurement of CSR (Turker 2009), stakeholders (Jamali 2008; Becchetti et al. 2012), CSR indicators (Zhao et al. 2012), and reporting (Hou and Reber 2011). It seems that academicians' concerns over CSR have no longer centered on whether CSR is an imperative, but rather how to make it effective (Smith 2003).

CSR has been aware of with outspread concerns over environmental stewardship and ecological crises in the globe (Berger et al. 2007; Carroll and Shabana 2010; Abreu et al. 2012). Many international companies such as General Electric (GE), PepsiCo, Shell and Barclays have behaved CSR more actively than before. For instance, GE is highly involved in finding some sustainable solutions to benefit the planet, people and economic entities, such as compiling its eleventh annual global GHG inventory. ISO 26000: Guidance on Social Responsibility provides business with guidelines for the fulfillment of social responsibility. In 2010, the European Commission enforced some guidelines on CSR behaviors in the construction industry. The Ministry of Commerce of China commissioned Chinese International Contractors Association (CICA) to compile the Guide on Social Responsibility for Chinese International Contractors (GSRCIC). There are some other instructions available for contractors to follow, such as Social Accountability 8000, Global Compact Initiative, and ECS 2000 Standard.

CSR is a main component of sustainable construction (Plessis 2005), requiring contractors to fulfill CSR in line with the triple bottom lines of sustainable development. However, as evidenced by Petrovic-Lazarevic (2008), there arise some large construction companies in Australia that manage CSR matters actively such as work environment, occupational health and safety, relationships with suppliers, and commitment to the welfare of local community. These CSR activities are also found meaningful to UK's leading construction companies which also emphasize the importance of human resources, customers, governance and ethics in the area of CSR (Jones et al. 2006). Morton et al. (2011) unveiled the scope of CSR behaviors through using the delivery of educational activities to young people who would not otherwise choose a career in construction. Meanwhile, CSR scopes in construction, government policy, and corruption from an international perspective have been addressed in previous studies (Murray and Dainty 2009). As highlighted in these studies, CSR in construction is multidimensional and unique, construction firms ought to fulfil CSR in right ways.

A major problem with contractors' CSR engagement is the determination of CSR boundary. It is noted that although many contractors have put considerable efforts to synthesize CSR into organizational business, turning CSR principles into managerial duties is still divergent and controversial. Moreover, CSR has been undertaken largely by some large construction enterprises (Petrovic-Lazarevic 2008; Barthorpe 2010), but they rarely release how an overall CSR framework is separated into workable plans.

Research aims. Although sustainable construction has obtained closer attention of academicians and practitioners in the past decades, the sustainability performance of the built environment is lowly satisfied especially in many countries (Plessis 2007). CSR in the built environment has been examined at two levels-industry and organization, but how to engage in CSR along the construction process remains obscure. Contractors usually place a large portion of resources to achieve traditional project goals, while relatively fewer resources are deployed to fulfill CSR on a construction site. This has formed some barriers to a higher level of sustainability in construction. Fundamentally, the sustainability performance of the construction process is determined in part by some non-technical aspects that cannot be resolved simply through green construction approaches. Effective ways to improve sustainability performance of construction process have not been pinpointed at full length. Can the sustainability performance of a construction project be improved by implementing CSR? If yes, and how? The study presented in this paper addresses a conceptual framework for embedding CSR in the construction process.

METHODOLOGY

Research methods such as case study and interview were adopted firstly to recognize the potential link between CSR and construction activities. Literature survey and content analysis were thereafter conducted to propose a conceptual framework for embedding CSR in the construction process.

Case study. In the current century, many contractors worldwide behave in socially responsible ways in order to improve the sustainability performance of construction process. Five contractors in the world have been identified. They are Skanska Property Hungary Ltd (Hungary), Wates Group (United Kingdom), CIMPOR (Portugal), Coop Costruzioni (Italy), and CITIC Limited (China). Their behaviors typically related to CSR were identified from websites and publications as described below.

Skanska Property Hungary Ltd (Hungary): responds to the increasing demand for green construction, develops an eco-design tool to ensure its sites are energy efficient from a lifecycle perspective, and organizes a training program on environmental education for workers and contractors before starting working on construction sites.

Wates Group (United Kingdom): responds proactively to legislation, and develops a “zero targets” plan and a waste management plan for reducing and reusing waste on project sites.

CIMPOR (Portugal): implements a system to recover the waste heat from production gases to generate electricity, minimizes risks for employees and other stakeholders, and adapts its occupational health and safety management systems.

Coop Costruzioni (Italy): limits the use of subcontractors by fixing a limit to maximum number of subcontracting in production, and controls all steps of supply chain with the aim of having a greater control and an easier assessment of safety on all worksites.

Interview. The approach of interview is a qualitative approach for defining and resolving research questions (Freire and Alarcón 2002). This method becomes a bridge connecting theoretical deduction to empirical study, and it carries out the conversation between researchers and respondents in which questions are prepared for obtaining information from interviewees. Face-to-face interview was adopted in the study to detail the practitioners’ perception on two main questions, namely, (1) “What is your understanding of CSR in the industry?” and (2) “How to implement CSR along the construction process?”

Interviewees selected should be knowledgeable in the practices of sustainable construction. Five professionals were interviewed, including three general managers and two project managers. They were chosen in view of their work experience in both CSR and sustainable construction. Interviews with contractors and scholars serve to compare with the general managers’ views. Each interview lasted about one hour with focal discussion on the two questions mentioned above. Notes were taken on site and edited/summarized afterwards, then sent to the interviewees for confirmation. The confirmed notes were compiled into five interview minutes. The interview minutes were deemed as part of evidence for supporting content analysis.

FINDINGS AND DISCUSSION

Embedding CSR in the construction process. The aforementioned four cases can demonstrate that (a) CSR includes philanthropic community investment and environmental impact mitigation; (b) CSR must be integrated into decision making of a company as well as core activities, and (c) CSR should be accountable for the effects of any of their actions on their community and environment. There are far more construction firms fulfilling CSR in the construction process in a similar way. For instance, Herbsthofer Austria works closer in the local region, reaching that 80 percent of its customers/suppliers are within 50 km from the company site. CITIC

Limited, a top Chinese international contractor, won a strongly competitive bid of an expressway project in Algeria in 2008 due to their excellence in corporate social performance. As reported by the media of Phoenix, CITIC was well recognized as submitted a CSR-based bid highlighting that their CSR behaviors would extend to the development local community beyond the project site. The efforts of both Herbsthofer and CITIC can also show that CSR at an organizational level can cascade to a broader project site and improve the sustainability performance of construction process as a consequence.

Basically, the construction process embraces a multitude of technical and managerial activities on some known project sites. These activities usually generate environmental and social impacts on the local community. As pointed out by Bowen (1953), businesses exist at the pleasure of society and their behaviors and methods must follow the guidelines set by society. Following Bowen's perception, academic efforts to improve the understanding of CSR and to develop a precise definition have not discontinued (Joyner and Payne 2002; Carter and Fortune 2007). The Agenda 21 on Sustainable Construction stressed the significance of socio-cultural and economic dimensions of sustainable construction and the need for an explicit treatment of these non-technical issues in construction policies and management practices (Kaatz et al. 2006). Griffith (2011) found that a contractor needs a socially responsible organisational approach which structures both corporate and operational management functions and applies them to the delivery of its business processes. Thereby, the vision, values, policies and objectives of CSR can be configured and embedded within routine business operation.

CSR in the construction process: four dimensions. While CSR engagement in construction has become popular, main contractors are criticized for poor performance in the area (Murray and Dainty 2009; Barthorpe 2010; Myers 2005). The poor performance can be attributed to several facts. The most influential one probably refers to the lowest price tendering mechanism, which has formed a strongly competitive business environment and it has resulted in low profit margin. To survive from fierce competition, contractors have to spend considerable time in satisfying clients' primary concerns over construction schedule, cost and quality. Firms are expected to take due roles in social affairs such as disaster recovery, cleaner production, work security, and the development of local communities. Nevertheless, as inputs into these sorts of business cannot generate economic profit in the short run, contractors have little incentive to do rather than some minimum legal requirements of CSR.

Contractors are advocated to embed the implementation of CSR in the construction process. In effect, as one of the hottest topics in the discipline of construction management (Shen et al. 2010; Tam et al. 2007; Zhao et al. 2012), CSR has been considered from the narrow economic perspectives of increasing shareholder wealth, to economic, legal, ethical and discretionary strands of responsibility to good corporate citizenship (Jamali 2008). The well-grounding of CSR in the literature lays a solid foundation for researchers to investigate how to develop a framework of CSR implementation in the construction process.

The work by Dahlsrud (2008) collated 37 definitions from 1980 to 2003 by means of a comprehensive literature review, and five dimensions of CSR were identified, namely environmental, social, economic, stakeholder and voluntariness as follows. Taking into account the attributes of construction activities, four dimensions of CSR in the construction process can be recognized as follows:

(1) An economic dimension: business has the predominant social accountability to maximize the value and profit of the company for its stockholders (Friedman 1962).

(2) An environmental/social dimension: those actions that are not required by law but that appear to further some social good and that extend beyond the explicit transactional interests of the firm (McWilliams and Siegel 2000).

(3) A voluntariness dimension: CSR behaviours are voluntary on that companies integrate social and environmental concerns in business operation and in the interaction with their stakeholders on a voluntary basis (Van-Marrewijk 2003; Steurer et al. 2005).

(4) A stakeholder-based dimension: stakeholders of a firm should be treated ethically. Stakeholders exist both within a firm and outside, inclding cunstomers, employees, communities, owners/investers, government, suppliers, competitors and the local community.

A framework for embedding CSR in the construction process. It is noted that the above four dimensions overlap with each other can be further categorized into two views, namely: A narrow view. A narrow view of CSR outlines that CSR embraces those efforts that firms put to resolve some social and ethical problems concerned with the relationship between business and society. Those decision and actions are usually beyond the firm's basic economic or technical interest (Davis 1960; Piacentini et al. 2000). A broad view, the understandings of CSR range from the aforementioned narrow economic perspectives of increasing shareholder wealth, to economic, legal, ethical and discretionary strands of responsibility to good corporate citizenship (Jamali 2008). This highlights a broad view of CSR. In line with this broad view, business has not only economic and legal obligations, but also certain responsibilities to society which extend beyond these obligations.

Based on the above discussion, a conceptual framework with four hypotheses is proposed as shown in Figure 1.

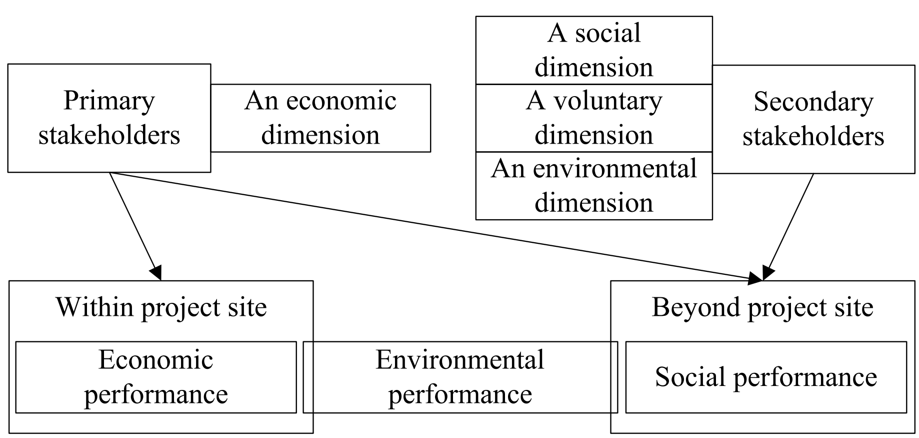

Figure 1.Embedding CSR in the construction process.

CSR efforts at a firm level can improve the sustainability performance of construction process from the perspective of a larger project site. CSR efforts related to primary stakeholders can improve the economic performance of construction process. CSR efforts related to secondary stakeholders can improve the social performance of construction process. The environmental performance of construction process can be improved by attaching CSR efforts to both primary and secondary stakeholders.

As pointed out by the World Business Council for Sustainable Development, CSR is corporate commitment to contribute to sustainable economic development, employees and their families, local communities and the whole society. The business is required to meet or exceed social expectations of industrial and commercial institutions in the ethical, legal, commercial and public areas. CSR is known to take responsibilities towards the environment and acknowledge the social dimension of sustainability which is often overlooked (Hutchins and Sutherland 2008). Corporations act in a socially responsible manner when they undertake two key activities - not harm their key stakeholders within which they operate, and they must rectify it whenever they bring harms to stakeholders (Campbell 2007). While ongoing efforts are expected to conceptualize CSR from both management philosophy and business operations perspectives, the crux of CSR controversies probably stems from the meanings of the world ‘social’ and how it links to daily construction activities.

CONCLUDING REMARKS

CSR in construction is primarily concerned with the preservation of a healthy environment, reductions in pollution, waste, carbon emissions, and energy use. This study found it important to take into account these issues in the construction process from the perspective of stakeholders. A framework of CSR which can be combined with construction process is proposed to align with the achievement of construction goals. It is implied that through implementing CSR activities in the construction process can sustainable construction be achieved better. Four hypotheses are proposed to provide a basis for debate in the future studies. The study has some limitations due to the shortage of empirical justification.

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A Safety Model for Construction Site Layout Planning Using ACO an Algorithm

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Abstract

Work environment safety can be enhanced by effective construction site layout planning (CSLP). The majority researches works on CSLP focused on developing different algorithms and program to generate site layout alternatives under the single objective function of cost. However, site safety should be considered under the different facilities layout in the construction site. The paper proposed a safety model to design a site layout in terms of the multiple objective functions of safety level and safety cost. In order to solve the multiple objective optimization problems, ACO algorithm was used to find the trade-off solution. The results show that the proposed model is promising.

INTRODUCTION

It is necessary to improve construction site safety management capability and construction management theory. The healthy development of the construction industry has become an important and indispensable force in invigorating and promoting the national economy.

Nowadays, the studies on safety management focused on safety risk management, safety environment and safety behavior, system safety evaluation and so on, which need a lot of objective and historical data support, such as risk analysis in risk management and dangerous influence in system analysis. Moreover, safety environment and safety behavior was influenced by the human being's subjective evaluation. One hand, there are less historical construction accidents data recorded in paper. In the other hand, expert evaluation influenced by personal experience and professional standard. The two aspects restrict the development on safety studies.

Recently, the researches abroad studies safety from planning stage before construction. According to document index, study on this aspect has hardly been found in china. Construction organization plan is a guide to organize the construction operation for construction firm. The plan clarified relationship among construction units in different construction stages and relationship between construction resources and construction work. Construction site is an important resource like labor, equipment, material and time and resources allocation was also important part in the construction organization plan. Construction site layout plan is optimization of construction site to put temporary facilities into free locations in construction site. A good site layout can shorten transportation time, reduce material transportation frequency, avoid material re-handling, reduced labor cost and thus to reduce construction cost. Through reasonable assignment of construction operation area, auxiliary operational area, material lay down area in construction site layout plan can avoid conflict between human and facilities, facilities and facilities, human and environment, facilities and environment thus to improve construction site safety level. The study aims to optimize construction site layout to avoid conflict in construction site, reduced safety risk and improve construction safety level. In order to guarantee the implement of construction site layout plan, the cost related to the site plan should be reduced. In the construction practice, construction safety was sacrificed when construction cost was improved, which is also the reason why construction safety level in construction firm is hard to improved. So, a good site layout should satisfy the requirement of safety improvement and cost reduction.

A SAFETY MODEL FOR CONSTRUCTION SITE LAYOUT PLANNING

Construction site layout planning can be regarded as a method of optimizing the usage of construction space by assigning site facilities to the available construction space, with the fulfillment of a number of conflicting and/or congruent objective functions, under a set of layout constraints. Construction site layout plan always be modeled as Quadratic Assignment Problem (QAP) and can be solve by optimization model established (Domschke and Krispin 1997). In the study, a construction site layout plan safety model was proposed and the conflicting objective functions are improve safety level in construction site and reduced safety cost deduced by construction site layout plan.

Objective functions.

$$f_1 = \min \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{l=1}^{m} \sum_{k=1}^{m} C_{ij} d_{kl} x_{ik} x_{jl} \tag{1}$$

$$f_2 = \max \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{l=1}^{m} \sum_{k=1}^{m} S_{ij} d_{kl} x_{ik} x_{jl} \tag{2}$$

Subject to the following constraints

$$\sum\nolimits_{i=1}^{n} x_{ij} = 1 \tag{3}$$

$$\sum\nolimits_{j=1}^{n} x_{ij} = 1 \tag{4}$$

and

$$x \in \{0,1\} \tag{5}$$

where C_{ij} in f_1 and S_{ij} in f_2 are the closeness relationship values for safety cost and Safety/environment concerns between facilities i and j respectively. d_{kl} is the distance between facilities k and l. x_{ik} means when facility i is assigned to location k and x_{jl} means when facility j is assigned to location l. The constraint of x_{ij} will be a binary variable which takes value 1 if facility i is assigned to location j and 0 otherwise.

Pareto-based ACO-GA algorithm. In order to find the optimization solution for the model, Pareto-based ant colony optimization and genetic algorithm was developed. ACO (Dorigo and Gambardella 1997; and Li and Love (1998) are commonly used in solving construction site layout planning problem, in order to improve the optimization capability of GA, the proposed algorithm make use of ACO to improve quality of initial population of GA. At the same time, the proposed algorithm combine Pareto optimization theory (Ning and Lam 2013) to ACO and GA to solve multi-objective construction site layout planning problem, the algorithm called Pareto-based ACO-GA. The workflow of Pareto-based ACO-GA algorithm is as Figure 1.

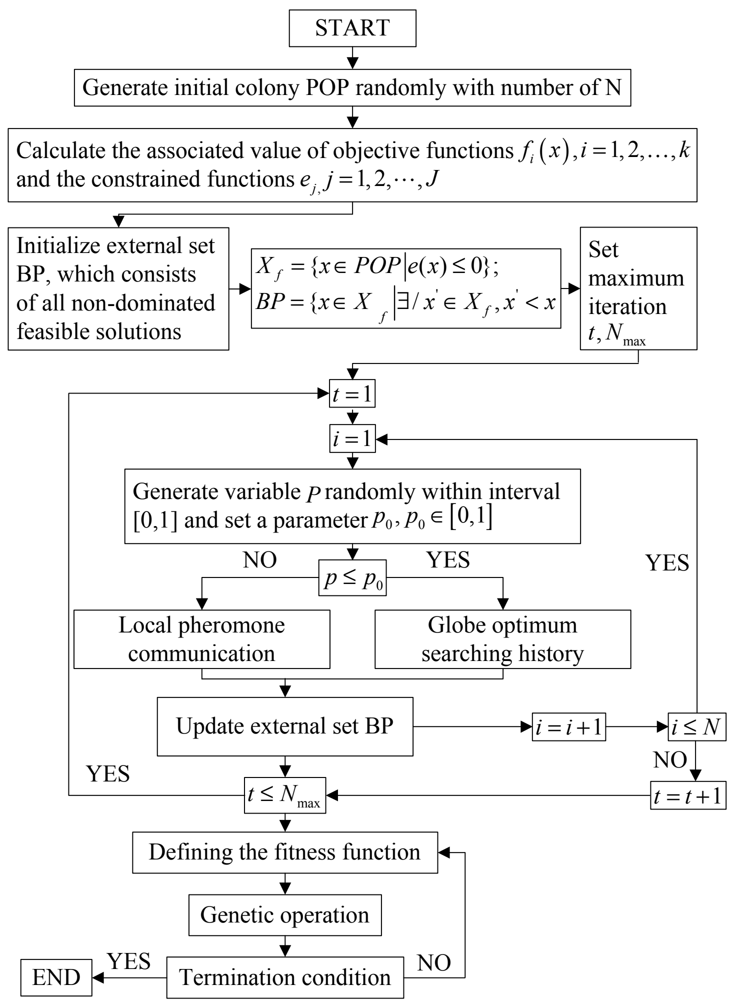

Figure 1.The flowhart of Pareto-based ACO-GA algorithm.

CASE STUDY

An international city complex is located near to Dalian World Expo Plaza. The construction cost of complex is 3 billion and construction area is 370000m^2. The key parameters in the MOO model are N, which is the ant colony population (solution population N) and the four parameters λ_1, λ_2, λ_3 and λ_4 for the different levels of pheromone density. In order to investigate the impact on the results caused by the parameter settings in this case study, the MOO model was tested under the two sets of parameters with $N = 100$ and $N = 200$ (See Table 1).

Table 1.Parameters Setting in the Model.

Parameters	Setting value
N	100/200
λ_1	0.01
λ_2	2
λ_3	8
λ_4	32

After optimized by Pareto-based ACO-GA, the construction site is showed in Figure 2.

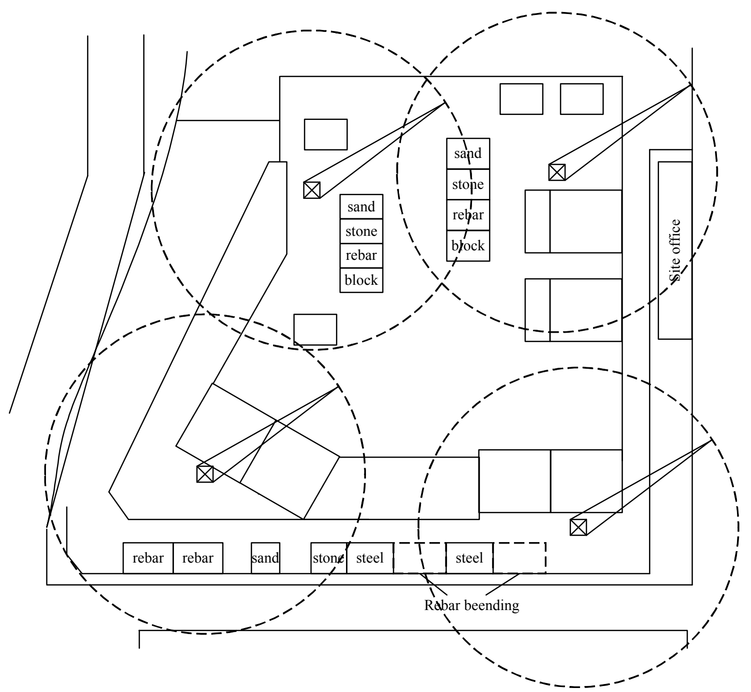

Figure 2.Optimized construction site layout.

The first objective function (f_1) can be represented by minimizing safety cost of the construction site layout. The second objective function (f_2) can be represented by maximizing the safety level associated with construction site layout. Safety/environment concerns (s_{ij}) in f_2 related to interaction flows (material flow, personnel flow and equipment flow) between facilities, noise, uncomfortable temperature and pollution, which affect site workers health and safety action. After optimization of the proposed model, the first objective function (f_1) of safety cost and objective function (f_2) of safety level can be reduced by 7.7% and improved by 13.9%. In the site layout, rebar storage area is in front of 3# building, rebar semi-finished product lay-down area is next to rebar bending area and are assigned in front of 1# building, which will reduce construction cost. While, the high frequency material transportation will increase the likelihood of accident happened. Thus, construction site safety level shall be reduced.

CONCLUSION

In this paper, the proposed Pareto-based ACO-GA was successfully applied to determine the optimal site layout for construction project. Construction cost and safety level of the optimized site layout can be reduced by 7.7% and improved by 13.9%. This optimal layout shows that Pareto-based ACO-GA is a feasible and efficient method of optimizing and solving site layout planning problems.

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Instruments of Strategy Management Accounting and Their Application in Inter-Organizational Cost Management

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Abstract

External orientation of strategy management accounting provided a means of releasing management accounting from the factory floor and gives a chance for inter-organizational cost management (IOCM) improvement. Although there haven't definite meaning of SMA, but several general methods of SMA is becoming more popular than any time, such as value chain analysis, strategy cost management, competitor analysis. A model of IOCM is proposed under SMA framework, on which depended SMA techniques and special strategy cost drivers. After analyzing existing methods and elements of IOCM, the paper analyzed an IOCM implementation framework based on product and relation driver's dimensions. Under product life cycle dimensions, IOCM adopt techniques such as Target costing and kaizen in different production phase. Under relation driver dimensions, three practices including FPQ, ICI, CCM is discussed for inter-organizational cost reduction.

INTRODUCTION

Increased competition and uncertain business conditions have put significant pressure on corporate management to make informed business decisions and maximize their company's financial performance. In response, a range of strategic management accounting tools and techniques has emerged. SMA came to prominence in the late 1980s as one of the range of new techniques and approaches designed to restore the lost relevance of management accounting. What differentiated SMA from many parallel developments was its external orientation (Roslender et al. 2003).

Roles that accounting practices need to fulfill in an inter-organizational context are different to the level of a single organization. In management accounting literature, IOCM can be defined as buyers' and suppliers' coordinated efforts to reduce costs (Simon 2008). Early studies of IOCM were primarily influenced by transaction cost economics. Whilst transaction cost economics supplied a valuable framework for early studies, it was found to have limitations regarding detailed exploration of inter-organizational phenomena. Nowadays, IOCM research have been involved by many modern theories, include such as strategic management, supply chain management, value chain, inter-organizational theory, evolutionary theory, contract theory and etc. Among these theories, external orientation and numerous methods of Strategy management accounting give a chance for Inter-organizational cost management improving.

EVOLUTION OF SMA AND ITS INSTRUMENTS

Definition comparison of SMA. While the SMA literature has since grown substantially there is still limited consensus on what is meant by "strategic management accounting". The term "strategic management accounting" was first used in 1981. The term explored the provision of an accounting perspective on competitor appraisal, which represented a significant departure from accounting's conventional internally focused orientation (Ralph et al. 2007). Some people's definition of SMA as: the provision and analysis of financial information on the firm's product markets and competitors' costs and cost structures and the monitoring of the enterprise's strategies and those of its competitors these markets over a number of periods. Some peoples identified SMA as a generic approach to accounting for strategic positioning, characterized by the attempt to integrate insights from the marketing literature into management accounting. While the recent past has seen increased interest in SMA, the area is still under defined and no universally accepted SMA framework exists. A review of the literature suggests two perspectives on SMA can be taken (Anders and Carsten 2007). Firstly, SMA can be conceived of as comprising a set of strategically oriented accounting techniques. Secondly, SMA can be viewed as concerned with the involvement of accountants in corporate strategic decision-making processes. Universal accepted SMA techniques include: value chain analysis, Competitor analysis, Strategic cost management, balance scored card and etc.

Instruments of SMA. (1) Value chain analysis. In the management accounting literature the VCA is regarded as a core analytic tool of strategic management accounting (SMA). Henri (2003) proposed that the core idea of the analysis is to break up "the chain of activities that runs from basic raw materials to end-use customers into strategically relevant segments in order to understand the behavior of costs and the sources of differentiation".

(2) Competitor analysis. Competitor analysis in marketing and strategic management is an assessment of the strengths and weaknesses of current and potential competitors. This analysis provides both an offensive and defensive strategic context to identify opportunities and threats. Competitor analysis is an essential component of corporate strategy. It is argued that most firms do not conduct this type of analysis systematically enough. Instead, many enterprises operate on what is called "informal impressions, conjectures, and intuition gained through the tidbits of information about competitors every manager continually receives." As a result, traditional environmental scanning places many firms at risk of dangerous competitive blind spots due to a lack of robust competitor analysis.

(3) Strategic cost management. Another contribution to the development of strategic cost management was that of Porter. Porter suggested that a firm has a choice of three generic strategies in order to achieve sustainable competitive advantage. They are cost leadership, differentiation, and focus. Where cost leadership

is selected Porter advocates the use of strategic cost analysis. Strategic cost management is extensively applied in the accounting literature but has not been widely utilized elsewhere. The theoretical underpinnings of strategic cost management lie in the economic model transaction cost analysis (TCA). In their pioneering work on StratCM, they suggested all costs internal and external to an organization must be considered, and they developed a framework for StratCM.

IOCM MODEL BASED ON SMA INSTRUMENTS

Traditional cost management and IOCM. Roles that accounting practices need to fulfill in an inter-organizational context are different to the level of a single organization. Traditional accounting practices, mainly represented by standard costing, often do not fulfill inter-organizational roles well enough to be considered relevant for decision making support. Traditional accounting practices are seen as an inappropriate to sufficiently address the integrative and process-oriented nature of supply chains.

Contract to traditional cost accounting, IOCM system can contribute to:

(1) Creating channels for the transmission of the competitive pressures facing the different parties involved in the supply chain.

(2) Providing support for inter-firm teams in R&D projects (e.g. designing the products jointly and thus searching for one global minimum).

(3) Allowing the negotiation of modifications to the specifications of products transmitted along the supply chain, so as to reach the planned cost objectives.

(4) Identifying ways of making the relation more efficient and helping members to reduce their production costs.

The definition of IOCM encompasses the following characteristics: the management of costs, which essentially employs various costing approaches to the supply chain; joint-cooperative efforts; involvement of upstream and downstream parties. IOCM have founded some cost management methods such as: strategy management accounting, target costing, kaizen, total-life-cycle costing, value-chain accounting. These methods inter-cross and influence each other, and used in different phases of supply chain coordination.

An IOCM management model. In management accounting research, early studies of IOCM were primarily influenced by transaction cost economics. Whilst transaction cost economics supplied a valuable framework for early studies, it was found to have limitations regarding detailed exploration of inter-organizational phenomena. In particular, a number of studies have suggested complex interrelationships between information needs, trust and control systems, which are not captured by transaction cost theories (Ariela and Angelo 2008).

According to the previous analysis, we proposed a IOCM model based on SMA, as shows in Figure 1. In this model, IOCM is implementing under Strategy management accounting framework. SMA instruments constitute basic analysis framework, and IOCM techniques and cost drivers provided implement tool for IOCM. ICOM cost driver is not equal traditional cost drivers and can spread from the view of production and relationship dimensions. ICOM techniques included some general method which emerged from inter-organizational practice and it will be discussed in following sections.

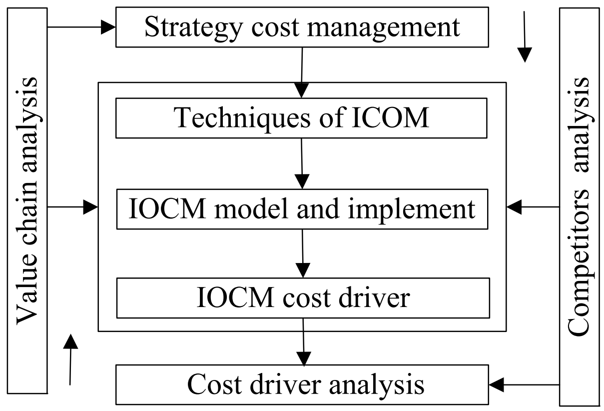

Figure 1.Model of IOCM based on SMA framework.

Strategy cost driver analysis. According to the concept of Porter's strategy cost management, the initial step in undertaking inter-organizational strategic cost analysis is to identify cost driver. Chris and Julia (1995) presented their list of cost drivers. In their work, they argued that the basic concept of strategic cost drivers is to get away from the notion that volume drives cost. In strategic cost management, cost is caused by a multitude of factors that are related to each other in complex ways. Identifying and analyzing these factors mean best explaining the changing relationship between these factors and costs over time and therefore understanding the cost behavior and cost structure of a company. As shown in Table 1, there give us a general cost driver's analysis.

Table 1.Cost Drivers of IOCM.

Structural cost drivers	Operational cost drivers
Economies of Scale	Workforce involvement
Scope	Total quality management
Experience	Capacity utilization
Technology	Plant layout efficiency
	Product configuration

Structural cost drivers. The first category is called "structural" cost drivers and deals with the following strategic choices: Economies of Scale: How big an investment to make in facilities for research and development, manufacturing and marketing. AS in inter-organizational setting, it may refers to, such as, assets specificity. Scope: Degree of vertical integration. Horizontal integration is related to scale. For example: relationship extents. Experience: How many times in the past, the firm has already done what it is doing now. For example, how long have been deled in the past? Technology: What process technologies are used at each step of the firm value chain? Complexity: How wide a line of products or services to offer to the customers.

Operational cost drivers. The most important execution cost drivers include: Workforce involvement (participation), work force commitment to continuous improvement. For example, work groups construction situation. Total quality management (beliefs and achievement regarding product and process quality). For example: supplier's quality qualifications; Capacity utilization (given the scale choice on plant location); Plant layout efficiency, how efficient against current norms, is the plant layout? Product configuration, is it the design or formulation effective?

IOCM techniques and practices analysis. Management accounting literature contributed abundant to ICOM techniques. Generally, literatures supposed that IOCM techniques can be broken down into three blocs: target costing, trade-off techniques and continuous improvement, and philosophies and techniques related to suppliers' costs. Alan and John (2006) considered that methods for determining and controlling costs in supply relationships included: Target Costing, Activity Based Costing, Simon (2008)'s research classified ICOM techniques into five fields: Attribute costing, Life-cycle costing, Quality costing, Target costing, Value-chain costing. In summary, this paper analyzes four major techniques popular used in supply chain cost management.

(1) Target costing. Target costing is a deductive process whereby production costs are determined by setting a target price according to market conditions and then removing the target profit (Lisa 2002). What remains is the target cost of production. Once the target cost has been determined, cross-functional teams (which may include suppliers) work together in order to achieve the target cost and profit. TC process covers the entire life cycle of a product, although the focus in the literature is on pre-production stages.

(2) Kaizen. Kaizen is the Japanese term for making improvements to a process through small, incremental amounts rather through large innovations. Kaizen's goals are reasonable, because when the product is already in the manufacturing process it is difficult and costly to make large changes to reduce costs. Kaizen costing contracts with target costing, it allows many more opportunities to effect change because it occurs much earlier in the product's life cycle. The kaizen costing system is quite distinct from a traditional standard costing system in which the typical goal is to meet the cost standard while avoiding unfavorable variances. Under kaizen costing, the goal is to achieve cost reduction targets that are continually adjusted downward.

(3) Total life cycle costing (TLCC). Products produced by a organization rely on different activities of the organization ad use different resources along the value chain depending on their specifications. As products move along the value chain they accumulate costs. Total life cycle costing is the name we give to the process of managing all costs along the value chain. A TLCC system provides information for managers to understand and management through a product's design development,

manufacturing, marketing, distribution, maintenance, services and disposal stages. From the manufacturer's perspective, total life cycle product costing integrates these functional life-cycle concepts: research development and engineering, manufacturing and post-sale service and disposal.

(4) Activity-based costing (ABC). ABC, which argues that any activity benefiting the production and delivery of goods should be assigned to final cost objects, was proposed in 1980s due to increased overhead (or indirect) cost from automation and technology usage. The principle of ABC is to allocate a cost to the activities related to the production of a product or service. ABC aims to enable managers to attribute, understand, control and reduce the costs related to specific transactions. The system should facilitate the identification of products that are profitable as well as the non-value adding activities that can then be targeted for improvement or removal.

FULFILLMENT FRAMEWORK OF IOCM

Step of IOCM implementation. Generally, the overall framework of IOCM is developed alongside two points of view: supply chain management and value chain analysis. Among them, two important is supply chain cost management (SCCM) model and value chain accounting (VCA). Some literatures proposed a two dimensions supply chain cost management framework. The framework classified SCCM into product design, production, interface optimization and network design. Other people add to the third level cost (transaction cost) based on direct cost and indirect cost (process cost).

Step 1: Determine Value and Cost Drivers. First, determine the drivers of the existing cost base. Managers must understand ICOM value and cost drivers, and how they interact. A value driver is "anything within or outside the business, in the present or future that directly or indirectly leads to cash inflow generation"

Step 2: Inter-organizational Cost Analysis. To cut costs strategically, consider the two following questions: What is the 80/20 split? Determine which 20 per cent of costs offer 80 per cent of the opportunities for major reduction in costs. Which costs can be re-engineered? Some costs are easier to reduce than others. Behavioral cost drivers, for example, the amount of stationery used by employees, is more easily modified than structural cost drivers such as size of the factory used in production.

Step 3: Strategic costs reduction. These two steps allow businesses to reduce costs without damaging long-term strategic prospects: a) Protect key value drivers and optimize long-term value. b) Review and reduce costs (Filip and Jozef 1996).

IOCM implementation framework. IOCM could not separate from inter-organizational properties characteristic. These properties include: production process and product type, transaction feature, communication channel, enterprises risk preferences and etc. the most properties of them is product and relationship dimension. From this view, the paper proposes an analysis framework of IOCM .From dimensions of relation, IOCM implementation is depended on relationship construction. Assets specificity and network contract are two institutional mechanisms, and trust construction and lean supply are two operational mechanisms. From dimension of product, IOCM implementation is alongside product life cycle. Target costing is mainly used in product design phase and kaizen is a kind of continued cost reduction techniques. Operational mechanisms in product and relation dimensions include such as functionality price quality (FPQ) tradeoffs, inter-organizational cost investigations (ICI), concurrent cost management (CCM) and value chain analysis (VCA).

IOCM IMPLEMENTATION BASED ON PRODUCTION AND RELATIONSHIP DIMENSIONS

IOCM based on production procedure. IOCM based on product procedure means that managers must understand and management cost through a product's design development, manufacturing, marketing, distribution, maintenance, services and disposal stages. Sometime it also refers to Total life cycle costing (TLCC). As products move along the value chain they accumulate costs. From the manufacturer's perspective, total life cycle product costing integrates these functional life cycle concepts: research development and engineering, manufacturing and post-sale service and disposal. We limited our discussion of some management accounting methods in product design and production phase as following.

In the phase of product design, the primary mechanism for IOCM intervention is target costing. Target costing (TC) is a deductive process whereby production costs are determined by setting a target price according to market conditions and then removing the target profit (Monden and Hamada 1991). Once the target cost has been determined, cross-functional teams (which include suppliers) work together in order to achieve the target cost and profit. In the phase of production design, Variance analysis under a standard cost system usually compares actual to standard costs. Under kaizen costing, the goal is to achieve cost reduction targets that are continually adjusted downward in supply chain. Kaizen's goals are reasonable, because when the product is already in the manufacturing process it is difficult and costly to make large changes to reduce costs. Kaizen costing contracts with target costing, it allows many more opportunities to effect change because it occurs much earlier in the product's life cycle. The kaizen cost target for each plant determined in the following manner. The amount of kaizen cost for each plant is subdivided to each division and subdivision as cost reduction goal.

IOCM under relationship context. IOCM practices cannot isolate from the broader organizational settings in which they occur. In here, we observed practices under some different relational contexts in which IOCM occurs.

(1) Relationship cost drivers and management accounting methods. Different forms of relational context exist, ranging from relationships that closely resemble markets to strategic partnerships in which organizations signal their desire to work very closely over the long-term (Cooper and Slagmulder 2004). Within this variety of contexts, the use of formal and familiar management accounting methods also vary quite significantly. Some studies have reported the use of inter-organizational budgeting and performance measurement, investment appraisal, target costing, value

chain analyses, activities based costing and open book accounting. In contrast, others have downplayed the role of management accounting, illustrating cost management being performed by non-accountants using methods such as value engineering, design sharing, and inventory reduction, or have indicated a constitutive role for accounting, which helps to establish a structure that is not a solution to coordination problems, but rather is a basis for negotiation and continuous adaptation.

(2) Three techniques analysis under different relationship context in IOCM. Inter-organizational settings in IOCM can be divided into different category depended on cooperation extent, simply, we name it: transaction relationship, strategic partnership and vertical integration. IOCM technique's implement is relied on different relationship characteristic; we observed three IOCM practices in different relationship dimensions.

Transaction relationship. Functionality price quality (FPQ) tradeoffs, helped to resolve relatively minor cost overrun problems and involved only modest specification changes in transaction relationship, and hence limited interactions among the firms' design engineers. An FPQ trade-off is initiated whenever the supplier determines that the manufacturing cost of the outsourced item will exceed its target cost and that the only way to reduce costs to the target level is to relax the functionality and/or quality specifications of the outsourced item in ways acceptable to the buyer. Strategic partnership: The second technique, inter-organizational cost investigations (ICI), is generally used in strategic partnership, and it was applied when FPQ trade-offs were unable to produce the desired level of cost reductions. The technique involved more intense interactions among the design engineers and more significant changes both to the design of the outsourced item and occasionally to the specifications of the end product. Vertical integration: Concurrent cost management (CCM) is mainly used on vertical integration (Gui and Zhang2004). It addressed cost problems that demanded the most significant cost reduction levels of all three techniques. It required the most significant interactions between the buyer's and supplier's design engineers and led to fundamental changes in both the buyer's product and the outsourced components. Concurrent cost management aggressively reduces costs by increasing the scope of design changes that the supplier can undertake.

CONCLUSION

Increased competition and uncertain business conditions have put significant pressure on corporate management to make informed business decisions and maximize their company's financial performance. In response, a range of strategic management accounting tools and techniques has emerged. In the recent past has seen increased interest in SMA, some instruments have been used in practices such as VCA, SCM, BSC and etc. An IOCM model is proposed based on four SMA instruments which interdependent and interrelate to support IOCM implementation. Existing techniques provided useful tools for IOCM. IOCM model is implementing under production and relation driver dimensions. Each of them is associated to different hybrid relational context. To summarize, IOCM could contribute much in cost reduction in inter-organizational setting from view of SMA, but there are no simple rules to apply and several unsolved problems remain.

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Research on the Index System of Comprehensive Benefits of the Reconstruction of Old Factory Buildings, Old Villages, and Old Towns

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Abstract

According to experience of reconstruct the old factory buildings, old villages and old towns in Guangdong Province in China. This paper defines what the comprehensive benefit of the Reconstruction of old factory buildings, old villages, and old towns is. Second, From the angle of view for sustainable development, an index system framework of comprehensive benefit was constructed, involving the index system for Political benefits and the index system for environmental benefits ,economy and social benefits after reconstruction. The index system provided theoretical basis for evaluating the reconstruction of old factory buildings, old villages and old towns, and also supplied references for mode of the reconstruction.

INTRODUCTION

"Reconstruction of Old Factory Buildings, Old Villages and Old Towns" (herein after referred to as "Three Old Reconstruction") refers to the reconstruction of "old towns", "old factory buildings" and "old villages" when the cities develop at a certain stage to meet the requirements for intensive development of lands. It is an urgent need to conserve and intensively use land resources by promoting the "Three Old Reconstruction". Meanwhile, this is an important means to improve the comprehensive competitiveness of the cities as well as an effective way to promote industrial upgrading, urban reconstruction and environmental reconstruction. In recent years, various places in Guangdong Province have launched a renovation boom and therefore explored many fresh experiences in "Three Old Reconstruction" with Guangdong characteristics. According to the data issued by the Guangdong National Land Agency, by the end of 2010, the province's total "Three Old Reconstruction" covered about 240,300 hectares, of which the old towns covered about 55,300 hectares, accounting for 23%; Old villages covered about 96,300 hectares, accounting for 40.1%; the old factory buildings covered about 88,700 hectares, accounting for 36.9%. The province's total transformed lands covered an area of about 4,913 hectares, and 1,554 “Three Old Reconstruction” pilot projects were competed; the investment of “Three Old Reconstruction” was close to 176.6 billion yuan, accounting for 5.03% of the investment in fixed assets over the same period. But at the same time, the reconstruction was complete at a low percentage, and the completion percentage of “Three Old Reconstruction” in Pearl River Delta was less than 23 %. The reconstruction process involves problems in various aspects such as laws, regulations and policy risk, investment risk, land ownership, land transaction specifications, compensation and resettlement of relocation and conflicts of interest and other issues. Especially, compensation and resettlement of relocation and conflicts of interest becomes increasingly obvious. “Three old Reconstruction” involves multiple stakeholders, reflects the interests game of multi parties. There are three main interest groups in the “Three Old Reconstruction”, namely the government, developers, the relocated residents or owners. The realization of the respective interests of the tripartite stakeholders is the most important driving force to carry out the three old reconstructions. The root cause of various above problems is the uneven benefits pursued by each party: government attaches importance to the political, environmental and other social benefits; developers, relocated residents or owners are in blind pursuit of economic benefits but they ignore cultural benefits. This is especially true for those reconstruction projects located in the historic areas. However, the “three old reconstruction” is a comprehensive issue involving economic, political, cultural and historical factors. It is a positive social change where economic efficiency is a prerequisite, the comprehensive development of the transformed cities is the purpose, and the development of urban infrastructure is the core. And it has very complex subjects and it can generate political, economic, cultural, environmental, and many other benefits. “Three old reconstructions” cannot be simply equated to the general urban renewal and it must balance the interests of all parties well and take sustainable development in the future into its consideration. It will of vital significance both in theoretical and practical sense to do a good research in such aspects. This research establishes an accurate Guangdong Province Evaluation Index System of “Three Old Reconstruction”, which can achieve sustainable development. This index system can lay a theoretical basis for evaluation and modes selection of “Three Old Reconstruction”.

LITERATURE REVIEW

Firstly is the literature review about domestic researches. Li and Zhang (2009) combined with the characteristics of urban renewal, built the social evaluation system of urban renewal from two aspects: resident satisfaction degree and social harmony degree. And they analyzed evaluation factors and corresponding evaluation indicators and adopted fuzzy comprehensive evaluation method to conduct empirical evaluation. An in-depth analysis of the procedures of the “Three Old Reconstruction

", the formation mechanism and performance characteristics of the policy performance, and designed a policy evaluation system for the "Three Old Reconstruction ". Lei et al. (2012) studied the "Three Old Reconstruction "plans of various pilot projects in Guangdong Province and made a case study of the "Three Old Reconstruction "in Gaozhou City, Guangdong Province. And they put forward the evaluation system framework of the "Three Old Reconstruction ". The evaluation system framework includes the evaluation indicator system to evaluate the improvement in the intensive land utilization after the reconstruction and the evaluation indicator system to evaluate the impacts of the reconstruction on social, economic and ecological benefits. Zhao and Hu (2012) took the Wuchuan City Old Village Reconstruction for an example and they established the index system and method for old village reconstruction. Then, they adopted the comprehensive indexes to make potential assessment over the old villages in various townships. Zhong and Gao and Li (2013) took Guangzhou North Shore Cultural Pier for an example and through field research; they analyzed the land utilization benefits in the three old reconstruction zones under the background of urban renewal from the economic, social and environmental aspects.

Secondly is the literature review about researches in foreign countries. For example, Hemphill et al. (2002) proposed a hierarchical model of urban renewal evaluation to analyze the sustainability of urban renewal via the Delphi method and multiple criteria. Dormois et al. (2005) used the public-private partnership (PPP) model in urban renewal projects in France, which is not concerned about social benefits. Yusuf et al. (2009) applied the fuzzy-logic-based artificial intelligence technology into evaluating environmental impacts of urban renewal. Lee (2008) took the urban renewal projects in Hong Kong for an example and established an urban renewal evaluation model featuring sustainable development from the following three aspects: economic, social and environmental benefits.

Domestic scholars made researches on the "Three Old Reconstruction " from various perspectives, but the researches are not comprehensive and rarely consider the comprehensive benefits that include economic, social and environmental benefits. Relatively speaking, foreign researches include both qualitative and quantitative researches, which is more comprehensive. This thesis draws experiences from foreign researches and then builds the evaluation indexes of comprehensive benefits based on the perspective of sustainable development. And the thesis gives formula to quantify the various indicators.

ESTABLISHMENT OF EVALUATION INDEX SYSTEM

Principles for establishing evaluation index system. (1) Evaluation indexes need to take into account of both scientificity and operability. The selection of indexes should be based on the recognized research theories. All kinds of indexes should fully reflect the connotation of comprehensive benefits of the "Three Old Reconstruction". The data acquisition should be based on objective facts and the measurement of data must be handled in accordance with the relevant standards and norms, to ensure the scientificity and accuracy of the data sources.

(2) Evaluation indexes should have integrity and systematicness. Integrity principle refers to that the established evaluation system should be able to fully reflect the comprehensive benefits of “Three Old Reconstruction” in both qualitative and quantitative ways. Meanwhile, the integrity principle also takes into account the direct and indirect impacts, and it can see not only recent effects but also long-term effects. As a system, the evaluation system should be able to reflect and measure the “Three Old Reconstruction” in an all-round way. Besides, the selection of the evaluation indexes must follow the systematicness principle.

(3) Evaluation indexes should have relative independence. Usually information overlap can be found in the evaluation indexes of the comprehensive benefits of the “Three Old Reconstruction”, resulting in redundant data. Therefore, in choosing evaluation indexes, try to select those relatively independent indicators in order to make such evaluation more accurate and scientific.

(4) Evaluation indexes should be dynamic and have relative stability. “Three old Reconstruction” is a dynamic reconstruction process. And the comprehensive benefit evaluation indexes are a dynamic system which is changing over time. Therefore, in terms of implementation of environmental benefit evaluation, the selection of indexes should also be dynamic. However, “Three Old Reconstruction” comprehensive benefit assessment is an assessment based on the reconstruction efficiency in a specific period of time and a specific level of production technologies. As a result, the evaluation indexes should have a relative stability in a given period.

Indexes selection in evaluation indexes system. On the one hand, in accordance with the lessons from the Western developed countries in urban renewal strategies, “Three Old Reconstruction” should firstly transform the physical (construction) environment of the project itself. The reconstruction of the social and economic environment will be closely followed. And such reconstruction should be done step by step. On the other hand, the” Three Old Reconstruction” is an effective measure to solve the urban economic and social issues; and it mirrors the comprehensive and complex benefits, namely social, economic and environmental benefits. Such three benefits are interrelated to each other, as shown in Figure 1 (Tamás 2012).

Economic benefits are the very prerequisite for the “Three Old Reconstruction” project to succeed. Without economic benefits, any “Three Old Reconstruction” is unrealistic, so its importance is self-evident. Social benefits and economic benefits have inherent links. All aspects of social benefits reflect whether a community (or village) is moving toward sound or degraded development. Besides, if the demographic composition of a community (or village) is improved by means of the “Three Old Reconstruction”, this can change the economic way, improve economic strength and ultimately achieve economic benefits. It is a common means to enhance economic benefits through social benefits. The improvement in environmental benefits can also give feedbacks to economic benefits. And this can be illustrated most directly in that a favorable environment has great attraction to businesses, citizens and travelers. The indexes system of comprehensive benefits in three old reconstructions is shown in Table 1.

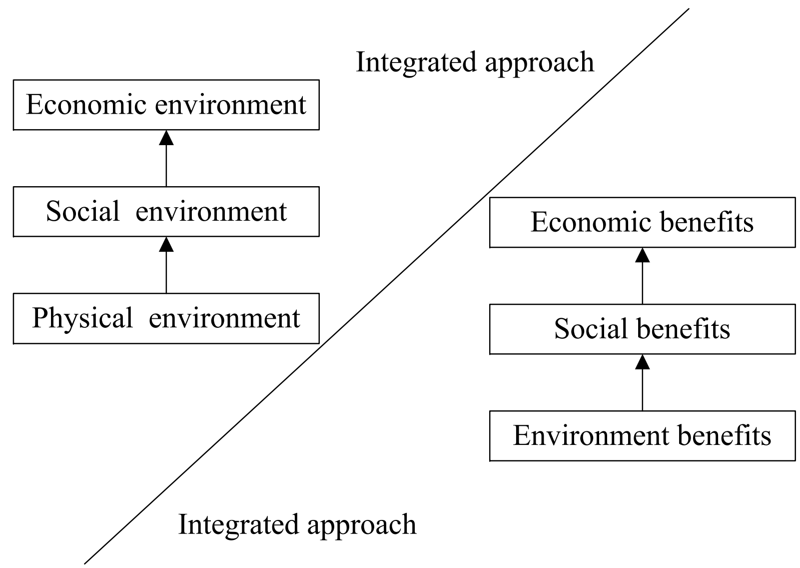

Figure 1.Linear and integrated approach of urban regeneration.

Table 1.Evaluation Index System of Comprehensive Benefits.

General Objective Layer	Criteria Layer (B)	Standard Layer (C)	Basic Indexes Layer (D)
Comprehensive benefits of three old reconstruction	Social benefits B1	Government benefits C1	Urbanization Level D1, Infrastructure Investment D2, Security Housing Construction Rate D3, Supporting Infrastructure Perfection Extent D4, Social Stability Degree D5, Built-Up Area Green Coverage Rate D6, Demolition Caseload D7, Demolition Case Reduction Rate D8

Table 1.(Continued).

General Objective Layer	Criteria Layer (B)	Standard Layer (C)	Basic Indexes Layer (D)
Comprehensive benefits of three old reconstruction	Social benefits B1	Villagers (residents) benefits C2	Land Economy Compensation Availability Rate D9, Per Capita Disposable Income D10, Social Employment Security Rate D11, Public Participation D12, Per Capita Public Green Area D13
		Cultural benefits C3	Architectural and Cultural Heritage Value D14, Historical Extension Value D15, Industrial Civilization Heritage Value D16.
	Economic benefits B2	Production benefits C4	Gross Regional Production D17, Per Capita Gross Regional Production D18, Industrial Output D17, Tertiary Industry Proportion D18, Regional Gross Product Growth Rate D18, General Financial Revenue D19, Arising Economic Growth Amount D20, Arising Economic Growth Rate D21
		Land benefits C5	Land Revenue D22, Land Economy Density D23, Per Unit Land Input-Output Ration D24, Per Unit Land Investment Amount D25
		Project value C6	Financial Net Present Value D26, Financial Internal Rate of Return D27, Dynamic Investment Payback Period D28, Loan Payback Period D29, Asset-Liability Ratio D30
	Environmental benefits B3	Resources and energy conservation C7	Land Utilization Rate D31, Reclamation Rate D32, Energy Output-Input Ratio D33, Building Materials Conservation D34
		Environmental performance C8	Environmental Quality Index D35, Volume Rate D36, Per Capita Green Area D37, Environmental Protection Investment Index D38, Building Anti-Disaster Ability D39, The Public Comfort Degree D40

Note:The indexes came from some references and project experience of “Three Old Reconstruction”

(1) Social benefits index. To assess the impacts of the social benefits of "Three Old Reconstruction", benefits of various aspects should all taken into consideration such as the sustainable development, social cultural security and social stability. In this thesis, the social benefits of "Three Old Reconstruction" include government benefits, villagers (residents) benefits and cultural benefits. In government benefits, the built-up area green coverage rate refers to the garden greens area per unit area there. The higher the index value is, the better the ecological environment will be. The security housing construction rate refers to the proportion of the affordable housing and low-rent housing in the dwellings within the built-up areas. In accordance with national policies and regulations, in the construction of newly approved, newly built commercial housing, the proportion of the houses with a building area of 90 m^2 or below shall not be less than 70%. In the villagers (residents) benefits, the land economy compensation availability rate refers to the implementation of the compensations for the renovation projects, which reflects the standardization degree of the project operation. Social employment security rate refers to the reemployment rate among the unemployed. Public participation degree refers to participation of the villagers (residents) throughout the process of the "Three Old Reconstruction". This index can reflect whether the reconstruction project has mobilized the masses or not and its degree of democracy. Per capita public green area refers to the average public green area occupied by each resident.

(2) Economic benefits index. Economic benefits indexes include three kinds of indexes: production benefits, land benefits and the value of the project itself. In the production benefits, the proportion of tertiary industry refers to its proportion of the added value in GDP. In the value of the project itself, financial internal rate of return refers to the discount rate of the three old reconstruction projects when the sum of the net present value of each year during the whole calculation period equals 0.

(3) Environmental benefits index. Environmental benefits index of the "Three Old Reconstruction" include resource and energy conservation and environmental performance. In the resource and energy conservation, the land utilization ratio refers to the ratio between the utilized land areas and the total land areas. In the environmental performance, the per capita green area refers to the ratio between the public green areas and the registered population in the reconstruction zone. Environmental protection investment index refers to the proportion of environmental protection investment in the GDP of the same year.

Evaluation indexes criterion and comprehensive judgment model. The evaluation index criteria should have clarity, reliability, flexibility, and maneuverability. The criteria can be made either on one single condition or many conditions. In this thesis, analytic hierarchy process (AHP) is adopted to determine the weight of each index, to qualify various indexes as much as possible (Grace et al. 2008). For other qualitative indexes that cannot be directly quantified, the expert scoring method is used to confirm the grades. First, indexes of each kind are divided into 6 grades: excellent, good, moderate, poor, qualified, unqualified. The quantification value for each grade is respectively 95, 85, 75, 65, 55, and 45. Then, each expert in the assessment expert group will give scores to the evaluation index in accordance with its content. Next, the score value of the evaluation index will be calculated in accordance with the following formula: the quantitative score of qualitative index = Σ Grade Coefficient / Evaluation Experts Number.

In analyzing the comprehensive benefit of the three old reconstructions, a series of qualitative and quantitative analysis has been made and the project benefit is judged and described comprehensively and objectively. Then, appropriate evaluation indexes have been selected and a more scientific and reasonable digital model is has been established. The comprehensive benefit can be calculated in accordance with the following formula: $Z=\sum_{i=1}^{m} W_i(X_{ec}+X_{en}+X_{so})$ Out of it, Z stands for project's comprehensive benefit evaluation index; X stands for the quantitative expression value of each benefit factor after standard processing; W_i stands for the weight value of the importance of the benefit factor to comprehensive benefits evaluation; i stands for the number of the special indexes elements involved in the comprehensive benefit evaluation.

CONCLUSION

The three old reconstructions aims to coordinate government benefits, villagers benefits and developers benefits and focuses on maximizing net social benefits. The comprehensive benefits created by different designing schemes for the same reconstruction project area are different. But all of them shall follow the maximum benefits principle. In addition, in this thesis, the comprehensive benefit evaluation indexes of the three old reconstructions are merely general but not fixed. The reconstruction projects of different types should be treated separately. For example, for the old factory building reconstruction projects, some more closely relevant benefits indexes may be added on this basis. And the weight of indexes of various types should be determined in accordance with specific actual conditions.

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Research on the Current Situation and Development Countermeasures of Engineering Construction Supervision

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Abstract

In order to strengthen the engineering control and ensure the realization of project and quality, the construction supervision system is introduced from aboard as a kind of engineering supervision and management system in China. This article contains analysis on present situation of the construction engineering supervision and existed problems. Construction supervision industry response and development measures are proposed mainly from the seven aspects including policies and regulations, industry regulation, the bidding mode, supervision business entrust contract model, the scientific construction of supervision relationship, and the industry development environment improvement. It aims to improve the engineering supervision level, develop the effect of engineering supervision, and ensure engineering construction.

INTRODUCTION

Implementing the construction supervision is a major reform in construction field. Supervision industry has been developed greatly since 1988. It is more and more significant and irreplaceable in construction including project quality control, progress, investment, security, etc. However, the construction supervision system in China starts late. Traditional project management system is operating with the conventional project management concepts that fetter development of supervision system. In addition, both project construction supervision regulation system and guidance mechanism are not perfect. Therefore, there are many problems in construction project supervision.

CONSTRUCTION ENGINEERING SUPERVISION STATUS IN CHINA

The wrong cognition to the supervision work status and the main legal status. The supervision work is interfered and restricted for proprietors' misunderstanding the status and functions of the supervision unit in engineering construction management system. Moreover, proprietors often mistake the supervision unit for the partner of the construction unit. Whenever problems emerge in projects, proprietors consider the supervision units for the main responsibility directly. Firstly, proprietors always think the supervision units with rising cost that are imposed on their country rather than hired voluntarily. Secondly, the construction contract is signed between the construction units and proprietors, and the project funds are paid by the proprietors ultimately. Thirdly, the wrong cognition on the supervision units leads to reduction of the real right (Yu 2009). Consequently, the construction units ignore the functions and instructions of the supervision units and refuse to implement the orders. The supervision units can't really play the role of whole part (Tang and Wang 2007).

The whole process supervision improvement. The original intention on establishment of supervision system is to provide with consulting services about engineering, technology and economic. On the contrary, the construction engineering supervisions which are basically severing the construction process in our country ignore preliminary stage such as design and bidding process. Even if the supervision works basically focus on quality, schedule and safety, there is a lack of comprehensive management in the progress, quality, investment, safety and environment. Compared with foreign engineering consulting company, domestic supervision needs to be improved greatly.

Supervision authority. The supervision responsibilities and rights are explicitly declared in "Code for construction project" (GB/T 50319-2013), supervision contract and the construction contract. To the contrary, the projects which are completely conformed to the requirements of the supervision responsibilities and rights are smaller amounts in the current engineering practice. Moreover, proprietors interfered the supervision works commonly for being affected by the construction industry situation and the interests. As a result, the supervision units have responsibilities but not rights. Proprietors always have wrong consciousness: They take themselves as the Party of the first part that pay for the supervision fees, make decision and command the supervision units in project. On the supervision's aspect, the supervision units do not want to offend proprietors that violate the supervision contract requirements, corresponding construction regulations and norms for the pressure of industry situation and competition. Consequently, the supervision work is lack of independence, fairness, impartiality, scientific. Actually, the supervision units have responsibilities, and their corresponding rights are not guaranteed. All these result in unequal power and responsibilities which affect the effect of supervision directly.

Supervision e**nterprises specification**. In current the development of China's construction market is not standardized. Enterprise survival environment is not good. Vicious competition behaviors exist in engineering supervision industry. At the same time, the supervision enterprises themselves are not standardized. Their qualities need to be improved. In addition, there are a lot of qualification rental phenomenons. All these conditions lead to supervision integrity decline and affect the reputation of the industry seriously. In the project, the supervision quality can't be guaranteed without abidance of site supervision mechanism construction requirements and high-qualified supervision personnel. These impact on its image of the supervision industry, make proprietors to prejudice the supervision units and lower social acceptance. Therefore, proprietors' work can't depend on the comprehensive management of project supervision entirely.

Supervision fee. Supervision industry is a high-intelligence-and-technology consulting industry that should belong to the high income industry. Compared with foreign supervision fee, the supervision cost rate in China is usually 0.6% - 2.5% of the project cost. In order to ensure the interests of enterprises, the supervision company can only reduce the supervision personnel income and the number of stationed on-site personnel. Therefore, it is difficult to configure professional supervision staff which result in difficulty to meet the needs of engineering quality supervision work. In addition, it is also a problem that the supervision enterprise accumulate enterprise development fund and attract qualified personnel engaged in supervision industry. For the profit, supervision enterprises are not willing to provide the high level service which makes the construction supervision industry in China into a vicious spiral development situation.

STUDY ON COUNTERMEASURES OF CONSTRUCTION PROJECT SUPERVISION DEVELOPMENT IN CHINA

Improve the positioning system and supervision regulations. On the basis of the relevant supervisory laws and regulations promulgated by state, all levels of local and industry construction administrative departments should announce specific, mandatory and binding supervision laws and regulations to implement construction engineering and ensure their legal status. At the meanwhile, it is significant for construction units to recognize the professionalism and importance of project supervision from the legal perspective by strengthening propaganda work and daily operation of the supervision. With doing this, it makes the supervision units more and more irreplaceable. The supervision units are employed positively instead, stands on their own development of supervision work, play the important part in supervision and create a good atmosphere.

Reform bidding mode and optimize evaluation methods. At present, project supervision units are chosen preferentially by the bidding forms of public or invitation. However, it is mainly embodied in the tender price competition instead of outstanding technology, management, credibility and comprehensive quality. Selecting low-cost supervision units takes a major point. It not only is contrary to the basic laws of the market value, but also deviates from the original intention of the implementation of bidding. Combined with the actual situation of our country, the construction administrative departments at all levels should establish supervision enterprise library with the corresponding standards and conditions. The supervision units that have better reputation, performance and comprehensive quality are chosen into the enterprise library with higher priority. Establish a regular review and selection mechanism is used to ensure the quality of units in the library. During the bidding process, only the storage enterprises have the qualification to attend the process.

In the bid evaluation method, the conventional ways that set the highest price should be changed into setting lowest price or interval price. At the same time, there is a need to weaken evaluation and reduce the share of scores about economic, highlight supervision outline review, recent supervision performance and evaluation, and choose the winning bidders with comprehensive evaluation methods. On the other hand, it is also possible to take a fixed price method in bid evaluation which chooses the winning bidders completely by the technical standards and business standards. For the ordinary engineering project that has no special technical requirements, the units can be selected from the enterprise library randomly. Random select method can avoid interference of artificial factors, ensure the selection of supervision units priority and lay a good foundation for the on-site supervision service quality. The tender and bid evaluation model is shown in Figure 1.

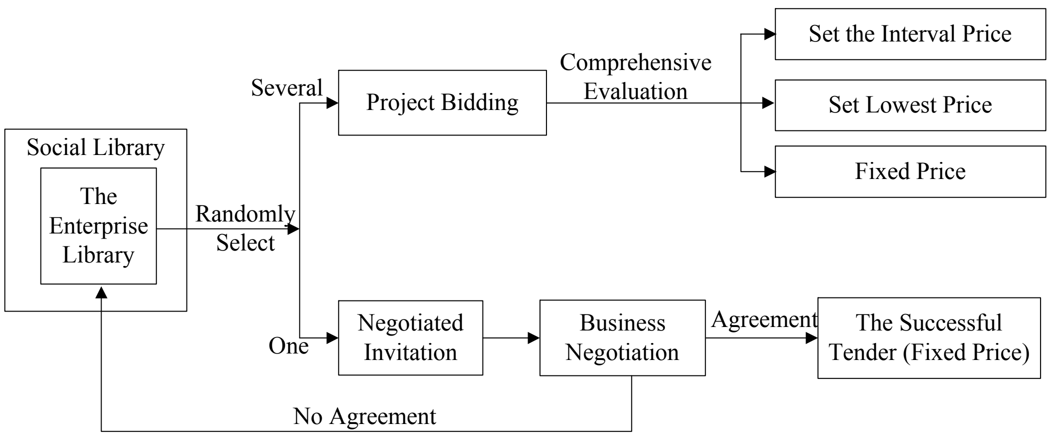

Figure 1.Tender and bid evaluation model.

Improve the level of supervision fee. The economic attribute of enterprises determines the level of supervision service quality greatly which is also restricted by the level of supervision fee. For the reasonable profit, the supervision enterprises can't construct the complete professional on-site supervision institution with the specifications and requirements. At the same time, it is difficult for the supervision enterprises to attract high-quality personnel into the supervision industry which results in the poor quality of supervision work, lower level realization of construction targets, and unwarranted maintenance of the reasonable interest in construction units. As a result, the state and the functional departments should improve the engineering supervision cost level on the side of law. Moreover, it is very important to limit the low price competition, set minimum supervision fee, and complete the process of supervision. If any units disobey the regulations of minimum supervision fee, take back its construction permit.

According to the standard, the cost of supervision should be listed in investment estimate preparation when construction departments at all levels carry out their project (NDRC price 2007). After fixed, any change of supervision cost is forbidden. It is a great need to improve the comprehensive quality of project supervision enterprises and the development of supervision industry, carry out the supervision system, and guarantee the supervision achievement.

Promote all-round-and-whole-process supervision. Because construction supervision that provides management consulting services for proprietors is controlled by the supervision enterprises, consulting services can be offered by construction units at each stage of construction. However in the practical work of engineering construction present, the construction stage supervision that occupies an important position emphasizes the quality and safety control, which is limited in the investment control, contract management and other aspects of the work. Moreover, the decision and design stage are important to the investment and quality in project. So it is in great need of technical and economic professional consulting service. Especially in years of lacking highly-skilled economic management personnel, all-round-and-whole-process supervision services are significant for general scheming and the completion of project construction.

Design reasonable supervision entrustment pattern. In order to solving the problem of unequal rights between proprietors and the supervision units, design reasonable supervision entrustment pattern is a perfect way to give the supervision right, emphasize supervision function and change the inappropriate status. According to many years of supervision practice, the first mode is that independent third-party administrative units are introduced as the employer of supervision project, which can eliminate disadvantages of direct contract by proprietors (Lu and Rao 2015). Commission of supervision mode is shown in figure 2. The second mode is that proprietors give the project supervision fees to the designated third-party administrative units which pay for supervision fees on the basis of supervision contract. Commission of supervision mode is shown in figure 3. Independent third-party administrative unit can be superior unit or located engineering quality supervision station. Design reasonable supervision entrustment pattern can change the situation that unequal rights between proprietors and the supervision units and enable the supervision units automation independency.

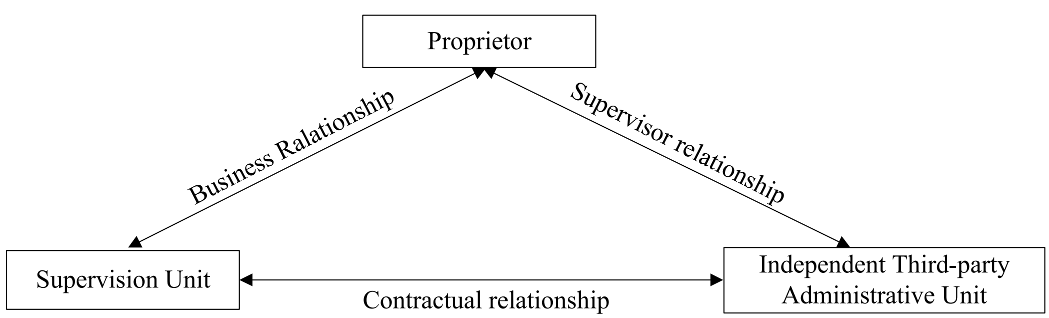

Figure 2.Commission of supervision mode (1).

Strengthen supervision and evaluation in quality supervision process. Combined with engineering construction of laws and regulations, the supervision contract and bidding documents, the industry supervision departments should complete the management and evaluation of supervision service quality. First of all, it is important to start from the organization, set up project supervision department, comply with strict requirements about rules, regulation, the post setting, staffing, equipments and other aspects. All these are required to meet the need of engineering supervision. Secondly, it is significant to ensure the director and professional supervision engineer certified and strengthen the quantity, quality and professional support of on-site supervision. With strict management on the project supervision department, it is possible to make high quality supervision work and lay a good foundation for the development. Thirdly, formulate the corresponding evaluation index, rewards and punishment and change the specific intervention on the supervision work in the past into management on the supervision quality. As a result, the supervision comprehensive quality will be improved with strengthening supervision and evaluation in quality supervision process.

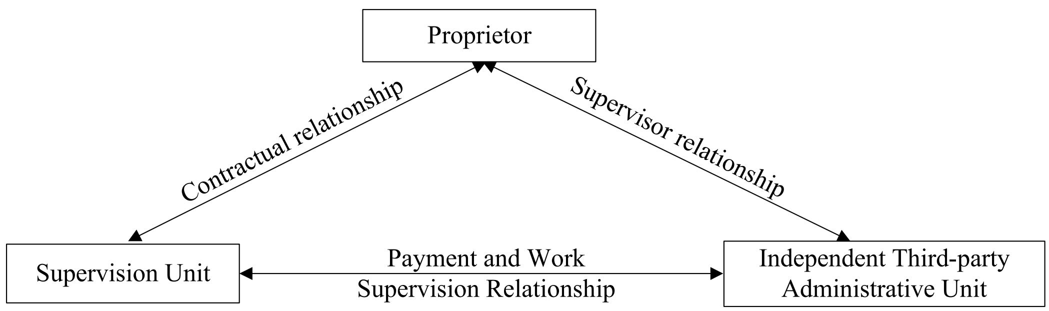

Figure 3.Commission of supervision mode (2).

Create reasonable regulatory relationships between supervision party and construction party. In order to strengthen the consciousness of obedience in construction party, the government can set up Party's legal regulatory relationship between supervision party and construction party in the form of signing agreement or contract from the viewpoint of law. First of all, the standard terms of supervision agreements or contract model texts should be set by the government, which mainly concern about rights, obligations, responsibilities and punishment measures. All these regulation should be enforced in the engineering construction. Otherwise, the construction is not permitted (Nie 2014). Secondly, both sides of the party must sign this agreement or contract to proprietors and quality supervision departments for the record before the commencement of work. Therefore, the relationship between supervision party and construction party will be strengthened in the form of the agreement or contract. These encourage both sides to abide by the rules consciously for any violation being illegal. Finally, effective and powerful regulatory relationships are truly built for the better supervision atmosphere.

CONCLUSION

In order to promote the function of supervision and the development of the industry, Vice Minister of Ministry of construction of urban and rural housing Mr. Wang put forward that it was urgent to cultivate a group of first-class supervision industry and give enough support which was cited in the television and telephone conference on the engineering quality management. It is absolutely required for the supervision industry to fulfill supervisory duties earnestly and improve the quality management and the level of the engineering supervision. Secondly, the supervision market should be further open for attracting foreign excellent consulting enterprises to enter the Chinese market. In fact, it is a good way to promote the supervision level through these commercial activities. In addition, it is very significant to establish reasonable regulations system and laws and break the barriers in system and mechanism. Although the development problem of construction supervision industry cannot be avoided, but the development level of the whole industry shows a positive trend. With strong collaboration among country, government and enterprises, these problems will be solved and the development road of the supervision industry will be full of sunshine.

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Workflow Analysis for the Lean Construction Process of a Construction Earthmoving Project

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Abstract

Lean thinking is an effective method to reduce or eliminate the waste in the life cycle of construction projects and improve the projects' productivity. It is more and more widely used in the construction industry. This paper takes lean construction as the theoretical basis. Management philosophy of lean construction was analyzed. The impact of workflow on construction projects efficiency, including workflow continuity and loss during the flow process, was elaborated. According to the characteristics of earthmoving activities, the earthmoving operations workflow model was proposed based on lean construction to specify dynamic changes of workflow and information flow in the construction process. The main influencing factors and constraint conditions for earthmoving operations were discussed. The proposed models can be used to adjust the construction process, maximize the resources allocation, and reduce the resource loss and waste in construction in order to improve the efficiency and productivity for construction projects.

INTRODUCTION

Under the increasingly competitive environment, the construction industry has higher challenges and requirements for project quality, productivity, and the techniques and methods of project management. It is urgent to improve the enterprises competitiveness, meet the clients' requirements, increase the usage efficiency of resources, and reduce the waste. The introduction of lean thinking to the construction industry can effectively improve these issues and improve the productivity for the entire industry.

Some researchers have been conducted on the implementation of lean construction concepts and tools in the construction industry. Rafael et al. (2010) used a BIM-enabled pull flow construction management software system based on the Last Planner System™ (LPS), called 'KanBIM' to visualize work flow, which can improve workflow and reduce waste by providing both process and product visualization at the work face. Usama (2013) used last planner system through execution of an industrial project in Egypt to minimize risk factors effect on time based on lean construction principles. Arayici et al. (2011) proposed a systematic approach for BIM technology adoption that improves the efficiency towards a lean architectural practice. Gao and

Low (2014) conducted a research on the perceptions of Chinese building professionals of the application of the LPS in Chinese construction projects. A SWOT analysis was employed to examine the influencing factors that have the impact on the implementation of LPS in construction projects in China. Timothy et al. (2012) did a comparative analysis of lean construction with design-build using a framework of contractual forms of agreement, which promotes lean thinking within the design and construction community. Tommelein (2015) presented a historic view on lean construction, referring to the application of lean thinking to the delivery of capital projects in the architecture-engineering-construction (AEC) industry. Lean thinking helps eliminate much self-inflicted, unwanted complexity from systems, so that people can accomplish more using simpler systems. Abhijeet et al. (2012) presented the techniques used by a midsize industrial construction contractor: purpose built facility, making decisions at the last responsible moment, lean audits, and 5S in the design of industrial projects to encapsulate and implement techniques of lean production in the management of design. Pestana et al. (2014) presented a two-phase study to investigate the submittal process in a construction company using lean construction concepts and tools, which provides the transparency to the submittal process, reduces the duration used to manage, and improve the efficiency for the management team. The concept of lean construction has been widely used. However, there is limited research on using the lean thought to describe the progress of construction activities dynamically in order to reflect the workflow and optimize the resources utilization.

WORKFLOW ANALYSIS OF LEAN CONSTRUCTION

Lean construction. Lean Construction (LC) comes from lean production, which is the derivative of lean production theory in the construction industry. The concept of Lean Production (LP) was proposed by James P. Womack who led the International Motor Vehicle Program at MIT. They conducted the research on the production ways of Toyota and proposed the concept with publication of the book The Machine That Changed the World in 1990, which made the term lean production known worldwide. LP is a systemic method for the elimination of waste within a manufacturing process. Lean also takes into account waste created through overburden and waste created through unevenness in workloads. Working from the perspective of the client who consumes a product or service, “value” is any action or process that a customer would be willing to pay for. There are five overriding principles to Lean which are identify customers and specify value, identify and map the value stream, create flow by eliminating waste, respond to customer pull, and pursue perfection. LP is not only a management mode but also a thought, which can produce products with minimum defects with less manpower, resource, cost, and time consumption to meet the clients’ requirements. It is the milestone of modern production mode.

While lean construction is identical to lean production in spirit, it is different in how it was conceived as well how it is practiced. Lean production is the flowing products and fixed people to produce while buildings are the fixed products but the flow of personnel. Construction project is complex and uncertain; therefore, lean construction is not the simple application of lean thought but the renovation of construction process based on the construction features. Combining the lean thinking and characteristics of construction industry, it is the construction process reengineering that forms a building system with comprehensive functions. There are many differences between the lean construction approach and the traditional construction approach. The characteristics are summarized as follows:

Lean construction is based on T-F-V theory, namely, Transformation-Flow -Value generation. These are the three complementary ways used as a production management paradigm to conceptualize the project-based production systems. Transformation is the production of inputs into outputs. Flow is defined as "Movement that is smooth and uninterrupted, as in the 'flow of work from one crew to the next' or the flow of value at the Pull of the customer." Value is "What the customer is actually paying for the project to produce and install." The traditional construction is based on transformation model that breaks down the construction projects into unit projects, sub-divisional and divisional works. The construction process is considered as a series of separate activities and the whole project is the integration of activities. Lean construction thinking manages the construction process from three views of task, value, and process, emphasizing the flow and eliminating or reducing the waste in the flow.

In lean construction, project control has the job of execution. The prevention beforehand is adopted and work process is identified in order to manage the project. The total quality management through dynamic control is achieved to reach the optimal situation for the project; whereas control method in the traditional construction relies on variance detection after-the-fact.

In lean construction, downstream stakeholders are involved in front end planning and design through cross-functional teams. It emphasizes on subjective initiative as well as coordination, adopting the dynamic process-oriented organizational structure. The enthusiasm of employees is aroused and work efficiency is increased. Traditional construction system emphasizes on the hierarchy in management, adopting the static organizational structure based on functional departments.

Value management in lean construction satisfies both inside and outside of the project. Traditionally it is difficult to recognize and meet the customers' demands. But in lean construction the customer identifies the value, which is the goal for the whole life cycle of the project.

Lean construction emphasizes on active and continuous learning and improvement. It is the process of pursuing perfection. While in traditional construction, people are passive and waiting. They make up for the loss or rework when the mistakes occur.

Lean construction is value-generating process and emphasizes on waste reduction. The entire construction system is the optimization target and transaction cost is decreased. Enterprises have win-win relationship. Benefit allocation and achievements sharing are based on strategic alliance and win-win mode. In traditional construction, market is the core, and constructors are self benefits-centered. Suppliers, contractors, and sub contractors consider each other as competitors.

Lean construction management philosophy. The term Lean Construction was coined by the International Group for Lean Construction in its first meeting in 1993 (Gleeson and Townend 2007). The Construction in "Lean Construction" refers to the entire industry and not the phase during with construction takes place. Thus, lean construction is for owners, architects, designers, engineering, constructors, and suppliers.

Lean Construction is a combination of operational research and practical development in design and construction with an adaption of lean manufacturing principles and practices to the end-to-end design and construction process. The lean ideal is to provide a custom product exactly fit for purpose and delivered instantly with no waste to the subse-quent actions that may be necessary in order for projects to pursue that ideal (CII 2007). This approach tries to manage and improve construction processes with minimum cost and maximum value by considering customer needs (Koskela and Howell 2002).

Workflow. The core of lean construction is to make each activity that creates value flow continuously. Resource (labor and equipment) and information flow are the basic units for lean construction. The flow is categorized as controllable and uncontrollable. Controllable flow includes management of material and equipment. Uncontrollable flow contains resource supply information from the suppliers and design information.

Construction process based on lean construction flow theory can be considered as flow process of workflow. In this paper, workflow means continuous movement for various labor and equipment in time and space.

Workflow continuity. Workflow continuity means when workflow goes through various work units, the idle or waiting time is minimum. It reduces the construction cost and maximum the clients' value. In the meanwhile, clients prefer paying the value-added activities and reduce the waste, which results in that the construction moves toward the direction of their maximum value.

Workflow continuity can expose the issues in the construction process and correct them. Once workflow interrupts or stops, it means that some problems occur. It is easy to trace back the root of the problems then improve them. Continuous operations can increase workers' practice level and productivity, which can also improve the workers' morale and project management quality. Traditional construction improvements focus on construction technologies that are the productivity increase for value-added activities. But since value-added activities are only part of the value flow, the improvement room is limited. The continuous workflow can also improve the non value-added activities.

Loss during the flow process. The complexity and uncertainty of construction activities create various losses in the flow process. The losses include:

Unreliability of the pre-construction tasks causes post-construction tasks to wait and idle. The time for material entering to working area, climate, labor efficiency, differences of labor intensity at various standard level, and labor changes for different work units, etc. can generate the working time uncertainty for pre tasks. The waiting and idle not only increase the project cost but affect the workers' morale and coordination between various working teams. The interruption of flow results in the decrease of productivity.

Congestion and conflict in the working area result in low efficiency. Because of the limited operation space, the added labor causes conflict in time and space, increased cost, and decreased productivity.

Uneven allocation of resources leads to uneven resource utilization for different workflow. For example, the resource utilization or productivity for installation of doors and windows is higher than that is for masonry work. This imbalance affects the workflow.

A large number of existing products exist. Overtime is a common way to accelerate the construction schedule. The productivity can increase but extra existing products are generated in the production line. Based on the lean thinking, the extra products are the waste.

LEAN CONSTRUCTION EARTHMOVING OPERATION WORKFLOW MODEL

Earthmoving operation is one of the main activities in construction projects. How to use lean thinking to establish the earthmoving operations workflow in order to reduce or eliminate the waste in the construction process and maximize the usage rate of various resources is key to improve the construction productivity.

Earthmoving activities. The core activities of earthmoving operations involve five works which are earthwork excavation, relocation within the construction site, load, haul and unload, see Figure 1. Typically, an earthmoving operation requires excavator, dozer, loader, and truck. In terms of operation characteristics, the construction equipment is classified as excavation and haulage units, loading units and haulage units.

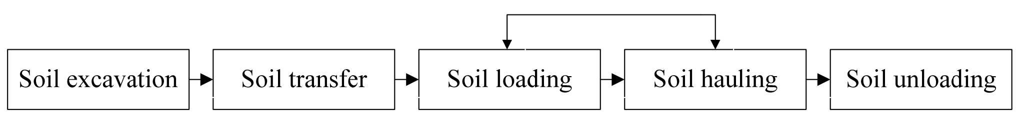

Figure 1.Core activities of earthmoving operations.

Excavation and haulage units refer to the excavator cutting the quantities of soil and the dozer moving the loose soil to the loading location. Loading units use trucks and loading equipment to move earth. Loaders complete the loading operations. Haulage units use trucks to deliver the soil to the designated locations. After unloading soil, trucks return and continue the haulage process. In most cases, instead of using the theoretical optimal equipment combination, contractors use lower cost or existing equipment to complete the tasks within the limited duration and cost range. This can decrease the efficiency of construction work in order to compromise the actual situations.

Earthmoving activities characteristics. Earthmoving operations directly affect the ultimate benefit for the entire construction project. It is a series of complicated dynamic discrete events. There are huge amount of soil excavation, short working time, and strict working duration. The typical earthwork for medium or large size projects is over hundreds of thousands of cubic meters. The duration from construction site preparation to the completion of earthmoving operations is limited to fifteen to thirty days.

A number of large equipment is used to work together. Construction activities, such as soil excavation, relocation, load, haul, and other preparations, are inter-proceeded. Equipment needs to be scheduled dynamically. The concurrent activities and usage of equipment result in interference in the construction process.

Earthmoving operations are affected by many factors such as geographic location, geological conditions, hydrology, and climates.

Main influencing factors and constraint conditions for earthmoving operations. The construction process is affected by internal and external factors. Any influencing factor that is out of control can create loss for projects.

The external influencing factors of earthmoving operations include geological, geographical and meteorological conditions. The influence of geological condition is that the soil condition requires different construction plans and affects construction efficiencies. Geographic conditions include whether permafrost exists and the disadvantages brought by low temperature in winter for activities in various construction phases. The climate influence includes the interruption of construction by rainfall, which decreases the construction productivity.

The internal factors include different plan requirements for earthmoving operations and various constraint relations among operation activities for soil excavation, soil transfer, soil loading, transportation, and unloading.

Workflow model. According to the workflow of general earthmoving operations and constraint relationship between equipment and operational activities, an information model of construction operations was developed. Figure 2 shows the main construction activities and constraint relationships in the model (Cheng et al. 2011).

Excavators work in the excavation locations. The excavated soil is temporarily placed near the construction surface and then transferred to a storage space in the soil loading location by dozers. Managers on-site decide whether the excavators are assigned to assist loaders in loading the soil simultaneously in terms of the number of waiting trucks and the amount of soil to be loaded. They also schedule the trucks that finish loading work to the unloading locations. After the loading work, trucks return to the temporary parking lot waiting for another operation assignment. The managers on-site assign the equipment for the earthmoving operations according to the actual construction situations. The efficiency is affected by multiple factors, such as road conditions, traffic, experiences of the managers, etc.

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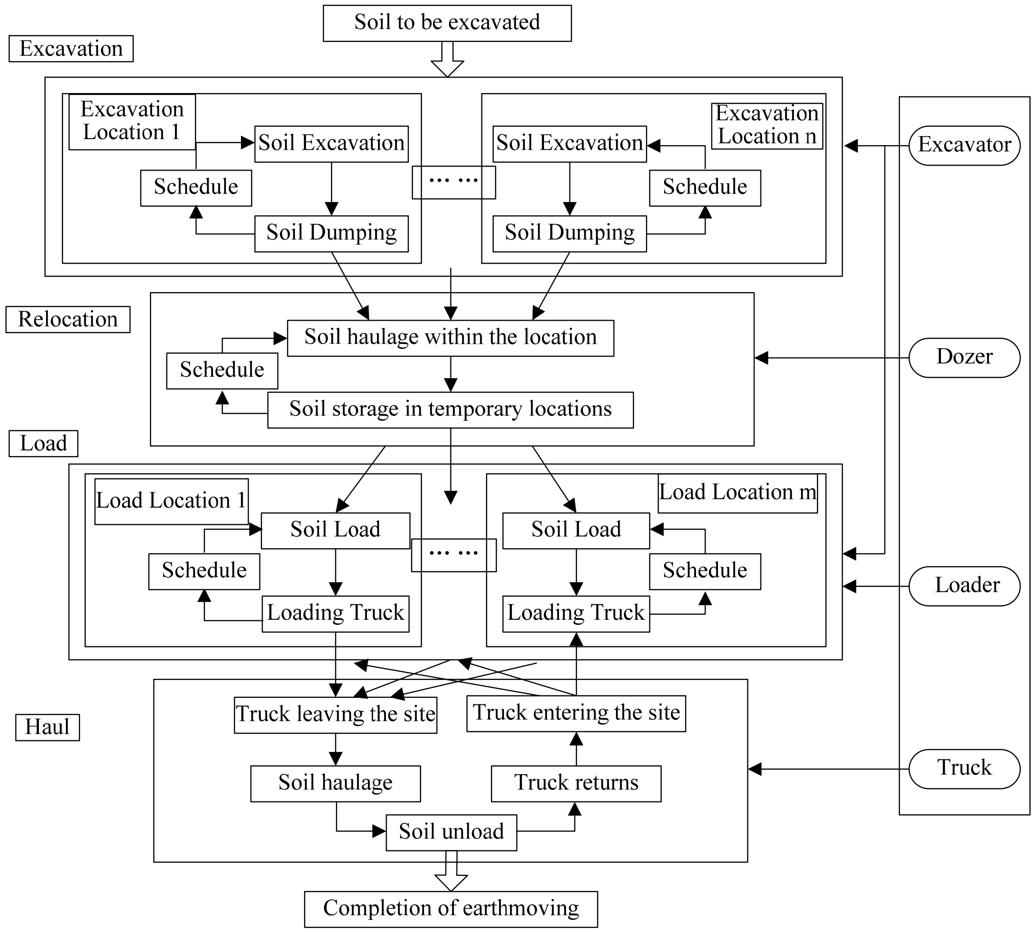

Figure 2.Workflow of earthmoving construction operations.

The workflow model can be broken down into various layers for the analysis of each module's work procedure. Figure 3 shows the trucks loading process.

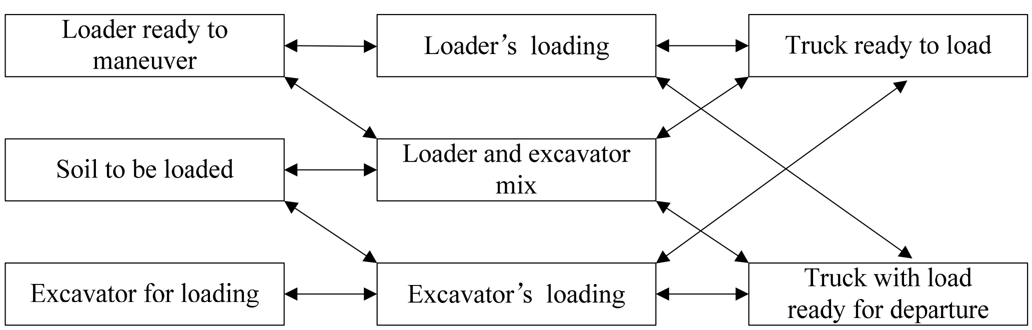

Figure 3.Soil loading layer of workflow model.

Three possible working patterns are identified as loaders operation, excavators operation, and collaboration of loaders and excavators. According to the control mechanisms for job-site equipment scheduling, there are three loading patterns: loader's loading, excavator's loading, and loader and excavator mix. Three loading patterns operate trucks. The loading volume of trucks is a random variable in a certain range. If the accumulated volume of soil exceeds the total capacity of trucks after the last loading is completed, the model will put the extra soil aside to be loaded.

CONCLUSIONS

This paper discussed the application of lean construction in the construction industry. The effect of workflow on project management is analyzed the purpose of which is to reduced the unnecessary procedures and processes, reduce the waste in the construction process, and maximize clients' benefits based on flow management characteristics. A lean construction workflow model for earthmoving operations is used to elaborate the complicated construction process, supervise, adjust, and manage the construction operations, as well as maximize the utilization of resources. It can also support the dynamics and visualization of simulation under complex construction conditions with multiple constraints in the future studies.

ACKNOWLEDGEMENTS

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Analyzing Factors Affecting Time, Cost, and Quality between Diverse Public Construction Agencies

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Abstract

Construction projects' overrun of deadline and budget with reduced quality of the end-product is a challenge which academics, politicians, and construction parties have become more aware of. The objective of this research is to review if factors affect public construction projects' time, cost and quality significantly different between different public construction agencies. The study was initiated by literature review and expert interviews, which lead to identification of 26 factors. A questionnaire was afterwards sent to the full Danish population of publicly employed project managers. The principal findings demonstrate that factors affecting time, cost and quality to a large extent do not differ significantly between the studied organizations. However, a significant difference between factors impact at time, cost and quality was established in the following post-hoc analysis. The conclusion is thus consequently, that the identified factors largely affect non-significantly different between organizations.

INTRODUCTION

Although several studies have been conducted regarding construction projects delay, cost overrun and quality level since Arditi, Akan, and Gurdamar (1985) as the first researcher focusing at public construction project cost overruns, this challenge still characterizes the construction and engineering sector. This increasing challenge is, according to Flyvbjerg, Holm, and Buhl (2002) and Flyvbjerg, Holm, and Buhl (2003), at a level which excludes coincidence as a realistic explanation. Large publicly funded construction projects' cost overrun frequency has not decreased in the last 70 years, and has an average cost overrun of 28 % regardless of project type. Similar results have been presented by Park, Kim, Yoon, and Nepal (2010) where optimistic expectations regarding project duration and budget was found to affect the level of productivity and quality during construction and completed project.

Based on previous studies focusing on factor ranking of either delay or cost overrun as individual perspectives, this research approach addresses a gap identified by Bhargava, Anastasopoulos, Labi, Sinha, and Mannering (2010) and Son and Rojas (2010). Due to the construction process and its factors are interrelated in a more dynamic complex structure. The debate of cost overruns and delays is further stimulating the theoretical definition and debate of what characterizes a successful project. Long, Ogunlana, Quang, and Lam (2004) define a construction project as successful, if cost and time are according to agreed contract, and in accordance with specifications and stakeholder satisfaction.

To elaborate this definition, is Flyvbjerg et al. (2002) define cost overrun as the gap between actual project after completion and estimated cost at the time at decision to start the construction project. Time overrun has however, compared to cost, two definitions. O'Brien (1976) states it as a delay beyond agreed deadline or date the parties have agreed upon. Second definition is proposed by Stumpf (2000) as an act or event that extends the task duration beyond agreed deadline. Finally, quality according to Flynn, Schroeder, and Sakakibara (1994) is divided between internal performance and external performance. Similar definitions are used by Fujimoto (1989), Voss and Blackmon (1994) and Fynes and De Burca (2005).

Looking into potential solutions to the described increase phenomena, Gibson Jr, Wang, Cho, and Pappas (2006) have demonstrated that the amount of pre-planning effort and the following success level of completed construction project are positive associated. However, they also argue that pre-planning should be conducted on each project with the right balance between design and build-ability. This is further supported by Thomas and Ellis Jr (2007), who by using simple pre-planning methods reduced the preliminary construction duration by up to 30 %. Benefits by pre-planning have further been studied by Hanna and Skiffington (2010) and Hwang and Ho (2011) among others, who find increased profit margin, reduced project risk and improved quality compared to normal reactive planned construction projects.

To understand the full extent of the research the present study was initiated by a literature review to comprehend already known results. This result was then explored by expert interviews with 10 % of Danish publicly employed project and property managers. The factors identified during the expert interviews were then generalized by a questionnaire survey with the full population of public agency employed project managers, at four different public construction agencies to gain the full perspective of these factors.

By looking at the state of art and the benefits associated to pre-planning principles within the construction industry there is clearly an untapped potential in studying how these factors affect public agencies in terms of project time, cost and quality. The aims of this paper are 1) to investigate, if the identified factors affect the tested agencies time, cost and quality significantly different from one another and 2) how significantly different the tested agencies are in terms of time, cost and quality.

RESEARCH METHOD

A questionnaire was created based on 26 factors, identified from the conducted literature review and expert interviews. All 26 factors were categorized into five categorizes, which was reflecting the factors contents (see Table 1).

Table 1.Factor Category and Description Used in the Questionnaire Survey, and the Following Data Analysis.

Category	Factor id.	Factor description
External	EX1	Delays or long process times by other authorities
	EX2	Soil conditions
	EX3	State of market conditions
	EX4	Project conditions
	EX5	Weather conditions
Contractual Relationships	CR1	Selection and assignment criteria
	CR2	Errors or inconsistencies in project documents
	CR3	Lack of requirement specifications in tender documents
	CR4	Lack of project structure or material
	CR5	Unforeseeable authority requirements or restrictions
Project Management	PM1	Miscommunication between project partners
	PM2	Conflicts and disputes between project partners
	PM3	Slow user decision making
	PM4	Change of partners in the project organization
	PM5	Inexperienced or newly qualified construction supervisors
	PM6	Inexperienced or newly qualified consultants
Project Changes	PC1	Errors or omissions in construction work
	PC2	Errors or omissions in the consultant material
	PC3	Lack of identification of needs
	PC4	Lack of preliminary examination before design or tendering
	PC5	Late user changes affecting the project or function
Finance and Scheduling	FS1	Optimistic expectation regarding time, cost and quality
	FS2	Political focus on reduced project costs or time
	FS3	Unsettled or lack of project financing
	FS4	Unsettled or lack of project planning
	FS5	Complexity or volume of the project

To secure that the questions and factor descriptions were easily understandable each question and factor description, objective was reviewed according to Sekaran (1992) suggestions for understanding, retention and application. To increase the respondents rate of the questionnaire was used and tested factor definitions from previous studies also used according to Forza (2002) suggestions. To measure the factor effect of time, cost and quality, an ordinal five point Likert scale was used as suggested by Aibinu and Odeyinka (2006) and Doloi, Sawhney, Iyer, and Rentala (2012) (1 = very low, 2 = low, 3 = medium, 4 = high, and 5 = very high) where a don't know option was added. The data collection was conducted according to the Danish Social Science Research Council S.S.R.C. (2002) guidelines, to secure the ethical standard of the study. The establishment and data collection of the questionnaire was conducted using the software SurveyXact. The survey was sent by e-mail to the full population of public agency employed project managers, whore educational backgrounds are architects, engineers building surveyors.

The data analysis was conducted using the software Statistical Package for the Social Science (SPSS). An initial data review was conducted where don't know responses were eliminated and recoded as "missing". To test the data reliability the Cronbach alpha test was applied as proposed by Kline (2013) who argue for an Cronbach value of minimum $\alpha = .7$. The following data analysis was conducted by using a non-parametric statistics approach.

To test for significant differences between the three independent respondent groups (A^1, A^2 and A^3) the Kruskal-Wallis test was applicable, if data contains more than two independent comparable groups. However, due to the relative limited dataset from each involved agency, the tests were supported with the Monte Carlo simulation as proposed by to Field (2009). All conducted Kruskal-Wallis tests were tested with a significant level of .05 as proposed by Fellows and Liu (2009). All significant test results were further analyzed by post-hoc Mann-Whitney tests. This test is comparable to the first conducted Kruskal-Wallis test, but only tests for significant differences between two independent samples. The conducted Mann-Whitney tests were similar to the Kruskal-Wallis test supported with Monte Carlo simulations. To reduce Type I errors further the Bonferroni correction was used as proposed by Field (2009).

RESULTS

The questionnaire was sent to the full population of public agency employed project managers with a total potential respondent rate of 111. However, the following response frequency was 56, which give a total respondent rate of 50.5 % (see Table 2). According to Flynn, Sakakibara, Schroeder, Bates, and Flynn (1990) a minimum respondent rate of 50.0 % is required. This rate is nevertheless debated where Malhotra and Grover (1998) argues for a minimum respondent rate of 20.0 %. The mean age of the responding project managers was 51 years (SD 11 years), where the youngest was 28 years old and the most experienced was 70 years old. Agency one (see Table 2) is specialized in construction and maintenance of university buildings, police stations, and courthouses. Agencies two (see Table 2) is focusing at construction and maintenance of military buildings and structures, and finally agency three (see Table 2) are two smaller agencies grouped together. Their focus is construction and maintenance of jails and maintenance of the country's cultural heritages and structures.

To review the data reliability the Cronbach alpha test for each category and involved agency was conducted (see Table 3). According to Kline (2013) an

Cronbach alpha value less than α = .7 indicates questionable data consistency, and generalization between categories and agencies should thus be carefully considered. However, all conducted total Cronbach values are well above the .7 limit (see Table 3). Further analysis of each agency related to time, cost and quality is thus feasible.

Table 2.Response Rate and Agency Distribution of the Conducted Questionnaire.

Agency No.	Potential respondents	Response frequency	Respondent rate(%)
Agency one - A^1	52	24	46.2
Agency two - A^2	38	24	63.2
Agency three - A^3	21	8	38.1
Total	111	56	50.5

Table 3.Reliability Values for Each Survey Category Divided at Each Agency Related Time, Cost and Quality Perspective.

Category	Time			Cost			Quality		
	A^1	A^2	A^3	A^1	A^2	A^3	A^1	A^2	A^3
External	.571	.685	.904	.332	.783	.845	.495	.856	.696
Contractual Relationships	.684	.755	.952	.574	.851	.927	.639	.894	.877
Project Management	.176	.852	.847	.667	.867	.830	.675	.903	.780
Project Changes	.512	.876	.965	.616	.895	.934	.667	.872	.833
Finance and Scheduling	.683	.907	.833	.739	.925	.923	.727	.905	.871
Total	.735	.956	.970	.799	.968	.960	.857	.968	.866

Kruskal-wallis test. To test for significant differences between the three agencies (A^1, A^2, and A^3) ranking of the 26 factors (see Table 4) affecting time, cost and quality the Kruskal-Wallis test was applied. Minimum sample size for such test is according to Fahoome (2002) is 11 dataset with an α = .05, where the smallest total dataset with all three agencies in tests are 46 (see Table 4). Testing H_0 yielded no significant differences between the agencies ranking of the studied factors.

Looking at the time perspective (see Table 4) five out of the 26 tests were found to reject the null hypothesis (CR3 - *Lack of requirement specifications in tender documents*, PM3 - *Slow user decision making*, PM5 - *Inexperienced or newly qualified construction supervisors*, PC3 - *Lack of identification of needs* and PC5 - *Late user changes affecting the project or function*) and 21 test accepting tested null hypothesis.

Regarding the cost related tests, (see Table 4) a similar amount of rejecting tests compared to the time perspective was demonstrated. Four out of the 26 tests were found to reject the null hypothesis (EX3 - *State of market conditions*, PM3 - *Slow user decision making*, PC3 - *Lack of identification of needs*, and finally PC5 - *Late user changes affecting the project or function*) and 22 test were accepting the tested null hypothesis. It has furthermore not escaped the author's attention that three out of the four factors rejecting the null hypothesis in the cost perspectives, are also rejected in the time related tests.

Table 4.Kruskal-Wallis Test for fhe Three Agencies Divided at Time, Cost and Quality, *Significant at the .05 Level, 2 Degrees of Freedom for All Conducted Tests.

Factor	Time			Cost			Quality		
id.	*N*	Chi-squ	*p*-value	*N*	Chi-squ	*p*-value	*N*	Chi-squ	*p*-value
EX1	56	0.700	.705	56	0.647	.723	56	0.804	.669
EX2	54	3.380	.185	54	3.884	.143	54	5.493	.064
EX3	55	3.065	.216	54	6.848	.033*	54	7.807	.020*
EX4	55	1.652	.438	55	0.353	.838	55	3.439	.179
EX5	55	0.137	.934	55	2.899	.235	55	2.807	.246
CR1	49	1.693	.429	49	1.523	.467	47	3.054	.217
CR2	54	3.896	.143	54	4.858	.088	54	1.646	.439
CR3	52	6.631	.036*	52	3.525	.172	52	11.506	.003*
CR4	53	2.373	.305	53	5.814	.055	53	4.508	.105
CR5	53	1.841	.398	53	0.158	.924	53	0.773	.679
PM1	51	1.381	.501	51	2.547	.280	51	0.441	.802
PM2	51	2.458	.293	50	1.999	.368	51	3.075	.215
PM3	53	6.652	.036*	52	10.276	.006*	52	4.814	.090
PM4	51	2.498	.287	50	1.155	.561	50	2.114	.348
PM5	49	6.379	.041*	49	3.339	.188	49	6.836	.033*
PM6	49	2.018	.365	49	0.509	.775	49	4.037	.133
PC1	49	2.874	.238	49	1.549	.461	48	2.995	.224
PC2	53	1.344	.511	53	1.514	.469	52	1.109	.574
PC3	51	6.321	.042*	50	7.236	.027*	50	13.115	.001*
PC4	48	1.630	.443	48	1.060	.589	49	5.411	.067
PC5	53	8.500	.014*	53	7.053	.029*	52	2.679	.262
FS1	48	0.039	.981	48	0.579	.748	48	3.828	.148
FS2	49	0.004	.998	51	1.629	.443	50	3.839	.147
FS3	46	0.557	.757	44	0.817	.665	44	2.270	.321
FS4	50	4.356	.113	50	3.787	.151	48	2.356	.308
FS5	51	1.781	.410	51	1.411	.494	51	0.169	.919

When it comes to the quality perspective (see Table 4) four out of the 26 tests were found to reject the null hypothesis (EX3 - *State of market conditions*, CR3 - *Lack of requirement specifications in tender documents*, PM5 - *Inexperienced or newly qualified construction supervisors,* and finally PC3 - *Lack of identification of needs*) and 22 test were accepting the tested null hypothesis. Similar to the cost and time perspectives there are clearly the same significant differences between the three tested agencies (see Table 4).

Post-hoc analysis for time. To explore variable patterns and relations, which were found significantly different in the Kruskal-Wallis tests, a post-hoc Mann-Whitney analysis was conducted. However, to reduce the amount of tests and type I errors the Bonferroni correction was applied with a *p*-value of .017 instead of .05 according to Field (2009). The minimum sample size for conducting the Mann-Whitney test is according to Sprent (1989) and Deshpande, Gore, and Shanubhogue (1995) 20 respondents, and the total smallest data in the tests contained 27 responses (see Table 5).

Table 5.Mann-Whitney Time Results for Significant Difference Between the Three Agencies, *Significant at .017 Level.

Factor id.	Factor combination	*N*	U	*p*-value	Z-value	Effect size
CR3	CR3-A^1 – CR3-A^2	44	167.00	.065	- 1.848	- .279
	CR3-A^1 – CR3-A^3	29	61.50	.253	- 1.142	- .212
	CR3-A^2 – CR3-A^3	31	44.50	.024	- 2.254	- .405
PM3	PM3-A^1 – PM3-A^2	46	161.00	.017*	- 2.388	- .352
	PM3-A^1 – PM3-A^3	30	47.50	.085	- 1.721	- .314
	PM3-A^2 – PM3-A^3	30	70.00	.595	- 0.531	- .097
PM5	PM5-A^1 – PM5-A^2	43	171.50	.136	- 1.492	- .228
	PM5-A^1 – PM5-A^3	27	42.00	.208	- 1.259	- .242
	PM5-A^2 – PM5-A^3	28	23.00	.012*	- 2.498	- .472
PC3	PC3-A^1 – PC3-A^2	45	149.50	.014*	- 2.460	- .367
	PC3-A^1 – PC3-A^3	28	62.50	.838	- 0.204	- .039
	PC3-A^2 – PC3-A^3	29	45.00	.176	- 1.355	- .252
PC5	PC5-A^1 – PC5-A^2	46	136.00	.003*	- 2.936	- .433
	PC5-A^1 – PC5-A^3	30	73.50	.715	- 0.365	- .067
	PC5-A^2 – PC5-A^3	30	55.50	.203	- 1.274	- .233

11 out of 15 tests were found non-significantly different, and four significantly different from one another. Three out of four significantly different tests were found between the agencies A^1 and A^2 (PM3 - *Slow user decision making*, PC3 - *Lack of identification of needs* and PC5 - *Late user changes affecting the project or function*) (see Table 5). Finally, one out of four significant tests was found between agency A^2 and A^3 (PM5 - *Inexperienced or newly qualified construction supervisors*).

Looking into the significant differences between the tested agencies, agency A^1 and A^2 differ in terms of how they rank end-user issues, such as late user changes and identification of needs. A possible explanation of the existing end-user differences could be found in the structure of each organization. Agency A^2 and the end-users are in the same organization and thus understand the user process and requirements better compared to agency A^1 which operates as an external organization linked to the user organization in each project.

Regarding the diverse view of inexperienced or newly qualified construction supervisors between agency A^2 and A^3, this could be based on the different expectations to competence level from the construction supervisors, as agency A^3 is maintaining the country's cultural heritages and structures. And most likely anticipate higher supervisor competence due to the more complex construction processes.

Post-hoc analysis for cost. Looking into the test results four out of 12 conducted tests were found significantly different, and eight tests non-significantly different (see Table 6). All four significant differences were found between agency A^1 and A^2 (EX3 - *State of market conditions,* PM3-*Slow user decision making,* PC3 - *Lack of identification of needs* and PC5 - *Late user changes affecting the project or function*) (see Table 6).

Table 6.Mann-Whitney Cost Results for Significant Difference between the Three Agencies, *Significant at .017 Level.

Factor id.	Factor combination	*N*	U	*p*-value	Z-value	Effect size
EX3	$EX3\text{-}A^1 – EX3\text{-}A^2$	46	150.00	.010*	- 2.587	- .381
	$EX3\text{-}A^1 – EX3\text{-}A^3$	32	91.00	.819	- 0.229	- .040
	$EX3\text{-}A^2 – EX3\text{-}A^3$	30	59.00	.158	- 1.411	- .258
PM3	$PM3\text{-}A^1 – PM3\text{-}A^2$	45	120.00	.001*	- 3.212	- .479
	$PM3\text{-}A^1 – PM3\text{-}A^3$	29	46.00	.100	- 1.644	- .305
	$PM3\text{-}A^2 – PM3\text{-}A^3$	30	76.50	.831	- 0.213	- .039
PC3	$PC3\text{-}A^1 – PC3\text{-}A^2$	44	134.00	.009*	- 2.631	- .397
	$PC3\text{-}A^1 – PC3\text{-}A^3$	27	62.00	.951	- 0.062	- .012
	$PC3\text{-}A^2 – PC3\text{-}A^3$	29	43.50	.157	- 1.414	- .263
PC5	$PC5\text{-}A^1 – PC5\text{-}A^2$	46	147.00	.008*	- 2.671	- .394
	$PC5\text{-}A^1 – PC5\text{-}A^3$	30	59.50	.279	- 1.082	- .198
	$PC5\text{-}A^2 – PC5\text{-}A^3$	30	69.00	.558	- 0.586	- .107

Looking into the demonstrated differences between agency A^1 and A^2 is it thus relevant to note that three out of four tested variables, were also found significantly different in the time perspective. A possible explanation of the end-user differences could be found in the structure of each organization as also described in the time perspective. Nevertheless, there is probably also an effect of positive correlation between factors, where an impact from one factor at the time perspective, will also affect the cost perspective. On the subject of factor EX3 (*State of market conditions*) and the demonstrated differences between the two agencies A^1 and A^2 it has not been possible to find a sound explanation of the identified differences. This is due to the fact that both agencies are dependent on the same market, its conditions and same legal requirements.

Post-hoc analysis for quality. Four out of 12 tests were found significantly different and eight tests non-significantly different (see Table 7). Three out of four significantly different tests were found between the agencies A^1 and A^2 (EX3 - *State of market conditions,* CR3 - *Lack of requirement specifications in tender documents*, and PC3 - *Lack of identification of needs*) (see Table 7). Finally, one out of four significant tests was found between agency A^2 and A^3 (PM5 - *Inexperienced or newly qualified construction supervisors*) (see Table 7).

Looking into the demonstrated differences which exist between agency A^1 and A^2, it is relevant to note that two out of three factors were also significantly different in the cost and time perspectives. Finally, the significant different tests between the agencies A^2 and A^3 were furthermore found significantly different in the time perspective. A possible explanation of the lack of project requirements in tender documents and, lack of identification of needs could be found in the organization structure. Agency A^2 and their end-users are representing the same organization and hence understand the general user process and requirements better than agency A^1 which operates as an external organization linked ad-hoc to the user organization in each project. Regarding the differences between the factors state of market conditions and inexperienced or newly qualified construction supervisors of the two agencies A^1 and A^2 there is no sound explanation as to both agencies are dependent on the same market, its labor conditions and same legal requirements.

Table 7.Mann-Whitney Quality Results for Significant Difference between the Three Agencies, *Significant at .017 Level.

Factor id.	Factor combination	N	U	p-value	Z-value	Effect size
EX3	EX3-A^1 – EX3-A^2	46	156.50	.012*	- 2.521	- .372
	EX3-A^1 – EX3-A^3	32	93.00	.885	- 0.145	- .026
	EX3-A^2 – EX3-A^3	30	48.50	.043	- 2.024	- .370
CR3	CR3-A^1 – CR3-A^2	44	104.50	.001*	- 3.368	- .508
	CR3-A^1 – CR3-A^3	29	65.00	.316	- 1.003	- .186
	CR3-A^2 – CR3-A^3	31	61.00	.142	- 1.468	- .264
PM5	PM5-A^1 – PM5-A^2	43	198.50	.411	- 0.823	- .126
	PM5-A^1 – PM5-A^3	27	26.00	.025	- 2.242	- .431
	PM5-A^2 – PM5-A^3	28	24.00	.014*	- 2.447	- .462
PC3	PC3-A^1 – PC3-A^2	44	98.50	.000*	- 3.482	- .525
	PC3-A^1 – PC3-A^3	27	54.50	.603	- 0.521	- .100
	PC3-A^2 – PC3-A^3	29	33.50	.045	- 2.005	- .372

CONCLUSION

An interesting application of this study is the continuation of research in factors affecting construction projects time, cost and quality between different agency organizations. The study reviewed 26 factors affecting project time, cost and quality between three different public construction agencies. Applying the Kruskal-Wallis test on time, cost and quality with the included organizations as grouping variables, potential significant differences were identified.

Looking into the time related analysis, five of 26 tests rejected the null hypothesis by demonstrating significant difference between the three independent construction agencies by $p < .05$. During the following post-hoc Mann-Whitney analysis four out of 15 conducted tests demonstrated significant difference below $p < .017$ using the Bonferroni correction. Three out of four post-hoc tests were found between agency A^1 and A^2, and one test among agency A^2 and A^3. All effect sizes of the tests were found small and medium in the range from $r = - .039$ to - .472.

Regarding the cost associated analysis, four out of 26 tests rejected the null hypothesis by $p < .05$ between the three agencies in the Kruskal-Wallis test. Appling the Mann-Whitney post-hoc analysis, four out of 12 tests were further found significantly different below $p < .017$ using the Bonferroni correction. All four significance cost related tests were found between agency A^1 and A^2. The effect sizes of all post-hoc follow up tests where of small and medium size in the range from $r = - .012$ to - .479.

Finally, factors affecting the quality, four out of 26 tests were found different by $p < .05$ in the Kruskal-Wallis tests. Throughout the following post-hoc analysis, four out of 12 tests demonstrated significant difference below $p < .017$ by applying the Bonferroni correction. Three out of four post-hoc tests were found between agency A^1 and A^2, and one test among agency A^2 and A^3. All effect sizes of the tests were found small to large, in the range from r = - .026 to - .508.

The outcome of this research could be implemented into project management systems within public construction agencies as key performance indicators (KPI´s). Furthermore, these results are extending the understanding of how factors affect project time, cost and quality differently between organizations.

However, due to the research focus, a comparison of results should be carefully considered, taking into account the fit between geographic dissimilarities of regions and industries. Nevertheless, the authors are confident that the results are comparable to countries and industries with similar market structures and general level of development.

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Representation and Reasoning for Common Quality Faults of Construction Based on Ontology

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Abstract

In China, common quality fault control of construction manual is widely accepted for solving quality fault. However, the present manner to solve different types of quality faults requires extracting useful information manually, it is time-consuming, lacking efficiency and prone to error. To conquer the problems, this paper presents a model of ontology-based common quality fault of construction. In the proposed model, control manual of common quality fault of construction is selected as main knowledge source, and extracted hierarchy and relationship of context information from the knowledge source is represented by ontology model. A reasoning framework presented in this paper leverages ontology for structuring knowledge about phenomenon, reason, precautions and improvement measure of quality during construction. Based on inputted quality fault a reasoning mechanism is put forward to identify fault's phenomenon, inference corresponding reason, precautions and improvement measure. And the quality fault ontology is validated by case study. Finally, the limitations of the proposed method and future research directions are discussed.

INTRODUCTION

Current approaches for quality control of construction are not effective, so they can't quickly identify quality faults, especially in the end of construction or operation maintenance phase can identify the fault. But in former researches, domain experts can handle faults by experience and knowledge directly when the quality faults are simple. However, when the quality fault is complex and not experienced before, the domain expert need to analysis and finds the reason according to the basic characteristic of quality fault, it is process complexity, time-consuming, and prone to error of detection results.

Common quality fault control of construction refers to quality fault in construction project, and it often happens and ubiquity (Peng 2002). Control manual of common quality fault of construction is often used in life-cycle of project to diagnose the quality fault during construction, and hence to prevent, or improvement quality faults, thus we choose the manual as knowledge source for quality fault detection. But knowledge of the manual is unstructured, which is difficult to share and reuse. Therefore, it needs to represent quality fault in a new method which can achieve knowledge representation and reuse easily.

The ontology is a structured knowledge representation method, it can describe concept accurately and clearly with hierarchical structure of concept, and it can also support knowledge reasoning. It provides a new method to knowledge acquisition that improves knowledge system to be reused and shared. The development of ontology is supported by W3C (World Wide Web Consortium), and the related researches in recent years, including ontology building, ontology representation language OWL (Web ontology language, Herman and Patel-Schneider 2012), rule language SWRL (Semantic Web Rule Language, Horrocks et al. 2004) and rule inference engine have got more attentions. Hence, ontology model can better solve the problem of quality fault detection, and provide better representation language that the results of quality fault detection are better used to sharing and reuse of knowledge.

The research introduces the concept of ontology into quality control of construction, eager to use that advantage of quality fault detection and domain building; it comes up with the constructing method of the domain ontology and reasoning by logical descriptions. Thus, the advent of ontology enables a potential solution to problems of quality fault detection. This approach can reduce the workload of project participants in process of fault detection and provide a convenience approach for quality fault of construction compared to traditional approaches.

This paper firstly discusses the research background of quality fault control of construction. Section 3 briefly introduces the proposed framework, including ontology representation and ontology reasoning. Section 4, in order to demonstrate the proposed ontology framework, presents a case study that validates that the framework can work. Finally, the paper concludes limitations of the proposed method and future research directions.

BACKGROUND

Control manual of common quality fault of construction. Control manual of common quality fault of construction is used to analysis, prevent and govern the common quality fault the domains of construction. Through the analysis and introduction common fault and frequently occurring fault, quality fault can be effectively prevented and reduced while the manual introduces phenomenon, analysis reason and provides precautions and improvement measure during construction quality fault.

The manual defines 1040 quality faults, and is widely applied to various areas of construction. Attempts of this paper to applying ontology to quality fault management will rapidly and effective find reason and solving measures, and realize information sharing and reuse in ontology framework.

Characteristics of quality fault. The characteristics of every quality fault differ from each other; several outlines can be summarized as follows:

(1) Heterogeneous. Such as building materials may come from different manufactures. As result of heterogeneity of quality fault, information fusion systems have to integrate and combine the multi-source data and reduce the ambiguity.

(2) Hierarchy. A quality fault of construction is caused by different reasons or phenomenon at different construction components. The definition of quality fault is that the process of construction have problems, thus the quality fault also be belongs to different construction processes.

(3) Correlations. One quality fault may have different fault phenomenon. Similarly, one fault phenomenon can indicate many kinds of problems in construction. The relationship between them is not one-to-one, but more complicated.

In summary, these studies provide essential information and technology about what can be leveraged when common quality fault are modeled to facilitate access to a common quality fault knowledge. Hence, these characteristics are taken into account in the proposed model.

Ontology modeling and representation. Lee et al. (2001) presented an extension to the World Wide Web (WWW) named the Semantic Web, which were able to handle Web data without human intervention. Compared with WWW, the existing data retrieval is more accurate and effective, also reuse and sharing of knowledge more easily based on Semantic Web. Ontology is the key technology of the Semantic Web, originates from the philosophy domain and is widely adopted in research efforts in the artificial intelligence and computer science domain in the recent 2 decades. Gruber (1993) defined ontology as "an explicit and formal specification of a conceptualization".

Several studies have been conducted related to the application of ontology to the AEC/FM industry.

Zhu et al. (2007) demonstrated the usability of Industry Foundation Classes (IFCs) for constructing a metadata model for RFIs that enhances the retrieval of RFI-related information.

El-Diraby and Osman (2011) developed domain ontology for construction concepts in urban infrastructure products; the ontology provided a conceptualization for knowledge in civil infrastructure.

Tserng et al. (2009) presented an ontology-based risk-management framework of construction projects through the project through the project lifecycle.

Hsieh et al. (2011) proposed the extraction of concepts, instances, and relationships from engineering domain handbooks to construct base domain ontology.

Wang and Boukamp (2011) built domain ontology for JHA that makes use of existing JHA documents from a construction company and checks the applicability of the safe approaches under specific conditions.

Zhang et al. (2014) put forward ontology in construction safety management, which consists of three main domain ontology models: Construction Product Model, Construction Process Model, and Construction Safety Model.

Ma et al. (2010; 2011a) established information model can be applied to the development of a construction cost estimating software and established a framework for BIM-based construction cost estimating (CCE) software that utilized the Chinese standards. This framework was proposed, and corresponding functions were systematically analyzed. The framework laid a solid foundation for the development of next-generation CCE software.

Ma et al. (2011b) created a discrimination model for BOQ items and the corresponding rule and semantic databases by analyzing the related Chinese standard. The IFC-based discrimination model for BOQ items was established, and a mechanism was formulated to intelligently generate BOQ from IFC data.

In summary, there have numerous researches on the ontology modeling and representation. Some research aim for conceptualization of construction knowledge. Others propose ontologies for product modeling and others are for key concepts in construction domain. However, there have been no studies using ontology to automate the detection in common quality fault.

COMMON QUALITY FAULT DETECTION ONTOLOGY MODEL

Quality fault detection ontology. In the quality fault detection ontology of construction, primary classes are used to represent the core concept within the domain of common quality fault, the four primary classes used are phenomenon, reason, precautions and improvement during the construction lifecycle. The names of the main classes and their relationships in ontology are shown in Table 1. Quality fault detection process is bidirectional, through the reasoning mechanism, is put forward to identify fault's phenomenon, inference corresponding reason, precautions, improvement measure, and achieve the locating of quality fault in construction. This research is mainly aimed at common quality fault detection ontology building, such as the representation model and reasoning mechanism, and that doesn't include location research of common quality fault. The ontology is abbreviated as detection ontology.

Representation model. The representation model leverages detection ontology modeling to model quality fault concept extracted from control manual of common quality fault of construction and to model relationships among concepts. After the discussion of representation, this paper proposes reasoning mechanism in which reasoning rules are established and discuss how quality fault can be reasoned about by defining these reasoning rules.

(1) Ontology building and concepts categorizing. The representation model consists of two parts: construction item and detection ontology.

Construction items: These items represent each phase and each building component of construction involving, like precast pile of common reinforced concrete.

Detection ontology: This part introduces core content of common quality fault in construction that includes reason analysis and reasoning precautions or improvement measure of the collected faults.

The paper uses Protégé, a free and open-source platform enabling development of domain models and knowledge-based applications with ontologies (Horridge et al. 2009). Although many researchers have been studied modeling of ontology, every building method is based on the analysis of the domain research field, but they don't

Table 1.Main Classes and Their Relationship of the Common Quality Fault Detection Ontology.

	Quality fault	Phenomenon	Reason	Precaution	Improvement measure
Quality fault	--	Having phenomenon	Having effect	For precaution	For improvement measure
Phenomenon	Phenomenon on	--	As result of	To prevent	To solve
Reason	Effect on	Resulted in	--	Reason to precaution	Reason to improvement measure
Precaution	To precaution	Precaution via	Precaution to reason	--	Happened
Improvement measure	To improvement measure	Solved via	Improvement measure to reason	Not happened	--

have universality for each of construction method. This research proposes the ontology building of common quality fault detection based on features of common quality fault in construction.

Through the knowledge extraction of the control manual of common quality fault of construction, many primary classes of the detection ontology, including quality fault, phenomenon, reason, precautions and improvement measure, etc. are obtained in this paper. The hierarchy of detection ontology is shown in Figure 1.

(2) Semantic relationships defining. The relationships among these classes are described the associations that occur between concept in the ontology. Relationship can be categorized as hierarchical and non-hierarchical. Joonhee and Bieber (2000) presented RNA its generic relationship taxonomy, describing their use for system analysis, and considered relationships that exist between classes to be internal and external. Two main types of semantic relationship are used in this research: hyponymy (superclass-subclass) and association. The linkage of concepts enriches their definition, so they are better enable us to describe related concepts.

When the quality fault concepts are represented in classifications, hyponymy relationships between the concepts are introduced. This part mainly introduces association relationship, including synonymy relationship (equivalent(x, y)), antonymy relationship (disjoint (x, y)), and meronymy relationships (whole-part(x, y)) the following describe the context semantics:

Synonymy relationship: Used to describe relative similarities between concepts. The following relationships represent types and categories: is the same as, is like, and is similar to.

For example, “混凝土” is the same as “砼” in Chinese, “concrete” is the same as “con’s” in English, because “con’s” is an abbreviation so it should be transformed to “concrete”.

Antonymy relationship: The relationship establishes that concept 1 is the opposite of concept 2. For example, pile foundations

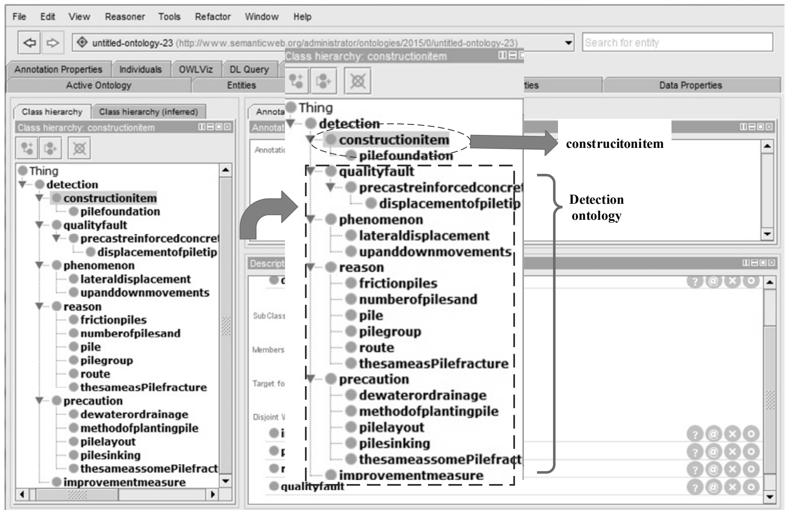

Figure 1.The hierarchy of detection ontology.

are seen as opposite to an earthwork.

Antonymy relationship: The relationship establishes that concept 1 is the opposite of concept 2. For example, pile foundations are seen as opposite to an earthwork.

Meronymy relationship (whole-part): Meronymy relationship describes whole-part relationship between concepts, that is, one concept is a part of the other. There are two methods to descript complex concept: decomposition into parts and decomposition into subclasses.

These meta-relationships aim to classify the most common relationships. The detection ontology including quality fault, reason, phenomenon, precautions and improvement measure, and the object property and their relationship with classes can be expression as shown in Table 2.

Reasoning about common quality fault. Reasoning mechanism developed in this paper aims to reason about detection ontology, the domain rules are expressed by SWRL, and the detection ontology reasoning is executed by Java Expert Shell System rule engine.

(1) Representation of detection ontology rules. Since OWL can only represent property restrictions of single individual, however the rules of detection ontology in construction always contain many individuals, which is beyond the representation ability of OWL. Hence, the reasoning rules should be taken to adding in ontology inference. We also use SWRL engine to infer new knowledge. SWRL, which is based on OWL, allows users to define rules to reason about OWL individuals and to inference the new knowledge (Beimel and Peleg 2011). According to the quality fault of construction contents, the classes and their relationship of the detection ontology are related by SWRL, which is used to describe the reasoning rules. The paper mainly introduces the content of pile foundation, if only one quality fault has happened, then the rule is described below:

qualityfault(?x) ∧ phenomenon(?y) ∧ havingPhenomenon(?x, ?y) ∧ reason(?z) ∧ havingEffect(?x, ?z) → asResultof (?y, ?z)

The rule above means that if the quality fault x has happened and phenomenon

Table 2.Object Properties of the Common Quality Fault Detection Ontology.

Object property	Domain	Range	Description
As result of	Phenomenon	Reason	The relationship between phenomenon and reason.
Solved via	Phenomenon	Improvement measure	The relationship between phenomenon and improvement measure.
Reason to precaution	Reason	Precautions	The relationship between reason and precaution.
Having phenomenon	Quality fault	Phenomenon	The relationship between quality fault and phenomenon.
Having effect	Quality fault	Reason	The relationship between quality fault and Reason.
For improvement	Quality fault	Improvement measure	The relationship between quality fault and improvement measure.
To precaution	Phenomenon	Precaution	The relationship between phenomenon and precaution.

on y is x, then reason of quality fault is z. Above the rule expression is simple based on only one fault happened, others is normal.

The SWRL rule is encoded by XML which is easy embedded in OWL file and it is convenient for computer recognition (Zhou et al. 2015).

(2) Reasoning. The overall process for creating inferred knowledge consists of three steps:

Step1： The reasoning layer binds construction item ontology and detection ontology using XSLT into bound XML data for query and retrieve, which is simple, non-redundant data.

Step2: The ontology and inference rules need to be translated into the rule language which can work in JESS inference engine.

Step3: The JESS knowledge base stores fact base and rule base.

The JESS rule engine which consists of fact base and rule base, JESS's reasoning is based on a list of known facts and a set of rules that try to match these facts in knowledge base (Jovanovic and Gasevic 2005). The JESS interpreter in its basic distribution interprets only JESS code. Thus, we need to transform the RDF and OWL format into the JESS code. The framework of common quality fault inference in this paper is shown in Figure 2.

THE IMPLEMENTATION OF QUALITY FAULT DETECTION ONTOLOGY

With the support of knowledge base, detection ontology reasoning is researched in this part according logic description. Usually, quality fault is represented through fault phenomena in construction, and happened in location of obvious component or construction process. We need to find all these information in construction through the reasoning for better quality control of construction.

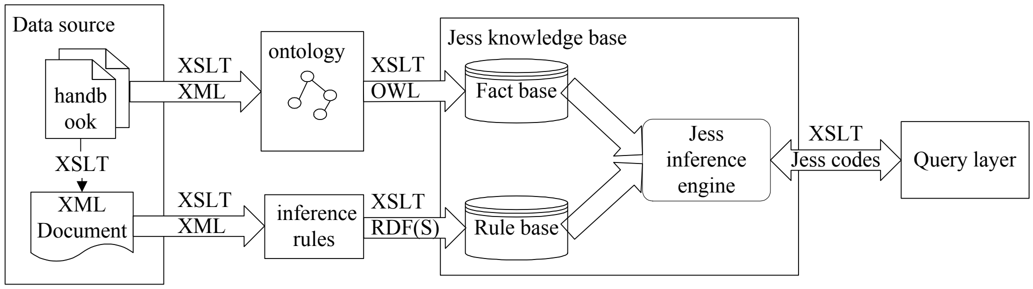

Figure 2.Framework of common quality fault inference.

Common quality fault detection ontology framework. The frmaework of quality fault dection ontology is shown in Figure 3. The porposed framework using data source to automate the search for the reason for quality fault, this process can help constructor to find precautions and improvement measure more easily and efficiently.

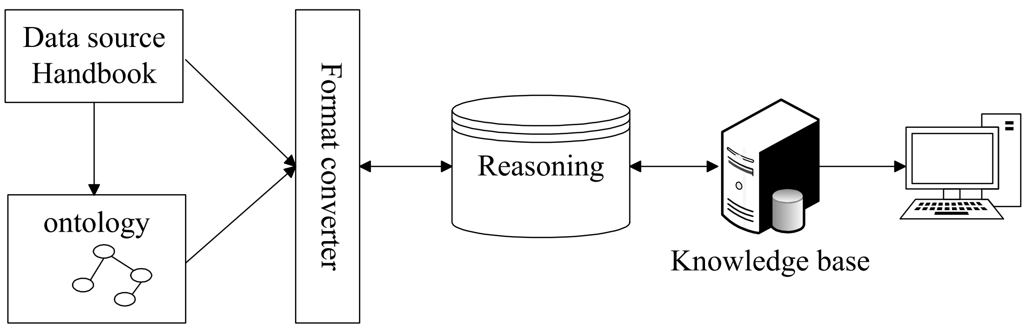

Figure 3.Framework of common quality fault detection ontology in construction.

Experiments of fault detection reasoning. All the knowledge of common quality fault is expressed by OWL and the related concepts and their relationships are also extracted and encoded in SWRL. The Quality fault ontology model is shown Figure 4.

The property has happened of the quality fault class *displacementofpiletip*, which indicates the fault of displacement of pile tip is true. After the reasoning of JESS inference engine, the reasoning rule and result are shown in Figure 4. The process is illustrated in Figure 4, which shows an example result for the reasoning operator.

CONLUSION

The paper propose a new approach to common quality fault control, which enables quality fault control to be based on explicit and accuracy. The new approach presents a framework that is composed of two parts: the representation model and reasoning. Quality fault knowledge are extracted from control manual of common quality fault of construction, are modeled in ontology, then the knowledge is translated into fact and rules by virtue of OWL and SWRL. With the help of JESS rule engine, the proposed framework can supply with information of reason, precautions and improvement measure. The method achieves knowledge share and reuse between quality control in construction.

According to experienced construction managers' feedback, the advantage of the proposed framework over the traditional quality control is beyond many people's expectations. Firstly, the framework is more easily used and retrieved quality fault knowledge and spent less time on quality fault detection. Secondly, for the expansibility of framework, this method can update and expand its quality fault and reasoning rules in actual construction.

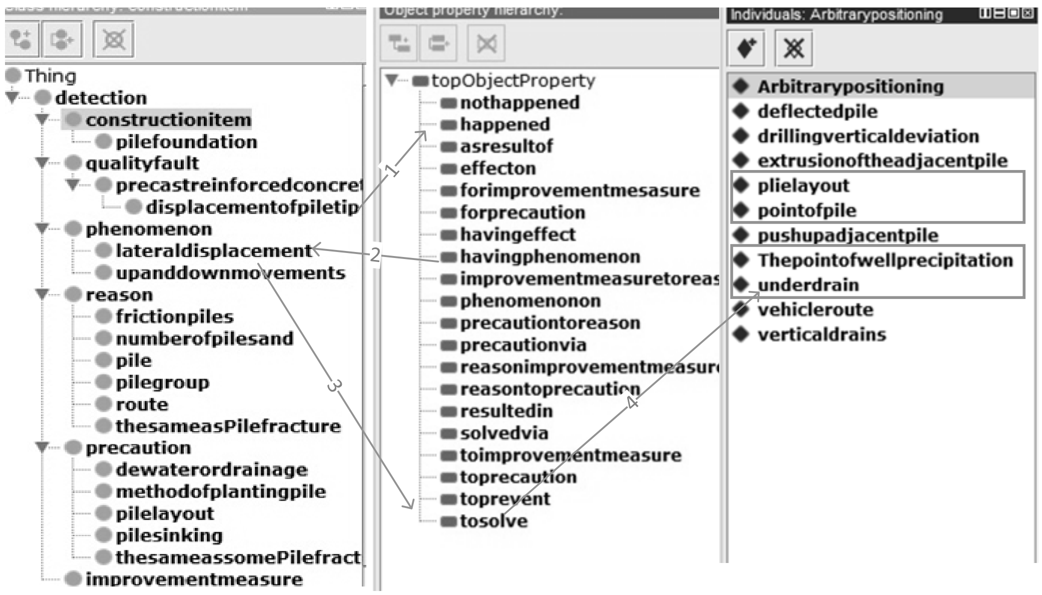

Figure 4.Quality fault ontology model.

There are also some limitations of the proposed method which need future researches. First, the proposed framework is not included location research; we aim to address this issue in the proposed framework in future. Second, the ontology model established in this paper is simple, thus the classes' amount and the relationships between classes not reflect synthesis and complexity of quality fault, and this need to continued perfection in the future work. Thirdly, the proposed framework is preliminary results, so we need collect enough information to enrich content.

ACKNOWLEDGEMENTS

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Empirical Study on the Contribution of the Construction Industry in Guangdong Province

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Abstract

This paper is to discuss the correlation between the trend of proportion of Construction industry output value in Guangdong province, gross product of construction industry and Guangdong's GDP base on Statistical data of 1989–2012. What is more, this paper measures the construction industry's contribution to the provincial economic using industry contribution model combining their trend of rate of increase. The result shows that, although the supporting function of construction industry lag behind relatively, yet the construction industry promote other industries' development hugely which means that the construction industry has significant influence on Guangdong's overall economy. The contribution index of construction industry, is merely 0.3701, shows that the contribution of construction industry presents a negative state. We suggest that the government should take a series of related measures which can provide good macroscopic development environment for construction and improve the level of the development of construction industry, in order to encourage the construction industry make more contribution for the province's overall economic.

INTRODUCTION

Construction is the pillar industry of national economy. It is a kind of production industry that specialized in civil engineering, housing construction, equipment installation and engineering survey and design work. The healthy development of construction is related to the development of the national economy. In order to reveal the relationship between the overall economic development of Guangdong Province and the province’s construction industry, this paper uses the industry contribution model to quantitatively calculate it. This paper analyzes macro opportunities brought about by the economic development of Guangdong province for the development of the construction industry, and explore promoting effect that the development of construction industry contributes to the economic development of the province. This paper may offer some reference for making the right policies and measures to guide the development of construction in a healthy, rapid and sustainable way.

LITERATURE REVIEW

As a branch of industry contributing to the content industry economics, many scholars have conducted research. Most of the research focuses on the aspects of manufacturing and high-tech industries. Zhang (2009) constructed industry comprehensive evaluation model using factor analysis of the contribution of regional to investigate the contribution of Qingdao manufacturing industry and development. Wu and Li (2009) study the high-tech industry contribution to Sichuan GDP and the traditional industrial output. For the construction industry, some scholars study the relationship between development of construction industry and overall economic development. Durdyev and Ismail (2012) analyze the relationship between the economic growth and the construction industry in Turkmenistan. There is some scholar’s study the construction industry’s contribution to the overall economic development directly. Wang et al. (2009) studied different industry’s contribution by their percentage of GDP, growth rate, the contribution of the intensity, the contribution rate, the driving force coefficient, drivers and other aspects. They found that the construction industry and real estate contribute hugely to Guangdong Province’s GDP and they play the significant role in overall economy. Huang et al. (2000) have measured the impact of the driving force of the construction industry on China’s GDP growth based on a regression model. Qi et al. (2012) studied the contribution of construction investment for stimulating economic growth multiplier influence coefficient and investment multiplier in production and consumption sectors using input-output model and multiplier theory. In summary, most of the researches on industry’s contribution are on the country level. Although some researches on this area are on the Province level, yet they are not profound enough. This paper discusses the relationship between the development of construction industry and the development of Guangdong Province’s economy and proves the importance of construction industry to the overall economic development in Guangdong.

ASSUMPTIONS & ESTABLISHMENT AND ANALYSIS OF MODELS

The expression of a certain industry contribution to the economy and influence on the economy often by measuring the industry accounted for share of the economy or the trend relation of the industry and economy. And the industry contribution can further reflect the influence of growth of the industry to economy. Assuming that Q_t^{GDP} represents gross domestic product (called GDP) of an economy in the t year, and Q_t^{GOV} represents the total output value (called GOV) of a certain industry of the economy in the t year.

GDP growth rate of the economy in the t year:

$$G_t^{GDP} = \left(Q_t^{GDP} - Q_{t-1}^{GDP}\right) \Big/ Q_{t-1}^{GDP} \tag{1}$$

GOV growth rate of a certain industry of the economy in the t year:

$$G_t^{GOV} = \left(Q_t^{GOV} - Q_{t-1}^{GOV}\right) \Big/ Q_{t-1}^{GOV} \tag{2}$$

Industrial contribution also known as industrial impetus means that a certain industry makes contributions, impact and effect to the whole economy growth. Measurement indicators of industry contribution are mainly contribution degree of industry F_t, industry contribution rate E_t and driving force strength q.

A certain industry growth in that year to the previous year economy output represents contribution degree of industry F_t. Contribution of industry reflects a certain industry growth accounted for the share of the previous year economy output. It also reflects the development of a certain industry's contribution to the whole economy. The contribution degree of the industry to the economy GDP it belongs in the t year:

$$F_t = \left(Q_t^{GOV} - Q_{t-1}^{GOV}\right) \Big/ Q_{t-1}^{GDP} \tag{3}$$

A certain industry growth to the economy output in the same year represents industry contribution rate E_t. Industry contribution rate reflects a certain industry growth accounted for the share of its economy output growth. Industry contribution rate is a comprehensive index; it reflects a certain industry comparative advantage in specific areas and its economic status and contribution in the study area. Therefore, the greater contribution of the industry, the bigger the role the industry plays on its economy development.

The contribution rate of GDP of the industry to the economy it belongs:

$$E_t = \frac{F_t}{G_t^{GDP}} = \left(\frac{Q_t^{GOV} - Q_{t-1}^{GOV}}{Q_{t-1}^{GDP}}\right) \Bigg/ \left(\frac{Q_t^{GDP} - Q_{t-1}^{GDP}}{Q_{t-1}^{GDP}}\right) = \frac{Q_t^{GOV} - Q_{t-1}^{GOV}}{Q_t^{GDP} - Q_{t-1}^{GDP}} \tag{4}$$

The dependent variable is G_t^{GDP}, independent variable is G_t^{GOV} which impacts G_t^{GDP}. Driving force strength of a certain industry of the economy it belongs can be composed of the following linear regression equation:

$$G_t^{GDP} = \alpha \cdot G_t^{GOV} + \beta \tag{5}$$

α is driving force coefficient, which reflects the percentage of GDP growth driven by the industry. β is the constant term.

Then we get the calculation formula of driving force strength:

$$q = \alpha \Bigg/ \left[\frac{1}{n} \sum_{t=1}^{n} \left(Q_t^{GOV} / Q_t^{GDP} \right) \right] \tag{6}$$

In the observation period which last for n years, $q \geq 1$ indicates GOV is equal to or more than its share of GDP, the driving force of the industry to the economy development is positive; $q < 1$ indicates GOV is lower than its share of GDP, the driving force of the industry to the economy development is negative.

THE BASIC DATA AND PROCESSING

This paper collects statistical data of the Gross Domestic Product (referred to as GDP) and Gross Output Value of Construction (referred to as GOVC) of Guangdong Province from 1989 to 2012. Taking into account inflation, price change factors that affect the target price of different years, enhancing the accuracy and comparability of index data, the selected data are converted to 1989 in accordance with the rate of inflation. All the basic data are derived from the Guangdong Statistical Yearbook (1990-2013).

ECONOMETRIC ANALYSES

From 1989 to 2012, according to the econometric results based on the basic data, the share of GDP and GOVC in Guangdong Province has been maintained at 3% ~ 10%, the average is 5.25% (see Figure 1).

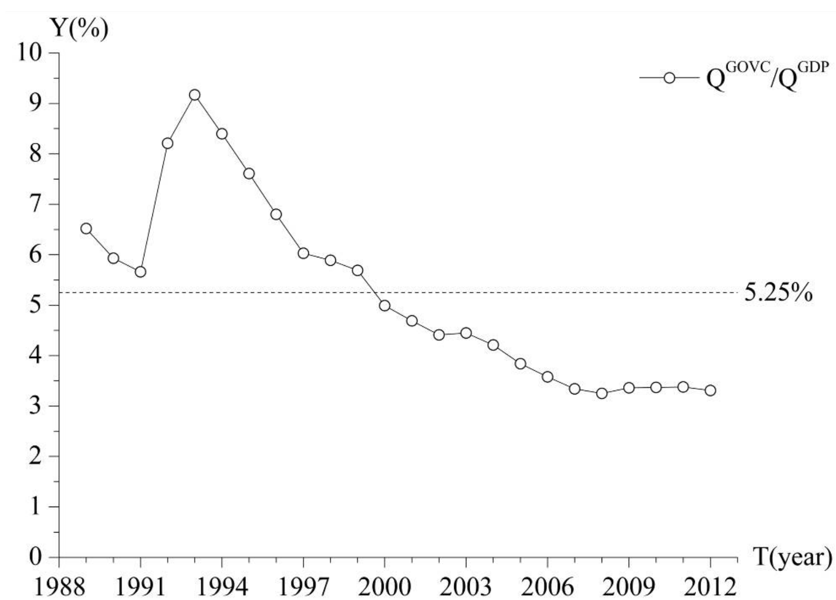

Figure 1.The trend about GOVC accounted for the proportion of GDP in Guangdong province.

The regression equation is:

$$Q^{GDP} = 35.5202 \cdot Q^{GOVC} + (-3783.7273) \tag{7}$$

Examine further the relationship between the GOVC and GDP of the province. According to the basic data, conducts the linear regression analysis of GDP and GOVC, then gets evaluation indexes and the OLS parameter estimation value. The goodness of fit $R^2_{(Q^{GDP},Q^{GOVC})} = 0.965$ reflects linear regression model composed of the independent variable Q^{GOVC} and the dependent variable Q^{GDP} of this equation has a very high degree of adaptation. If $\alpha = 0.01$, according to the freedom degrees $df_1 = 1$ and $df_2 = 22$, $F_{0.99}(1,22) = 8.02$, apparently test value $F = 602.281 > 8.02$. It explains that regression equation is significant when the significance level is 0.01. At the same time, $Sig. = 0.000 < 0.05$, which also has passed the test. In general, the equation can be used as quantitative formula of the GDP and GOVC of Guangdong Province. There has a great linear correlation between the GDP and GOVC of the Province. Figure 2 shows the scatter plots and straight line of regression equation of Q^{GDP} and Q^{GOVC}.

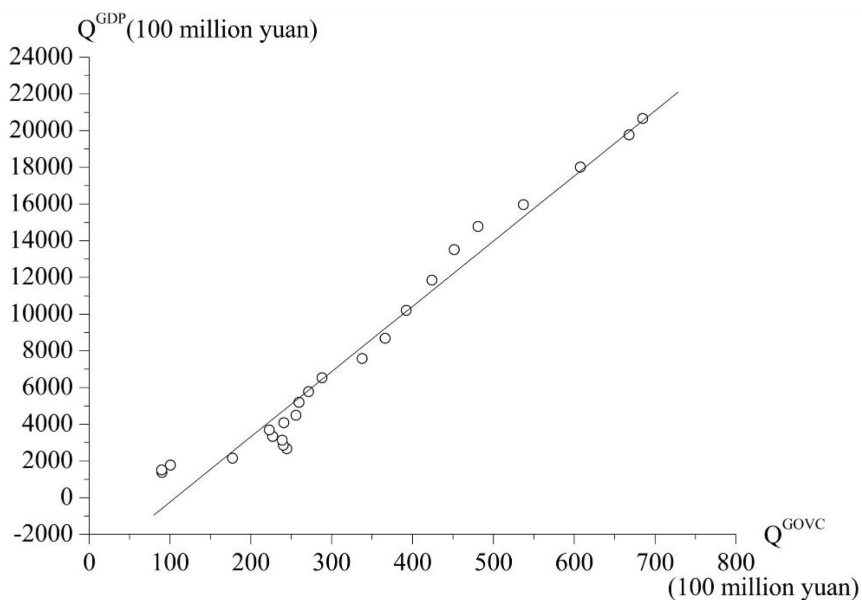

Figure 2.The correlation between GOVC and GDP in Guangdong province.

According to formula (1)-(2), calculates the value added and growth rate of the GDP and GOV each year of Guangdong Province. Then, according to formula (3) ~ (4), calculates and contribution degree and contribution rate of the construction industry's to GDP. From 1989 to 2012, Guangdong Province GDP's annual growth amount is 83.832 billion Yuan and the average annual growth rate is 12.48%. In this province, GOV's annual growth amount is 2.585 billion Yuan, with an average annual growth rate of 9.22%. The average contribution degree of GOVC to GDP is 2.99%; the average contribution rate of GOVC to GDP is 18.13%.

According to the measurement results of growth and contribution about GDP and GOVC in Guangdong Province, making a figure of the growth rate trend of GDP and GOVC (see Figure 3).

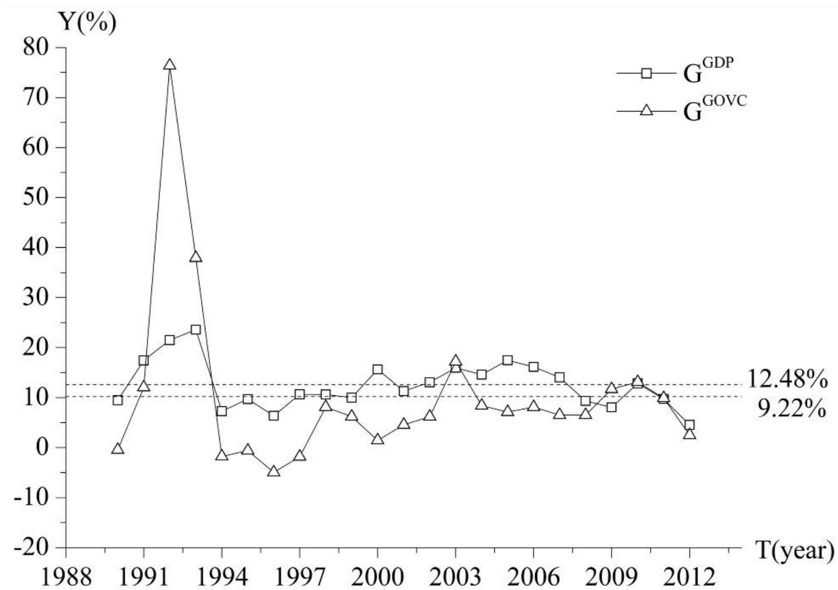

Figure 3.The growth rate trend of GDP and GOVC in Guangdong province.

During the observation period of 1989-2012, GDP annual growth amount is 83.832 billion yuan of Guangdong province, with an average annual growth rate of 12.48%. GOVC annual growth amount is 2.585 billion yuan, with an average annual growth rate of 9.22%. Since the end of 1989 to the end of 1993, a short 4 years, this province's GDP growth rate was beginning at 9.47% and quickly peaked at 23.58% in observation period. The growth amount increased from 13.076 billion yuan in 1990 to 50.879 billion yuan in 1993. During this period, the growth rate increased from -0.44% to a peak of 76.39% in observation period and the growth amount increased from -0.04 billion yuan to 7.676 billion yuan. Although the growth rate declined to 37.93% in 1993, but the growth amount was still as high as 6.722 billion yuan. The following year, the province's GDP and GOVC growth rate were both fall below the respective average annual growth rate in observation period. Growth rates were 7.28% and -1.75%. Growth amount was 19.426 billion yuan and -0.427 billion yuan. From the beginning of 1995, the GDP and GOVC growth rate began to increase slowly. The growth rate of GDP reached the peak again after picking up until 2005. At this time, the growth rate was 17.46% and the growth amount was 2.61 billion yuan. With the growth rate reaching 17.22% and the growth amount reaching 4.962 billion yuan, GOVC reached the peak after picking up in 2003. After that, the growth amount of the GDP and GOVC were slow to come down around the respective average annual growth in observation period again, but the fluctuating law of them was different. At the end of observation period in 2012, the growth rate of the GDP and GOVC dropped to 4.53% and 2.51% respectively, the growth amount of the GDP and GOVC dropped to 1.679 billion yuan and 1.87 billion yuan (see Figure 4).

During the whole observation period, the average contribution intensity of the construction industry in Guangdong province contributes to the region's overall economic is 2.99% and the average contribution rate is 18.13%. Obviously, the fluctuation range of contribution rate is much larger than the fluctuation range of contribution intensity. This performance is particularly prominent in the early observation period, but the two fluctuations generally maintain mainly trend of increase and decrease. From 1990 to 1993, the fast-growing GDP period, the construction industry contributed a lot to the region's overall economic. The contribution intensity increased from -0.31% to 20.10% and the contribution rate increased from -3.23% to 93.52% in this three years. The contribution intensity and the contribution rate began to appear a certain decline in 1993; they dropped to 13.21% and 56.03% respectively at the end of the year, but still remained above the average value of the observation period. In 1994, the contribution intensity and the contribution rate further decreased sharply below to the average value of the observation period, only -2.20% and -30.20%. From 1995 to 2003, contribution intensity showed a trend of a steady upward and kept staying near the average value. Although contribution rate also gradually picked up, the state fluctuated very often. Among them, the contribution rate in 1996 decreased to the lowest value point of observation period, only -92.76%. From 2004 to the end of the observation period, contribution intensity still stayed near the average value. The contribution rate appeared to rise slightly.

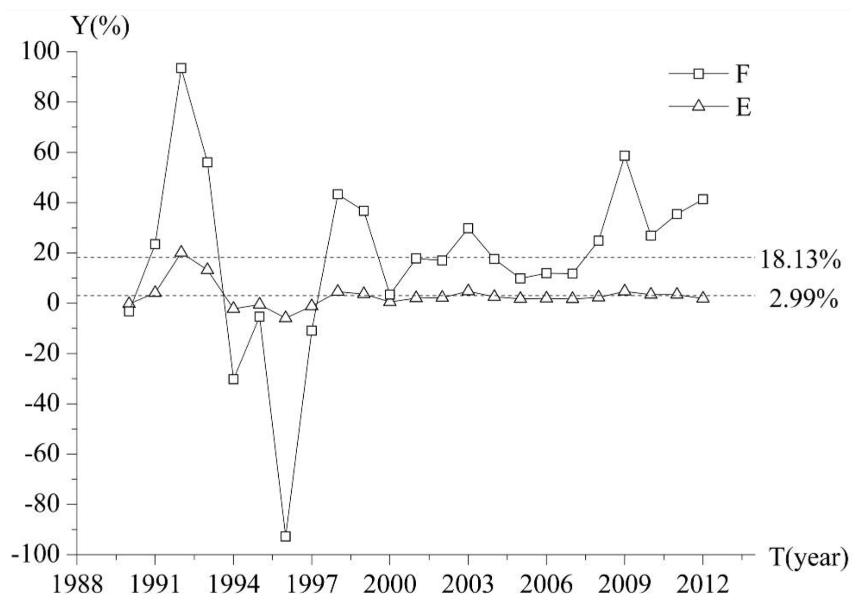

Figure 4.The trend of contribution intensity and contribution rate of construction industry in Guangdong province.

The regression equation is:

$$G^{GDP} = 2.4431 \cdot G^{GOVC} + (-0.2053) \quad (8)$$

We conduct the linear regression analysis of GDP growth rate and GOVC growth rate, and then get evaluation indexes and the OLS parameter estimation value. The correlation coefficient $R_{(G^{GDP}, G^{GOVC})} = 0.688$ and the goodness of fit $R^2_{(G^{GDP}, G^{GOVC})} = 0.473$ reflect linear regression model composed of the independent variable G^{GOVC} and the dependent variable G^{GDP} of this equation has a general degree of adaptation. If $\alpha = 0.01$, according to the freedom degrees $df_1 = 1$ and $df_2 = 21$, $F_{0.99}(1,21) = 8.02$, apparently test value $F = 18.879 > 8.02$. It explains that regression equation is significant when the significance level is 0.01. At the same time, $Sig. = 0.000 < 0.05$, which also has passed the test. In general, the equation can be used as approximate quantitative formula of the Q^{GDP} and Q^{GOVC} of Guangdong Province. Then driving force coefficient of GOVC to GDP is 2.4431. That indicates if Q^{GOVC} increases 1%, Q^{GDP} will increase 2.4431%. Figure 5 shows the scatter plots and straight line of regression equation of Q^{GDP} and Q^{GOVC} .

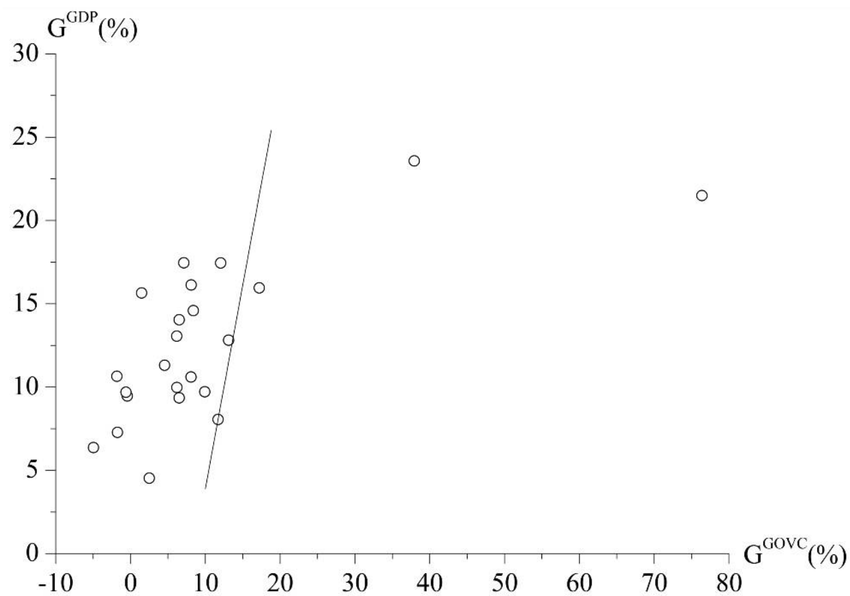

Figure 5.The correlation of growth rate between GDP and GOVC in Guangdong province.

Given that $\alpha = 2.4431$, based on the basic date, according to the formula (6), then gets driving force strength is 0.3701 and found it less than 1. That indicates GOVC is lower than its share of GDP, the driving force of Guangdong Province construction to the whole area economy development is negative.

PROBLEMS AND SUGGESTIONS

Regional economic growth is the sum of value added by many industries. The construction industry as an important manufacturing industry of economy plays an important role in promoting the development of the whole regional economic. During 1989-2012, the total output value of construction industry holds 3% ~ 10% of regional GDP of Guangdong Province, and the average is 5.25%. The role of construction industry becomes less significant for the regional GDP of Guangdong Province form Figure 1. The development of whole area economy depends on the assets investment. However, the proportion that construction industry holds decrease. The reason for this problem is the restrictions of statistical accounting. The total output value of construction industry is accounted by cooperation's registered area. Many construction projects in Guangdong Province are outsourced by cooperation that register outside Guangdong Province, especially some roads, bridges, tunnels, rail and other high technology projects, which reflect the weak competitiveness of construction enterprises. This problem becomes more obvious in country level construction enterprises. Focusing on this problem, the government should continue to restructure the construction enterprises, and support the large enterprises continually so as to strengthen the construction enterprises in Guangdong Province.

The total output value of construction industry and GDP are highly correlation. They basically kept stable linear relation. The construction industry provides a solid type of fixed assets for other industries, and its production are demanded in other industries as intermediate input products in a small number. However, the construction industry requires a large number of consumption of other industrial products in the manufacturing process, which decide that the construction industry depend on other industries. So the construction industry has a significant impact on the development of regional overall economy. The government should fully understand that, and continue to improve the scale of construction industry. Guiding the construction industry to expand their business to the real estate, building materials manufacturing and other related industries can extend the industrial chain and diverse the capital, which strengthen the industry overall risk resisting ability and promote other industries. According to Figure 1-5, throughout the province of regional GDP growth rate, the total output value of construction industry growth rate, construction industry contribution and its growth rate, they keep a similar trend.

Driving force coefficient of Guangdong Province construction industry to the whole area economy is 2.4431. That construction output increased 1%; gross domestic product of the province will be promoted the growth of 2.4431%. Considering only from promoting incremental percentage terms, the promoting increment of the Guangdong Province construction industry to its gross regional product is 2.4431 times its own increment. Combined the average of the total output value of construction industry in Guangdong Province accounted for the proportion of GDP, the actual driving force strength is only 0.3701. Guangdong province construction industry output value less than its share of GDP in the region. It indicates that Guangdong Province construction industry for the development of its whole economy presents a negative state. Recommended that the Government should take reasonable measures to guide the construction industry to integrate various resources, strengthen the depth of their own advantages and develop a wide range of contracting model. As far as possible to provide differentiated products to meet the demand for the market, extend the industrial business ability, cultivate new industrial economy growth points, increase its share in the GDP, and promote the driving force of industries to the overall economy.

CONCLUSIONS

This paper mainly discusses the trend of percentage that the construction industry holds in GDP of Guangdong Province and their correlation. On that basis, this paper has discussed the contribution of construction industry to the overall economy and analysis the level its contribution to the overall economy of Guangdong Province. To cope with the fact that the construction industry becomes more and more significant to the overall economy of Guangdong Province with low contribution rate, this paper recommends that the government should improve the microenvironment of construction and promote the developing level of construction industry.

ACKNOWLEDGMENTS

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Simulation Analysis of a Contract Modification Process Based on Stochastic Petri Nets: A Case Study of Mechanical and Electrical Installation Projects in the Guangzhou Metro

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Abstract

On account of many unpredictable factors, modification of contract during project construction is almost inevitable. At present, the contract modification management is inefficiency, leading to high change frequency and high cost. In this paper, a simulation model of Stochastic Petri Nets systems is built to analyze the contract modification process of construction project, current process of mechanical and electrical installation contract modification in Guangzhou metro is taken as a case study. According to quantitative analysis and simulation results, this paper finds that the bottleneck problems of modification process lay in these three areas: modification files writing by construction organization, supervising engineer's review, and sponsoring department’s review. Taking the average process efficiency into consideration, we suggest that optimized objects and factors focus on sponsoring department who should improve the efficiency of approval process in change review meetings and timely adjustments for changes in cost, to improve management lever of metro construction.

INTRODUCTION

Along with the rapid development of national economy and the continuous expediting of urbanization, the construction of infrastructure has rapidly increased. Large building projects have sprung up, huger project size and complex construction technique has led to expansion of professional work types and complex relationships between different stakeholders and increased number of intangible risks. However, limited by limited system, management lever, firm capabilities and many other aspects, problems inevitably arise during whole project life cycle (Wu 2006), among which contract modification is one of the key causes for contradiction. In order to ensure the smooth implementation of contract, it is important to strengthen the contract modification management.

This paper applied Stochastic Petri Net to simulate and model contract modification process based on the case study of Guangzhou Metro mechanical and electrical installation projects, and optimizing opinion is given according to the performance analysis results of simulated system.

LITERATURE REVIEW

In terms of contract modification management, Chen (2012) built a contract database, according to the theory of interface management, through cooperative information platform, and has raised suggestion on decreasing contract modification frequency by strengthening data sharing. Zhao (2010) and Ding (2008) applied Stochastic Petri Nets to build a management optimization model of contract modification under government agent construction system to find the bottlenecks of inefficiencies, and optimizing opinions on phased-mission systems was proposed according to the analysis result. Perkins (2009) pointed out it is the change in government's demand and administrative intervention that caused contract modification rather than design change. Arain (2008) argued that project modification management system based on IT technology needs to be built to participate, recognize, assess, solve, control, archive, rethink those happened modification cases. Li et al. (2012) applied Petri Nets in program management, project programmed was decomposed into a series of workflows, projects tasks are carried out according to workflow rules such as time, resource and other factors so that to achieve a organic whole of source allocation and collaborative management.

STOCHASTIC PETRI NET

"Stochastic Petri Net" was named by CA. Petri (Azgomi and Khalili 2009). Stochastic Petri Nets have a great of advantage in performance analysis and have been widely applied.

"Stochastic Petri Net" SPN $=(P,T,F,W,M_0,\lambda)$

(1) $P \cup T \neq \Phi$, P refers to a finite set of Place, T refers to a finite set of Transition;

(2) $F \subseteq (P\times T)\cup(T\times P)$, F refers to Flow Relation, only existing between P and T;

(3) $W: F \to N^+$ refers to arc weight function, $N^+=\{1,2,\cdots\}$;

(4) $M_0: P \to N$ refers to initial domain identifier, $N=\{1,2,\cdots\}$;

(5) $\lambda=\{\lambda_1,\lambda_2,\cdots,\lambda_m\}$ is a set of the average implementation speed of transition, the value if each λ_i is defined by simulated results or predicted by some

specific requirements. We can assume λ_i obeys index distribution, $1/\lambda_i$ refers to average delay time of t_i.

A SPN is isomorphic to a Markov Chain in a continuous-time. Every mark of SPN is mapped to a state of MC. One finite SPN is isomorphic to one finite MC. When stationary distribution exists in MC, we can get the stationary probability of system. Stationary probability can be represented by row vector $\prod = \{\pi_1, \pi_2, \cdots, \pi_r\}$. According to relevant theorems of MC stationary distribution and Chapman-Kolmogorov equation, we can get:

$$\begin{cases} \Pi Q = 0 \\ \sum_{i=1}^{r} \pi_i = 1 \end{cases} \tag{1}$$

Q is transfer rate matrix of Markov, element of q_{ij} can be calculated by:

$$q_{ij} = \begin{cases} \lambda_k & \text{if } i \neq j, \text{ and there is a } t_k \in T \text{ which makes } M_i \big| t_k > M_{j-}, \\ 0 & \text{if } i \neq j, \text{ and there isn't a } t_k \in T \text{ which makes } M_i \big| t_k > M_{j-}, \\ -\sum_{M_i | t_k > M_{j-}} \lambda_k & \text{if } i \neq j. \end{cases} \tag{2}$$

Performance analyze of simulate model applying SPN is a three-step process:

(1) Build SPN model according to practical project: Establish P/T nets first, then add a set of average implementation speed λ, then a SPN is built.

(2) Make MC isomorphic to SPN. Find SPN reachability graph, and translate T of every arc into λ_i, then a MC is built.

(3) System performance analysis. Based on MC stationary probability, we can solve practical problems through system performance analysis and give improvement suggestions.

CASE STUDY

Stochastic Petri Net simulation and Model. This model is built based on a case study of Guangzhou Metro M&E installation contract modification. Based on principle of easy to identify of subjects, we establish $11P$ and $13T$ according to practical processes and flow state of contract modification information (See Figure 1).

In Figure 1, Place refers to the states of every participant units in contract modification flow. Transition refers to the time request of every contract modification processes by participant units. The definitions of Place and Transition are shown in Table 1 and Table 2 respectively.

Correctness analysis based on reachability graph. By verifying the correctness of simulation model structure, we could find out structural problems of the process in time, such as deadlocks of process, abnormal termination, etc. The model is a deadlock when the identities of simulation model must be triggered only in the state

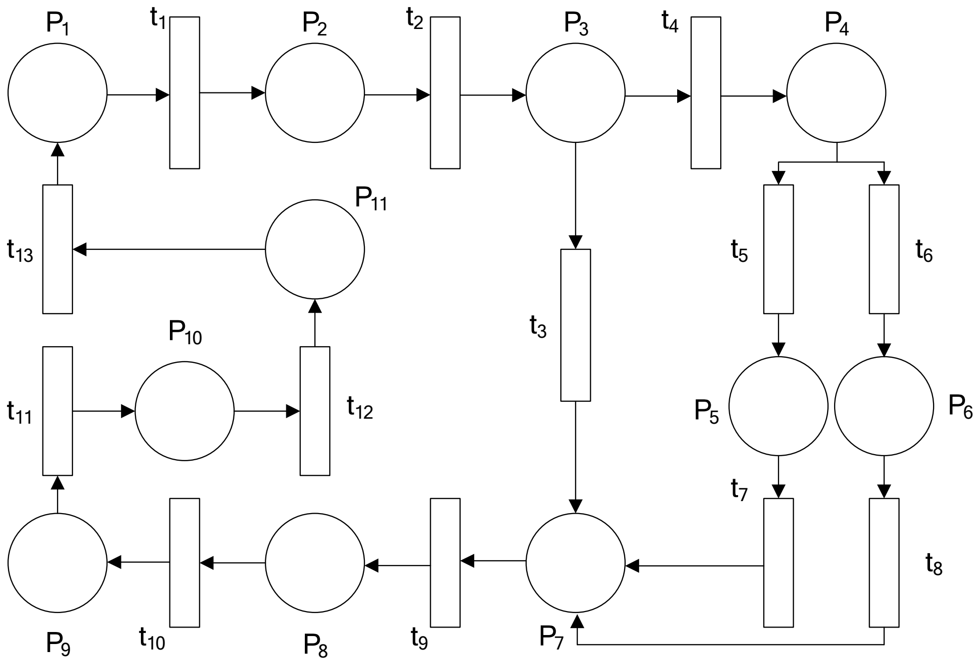

Figure 1.Stochastic Petri Net of contract modification approval process.

Table 1.Definition of Place.

p	Definition
p_1	Parties prepare to proposed contract modification
p_2	Supervising units prepare reviewing engineering data and volume of project
p_3	Sponsoring units prepare reviewing engineering data and volume of project
p_4	Waiting for contract modification review board meetings
p_5	Sponsoring units prepare conducting contract modification review board meetings
p_6	Contract budget and settlement units prepare conducting contract modification review board meetings
p_7	Sponsoring units prepare reviewing engineering data and volume of project
p_8	Contract budget and settlement units prepare reviewing engineering data and volume of project
p_9	Pending approval by leaders from contract budget and settlement units
p_{10}	Pending approval by leaders from sponsoring units
p_{11}	Pending approval by general manager

Table 2.Definition of Transition.

t	Definition
t_1	Construction units calculate the engineering quantity and prepare modification data
t_2	Supervising units review modification files
t_3	Not approved by sponsoring units to conduct contract modification review board meetings
t_4	Approved by sponsoring units to conduct contract modification review board meetings
t_5	Contract amount modified by sponsoring units is less than 500 million

Table 2.(Continued).

t	Definition
t_6	Contract amount modified by sponsoring units is equal or greater than 500 million
t_7	Sponsoring units conduct contract modification review board meetings
t_8	Contract budget and settlement units contract modification review board meetings
t_9	Sponsoring units reviewing engineering data and volume of the project
t_{10}	Contract budget and settlement units reviewing engineering data and volume of the project
t_{11}	Approved by leaders from contract budget and settlement units
t_{12}	Approval by leaders from sponsoring units
t_{13}	Approval by general manager

of waiting for stimulating. Abnormal termination may also prevent the tasks of simulation model from implementing. In this paper, reachability graph is used to analyze the correctness of simulation model in contract modification approval process qualitatively. In the process of simulating the model, since the initial marking of Token, every time a Transition occurs as token move, the state marking of every Place in different point of time can be simulated. Sequence sets formed though the move of Tokens in Place is the reachability graph. As is shown in Figure 2, $m_{01} - m_{11}$ refers to states identities in each time point. The matrix of m_i refers to the state of t_i in each Place. For example, $m_{03} = (00100000000)$ indicates Place p_2 is under active state, which means that sponsoring departments are preparing reviewing engineer data and quantities in reality.

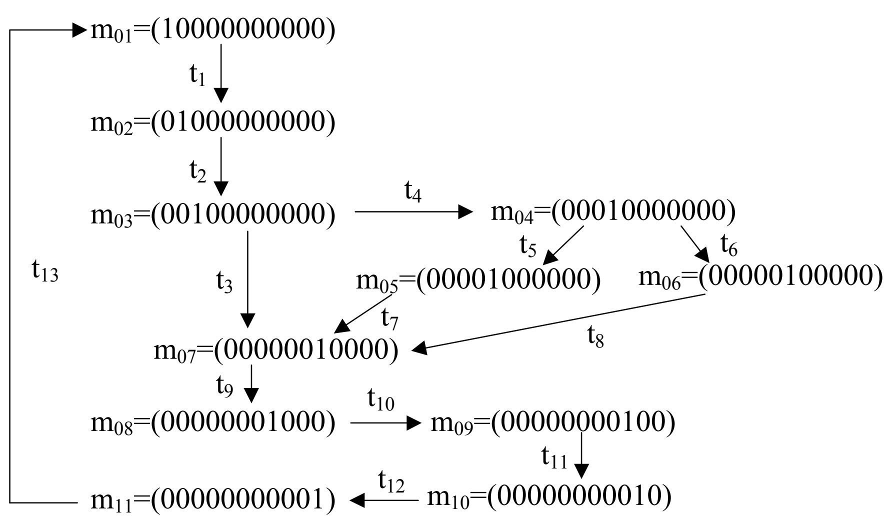

Figure 2.Reachability graph of each status.

Based on reachability graph, qualitative analysis is done as follows:

(1) The states of all Places include 1 or 0 only. There's no repetition in a single loop, which verifies the model's safety.

(2) In the graph, there is no weight factor ω in all nodes. So the model is

bounded, bounds overflow is not exist.

(3) Any status identity m_i could be realized after a series of transition. The abnormal state, such as deadlock or endless loop will never happen.

(4) The model is reversible obviously. And there isn't a directed circulation loop containing all transition. So the model is partly consistent.

From the analysis above, the model is safe, bounded, active, reversible, and partly consistent. Therefore, our simulated model is correct.

Time performance analysis of Petri net model. Based on the theory of Stochastic Petri Net mentioned above, the trigger time of Transition obeys continuous random exponential distribution of t_i. Because reachability graph of SPN is isomorphic to Homogeneous MC matrix, it can be solved by Markov stochastic process.

We set spatial vector E as the set of each identity, t equals to $\{m_0, m_1, m_2, \cdots, m_{11}\}$ from reachability graph. So, transfer velocity matrix Q of status identity could be formulated. The element q_{ij} in matrix Q denotes the velocity from m_i to m_j. For the element in diagonal, we set $q_{ij} = -\sum_{t=1}^{i} q_{jt}\left(t \neq j\right)$. By solving Markov stochastic process of Homogeneous MC matrix and normalization, stable probability vector $\prod$ is formed, which opens the door of quantitative analysis.

$$\prod = \{\Omega_1, \Omega_2, \cdots, \Omega_{11}\}$$

Aiming at the existing contract modification approval process, the time request of each Transition in contract modification approval process is taken by the regulated time of Guangzhou Metro. Time unit d refers to one day, not including weekends or legal holidays.

$$t_1 = 60d, t_2 = 28d, t_3 = 3d, t_4 = 3d, t_5 = 1d, t_6 = 1d, t_7 = 5d, t_8 = 5d, t_9 = 15d, t_{10} = 5d,$$
$$t_{11} = 5d, t_{12} = 5d, t_{13} = 3d$$

Then, introduce the time into reachability graph. According to the SPN theory and status identity graph mentioned above, transfer matrix Q can be easily got.

$$Q = \begin{vmatrix}
-0.017 & 0.017 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -0.0357 & 0.0357 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -0.667 & 0.333 & 0 & 0 & 0.333 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & -2 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & -0.2 & 0 & 0.2 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & -0.2 & 0.2 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & -0.067 & 0.067 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & -0.2 & 0.2 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -0.2 & 0.2 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -0.2 & 0.2 \\
-0.333 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -0.333
\end{vmatrix}$$

By solving this function $\prod Q=0$ and after normalizing it, stable probability vector $\prod$ is formed. Then, the stable probabilities of each place in SPN are as follows:

$$\prod=\{0.47904\ 0.22355\ 0.01198\ 0.00200\ 0.00998\ 0.00998\ 0.11976\ 0.03992\ 0.03992\ 0.03992\ 0.02395\}^T$$

(1) The place busy probability. The place busy probability refers to the probability of every main body's busy status. It expresses how much time every department costs in the contract modification process. Through comparing the time cost of every department horizontally, the department who accumulates more modification information can be found. In accordance with the stable probability vector theory, it is easy to find out that busy probability of the place equals to stable probability of each status.

$$\Pr ob\left[m(p_1)=1\right]=m(p_1)=0.47904 \quad \Pr ob\left[m(p_7)=1\right]=m(p_7)=0.11976$$
$$\Pr ob\left[m(p_2)=1\right]=m(p_2)=0.22355 \quad \Pr ob\left[m(p_8)=1\right]=m(p_8)=0.03992$$
$$\Pr ob\left[m(p_3)=1\right]=m(p_3)=0.01198 \quad \Pr ob\left[m(p_9)=1\right]=m(p_9)=0.03992$$
$$\Pr ob\left[m(p_4)=1\right]=m(p_4)=0.00200 \quad \Pr ob\left[m(p_{10})=1\right]=m(p_{10})=0.003992$$
$$\Pr ob\left[m(p_5)=1\right]=m(p_5)=0.00998 \quad \Pr ob\left[m(p_{11})=1\right]=m(p_{11})=0.02395$$
$$\Pr ob\left[m(p_6)=1\right]=m(p_6)=0.00998$$

By comparing the busy probability of each place horizontally, the probability of place p_1, p_2, p_7 is higher. Namely, the processes that accumulate most modification information lay in these three areas: modification files writing by construction enterprise, supervising engineer's review, sponsoring department's review.

(2) Utilization of system transition. Utilization of system transition is equal to the probability of stability of identifier when Transition is enforceable in time nodes t_i, which stands for the utilization of every unit under approval process. According to the definition, we can found:

$$U(t_1)=p(m_1);U(t_2)=p(m_2);U(t_3)=U(t_4)=p(m_3);U(t_8)=p(m_6);U(t_5)=U(t_6)=p(m_4);U(t_7)=p(m_5);U(t_9)=p(m_7);U(t_{10})=p(m_8);U(t_{11})=p(m_9);U(t_{12})=p(m_{10});U(t_{13})=p(m_{11})$$

Known from calculating results, utilization of Transition t_1,t_2,t_9 is relative high, showing they are relatively time consuming. So optimizes for these process can greatly improve general efficiency, that is to say, construction units calculate the engineering quantity and prepare modification data, supervising units review modification files, sponsoring units reviewing engineering data and volume of the project are key point in optimizing. And this result is consistent with the Place busy probability.

(3) Flow velocity of Transition. Flow velocity of Transition predicted the actual rate of every Transition, in process of contract modification; it refers to reciprocal of approval time. By comparing flow velocity, bottlenecks can be found. Flow velocity of every Transition is:

$$R(t_3,p_7)=R(t_4,p_4)=0.00399$$
$$R(t_5,p_5)=R(t_6,p_6)=R(t_7,p_7)=R(t_8,p_7)=0.00200$$
$$R(t_1,p_2)=R(t_2,p_3)=R(t_9,p_8)=R(t_{10},p_9)=R(t_{13},p_1)=R(t_{12},p_{11})=0.00798$$

According to approximately equivalent formula of Stochastic Petri Nets series and choosen workflow model, we can obtain the average system velocity:

$$R = 1/39 = 0.00719$$

Results show: $R(t_1, p_2)$, $R(t_2, p_3)$, $R(t_9, p_8)$, $R(t_{10}, p_9)$, $R(t_{13}, p_1)$, $R(t_{12}, p_{11})$, $R(t_{11}, p_{10})$ are similar to average velocity when taking approximate error of simulated modle into consideration. $R(t_3, p_7)$, $R(t_4, p_4)$, $R(t_5, p_5)$, $R(t_6, p_6)$, $R(t_7, p_7)$, $R(t_8, p_7)$, howerver, are slower than average velocity, among which, $R(t_5, p_5)$, $R(t_6, p_6)$, $R(t_7, p_7)$, $R(t_8, p_7)$ are slowest and are where major improvements are needed. In actural, it means that time delay is likely to happen when sponsoring units reviewing contract amount and conditions of contract modification review board meetings, as well as conducting. Delayed moditication files rewiewing in sponsoring units will lead to data accumulation, therefore, sponsoring units should make significant improvements in those processes.

CONCLUSION

We have build three quantitative index, and analyzed the efficiency from two aspect, and compared process time request in different units, results show that data accumulation is more likely to happen in 3 process: construction units prepare modification files, supervising units reviewing and sponsoring units reviewing; Considering from average efficiency, velocity of sponsoring units reviewing contract amount and conditions of contract modification review board meetings as well as that of conducting meeting are slower than average, which means those processes may easily lead to time delay. In this paper, practical optimizing suggestions are given in reducing redundant processes, improving approval efficiency, avoiding return step and files missing.

(1) Using standardized contract modification format. Standardized modification format could be applied in civil contract, and had been proved to avoid return step and files missing effectively. We can adopt standardized format and apply it for E&M contract modification, and by taking the appropriate changes to suit more different projects.

(2) Expand the use of information system to improve flow rate. OA (Office Automation) has been applied in Guangzhou Metro Construction Department for long; however, that contract modification information exchange in different units was remained in paper files, which did not show the advantages of OA. Taking full use of OA system can better faster flow rate, so to improve efficiency.

(3) Using standard work processes of units and regulate processing time. From simulated results, it is time consuming in 3 processes: construction units prepare modification files, supervising units reviewing and sponsoring units reviewing. Therefore, establishment of effective restraint mechanism is a good way to regulate work processes, such as limit site visa and modification approval time.

(4) Modification contract amount shall be examined for approval at 3 levels. Current contract modification process is fixed regardless of contract amount, leading to low efficiency. In order to solve inefficiency, different approvals processes need to be built in accordance with different contract amount level. Correspondingly, each level has different approval limits.

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An Integrated BIM-Based Framework for the Energy Assessment of Building Upstream Flow

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Abstract

The construction and operation of buildings account for a significant part of the energy use and greenhouse gas emissions. Most design approaches to reduce the use of energy are focusing on the operational phase of a building's life. Consequently, the embodied energy from the upstream flow, including production of building material and components, transport and assembly on-site, is often disregarded in the development of energy-efficient buildings. The purpose of this research is to propose a method to facilitate the assessment of the embodied energy and carbon footprint during the design and planning stage from the production of building material and components including the transportation to site. The framework makes use of Environmental Product Declaration (EPD) and supply chain information stored in a relational database of building materials and components, Building Information Models (BIM) for the assessment of the embedded energy in the building. Further, the feature manipulation engine (FME) is used to track transportation distances and transportation times from Google Map (GM) for the assessment of embedded energy from supplier to the construction site. Finally, a prototype is developed to demonstrate the practical application of the framework and to observe possible limitations and barriers.

INTRODUCTION

The construction industry is considered as one of the major emitter of greenhouse gases (GHG). A recent report from the Royal Swedish Academy of

Engineering Sciences (IVL 2014) and the Swedish Construction Federation indicates that the total climate impact associated with the upstream flow (i.e. material production, transportation and on-site construction) in the Swedish construction industry accounts for approximately 10 million tonnes of carbon dioxide equivalents per year, which is the same size as emissions from all of the cars in Sweden. On the other hand, mitigation of the GHG emission in the building sector requires a reduction of energy use due to the high interaction between energy and GHG emissions. The focus during the last decades has been on the reduction of energy use through the buildings operational life (Nässén and Holmberg 2005). As a result, many low-energy buildings, passiv houses and near zero-energy buildings has been built. However, the focus on reducing the operational energy has drawn the attention from the energy use concerned with the building upstream processes (i.e. production of building material and components, transport and on-site construction) also known as embodied energy. Estimation indicates that the contribution of the embodied energy to the total energy use in a conventional building is between 2 to 36% and this range increases to somewhere between 9-46% for low energy building (Sartori and Hestnes 2007). This increase in embodied energy originates from use of materials such as thicker insulation layers in the building envelope, employment of new technical solutions, transportation of higher quantities of materials and components to the construction site, etc. The significance of the embodied energy has been emphasized by many researchers (Thormark 2002; Hernandez and Kenny 2010) since it contributes to a significant part of the total energy use in the low-energy and self-sufficient buildings. Gustavsson and Joelsson (2010) claim that the embodied energy in relation to the total energy use can be as high as 60% for low energy buildings, depending on the energy supply system. Hence, the energy use in the operational phase of a building's life cannot be the only decisive factor, the embodied energy should also be considered in the design of low-energy buildings. The energy use of a building shall be addressed and tested with different design alternatives during the planning and design phase when the level of influence is high (Paulson 1976; Bogenstätter 2000; Schade et al. 2011). Today, assessment of the embodied energy and carbon footprint associated with the building upstream flow is estimated through application of life cycle assessment (LCA) tools (Anderson et al. 2015). However, there are some drawbacks that make these tools less applicable as the decision making support tools in the design process. One is that LCA tools are mainly developed to assess the environmental impacts of the materials with less intention for the particular estimation of the embodied energy and carbon impacts (Buyle et al. 2012). Second is the adoption of different weighting factor systems that assigned to each impact category by these tools (Chau et al. 2015). The third is that the life cycle inventory (LCI) databases which are employed by these tools do not contain the impacts and embodied energy of each specific product from different manufacturers and they are mostly based on the industry-average data (Thormark 2000; Chau et al. 2015). In addition, there is a lack of interoperability between LCA tools and building information modeling (BIM) tools, which is increasingly used by architectures and designers to digitally represent the building in the early design stage (Zabalza et al. 2009). All these demonstrate the significance of developing new methods and tools which has the ability to assess the energy use and GHG emissions associated with the upstream process of the building more accurately in the design process. Therefore, this research is aimed to fill this gap and provide a framework that facilitates the assessment of the embodied energy in the building design stage.

This paper is outlined as follows; first the scope of the research is defined by providing the theoretical background in the second chapter. In the third chapter, the research approach is presented by stating the aim of the research along with the proposed framework. In chapter four the framework is demonstrated through employment of a practical application. In that last chapter the result of the prototype is discussed and concluded.

THEORY

Life cycle assessment and life cycle energy assessment. LCA is a method for analyzing the environmental performance associated with the production of materials and components throughout their life. The concept of LCA was developed in the 70s, focusing on the quantification of energy- and material use along with the environmental impacts associated with the material production. A comprehensive clarification of the considered procedures in the LCA can be found in ISO 14040 (2006) and ISO 14044 (2006). A building's LCA contains four stages, production, construction, operation and end-of-life. The production phase refers to the manufacturing of building material and components from raw material acquisition. The construction phase consists of transportation of materials and components to the building site along with the required activities and services associated with the erection of the building on-site. These two phases together define the upstream flow. The operation phase (use flow) includes the energy use during the occupied period in order to obtain a comfortable indoor climate and provide hot water for the occupants. The use phase also contains the recurring refurbishment and maintenance services during this period. Finally, the last phase is assigned to the end-of-life of the building (downstream flow) comprising deconstruction, transportation and the end treatment, i.e. either reuse, recycling or disposal of materials to the landfill. A similar framework that is particularly developed to assess the energy use of the building throughout its whole life is the life cycle energy assessment (LCEA). The LCEA has been developed during the last two decades, but the definition of the system boundary is still ambiguous (Fay et al. 2000). Ramesh et al (2010) define the building LCEA in three phases, manufacturing, operation and demolition and hereupon the energy use is also divided in three parts, embodied energy, operating energy and demolition energy. In accordance with this definition, the initial embodied energy and recurring embodied energy are the main constituents of the embodied energy in which the initial embodied energy is attributed to the total energy use concerned with the upstream flow and the recurring embodied energy is the energy used for the refurbishment and maintenance activities during the lifespan of the building. In figure 1 the relation between a buildings LCA and LCEA stages is shown (Zabalza et al. 2009; Ramesh et al. 2010; Shadram et al. 2014).

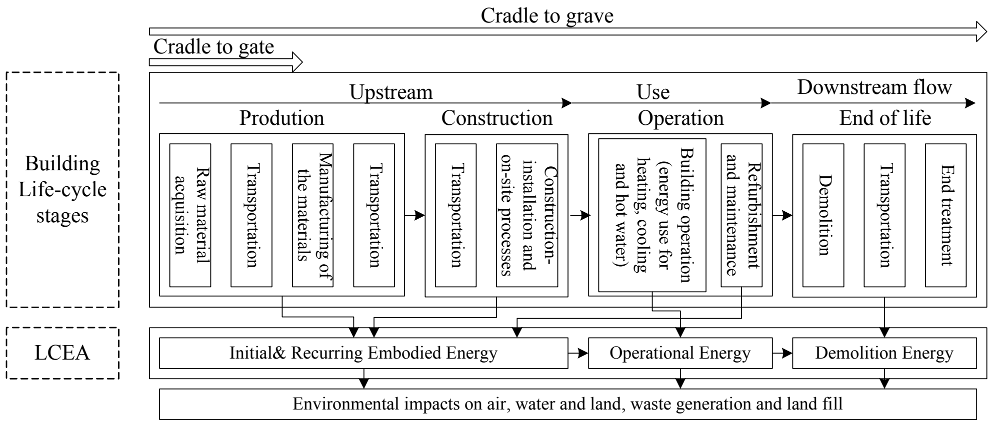


Figure 1.Building's life-cycle stages along with life cycle energy assessment, adapted after.

Ding cited in (Dixit et al. 2010)) claims that approximately 75% of the embodied energy belongs to the production of building material and components off-site. The contribution of transportation to the initial embodied energy (and GHG emissions) associated with the upstream flow of the building is estimated to in the range between 1-8% (Adalberth 1997; Chen et al. 2001; Chau et al. 2007; Yan et al. 2010). However, when building material and components are imported from overseas the contribution from transportation increases (Adalberth 1997; Ortiz et al. 2009). A recently published report by IVL (2015) indicates that the embodied energy and carbon footprint associated with the upstream flow in a low energy building located in Stockholm is on the same level as the operational energy use calculated on a 50 year lifespan. 87% of the embodied energy and GHG emission belongs to the production and transportation of building material and components off-site to the construction site. These studies indicate the significant impact on the energy use and carbon footprint from the upstream flow production and transportation of building material and components to the construction site. In this research the initial embodied energy coming from the construction and erection of the building on-site has been excluded.

Building information modeling and use of extract, transform and load technology. BIM is the process of generating and managing building information in an interoperable and reusable way (Lee et al. 2006). BIM is increasingly applied by the architectures and designers to digitally represent the building in the early design stage. The prominent competency of the BIM in the sharing of information has been appreciated by the sustainability approaches, particularly with the decision making during the design stage, which can benefit to the design optimization in terms of energy reduction and eventually environmental impact mitigation (Schade et al. 2011; Wong and Fan 2013). Nevertheless, Nguyen et al. (2010) claim lack of substantial information regarding the evaluation of the building sustainability performance in the composed digital BIM models. In addition, the current BIM technology has limited impact on the green building process (Jrade and Jalaei 2013) and the data shall be exported to the sustainability analysis tools in which requires significant time and effort for modification and matching of the input format to the sustainability analysis tools (Zabalza et al. 2009; Shrivastava and Chini 2012). BIM technology can further be explored by the use of extract, transform and load (ETL) technology to manage big sets of data sources of different data formats and data models. ETL software are such tools which can extract, transform, cleanse, reengineer and move data from one location to another converting and integrating unstructured data to structured formats on the basis of analytics to be performed (Chen et al. 2011; Cuzzocrea et al. 2011; Demirkan and Delen 2013). Modern spatial ETL tools such as Feature Manipulation Engine (FME) can manage the exchange of spatial and non-spatial data based on the principle of "semantic mapping", which provides the function of reconstruct data during the process of data conversion. Because of this, FME can realize data conversion among 300 different spatial data formats (He et al. 2011). Carrión et al. (2010) and Johansson and Olofsson (2014) used FME to convert and integrate building information and energy data in an automated way to construct 3D city models showing the operational energy use of the buildings in the city. The functionality of FME in combination with BIM and other data sources offers new functionalities to extract, combine and integrate different kind of analysis with the design information stored in BIM.

Product category rules and environmental product declarations. Building material manufacturers have gradually been imposed to provide verified, relevant and comparable information about the environmental performance and embodied energy of their products, commodities and services in the form of environmental product declarations (EPD). An EPD is the summarized data from LCA of a specific product and is verified by a third party based on the ISO standard requirements (ISO 14025 2006). International EPD system (2015) and Magnor (2015) are two international databases that gather and stores generated EPDs worldwide. To be able to conduct the LCA and provide an EPD for its product a manufacturer shall primarily utilize existing or create new Product Category Rules (PCRs). PCRs guide the development of declarations for products that are comparable to others within a product category and lays out the rules for the LCA i.e. defines the scope, system boundaries and impact categories of the LCA. However, application of the EPDs for the building embodied energy- and impact assessment requires great effort and is very time consuming. This is mainly due to the application of different functional units (FU) by the EPDs and the vast number of the material and components employed in the buildings 1. In addition, the presented information in the EPDs regarding the energy use and environmental impacts of the material transportation from the manufacturer to the construction site is mainly based on average estimations of distances related to the country where the manufacturer is located. Hence, this information about the energy usage and GHG emissions is less applicable particularly when the construction site is located overseas and longer distances shall be traversed.

RESEARCH APPROACH

Aim and method. The purpose of the research is to assess energy use and environmental impact of the upstream flow of buildings from cradle to site. Hence, a framework is proposed which enables the assessment of embodied energy and environmental impact associated with the building material production as well as the required transportation from the suppliers to the construction site. The long term goal is to facilitate the automation of the assessment by using EPDs of material and components as core components. The proposed framework will be tested by a developed prototype in a small scale case study. The prototype covers the retrieval of EPD information from production of material and components through application of a relational database. This information together with quantity take-off from the BIM model and energy use associated with the transportation are then used to assess embodied energy and carbon emissions from cradle to site. The results of the small scale case study are then discussed and limitations and barriers are highlighted for further development in the future research.

Proposed framework. The building design process suffers from to narrow focus on building layouts and materials selection impact on the production costs, thus limiting the attention on environmental issues such as energy use and GHG emissions, Jensen et al. (2013). Today, many cost estimating programs have been developed to provide the preliminary cost even in the early design stage. The framework in this research proposes that the assessment of environmental impact such as embodied energy can be made in parallel with the cost estimation in the design stage, see Figure 2.

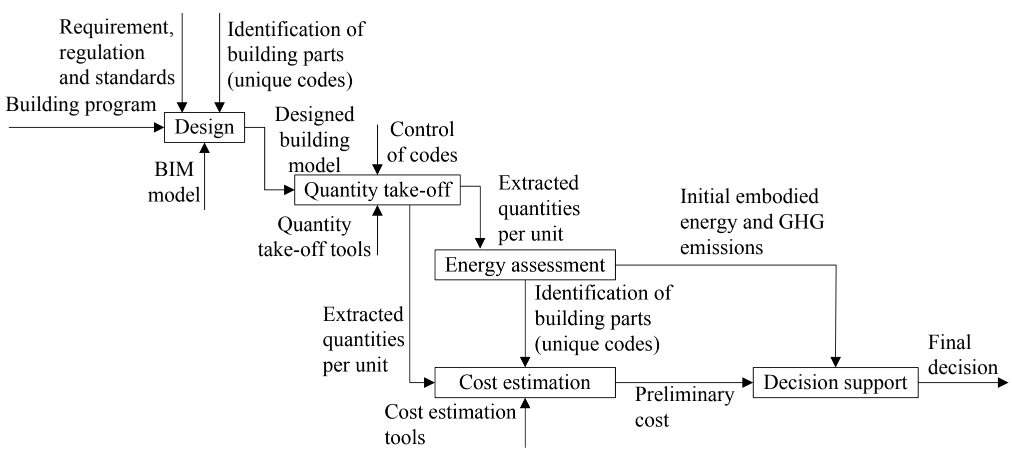


Figure 2.The general concept of the proposed framework.

Assessment of embodied energy. The assessment of the embodied energy is divided into 3 activities; Defining suppliers and building recipes, Tracking transportation distances and Final assessment (see Figure 3).

(1) Defining suppliers and building recipes. Cost estimation tools are composed of predefined recipes of building parts along with associated cost of materials and resources. Unlike the recipes for cost estimation, the recipes of building parts for the assessment of embodied energy are composed of EPDs. The EPDs provide third party verified environmental information from cradle to gate including embodied energy and GHG emission of each specific material and/or

component of the manufacturer. Hence, In order to be able to build an EPD inventory and later be a able to attribute them to the components and finally assign the components to the building parts, a relational database can be applied that facilitates the execution of different linking functions through employment of primary keys and foreign keys. An advantage with application of the relational database is that individual relationship tables and views can be made, modified and/or removed without disturbing the rest of the database. Labeling of building objects in the BIM model facilitates the linking between extracted quantities and built recipes regarding environmental impacts of associated building parts.

(2) Tracking of transport distances. The FME software reads the addresses of suppliers from the EPD database and the construction site latitude and longitude from the BIM. A web service such as Google Maps can be used to calculate the transportation time and distance between suppliers and construction site. The distance and time is then registered in the database.

(3) Assessment. The final step is the application of the assessment tool, from where the embodied energy and carbon footprint associated with the building material production as well as the transportation is estimated. Alternative materials and or building components from different suppliers can quickly be assessed if the building design is not affected. The assessment of the embodied energy and global warming potential (GWP) in combination with cost estimation provides a more holistic decision support in the design process.

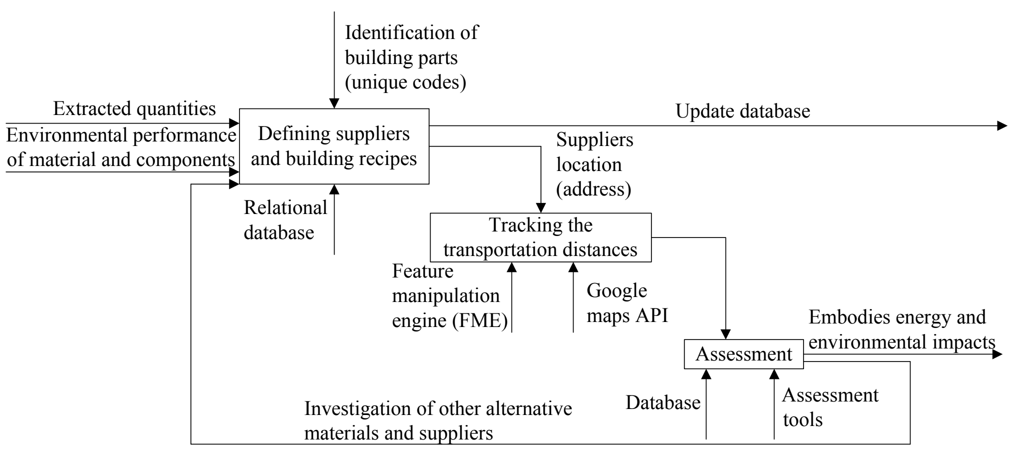


Figure 3.Assessment of embodied energy.

PROTOTYPE

Assessment of embodied energy and environmental impacts. A prototype was developed to demonstrate and evaluate the practical application of the proposed framework shown in Figure 3. A 3D BIM model (in Autodesk Revit Architecture) of a built tower block located in Stockholm was used in a small scale case study. The window and balcony door objects in the building was attributed the suppliers Magnore (2015) in Norway and NorDan (2015) in Poland. A relation database application was designed in PowerPivot, an add-in for Excel, consisting of tables to store information about EPDs, Component and Building parts. In the Swedish construction industry, two classification systems, SBEF and BSAB are used as identification of building parts (production codes) and building components (design codes) to facilitate the information exchange between different actors in the building process. The BSAB-code can be applied at the component level and SBEF-code for identification of the realized building parts. However, these codes do not uniquely identify the relation between components and the selected building part. Therefore the part name is used to establish the relation between the building part and component in the BIM in order to be able to link extracted quantities from BIM model with the database application. The EPD table consists of suppliers' EPDs where the EPD number is set to be the primary key. An EPD record consists of the functional unit (FU), application area, category, manufacturer, manufacturer's address and the amount of embodied energy and environmental impacts from cradle to gate. Since there are many to many relationships between the components and EPDs as well as the building parts and components, additional relations, i.e. component material and building part component are created in the database to link EPDs, components and building parts together, see Figure 4.

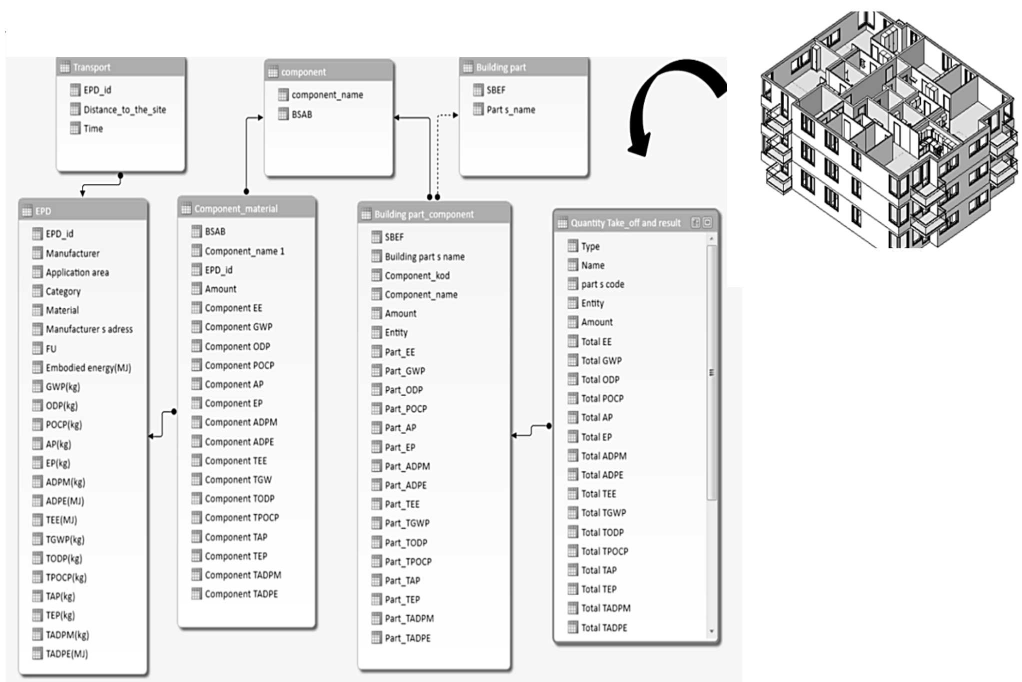
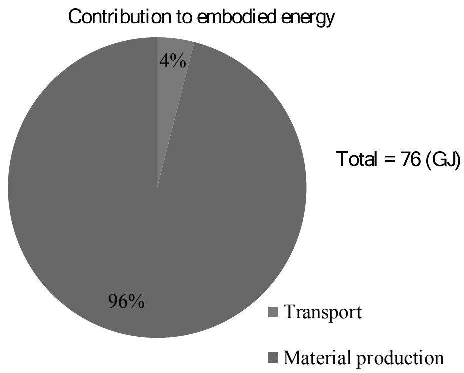


Figure 4.The 3D model of the building along with the implemented database.

Result. The result of the small case study indicates that the contribution of the production of all the windows and balcony doors from the total embodied energy is 96% in which 4% is attributed to the transportation of these components to the construction site. In total 11,2 ton carbon dioxide equivalent is emitted for both the production and transportation in which 93% belongs to the material production and 7% is assigned to the transportation, see Figure 5.



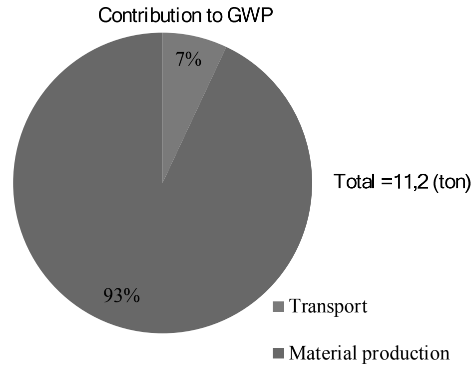


Figure 5.Contribution of transportation and material production to the embodied energy and GHG emissions.

DISCUSSION AND CONCLUSION

The proposed framework represents an analysis and decision support tool for the assessment of embodied energy and environmental impact of building in the design process. It's designed to be integrated with the cost estimation which means that the same extracted quantities from the BIM used in the cost estimation process can be used to calculate embodied energy and environmental impact. The framework will be affected by the project delivery system. The framework will probably be easier to implement in design-build contract, which relies on a single contractor responsibility for both the design and the construction process. This is mainly due to the fact that in the design-build, it is possible to investigate alternatives in materials and designs and how it will affect the outcome both in cost and environmental performance (see Figure 2). In the design-bid-build project delivery systems the design is already provided by the architectures and design engineers in the procurement of contractors. Although investigating of different alternative designs seems to be less feasible in this type of project delivery system, the proposed embodied energy assessment can still be applied to select more environmentally friendly materials if the design is not affected. The proposed framework in this research doesn't cover different type of vehicles that can be applied for transportation and the amount of energy used in the assembly operation on-site. The framework needs to be further developed to include different transportation options, especially when building materials are imported from overseas suppliers. Also, the framework can only include building materials and parts that have EPD. In the future the framework will be extended to overcome these barriers and further developed to enable the assessment of the embodied energy and environmental impact associated with on-site construction activities.

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Research on Housing Component Searching Based on BIM and E-Business

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Abstract

The promoting of housing industrialization makes the huge change of production mode in housing construction in China. Housing component, as an important means of promoting housing industrialization and the production in construction sector, gets more and more attention. New information and communication technologies (ICT) have stimulated change and modernization of traditional working methods, especially in the areas of Building Information Modeling (BIM) and e-business. The products online trading has become an important means of consumption in people's daily life. How to find the needed products rapidly and accurately online, which is the first important problem to solve in e-business. This paper presents a research on housing component searching in e-business environment using BIM. It analyzes the information classification and search method of housing component, and focus on the influence of BIM on the housing component online searching.

INTRODUCTION

The modern manufacturing industry comes from the mechanization of production mode to replace the traditional manual operation. There is a set of complete production and supply the way in manufacturing, which makes fast, efficient and high quality output. Component, as a unit of output and flow, is the basis for the development of the manufacturing industry.

Since the 1920s, the French first put forward the necessary of reforming the traditional housing construction process; components are produced by professional factory, and then complete the housing construction by assembly in site. The manufacturing production mode is infiltrated in the construction business, formed the early housing industrialization theory. The promoting of housing industrialization makes the huge change of mode of production in housing construction in China. Housing component, as an important means of promoting housing industrialization, gets more and more attention. Using the industrial manufacture, most of the work of the construction is concentrated in the factory. Achieve the purpose of building houses like making cars.

New information and communication technologies (ICT) have challenged traditional working methods, like BIM and e-business (Grilo and Jardim-Goncalves 2011). More suppliers have been advertising and posting new production or service information online, seeking global business opportunities. Therefore, housing components online searching is a very important problem need to be settled. This paper is a research on housing component online searching, starts by reviewing current knowledge about housing component, search method, and electronic procurement in construction sector. Then this paper will illustrate the impact of BIM technology on housing component online searching.

INFORMATION CLASSIFICATION OF ONLINE HOUSING COMPONENT

The conception of housing component. Housing component is the component in construction sector. The word "component" comes from Japanese; there are more definitions about component. The first definition is that components are not skeleton part, are more likely to break out of the building. The second definition is that components are factory products. The third definition is that components are independent of the concrete buildings by means of standardization and serration, in order to realize the circulation of commodities. The fourth is that component should be suitable for the industrial added value of production and circulation of commodities (GB/T226).

There is a definition of component in ISO/FDIS 6707.1 (2002E) building and civil engineering - vocabulary - part one, Component: Products manufactured as a distinct unit to serve a specific function or functions.

Components have independent commodity attribute, which can form the circulation of commodities in the market, have the characteristics of standard and general in a certain range, can be produced in the assembly line, meet the needs of mass customization.

The characteristics of housing component. All the housing components have four characteristics as follows:

(1) Standardization. There is a common characteristic, components have a certain standard of product categories and series, only the standard component is housing component. The standardization of each component is to ensure the construction installation efficiency. Housing component is mass production, have stable quality and moderate cost, can be afford by the general residents, and compliance with building codes and specifications (Tain et al. 2005).

(2) Universalization. Universalization is that components in common use in many parts of the building, level and general between horizontal series products, by the means of certain functions and similar size of the components.

Ultimately, the number and type of components, and the production cost of components can be reduced, reach a target of large-scale industrial production.

(3) Serialization. The serialization of housing component can be easy to the diversified choices in the process of construction. It is an important characteristic of housing component, also the result of standardization and universalization.

(4) Large-scale. Large-scale housing component is the mass production in the factory. Components are finished products or semi-finished products that produced in the factory, just need to simple assembly in the site.

Information classification of online housing component. In China, a national standard of housing component term had been issued in 2008.The standard is mainly based on the type of housing construction. The scope of classification is mainly about the housing construction, including walls, doors and windows, floor, etc. The existing classification is on the point of functions of construction, the building is divided into the roof part, sanitary ware products, etc, and it is a macroscopic information classification.

At present, there is not a complete housing component information classification system, no clear policy guidance and product production standards in China. The information of online housing component including component name, model, etc. But since there is no uniform information classification standard of housing component, similar online housing components may have different information type and production description or standard produced by different suppliers, which is the reason of the complexity of the online housing component information.

The influence of BIM on housing component information classification. In the 1990s,International Alliance for Interoperability (IAI) propose the construction product interaction model based on the EXPRESS language, known as Industry Foundation Classes(IFC).In the construction industry, IFC can contribute to share the same data source in different professions and in different software of the same profession, so as to achieve the sharing and interaction of data .IFC data model covers most of the AEC/FM areas, and putting forward along with the new requirements in constant expansion.

IFC is the main standard for data exchange of BIM technology, the development of BIM can solve the problem of complexity of the component information. BIM itself has the advantage of data sharing, in the process of design and construction information can transfer smoothly. No matter from the standardization of design, factory production, construction, or the installation of assembly, all aspects improve the accuracy, making the accuracy of the construction can be comparable manufacturing. Using for reference of Contemporary Integrated Manufacturing Systems (CIMS), forming the Contemporary Integrated Construction Systems (CI-CS) of construction industry is an important path of development.

The application of BIM technology can help people to manage large amounts of information, including all the information of building life cycle, from the construction design stage to the final recover. It is very important to foresee the final assembly components, must start in the design stage. Therefore, BIM visualization is a tool to know the whole part of the supply chain, component assembly also can be organized through the BIM.BIM simulation is also a kind of realization of full 3D information management mode, the housing component seamless docking rely on simulation technology.

ONLINE SEARCH METHOD

Reason analysis. The development of electronic commerce makes the manufacturing productions sales all over the world, housing component as a production also can adopt in this remote supply mode to realize global procurement. Meanwhile, Computer-Communication-Controlling (3C) technology makes all parts of the supply chain closer, form a virtual enterprise (Zhang and Tao 2001). In the construction industry, it is the application of E-commerce in construction sector.

Purchasing the housing components online, may meet a question of searching the needed housing components. How to find the needed products rapidly and accurately online, which is the first important problem to solve in online trading. In a process of EC, searching become the important part of the Internet consumer behavior model (Huang et al. 2009). The constant improvement of search engine technology greatly reduces the search costs. Once consumers enter keywords to search engine, means that the generation of driven by consumer demand. Search engine just accord with modern marketing concept. SEM (Search engine marketing) has advantaged advantage in cost control, brand promotion, mining potential customers and target customer (Li et al. 2014).

The influence of semantic technologies on the search engine. Traditional search engines are oriented to public knowledge popularization, semantic search engine positioning in the field of knowledge intensive. In the construction sector, housing components have mass information of structured and unstructured, using semantic search engine is more appropriate. The most classic traditional search engines are Yahoo and Google. Yahoo represents the directory type traditional search engine; Google represents automatic indexing type traditional search engines. Now, search engines start to focus on the demand behind the user query words, not the query words themselves, including the analysis of the semantic, the integration of the related content, to provide more help for the user's query. The semantic web is not a substitute for the World Wide Web (WWW), and is its extension.

Searching for Architecture, Engineering, and Construction (AEC) product information through the Internet has both strengths and weaknesses and a favorable use of this resource is only made possible through a better understanding of this resource. One notable advantage of employing the Internet to survey the virtual product market is its comprehensiveness. However, there are also issues that demote the online searching performance.

The first issue is related to using natural languages for describing the conveyed information. Generally, the textual content of a document is considered the advocate of the information hidden inside the document. It is necessary to abstract information for processing large document collection automatically. However, it is very hard to verify the semantics of a textual description.

The second issue comes from the arbitrary or proprietary product properties, product domain lexicons, and product information formatting in the AEC industry. There is not an industrial-wide standard for describing AEC products, which increase the difficulty of information query. The third issue is caused by a searcher's capability to formulate effective search queries.

Existing approaches (e.g., past experiences, professional magazines, product catalogs, and so forth) for locating candidate construction products are very limited in their coverage and cannot take full advantage of the abundant online resources to survey the virtual product market. Although the use of a general search engine in this case might address the "coverage" problem since popular search engines visit a tremendous number of product Web pages for ranking, it is also this enlarged "coverage" that brings in much unwanted information to the search results. The housing component as a commodity also can use the semantic search engine to search online. To address the lack of a domain-specific online search tool for industry practitioners, Liu (2014) experimented and adapted information retrieval approaches with domain knowledge to develop an AEC online product search engine. This paper will introduce two kinds of search engine framework as follows.

(1) Traditional search engines. Based on the keyword search engine, including Information collection, information processing and user query. In Figure 1, consists of multiple modules, they are crawler module, query engine and indexer.

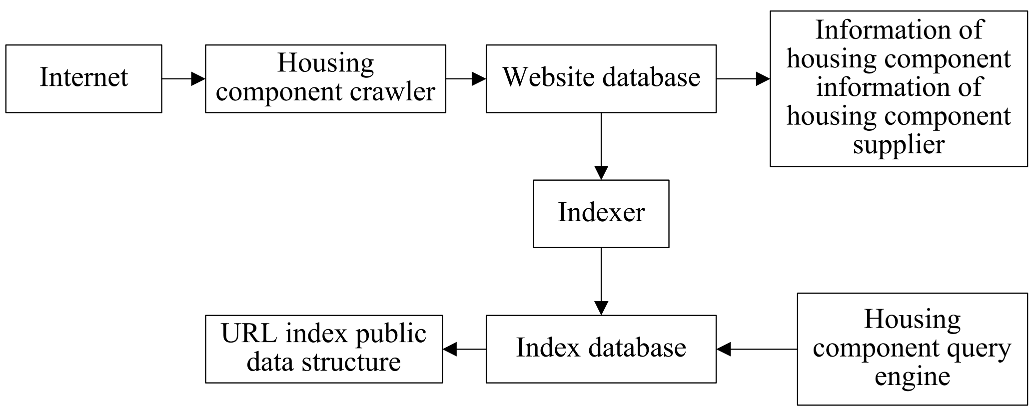

Figure 1.Traditional search engine frame.

(2) Semantic search engine (Manjula and Geetha 2004). The biggest difference between semantic search engine and the traditional search engine is the intelligence of search and content processing. So semantic search engine increase the knowledge base and inference engine. Semantic search engine are consists of the following aspects crawler module, query engine, indexer, knowledge base, inference engine (see Figure 2).

THE INFLUENCE OF BIM ON THE HOUSING COMPONENT ONLINE SEARCH

Barriers of electronic procurement in the construction sector. In the construction industry supply chain, procurement is a very important role. Searching for desired products over a wide range of available products from a large number of product suppliers is an important activity in the procurement activity (Grilo and Jardim-Goncalves 2011). However, there are some limitations about e-procurement in construction sector. Construction materials generally have a large number of specification parameters. Entering the specifications into web-based forms of several e-commerce sites to find the best product is a time consuming task for a contractor. A contractor has to acquire and maintain a list of several web addresses, interpret and understand the semantics and navigation methods used in different sites, be aware of new sites coming into the market, and do a manual evaluation of all the information acquired from different websites (Kong et al. 2004).

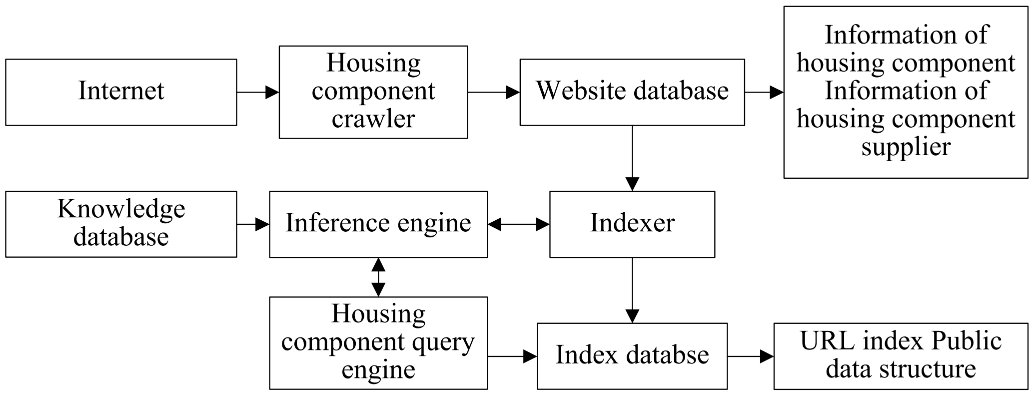

Figure 2.Semantic search engine frame.

Some of these difficulties may be overcome by the aggregation of information through e-marketplaces (Pahwa et al. 2006). Different e-marketplaces use different attributes for storing construction material data, have their own search engine and display patterns. There is heterogeneity in the management of similar types of information by different suppliers. The same products provided by different suppliers may store descriptions differently using different attributes, for a contractor, it is hard to identify the similarities between the two.

BIM and electronic procurement in the construction sector. BIM promotes a more cooperative work between all specialties during the different stages of the construction project and also used during the life cycle of the construction allowing a more efficient management of the building operations costs, decrease of errors due to lack of information, and a more efficient use of resources (Eastman et al. 2008; Volk et al. 2014; Grilo and Jardim-Goncalves 2010).

To address the problem in sector 4.1, lots of efforts have been undertaken. The most important work is related to the development of standard formats, such as the industry foundation classes (IFC) (Zhang and Issa 2013). IFC is an object-oriented interoperable format for representing building product model data and may be the most used format for interoperability purposes.

In order to achieve integrated and automated work processes, ultimately achieve the purpose of reduce the cost and time; the construction industry is gradually starting to understand the importance of interoperability (Ma et al. 2013). The need for interoperable applications grows clearer with more disciplines of the construction industry adopt BIM (Lipman et al. 2011). In an interoperable scenario, BIM is a powerful tool to support lifecycle integration, and also to support the e-procurement process. The information contained in the BIM-based design model can be shared directly in an e-procurement process, which can reduce the manual errors in traditional work and the heavy human workload. Concentrating all the information on a particular model can improve the efficiency and accuracy of the process. Prime researches illustrate that BIM technology can be combined with electronic procurement in the construction sector, output is a BIM based electronic procurement platform (Cheung et al. 2004).

This platform can make full use of some characteristics in a BIM model, such as parameterization, visualization, information integration, realizing housing components electronic procurement. Unlike traditional e- procurement platform, a BIM based electronic procurement platform is dedicated to research and development in construction sector, oriented to the electronic procurement of housing components. Therefore the housing component selection is a key problem need to be settled on the platform development process.

BIM and housing industrialization. The goal of housing industrialization is to transform the construction project process from the model of “design, site construction” to the model of “design, factory, installation”. BIM can solve the problems effectively. Using BIM technology can promote the collaboration in different departments, and consider the design, manufacture and installation of housing components. Hence, housing component design has the unified standard and universal. BIM as the core of housing industrialization process is shown in Figure 3. In manufacturing the main reasons of improve the production efficiency, reduce the cost are 3D based product data management (PDM).BIM is the PDM in construction industry. Figure 4 is the BIM model of housing components.

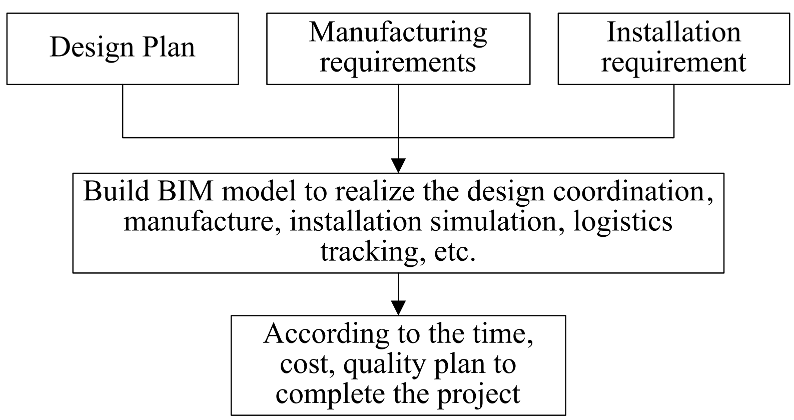

Figure 3.BIM as the core of housing industrialization process (He 2011).

CONCLUSION

This paper aims to demonstrate some problems on housing component searching. The first part is about the information classification of online housing component, introduce the conception and characteristics of housing component, the existing classification standard in China, and how BIM can impact information classification of online housing component. Then, discuss the search method of housing component, two kinds of search engines are mentioned, that is traditional search engine and semantic search engine. Finally, focus on the development of BIM technology; discuss its impact on housing component online searching.

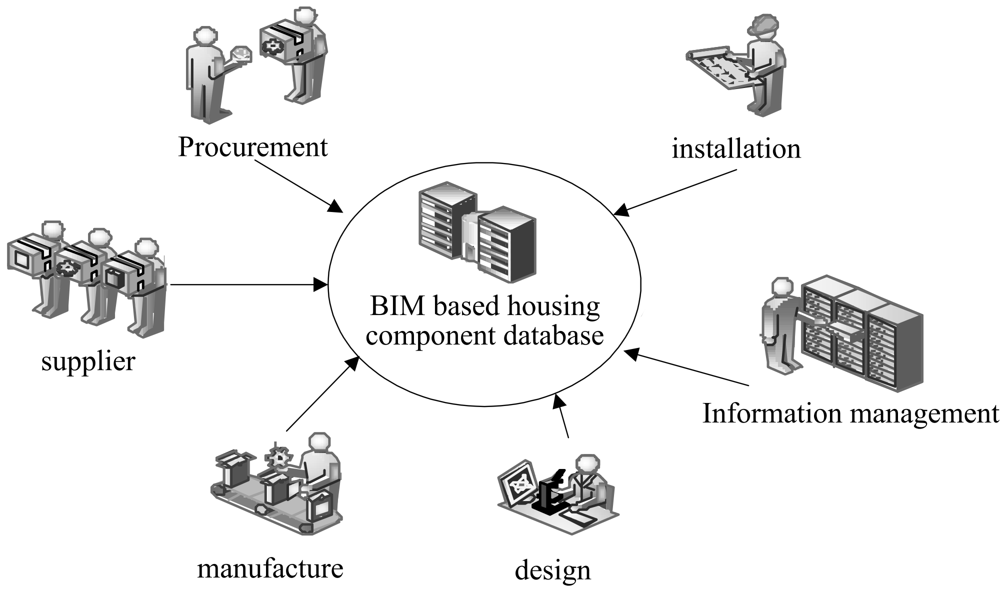

Figure 4.The BIM model of housing components.

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The Research on Urban Public Service Equalization on the Basis of GIS: Take the Main Urban Districts of Nanchang City as Example

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ABSTRACT

This paper, with the help of GIS, aims to build a spatial data model which includes the top three hospitals, education facilities and parks. By the buffer analysis and overlay analysis of the time cost of the passage, education facilities of primary and secondary schools as well as several park services, this paper tries to discuss the characters of their spatial arrangement. Meanwhile, taking the main urban areas of Nanchang City as example, following conclusions can firmly be drawn: (a) Public service scope is mainly around the old town, which is overlaying seriously. (b) Due to the shortage of park resources in Nanchang City, the service scope is quite limited. (c) Districts, like north of the Qingshanhu district and Honggutan district, are lack of public service, which has caused the inequality of the public service. This paper provides some reference for the planning of public resource and old town.

INTRODUCTION

Urban public service equalization is one of the essential facts of the social justice under the condition of modern economy, which is also an important public policy that enables our country to implement the Scientific Development Outlook and construct a harmonious socialist society shared by every citizen. The party's sixteenth session of the six plenary session of the Central Committee first pointed out: to improve the public finance system and gradually achieve the equalization of basic public service." The first meeting of the eleven session of the National People's Congress, Premier Wen Jiabao pointed out: "in strengthening and improving and economic regulation, market supervision, pay more attention to social management and public service, safeguard social justice and social order, promote the equalization of basic public services." It is obvious that to better and earlier achieve economic development and realize the public equalization of public service is one of the significant jobs under the new historical conditions. Meanwhile, it is also a strategic mission to implement the Scientific Outlook and realize social harmony and justice. After the proposal of "equalization of public services", it has been one of the key topics of the researches.

In western countries, the concept of public equalization has existed from the very early age. Many researchers have recognized that the allocation of public services study is the focal point for promoting the equalization of basic public services and effectively improving the livelihood of the people. Demand, an American researcher, is one of the researchers who began to study the allocation of public service from the very age. And the researchers after him began to study from new aspects, such as facilities configuration mode and spatial optimization allocation. Okafor (1981) proposed a new model: using some fixed points to expand the network of public services allocation. Teixeira and Antunes (2008) proposed a discrete type of grade configuration of public service facilities and testified the validity of this mode by using the cases of school network planning. Some researchers like Langford et al. (2008), using method of two step mobile search, analyzed the impact that the amount of population has on the availability of public services on the basis of GIS and spatial alternatives analysis. He also carried out some empirical study towards the South Welsh Cardiff areas. In sum, the foreign professional studies on the equalization of public service configuration are relatively limited and the objects are simple.

Compared to the foreign studies, the local researchers began later. They didn't start study until the late 90s of the 20th Century. Some researchers like Li et al. (2009) have systematically studied the characteristics and mechanism of the public services. They found out that there are some correspondence between the inequality of social public service and that of the economy. The differences of regional public services are big and tend to expand. Gao et al. (2011) took Guangzhou City as example, using the questionnaire survey method, analyzed the spatial configuration of urban public services from the viewpoint of social ecology. There are significant differences in public service facilities and accessibility of different social class groups living unit. Chen (2010) proposed to construct a system of public service that integrates the urban and rural areas. He takes the counties as basic units and divides the units into four levels, on the basis of which he allocates the according public services. Zhou Xiaoping, using the GIS, researched the spatial configuration of hospitals in the Tianmen Districts of Hubei Province. In sum, domestic studies on equalization of public services mainly focuse on the qualitative analysis method and questionnaire method, which is backward. Only some researchers have studied the spatial configuration on the basis of GIS. However the study objects are monotonous which only restricted to hospitals and schools, and the study methods and objects still need to be developed. Meanwhile, when researching the scope of service facilities using GIS, facility point is taken as the center point and distances as radius. Thus the circle shaped was regarded as the service scope. This method has no regard for time cost, which is not developed.

This paper, with the help of GIS, aims to study the scope of public services of medical, educational and park in Nanchang city. It overlies the services areas and simulates the scope of service facilities with the passage of time cost along the road to analyze the configuration of public services and promote the reasonable planning of public services which will provide reference and theoretical and practical significance for the planning of public services and the transformation of old urban areas.

STUDY OBJECTS, METHOD AND DATA SOURCES

Study objects. Public services refer to facilities provided for the public carrying the characteristics of publicity and service. According to specificities of project, it can be divided into following aspects: medical service, educational service, entertainment service, transportation service, sport service, social welfare and security, administrative management and community service, mail and telecommunications and business financial services, of which the first three are the most important public services.

This paper discusses the equalization of the medical service, education service and park service in the main urban areas. The hospitals in this paper refer to those top three hospitals that can meet the medical needs of residents. There are 7 hospitals that can satisfy the requirements. Meanwhile, education services refer to key primary and secondary schools that can provide the nine-year compulsory education. There are 39 of them. Park services are the parks that enable the residents to entertain and relax, there are 18 of them. As regard to the research scope, the main urban areas include the expanded territory on both sides of the Ganjiang River, which are the economic, political, educational and financial center of Nanchang City. The research areas include the Fengsheng Highway to the west, Changdong Road to the east; Kong Muhu Street, Hero Bridge and Fu Dayou road to the north, Xiangyun Road, Shengmi Bridge and Changnan Road to the south (see Figure 1). The vecocrization data of hospital, schools, parks and traffic network is in accordance with the traffic map of Nanchang City published in 2014.

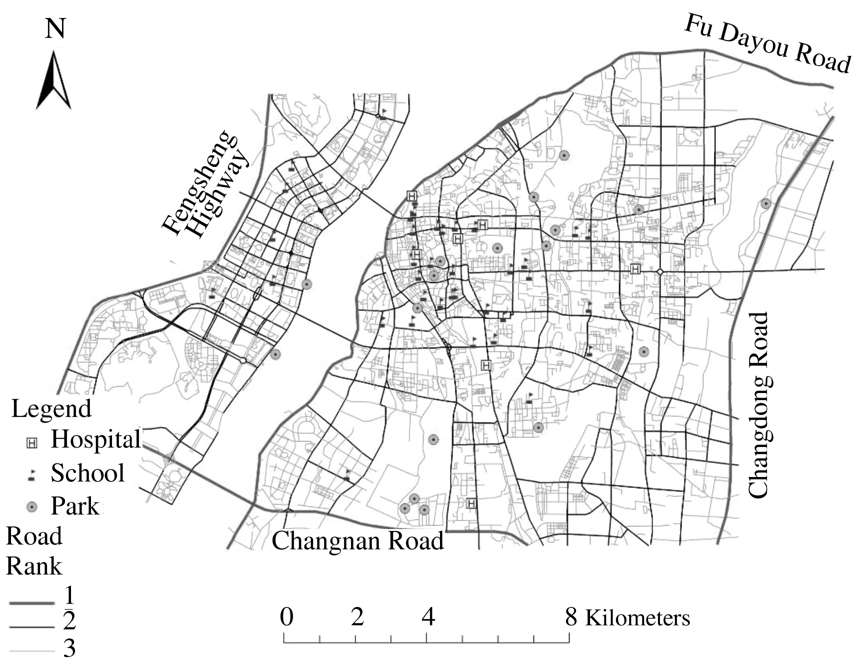

Figure 1.Research location and traffic map.

Study methods. This paper studies the scope of public services on the basis of road network analysis and buffer analysis of GIS, overlying each scope to analyze their spatial configuration. As for the urban road network, we should not only take the change of network, but also the change of urban transportation modes, like travelling mode, the change of bus travel rate, etc. Thus, in order to measure the scope of public services, a typology vector road network that can simulate the change and to assess the travel mode of the residents are to be built. This paper builds a traffic network mode which mainly focuses on the bus travel network to simplify the problems and also consider the cars secondary to the bus. This paper also classifies the speed of bus into three levels according to the road level: the main road as the first level with the speed at 35km/h; the secondary road as the second level with the speed at 20km/h and the streets and lanes as the third level with the speed at 10km/h. The service scope of top three hospitals and key primary and secondary schools is realized by simulating the time cost of urban transportation, the realm of park is realized by the size of radius. After a comprehensive expert scoring method, conclusion can be drawn that the reasonable travel time cost of top three hospitals and key primary and secondary schools is 15 min, the service radius of park is 2500, and finally conclude the degree of equalization of public services and comprehensive degree of equalization.

Data analysis. This paper simulates the scope of public service of the 7 top-three hospitals, 39 key primary and secondary schools and 18 parks according to the travel time cost and service realm using the GIS road network analysis method and buffer analysis method. The result is illustrated in Figure 2.

It can been see in the Figure 2 that the scope of top-three hospitals mainly locates at the East Lake District and West Lake District, it covers a little at the Qingshan Lake District and Qing Yunpu District. It is worth mentioning that the newly developed Hong Gutan District does not have any top-three hospitals, the medical facilities need to be expanded because of the inequality of medical service. The scope of key primary and secondary schools covers more, it mainly lies in the West Lake District, East Lake District, and Xiang Lake District, while little in Red Delta District, east to the Qing Yunpu District and north to the Qingshan Lake District. The service scope of park covers most in these three types, however inequality can still be found in the Red Delta District and Phoenix District.

CONCLUSION AND EXPECTATION

Three kinds of public services in the main urban area are studied with the GIS method. It's innovative in simulating the service scope of facility point with the time cost, trying to survey the equalization of public services of the urban areas. Following conclusions can be drawn: (a) Public service scope is mainly around the old town, which is overlapping seriously. (b) The second level service realm of public services mainly locates at the center of Honggutan District and Xiang Lake District, however the realm is limited. (c) In a whole, some districts in Nanchang City like north to the Qingshan Lake District, east to Qing Yunpu District and Honggutan new District have very little public services and inequality exiting in these areas. But in the process of analyzing, we find that some points can still be developed. For example, time cost of passage had no regard for the change of time cost due to the traffic jams and traffic lights.

Figure 2.The realm of public services of top-three hospitals(A), key primary and secondary schools(B), park(C) and comprehensive degree of equalization(D).

The equalization of public services will caused two disadvantages: on one hand, residents living in the areas that lack of public services can't enjoy the high-quality public services, which is contrary to the core meaning of social justice; on the other hand, public resources in the areas that are superfluous in public services can't be fully used, which will decrease the efficiency of public services and waste the resources. Therefore, present spatial configuration of public services should be optimized due to the inequality of public services in the main urban areas. A certain number of public service facilities should be increased in Honggutan, Xianghu area. In the transformation of old town planning, the resource overlap areas such as Donghu district, Xihu district can make some adjustments The conclusion of this paper is complied with the reality and preliminarily reaches the desired results, which can provide useful reference for the planning of public resources and the transformation of old town areas.

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A Construction Safety Management System from Contractors' Perspectives

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Abstract

Safety is a basic requirement as well as a difficult problem. Although Chinese contractors grow fast and become more professional, they never feel relaxed to ensure safety and avoid accidents, because construction market and project environment also change. Contractors who only use instinct and experiences cannot manage safety issues well. Rather, they should establish a safety management system and apply it in all projects. This paper attempted to develop a model of contractors' safety management system, for that, an expert interview was conducted. First, the authors revealed defects of contractors' safety management in present. Some defects were mentioned in literatures and agreed by a large number of experts, while some were newly discovered through this survey. These defects need special concern from contractors. Then, the authors proposed corresponding measurements for defects from three view angles, namely, safety culture, regular safety programs, and cooperation mechanisms. The safety management system and related measurements can provide a reference for contractors.

INTRODUCTION

Safety is a primary objective of construction project management and a basic requirement for contractors (Zhang and Zhu 2013). Contractors need to improve project duration, cost, and quality control so as to gain profits, but firstly they must ensure workers safety, structures stability, and no accident happening. Accidents, if happened，may bring deaths, severe injuries, bad company image, and long-term negative social influence. The China Sino-hydro Construction Group has just suffered such an accident. On Dec. 13, 2014, one of their projects, the No.1 shaft of the Sinclair hydropower Station in Ecuador suddenly collapsed and caused 13 deaths and 12 injuries. Therefore, although Chinese contractors grew stronger in the past decade, they never felt relaxed to ensure safety and avoid accidents, because the construction market and project environment also changed as following.

(1) As the investment of infrastructure in China increased every year and construction companies merged or grew bigger, contractors needed to undertake more projects and faced heavier safety management pressure.

(2) Because of high competition in the construction market, contractors

always lowered the bidding prices and reduced input into safety management.

(3) As more complex and bigger-size construction projects were built, such as underground railways, high-speed railways, tunnels, highways, and hydro power stations, contractors had to manage more risks due to the long project duration and unpredictable geological conditions.

(4) As China gradually stepped into an old-age society, young migrant workers became deficient. Workers frequently moved from one project to another. Some workers received little safety training and lack of safety awareness and knowledge.

In the construction industry, contractors' management and workers used to manage safety issues based on instinct and experiences (Hallowell and Gamatese 2012). Experienced management and workers can only manage their own projects well. However, if contractors can refine all good experiences as institutions or regular programs and use them in all projects, they may manage safety issues better. Therefore, this paper aimed to: conduct an expert interview to reveal defects of contractors' safety management; and establish a model of contractors' safety management and present corresponding measurements to amend those defects.

LITERATURE

Normally, Contractors manage safety issues at three basic layers, namely, companies, projects, and worker teams. For construction companies, Hallowell and Gamatese (2012) summarized 13 safety programs, such as upper management support, project-specific training, frequent worksite inspections, and so on. Zheng (2008) proposed five safety management methods, including responsibility mechanism, institution, training, money input, and worksite inspection. Chen (2011) supplemented another two methods, safety performance evaluation and incentives. Liu (2012) thought construction companies should improve safety management through safety standardization, safety culture, and hazard management.

For construction projects, Fang et al. (2006) found that good safety climate could form through ways including management commitment, safety consultation, safety training, supervision, and workmates cooperation. Li and Mao (2009) listed safety plan, hazard identification, safety inspection, and defects elimination as the key issues of construction safety management. Bai (2014) summarized defects of safety management and proposed seven corresponding measurements, such as safety training and hazard identification. Zhao et al. (2008) also gave some suggestions, such as safety equipments, safety insurance, and document management.

For worker teams, Mitropoulos and Memarian (2012) found that four factors distinctly affected safety performance of worker teams, including team cognitive attributes, team motivational attributes, team behaviors, and enhancing effectiveness. Jiang et al. (2014) adopted a system dynamics method and analyze the relationships between individual factors (e.g., safety awareness, safety knowledge, and attitude), environmental factors (e.g., hazards), management factors (e.g., communication, check, and training), and workers' unsafe behavior. Then he verified that preventive measurements are more effective to reduce workers' unsafe behavior than emergency measurements. Huang (2013) pointed out some defects of worker teams' safety management, such as low ability of team leaders, low safety awareness of workers, and deficient site inspections, and suggested adopting some safety programs, such as safety standardization and safety training. As an official of a Construction Safety Inspection Station, Shi (2013) thought worker team leaders affected workers' awareness and behavior, therefore, the selection and training of them were important.

RESEARCH METHOD

An expert review was conducted to reveal defects of contractors' safety management and seek for corresponding measurements. A total of 14 experienced and representative experts were selected:

(1) They were from six cities, covering three areas of North China, Central China, and South China;

(2) Twelve experts were from construction companies, and the other two were from Government Safety Inspection Stations;

(3) They had averagely 13.42-year experience about safety management;

(4) They worked at different management levels, including deputy general manager, chief engineer, safety director, project manager, and engineer;

(5) Each expert had a bachelor degree at least;

(6) Ten experts were interviewed face to face, while the others by telephone.

The survey was conducted in two rounds. First, the authors and experts discussed about contractor's safety management practices and defects, listed the defects in a table, and recorded the feedback times of each defect. Then for the defects with high feedback times, the authors developed a model of contractor's safety management system and proposed corresponding measurements, see Table 1.

Table 1.List of Experts Interviewed.

No	Location	Post	Working years	Education background	Interview way
A	Beijing	Engineer	13	Bachelor	Face to face
B	Beijing	Project manager	14	Doctor	Face to face
C	Beijing	Project manager	14	Master	Telephone; mail
D	Wuhan	Vice head of inspection station	15	Master	Face to face
E	Wuhan	Vice general manager	11	Master	Face to face
F	Wuhan	Engineer	8	Master	Face to face
G	Wuhan	Vice general manager	12	Bachelor	Face to face
H	Zhengzhou	Project manager	13	Bachelor	Telephone; mail
I	Taiyuan	Chief engineer of inspection station	18	Master	Telephone; mail
J	Guangzhou	Vice general manager	14	Bachelor	Face to face
K	Guangzhou	Safety director	14	Bachelor	Face to face
L	Guangzhou	Engineer	9	Bachelor	Telephone; mail
M	Shenzhen	Vice general manager	20	Bachelor	Face to face
N	Shenzhen	Safety director	13	Master	Face to face

DEFECTS OF CURRENT CONTRACTORS' SAFETY MANAGEMENT

Through literature survey and the first-round expert interview, the authors concluded 24 defects of contractors' safety management. However, due to the length limit, this paper could only list the survey results briefly.

Some defects were mentioned in literatures but agreed by few (no more than four) experts in this survey, including: deficient money input; and weak safety equipments. It meant these defects were greatly improved.

Some defects were mentioned in literatures and still agreed by a large number of (five or more) experts in this survey, including: deficient management staff; too short project duration; deficient site inspectors; delayed defects discovering and elimination; bad leadership of worker team leaders; bad safety awareness of workers; frequently flowing workers; few and inefficient trainings; and ineffective incentive mechanism.

Some defects were newly discovered but agreed by few experts in this survey, including: bad cooperation among different departments; deficient site inspections; bad working and living conditions of workers; and ineffective safety performance evaluation.

While the other defects were newly discovered and agreed by a large number of experts in this survey, including: weak upper management support; bad leadership of project managers; deficient safety knowledge of site inspectors; few promotion chances for safety inspectors; inadequate hazard identification; deficient safety knowledge of workers; lack of daily safety meeting; inefficient supervision methods from companies to projects; and mistrust among site safety inspectors and workers.

MODEL OF CONTRACTORS' SAFETY MANAGEMENT SYSTEM

In order to amend the above defects especially those with high feedback times, the authors advised to improve safety management in the following aspects.

Companies and projects should have good safety culture or climate, and management and workers should have good safety awareness. Safety culture refers to a subfacet of organizational culture that affects workers' attitudes and behavior in relation to an organization's on-going safety performance (Mohamed 2003). Safety climate reflects employees' perceptions about the safety management system, including policies, practices, and procedures that show how safety is implemented within the working environment. Safety climate can be considered as a subcomponent of safety culture (Choudhry et al. 2007).

Regular safety programs, such as safety plan, hazards identification, safety training, and safety performance evaluation, should be implemented at all three layers of companies, projects, and worker teams.

Effective supervision and cooperation mechanisms among three layers should be established. The management of companies, projects, and workers should communicate more, share safety knowledge, and try to help each other.

After discussion with experts and referring to the research work by Cooper (2002) and Choudhry et al. (2007), the authors developed a model of contractors' safety management system, as shown in Figure 1.

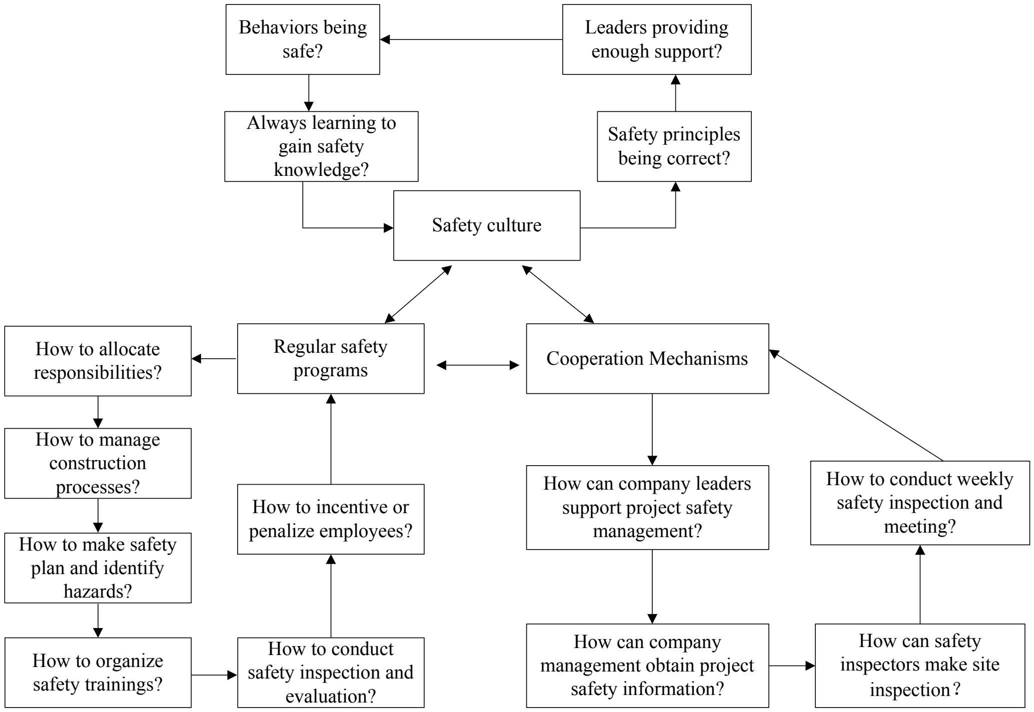

Figure 1.Model of contractors' safety management system.

SAFETY CULTURE

Safety culture, climate, and awareness can be considered as foundations of contractors' safety management. Without good safety culture, climate, and awareness, safety issues cannot be managed well. In this aspect, fiver measurements were proposed.

Safety principles. Construction companies should have their own safety principles, which should be simple to understand and remember, thus can provide an effective reference for employees' safety behaviors.

Safety behavior standards. Departments of construction companies can summarize basic safety rules, technical requirements, and other safety knowledge, and compile them as safety behavior standards. They can use the standards to train employees, and employees can gain safety knowledge and reduce unsafe behaviors.

Leadership. In current Chinese construction industry, top management of construction companies always emphasize safety management in word more but take real actions less. As expert K said, top management needed to undertake more responsibility for safety management. If top management of companies were required to take charge of certain projects, they would input more attention, labor hours, and money to safety management.

Safety learning climate. Nowadays learning has become a popular word all over the world. People realize that learning is important. Employees in the construction industry should also keep learning to master new technologies, methods, and materials. Five experts (A, B, C, J, and I) mentioned that their companies frequently conducted training for employees, including safety training.

Safety-benefits conception. In someone's eyes, safety management meant only input of labor hours, money, and other resources. It was incorrect absolutely. Through safety management, people can prevent accidents happening, and thus avoid losses of time, properties, and lives. Safety can produce great benefits, each employee should know about that.

REGULAR SAFETY PROGRAMS

Construction companies, projects, and worker teams should conduct some normal safety programs regularly, which have been proved to be effective. Eight safety programs were listed in Table 2. They were simple to understand, only two of which need further interpretation.

Responsibility allocation mechanism. Safety is the same objective for all employees. People should cooperate to ensure safety. Different management layers and workers should undertake proper responsibilities and do their job well. Project managers are leaders of construction project teams, but they need to input more time and attention to safety management. Correspondingly, incentive is also an important issue. The project manager and team should get reward for good safety performance and penalization for bad safety performance.

Process management. Safety management is systematic, and can be decomposed into different tasks. These tasks can be properly arranged and accomplished in a process management way. The company of experts J and K has explored this way. Safety management was decomposed into tasks and illustrated as a total of 54 flow charts. The flow charts provided a good reference for management to conduct safety planning, checking, training, evaluation, and other tasks.

COOPERATION MECHANISMS AMONG DIFFERENT LAYERS

Besides safety management at each layer, interaction among layers is also important, but weak at present. For example, construction companies have inadequate safety inspectors so that cannot inspect safety status of projects frequently, but few project teams are willing to report bad status and troubles because it may affect their safety performance, thus companies cannot get detailed safety information of projects in time. For another example, some worker team leaders do not make good safety plans or hold safety meetings every day, but management of projects has little communication with workers so they cannot know safety status of worker teams quickly. Therefore, more intense and effective supervision and cooperation mechanisms should be built, five methods were proposed for that.

Table 2.Improvement Methods for Construction Safety Management.

Group	Methods	Contents
Safety culture	Safety principles	As the basis of safety culture, several safety principles being refined, understood and obeyed by employees
	Safety behavior standards	Safety behavior standards being compiled by the management and learned and obeyed by all employees
	Leadership	President of companies and project managers always attend safety meetings, training and other activities
	Safety learning culture	Considering learning issue, and usually organize safety training programs for the management and workers
	Safety benefits conception	Employees can understand the value of safety. For a well managed project, both management staff and workers can get reward. Safety benefits conception links with incentive mechanism
Regular safety program	Responsibility allocation mechanism	Safety responsibility allocation among different positions of companies, project teams, and workers being stated in written files and obeyed by all employees
	Processing management	Safety management of companies and projects being decomposed to processes and shown as flow charts
	Safety plan and hazard identification	Different departments of companies and different project teams make safety management plans, analyze and identify hazards in affairs or projects, and propose corresponding measurements
	Safely plan implementation	Different departments of companies and project teams implement safety management plans, eliminate hazards, discover and resolve problems, and immediately investigate and handle accidents if happen
	Safety training	Companies, project teams, and worker teams organize safety training about policies, processes, techniques, and hazard elimination, etc., according to their requirements
	Safety inspection	Self-inspection at each layer of companies, projects, and worker teams. Parallel inspection by the safety department to other departments. Inspections from companies to projects, and from projects to worker teams
	Safety evaluation	Self-evaluation at each layer of companies, projects, and worker teams. Companies-to-projects and projects-to- workers evaluation of safety management
	Incentives or penalties	Incentives or penalties based on safety evaluation results at each layer of companies, projects, and worker teams

Table 2.(Continued).

Group	Methods	Contents
Monitoring and cooperation	Company leaders linked with projects	The president, vice presidents, and chief engineer of companies being linked with projects, not only giving severer supervision but also providing stronger support to projects
	Regular reporting mechanism	Project teams report monthly safety management reports of projects. The safety departments of companies compile monthly, season, and annual safety management reports of companies
	Sectional safety inspection	Construction site being divided to several sections, and each section being assigned to one safety inspector. Safety inspectors inspect their own sections every day, find defects of site safety management and handle them
	Joint weekly safety inspection and meeting	A thorough site safety inspection held every week, leading by project managers, participated by vice managers, chief engineer, safety inspectors, related departments, and worker team leaders. Weekly safety meeting after the inspection
	Joint safety training	Safety training for staff of companies and projects jointly, or for staff of projects and workers jointly

Company leaders take charge of safety management of projects. In experts J and K's company, the president, vice president, and chief engineer were required to take charge of safety management of several projects. This way was special and observably enhanced communication between companies and projects. The leaders not only inspected projects from time to time, but also gave more support. Moreover, safety management of projects was improved.

Regular reporting mechanism. As expert K said, the safety department of his company had only four people but managed 14 projects (in 2014). Safety inspectors could not inspect each project every week, so they had to use another method, enquiring project teams by telephone. However, they could not judge the truth and accuracy of information collected in this way. The authors thought the safety department should use a more effective and high efficient method to get project information. In this method, project teams should report safety data in a designed template to safety departments of companies once each week, and then safety departments can handle safety data of all projects and compile monthly safety reports of companies. Furthermore, safety departments can aggregate monthly safety reports to season reports, and season reports to annual reports. Even more, safety departments can organize special safety reporting meetings each season, and require all project managers to report safety status of their projects. If project managers report untrue or inaccurate safety data but pointed out by others, they may get punishment. This projects-companies reporting mechanism. may be more effective than the companies-projects inspection mechanism.

Sectional safety inspection. Site safety is a main part of project safety. Workers should finish each procedure according to construction specifications, if they violate the specifications, site safety inspectors should point out their mistakes and tell them how to correct. Site safety inspectors and workers should communicate often. However, in current Chinese construction industry, site safety inspectors and workers do not have enough trust and cooperation. If site safety inspectors and workers have the same interests, they will be likely to help each other. Thus, the project team can divide construction sites to several sections and assign site safety inspectors to sections. Each site safety inspector will take charge of safety status, workers' behavior for the section assigned to him. If a section gets good safety performance, both the site safety inspector and workers of this section can get reward. The expert K's company has accumulated experience for this method.

Joint weekly safety inspection and meeting. Weekly safety inspection is widely used in the construction industry. Normally project managers lead weekly safety inspections, and vice managers, chief engineer, safety inspectors, and departments attend. The inspection aims to find hidden hazards, correct unsafe behaviors, and resolve problems. It is also important for worker teams. The authors thought worker team leaders should also attend the inspection. After the inspection, weekly safety meeting should be held soon. First, worker team leaders report site safety status; then site safety inspectors point out defects and problems of safety management; then chief engineer and vice project managers give comments and advices; and finally the project manager summarizes and evaluates total safety management of the project in this week. Joint weekly safety inspection and meeting change the center of safety management from top management to first-line worker teams, and build a communication mechanism between project and worker teams.

Joint safety training. Safety trainings can be organized for different layers at the same time. For example, management of both companies and projects need knowledge of safety policies and management, while management of both projects and worker teams need knowledge of construction technology, safety equipment, and safety behaviors. Joint safety training can also enhance communication among different layers.

CONCLUSIONS

This paper aimed to reveal experiences and lessons from contractors' safety management. The authors considered three management layers (companies, projects, and worker teams), and developed a model of contractors' safety management system. An expert interview was conducted to reveal defects of contractors' safety management practice and seek for corresponding measurements. Fourteen experts from North China, Central China, and South China were interviewed face to face or by telephone. Twenty-four defects were discovered through the first round interview. Some of them were studied in previous researches but still serious at present, such as deficient safety management staff and bad safety awareness of workers. While some were newly discovered in this survey and agreed by a large number of experts, such as inefficient supervision methods from companies to projects. Both groups need special concern and proper settlements.

During the second-round interview, the authors developed a model of contractors' safety management system and proposed corresponding measurements at three aspects, namely, safety culture, regular safety programs, and cooperation mechanisms. It contained five methods for safety culture, eight methods for regular safety programs, and five methods for cooperation mechanisms. The safety management system and corresponding measurements were concluded from real-practice experiences, and may provide valuable reference for contractors.

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Application of an Online Consumer Review in Real Estate Marketing

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Abstract

Considering the application status of online reviews in the real estate industry, this paper mainly discusses the significance of online reviews for cyber marketing in the industry based on existing theoretical studies. Additionally, reasons of why online reviews are not further applied in real estate as in other industries are analyzed. Finally, several suggestions on effective utilization of online reviews to promote real estate online marketing are also given in this paper.

INTRODUCTION

With the rapid development of Internet technology, Word Wide Web has not only brought great changes to companies, but also has had a profound impact on the behavior patterns of consumers. According to statistics, by the end of 2012, the number of global Internet users has reached 2.405 billion. The Chinese Internet user amount has leapt to the first place in the world since 2008. Up until December 2013, Chinese netizens had reached 618 million, Internet penetration rate up to 45.8%, an increase of 3.7 percentage points compared with that of the end of 2012. By 2013, Chinese online shopping users had reached 302 million people, and the utilization rate reached 48.9%, with an increase of 6 percentage points compared to that of 2012.

Till December 2013, the proportion of national enterprises to develop online sales and online procurement were 23.5% and 26.8% respectively, and the rate of launching online marketing activities was up to 20.9%. Influenced by its own industry characteristics, the real estate enterprises possessed a low percentage of online sales. However, the proportion still reached 11%. In 2013, Chinese e-commerce market scale was 9.9 trillion yuan, with an increase of 21.3%; the online shopping market transaction scale exceeded 1.85 trillion yuan, with an increase of 42.0%.

In recent years, with the rapid development of Web 2.0 technology, the traditional way of information dissemination has experienced a phenomenal transformation. People tend to appeal purchase decisions help from consumer-created information, particularly the product reviews, instead of traditional offline friends. The online reviews that reflect consumer's attitudes and views are playing an increasing important role especially in online shopping. Based on the consumer shopping behavior report released by Channel Advisor in 2010 and 2011, we can find that: the impact of product reviews on online shoppers' decisions has increased significantly: 92% of U.S. surveyed users read product reviews in 2010 with 46% claimed that the reviews will affect their buying decisions, while in 2011, 90% of the global users read product reviews, up to 83% of users reckon that reviews will affect their buying decisions. Online product reviews have been the most critical factor to consumer purchase decisions, and become the most concerned external information before online purchase, beyond the suggestions from family and friends. Another report shows that people of different ages have different concerns on online shopping, but user-based review is the first consideration among all ages. It's indicated from these data that online reviews can take profound influence on consumer purchase decisions, being a more influential factor than information coming from other sources.

DEVELOPMENT STATE

Bickart and Schindler (2001) considered that online forums, bulletin boards, listservs, and newsgroups all provide consumers with a platform to share their experiences and opinions. They found that exposure to online reviews generates more product category interests than exposure to marketer-generated sources of information available on the Internet, for online reviews possess greater credibility, greater relevance, and a greater ability to evoke empathy.

Park and Kim (2008) defined online consumer reviews as consumers to release their reviews and opinions on the internet based on their own usage experiences.

Park et al. (2007) used the elaboration likelihood model to explain how level of involvement with a product moderates the persuasive impact of online consumer reviews. They found that the quality of online consumer reviews has a positive effect on consumer purchasing intention. Reviews which are logical and persuasive, with sufficient reasons based on specific facts about a product, have a strong positive effect on purchasing intention. Consumers' purchasing intention increases along with the number of the reviews.

Chen and Xie (2008) argued that being compared with seller-created information, consumer reviews are more user oriented and have an advantage in helping consumers find products matching their preferences. This information is particularly important for unsophisticated consumers. They suggested sellers to develop unique strategic response to consumer review information.

Senscal and Nantel (2004) found that purchase ratio will double when consumers are exposed to online reviews comparing with those who are not exposed to online reviews. The sites which provide consumers with references will not affect the credibility of the online reviews and will not affect consumers to refer to the comments. However, product category has a significant influence on whether the customer will refer to the online reviews. Based on empirical analysis of 445 valid samples of Amazon.com, Liao and Cai (2013) found that the depth of the reviews as well as purchase experiences has positive correlation with the usefulness of online reviews.

By grasping all the online reviews of three kinds of search goods and experience goods, Li (2013) discovered that the polarity of product reviews, review content length, product attributes mentioned in the review, the total number of helpfulness votes, and the number of reply can affect the helpfulness of online reviews, and product type plays a moderating role in the relationship between helpfulness and the polarity of product reviews. Being driven by the development of information technology and service economy, features like personalization and socialization of E-commerce have come out gradually. Large amount of online consumers experience participation and interaction by purchasing, give online reviews, and form many network communities of which internet forum is the typical representative. Users' participation, shared public resource, and frequent emotional interactions among netizens of E-commerce based on Social Network (ESN) largely affect emotion and purchase behavior of consumers.

As an emerging marketing phenomenon, online consumer reviews have become an increasingly popular and important channel for product information and played an increasingly important role in consumer purchase decisions. For this reason, there is great significance to study online reviews' practical application.

THE APPLICATION OF ONLINE CONSUMER REVIEW IN REAL ESTATE MARKETING

The status quo of online reviews on real estate website. Under the traditional shopping patterns, a property buyer has to go to the sales office or the house spot for 3 to 5 times on average before him finally signing the contract. The process requires a great deal of time and energy.

Online marketing can contrastively save buyers' time to a great extent. Property buyers can find out housing information on the Internet. Online customer reviews are important information to help buyers make their decisions.

We collected statistics data about online customer reviews from 12 popular properties (SouFang.com) and ranked as Table 1. From the Table 1, we can conclude that the enthusiasm to publish personal feelings about the house and relative comments online is not high currently. The number of people who comment online is far below that of people going to the spot. It also suggests that people are more willing to mark the house online, of which the score can be objective to a certain extent, seen from the grades. As a simple way of online reviews, online scoring has certain impact on users, like movie scores, but lack of concreteness than online reviews. Therefore, scoring cannot influence users as same as reviews. Finally, the ratio of netizens who write online reviews about the house properties they have visited is extremely low being compared with that of users who comment on daily consumer goods. The main reasons are as follows:

(1) The regionalism of product. Consumer goods are not limited by the selling places. The customers are nationwide. While real estate projects are regional, only local buyers and a small part of the investors from other places may have interests in the house and will visit it. Therefore, there are only a few of users qualified to address online reviews.

(2) The incentive mechanism of the websites. Some websites such as Tmall,

Amazon will encourage customers who address comments of their usage experiences by cumulative scores. Users who address online reviews will be awarded some scores. When the scores are accumulated to a certain degree, the user will get discount benefits. However, there are no corresponding measures in Chinese leading real estate website (SouFun.com, House.sina, anjuke.com, Sohu. focus. etc.) Hence, even though people have seen the house in private and have some opinions, they have no enthusiasm or motivation to do so.

(3) Lack of connecting channels. There are no effective channels between house buyers and real estate websites on which consumers can release their reviews. House visitors and buyers do not necessarily address their personal opinions and experience online, and users who address reviews online cannot be guaranteed to be the house visitors or buyers.

Table 1.Online Reviews of Hot Properties in Dalian.

No.	Name	No. of online reviews	No. of people mark online	Score
1	Chun Tian	161	5036	92.92
2	Dahua·Jinxiuhuacheng	64	15609	80.36
3	Huarun·Haizhongguo	63	8430	99.64
4	Hongdufengjing	58	2853	77.56
5	Wanke·Lanshan	39	2344	57.52
6	Jindi·Yijing	34	5952	75.12
7	Huarun·Haizhongguo	27	5351	97.64
8	Wankeshu	19	1387	82.12
9	Zuanshiwan	15	13825	90.29
10	Xinghaiguofu	13	1440	91.16
11	Yuyuan	12	1992	97.84
12	Yida·East Santa Clara	6	9484	27.92

The significance of online reviews in real estate online marketing. Online reviews influence the online marketing of real estate industry in several aspects:

Online reviews can help potential buyers gain the information of the projects. By browsing house information online, people can reduce frequency of visiting the house in person, thus to save time and energy for themselves. House property has its specificity for great value. Most consumers will visit several projects before them making their final decisions. People tend to search information online to decide which places to go, and online reviews can be important supplement to the information they need.

Moreover, with the constant development of e-commerce, the real estate industry has also penetrated into online selling market. With the help of 3D technology, people can experience the project online just like they visit in person. Online reviews will subsequently increase in their importance to help consumers decide which house to buy totally online.

Suggestions. House property dealers or intermediary agents can organize various activities to establish effective communications with customers. Some influential and active users from popular websites and Internet forum can be invited to visit the project in person and address their reviews online. Thus the popularity of the project can be promoted and more customers can be attracted to the projects.

In addition, learning from Tmall and Amazon, real estate website can take certain incentive measures to improve the quality of online reviews. For example, when users address logical and persuasive reviews and personal visiting experiences, they can be awarded some discount or given some scores online which will be beneficial to them.

Finally, set up a channel between house buyers and the platform of online reviews. Property dealers can cooperate with real estate websites to achieve this goal. For example, the dealers can put up a poster with QR code at the selling office. By scanning the QR code, customer can log in the related websites and share their visiting experiences.

CONCLUSION

The internet consumers' behaviors, especially group behaviors, have important impacts on the real estate market. How to analyze the information of customers' emotion, product cognition, etc. and predict their purchase behaviors on the basis of a mountain of online reviews has great practical theoretical significance.

Many studies have been conducted to analyze the influences of online reviews to the consumers' purchase behaviors and consumption psychology. However, the investigations of its impacts on the real estate market are still at the initial stage. Therefore, this study just makes a preliminary discussion, and it still requires further analysis and proof.

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A Study on the Innovation Mode of a Chinese Construction Management Certified Qualification System Based on Knowledge Integration

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Abstract

This paper summarized systematically present situation and problems of the construction management professional qualifications set-up and exam management mechanism in China, as well as analyzed the knowledge and skill feature for various construction management certificated qualifications which are of knowledge relation in detail. As for these problems, based on the conception of knowledge integration of complete life cycle management of construction projects, this paper has proposed a definite operating scheme to reduce the current quantity of exams for certifications of construction management qualifications and to reform the examination and management of professional qualifications at present.

INTRODUCTION

In recent years, there have been a number of prominent issues of Chinese qualification system in the implementation process. Especially in the field of construction, the connection between enterprise resources and the number of professional qualifications has led to the blind pursuit for quantities of credentials, discouraging sustainable and healthy development of the construction industry. In view of this phenomenon, the State Council, the Ministry of Human Resources and Social Security and related industry authorities have issued a series of documents to rectify the field of professional qualifications on a large scale since 2007, aiming to take effectiveness to curb confusions of the professional qualification set-up, examination, certification and other activities.

The mentioned problems especially in construction management professional qualifications are caused by the unreasonable management mechanism, management mode and excessive professional qualification types. However, the relevant research focuses more on the combination of students' education & training system and the existing system of professional qualification (Yuan and Li 2007; Li 2008; Gu and Zhang 2012; Ding and Liu 2013) and the internationalization of Chinese professional qualifications set-up (Tao 2002; Liu 2003). The research on set-up and management mechanism of professional qualifications is still very rare, such as the only theoretical conception put forward by Tai and Li (2014). But their paper focuses on the feasibility of merging the four construction management professional qualifications from knowledge integration's perspective, and did not elaborate on top-level design to operation and how to operate. Hence, on the basis of theoretical knowledge integration of the project life cycle management, this article has proposed a new system of construction management professional qualification set-up and management mode in order to break the current compartmentalization management among departments, which is not only helpful to improve the economic &management abilities of practitioners, but also to save social resources as streamlining the organization from the industry department.

CURRENT PROBLEMS ON THE SET-UP AND MANAGEMENT OF CONSTRUCTION MANAGEMENT CERTIFIED QUALIFICATION

Status quo of qualification set-up involved by construction projects. According to life cycle theory of construction projects, qualifications of construction management comprise Registered Investment Consulting Engineer (RICE), Registered Bidding Division (RBD), National Certified Constructor (NCC), Registered Cost Engineer (NCE), Certified Supervision Engineer (CSE), Certified Property Manager (CPM) and Real Estate Valuer (REV) roughly. From the point of the history of professional qualifications, CSE, RCE and REV originate as early as the professional qualification system in China. Because of various market demand for qualifications and influence of the relevant laws and regulations in different stages, various qualifications embody various levels of "gold content", under the case that enterprise qualification concerns about the number of professional qualifications in china. In view of the number of candidates, the most popular professional qualification is NCC. According to incomplete statistics, the nationwide registration for NCC was over 2 millions in 2014 exclusively. Figure 1 has shown various qualifications and their corresponding cycle stage in the life cycle management of construction project, in which the solid line represents the major stages of projects when the corresponding professional qualifications work, while the dotted line showing the weak participation. Table 1 has shown the characteristics and departments of qualifications, from which it's concluded that the management concerned with professional qualifications of decision on project investing and bidding belongs to National Development and Reform Commission (NDRC), while other qualifications of construction and operation management are managed by Ministry of Housing and Urban-Rural Development (MOHURD).

Major problems on the set-up and management of construction management qualifications. (1) There is no perfectly unified law system on the set-up and

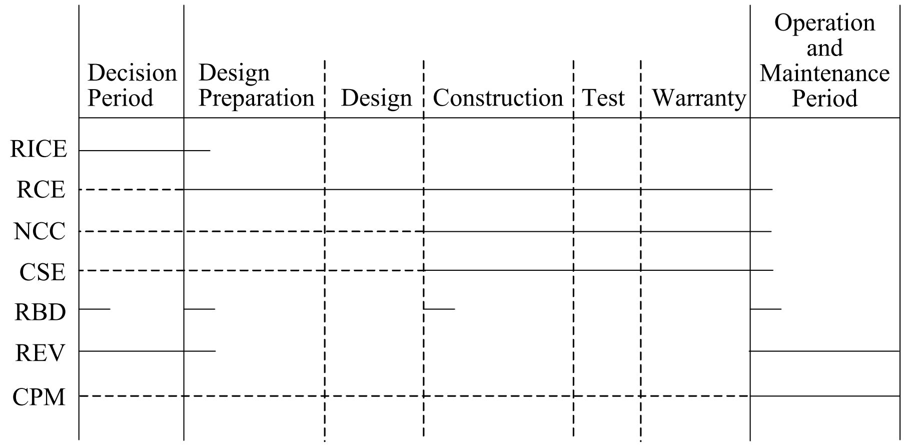

Figure 1.Corresponding qualifications in construction projects life cycle.

Table 1.Characteristics of Various Professional Qualifications.

Professional qualifications	Major stages	Establishment date	Characteristics	Department
RICE	Decision	2002	Economic evaluation	NDRC
RBD	Various	2007	Economic evaluation	
NCC	Implement	2003	Process management	MOHURD
A-NCC	Implement	2003	Process management	
CSE	Implement	1993	Process management	
RCE	Implement	1996	Cost management	
REV	Decision & Operation	1995	Economic evaluation	
CPM	Operation	2005	Operation management	

Remarks: A-NCC=Associate-NCC

management of professional qualifications but mainly departmental rules. By August 2014, there exist 84 kinds of qualifications of admittance and even more other qualifications of proficiency. The State Council has requested that a set of professional qualifications, which is scientific, operated normatively and supervised by law management system, should be built elementarily by 2017. However, considering the operational status quo, mostly it's departments of industry who draw up regulations and set up professional qualifications. Department interests have brought about "disordered examination" & "indiscriminate certificates" and some behaviors of violations resembling the pursuit of quantities of credentials. Essentially, the "Law of Professional Qualification" or "Set-up Regulations of Professional Qualification" are still out of formulation whose powers go beyond administrative authority of departments to work on standardizing and guiding the set-up &exit mechanism and procedures in and among the departments. Presently, it's urgent to integrate qualifications of various departments, evaluate periodically and adjust qualification catalogue and related systems according to actual situations.

(2) The excessive professional qualifications neglected the relevance among them and restricted the flow of talents. Currently, total life cycle management of

construction projects professional qualifications are divided into 8 categories. It's claimed clearly that identities of personnel with qualifications for projects participation are not limited in specific enterprises, but the exertion of many kinds of qualifications' professional value is limited in specific types of enterprises, given the rules on the practice areas and origination. For instance, Constructor fits construction companies, Supervision Engineer fits supervision agencies, yet they are almost the same in knowledge and skill request but different in identities for projects participation merely. This is largely due to fragmentation management and departmental interests, along with the development of construction industry management in China. Operational qualification mode has restricted the flow of talents in various enterprises and industry, for instance an out-standing CSE is capable of NCC qualification, and he cannot still make it a project manager of engineer projects.

(3) Professional qualification certification system fails to play a linked role on the domestic talents training and international professional certification. It generally takes 3-5 years at least for those fresh graduates majoring in construction economic management to gain access to professional qualification examinations since graduation, and passing the exams means the top level of recognition of professional qualifications. There are only two levels of personnel training paths for engineers with professional registration qualification, which is not conducive to the training of professionals in the long run. While four comparatively complete personnel training levels are set up by CIOB of the UK, that is Student Member- Associate Member - Regular Member - Senior Member (Li 2003; Wu 2009), among which Associate Member is a transitional role between Student Member and Regular Member with official qualification for professional registration, and Senior Member indicates where the personnel are headed. Besides, present personnel training as well as professional certification in Chinese Universities is obviously inferior to advanced level internationally, facing the low even difficult degree of recognition. That is partly obstructed by language problem and largely owing to the knowledge, professional quality and technical gap.

INTEGRATED DESIGN OF PROFESSIONAL QUALIFICATIONS BASED ON KNOWLEDGE RELATION

The integration and the reform paths to qualifications for registration must be based on knowledge features and related to characteristics of talents' development. Through systematic analysis and comparison of various professional qualification syllabus and teaching materials, we can learn exam contents of various qualifications are of high repeatability and many of the basic theories and methods are consistent; coupled with the high degree of correlation among various qualifications, we can adjust and unify public subjects as well as distinguish professional practice qualification examination subjects of various qualifications by integrating knowledge. Their separation can loosen the register condition of public subjects and carry out demanding requirements for professional practice examination, aiming at a promotion to reform the set-up and assessment of construction management qualifications.

Characteristics of categorical exam content and register condition. (1) Public subjects exam contents are of high repeatability, while the exams mainly differ in professional practice examination subject. Generally, exam subjects of professional qualifications related to complete life cycle management involve public subjects and professional practice case study subjects (see Table 2). Chapters of public subjects are concerned with Laws and regulations, Project management, and Engineering Economics and Cost, whose differences are mainly reflected in professional practice case study. Combined with Figure 1, it can be concluded that exam material of various public subjects are of high consistency by the comparison of the detailed syllabus and exam material, and, in the perspective of professional competence requirements and difficulty for examination, the knowledge and job of REV and CPM overlap partly, yet the former requires more in professional capacity. So is the case with CSE and NCC and the latter requires more.RCE more than RBD and complements RICE, and RCE concentrates more on management of engineering cost while RICE more on economic evaluation during the investment decision period. The differences in capability requirements between various qualifications and limitation for practical scope contribute to, on the one hand, lessening the candidates who are weak in professional capability and competition of personnel, and restrain the access to other types of businesses for the personnel with high competence of qualifications on the other hand.

Table 2.Exam Subjects and Register Condition of Various Qualifications.

Qualification	Public subjects on engineer			Professional practice operation case study	Register condition
	Laws and regulations	Management theory and method	Economy theory and methods		
RICE	Engineering consulting	Organization and management of project	Policy and development plan on project decision	Ways and practices of modern consultation	The criteria between major and educational background is different
RCE		Construction cost management	Construction price	Case analysis on construction cost	
RBD	Knowledge and laws of bidding procurement	Bidding procurement projects/ contract management		Bidding purchasing professional practice	
NCC	Knowledge and laws of construction engineering	Construction project management	Construction economic	Management and practice of specialized engineering	
A-NCC	Knowledge and laws of construction engineering	Building engineering management		Management and practice of specialized engineering	

Table 2.(Continued).

Qualification	Public subjects on engineer			Professional practice operation case study	Register condition
	Laws and regulations	Management theory and method	Economy theory and methods		
CSE	Basic theory and laws of construction	Construction contract/ objective management		Case analysis on construction supervision	
REV	Basic theory and policy of real estate	Real estate management specialty	Theory and methods of real estate appraisal	Case study on real estate evaluation	
CPM	Basic theory and policy	Property management/ Management method		Property management practice	

(2) Register condition is influenced by educational background and technical relevance and time for registering is limited unscientifically. With current emphasis on technical relevance, educational background and work experience, it goes with evident discrimination of diploma and major objectively. Personnel with inferior academic attainments do not always behave worse than those with superior attainments; in a similar way, it's quite possible to be admitted into construction management field for those who graduate from the major of slim relevance with construction management but persist studying by oneself or long-term work. The register condition also has caused mistakes that personnel are distinguished by major and examination. Besides, limitation of register time has obstructed personnel with excellent ability of study and work to get certificated early and their further study from graduation to attending professional qualification examinations. Also, as for the people who are weak in learning, experience accumulation and practical ability, it can't help to improve the standard and competence of talents with the requirement of long work experience. Generally speaking, present set-up of register time is so one-size-fits-all that label discrimination for talents are resulted, even though it can classify people with different educational background. The access to certificated professional qualifications shouldn't be decided by educational background, major or work experience, and the problems of present set-up of register condition can be surely improved by extending the path to professional qualifications.

Updated set for professional qualification and examination plan after knowledge integration. Based on the foregoing analysis, this paper proposes the reform and integration of the seven mentioned professional qualifications as a whole and delivers the following reform program in the respect of professional qualification merger, exam subjects, register condition and range of occupations.

(1) Merging operational seven classes of qualifications into three directions collectively called as Certified Construction Manager.

The basic idea is to merge those qualifications which have similar requirements for practitioner's capacity and knowledge. Having classified the public subject exam materials into three subjects, laws and regulations, theory and method of construction management, and economics and cost of projects, new professional practice operation should be defined mainly in accordance with those qualifications of high capacity requirements, thus various qualifications can be distinguished. In detail, merge REV and CPM into Real Estate Manager (REM) to engage with international professional certification of real estate consulting, merge CSE and NCC into Certified Construction Consultants (CEC) to engage with international professional certification of constructor, merge RICE, RCE and RBD into Certified Construction Economic Consultants (CCEC) to engage with international professional certification of engineering cost consulting. Three adjusted professional qualifications for the three directions or stages in the complete life cycle management of construction projects are collectively called as Certified Construction Manager (CCM).

(2) Separate public subjects and professional practice subjects, and add a qualification of Associate Certified Construction Manager. The examination for CCM is still divided into public and professional practice exam subjects, but the public part and professional practice part should be separated. Unify the test subjects of three qualifications and unify professional basics into the public subject, which used to be involved by various qualifications, aiming to encourage practitioners of various qualifications to reflect a range of job roles' interest demand in view of the complete life cycle of engineering project, and to enhance professional competence and quality of employees on the whole. In the meanwhile, abolish the restrictions on work experience of public subject participation, take the achievement of public subject examinations into assessment for the current level of professional competence of universities, and increase quantitative weight of evaluation. Moreover, the issuance of qualification of Associate Certified Construction Manager (ACCM) to those graduates and personnel who have passed the public subject can make itself a transition sector between graduates and capable engineers.

(3) Take work performance standards as major measurement for register condition of professional practice examination. Present set-up of register condition partly limited the career development of personnel with different major and educational background, especially the latter, labeling people with their qualifications strongly, to some extent. Since one is qualified to pass the examinations and work in this field, he deserves similarly equal exams and career development opportunities. The foresaid personnel who have been awarded ACCM qualification through public subject examinations prove themselves equipped with theoretical knowledge for the field, thus it is essential to clear the register condition for professional practice by restriction of work experience and provide access to engineers with qualification for professional registration if passing exams. In that this restriction is not bound to reflect actual operational capability of practitioners entirely, and a complex and hard-to-operate set-up for time limit is not that necessary. A 3-5 years limit is considered to be sufficient according to production and operations management features of construction projects. Surely, to further encourage the talent and relax register conditions, it can be a more scientific way to determine their registration qualification by work performance standards, such as project scope, technical difficulty, investment, etc.

The integrated professional qualification exams and management mechanism. Facing current situation, various industry associations for complete life cycle of construction projects are in urgent requirement to be integrated, in order to save public resources, recapture its administrative authority in professional qualifications, registration and management to government and strengthen its capacity to conform to some international associations such as FIDIC, CIOB by anti-driving mechanism. The merger and ruduce of qualifications have inevitable impact on the interest of related departments and existing management organizations. Therefore, on the basis of the change of test material and the setting for professional qualifications, the current management mode of rgistries and industry associations concerned with qualification exams also need reform and adjustment.Given the maneuverability and present circumstances of various qualification exams and registration management, the detailed operating procedures and path of reformcan be progressive.The reformed management mechanism of professional qualification exam and certificatedqualification is shown in Figure 2.

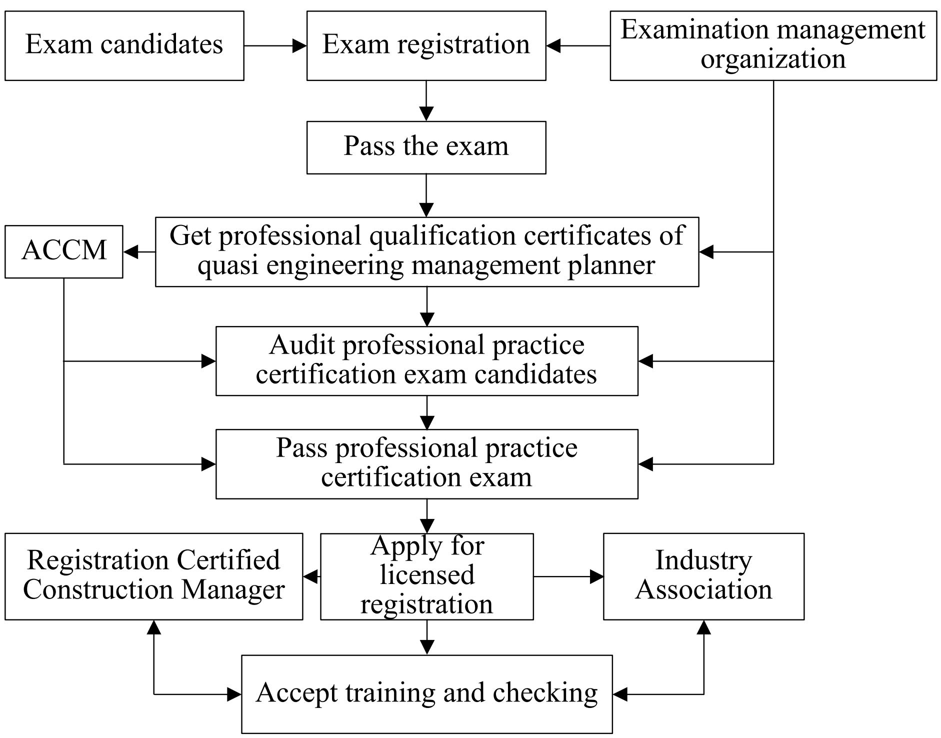

Figure 2.The management mechanism of professional qualification exam and certificated qualification.

The first step is the establishment of new cross-sector administration of certificated professional qualification examinations and the handoverof excution related to qualification exam which used to be powered by industry association to administration;it's followed by the gradual consolidation of the current small, scattered, weak industry associations and the enhanced efforts for construction oflarge and strong international industrymanagement association to the direction ofthe internationally renowned industry associations; lastly, transferthe registration certification and practice managementin respect of professional qualifications to industry associations completely when finishing the transition process, so as to form a final sustainable and healthy development mechanism which contains self-management and self-remoulding for industry.

CONCLUSION

Through the above method of knowledge integration, not only the quality of qualifications can be lessened, but also the practice standards of the construction industry practitioners are improved in a more effective way. The main work and value embodied in this paper are listed as follows:

(1) According to the characteristics of complete life cycle of construction projects, squeeze seven classes of construction management qualifications to three classes, among which it's divided into two directions for the implement period according to the features of economic management and procedure management, and classify the qualifications which carry weight during the operation management period. The integration of knowledge can make the qualifications more valuable, highlight traits of practice, promote the flow of talents and improve the ability to make decisions and manage during construction and operation.

(2) The consolidation of all the public subjects of construction management qualifications and separation with professional practice certification exams can bring along general improvement of the ability and professional quality of practitioners. In addition the examinations and certification for public subjects are beneficial for internationalization of personnel training and its engagement with international certification of qualification; also it can improve training level of industry and competition intenseness, leading to the interaction of healthy competition between school education and non-school education of construction management.

As a fatal method to assess personnel capability, professional qualifications wait for a long process to acquire the self-management capability of industry interior when it comes to the condition in China, since the qualifications of construction management come down to public safety and interest. This paper has put forward a plan to optimize current qualifications of construction management according to requests of the State Council and the aim to set up a professional certification management system with Chinese characteristics. Still, there are some inevitable limitations in this paper. We sincerely hope to cast a brick to attract jade and call out further discussion from scholars, in the expectation that contributions are made to promote the development of professional qualification certification system and the level of decision and management in construction field in China.

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Application and Research of a Construction Monitoring System for Construction Enterprises

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Abstract

With the continuous expansion of construction project scale, gradual enhancement of construction technical content, and increasingly intensifying scope of multi-project management of construction enterprises, it has become a problem that must be considered in safety management at construction site of construction industry to realize real-time, whole-process and uninterrupted safety monitoring by utilizing modern information technology and optimizing monitoring means. A construction monitoring system is designed in this paper by studying hazard sources at construction site, so as to identify, control, manage and prevent hazard sources, to grasp dynamic conditions at construction site, to promote safety management of construction site, and to improve the informatization level of project monitoring.

INTRODUCTION

With continuous development and perfection of socialist market economy, the construction products have been greatly improved in terms of quantity, height, depth, influence and technology content, which has raised higher requirements for modern construction project (MCP) management in China. On-site risk evaluation based on experience is no longer reliable. As is demonstrated in Hazard Recognition and Risk Perception in Construction (Perlman et al. 2013), experienced construction managers cannot identify all hazards in their working environment and there is a gap between the risk evaluation methods they apply and the most appropriate ones. By combining modern information technology with management tools and designing monitoring system at construction site, hazard source at construction site can be effectively identified, classified, analyzed, controlled, managed and prevented. Thus, the safety management level of MCP will be improved. In this way, safety hazards and potential construction hazards can be turned into management issues that can be controlled and eliminated by on-site management, which contributes to the enhancement of safety management of MCP.

As Naticchia et al. (2013) point out in A monitoring system for real-time interference control on large construction sites, on-site arrangement of monitoring system optimizes precise management of construction schedule and quality control. Therefore, integrating modern informationalized technology of monitoring system with identification and control of hazard source at construction site on the basis of monitoring system, reasonable avoidance of hazards at construction site, and informationalized as well as standard management for construction engineering project is of great significance to informatization progress of construction enterprise monitoring.

OVERVIEW ABOUT CONSTRUCTION HAZARD SOURCE

Hazard source at construction site is the direct reason of causing various accidents as well as the important part of study on construction site safety management. As the key to effective construction site safety management, hazard source is at the initiating terminal of accident chain, and the dangerous accident can be caused by a single factor, multiple factors or a system. Owing to the characteristics of diversity, concealment, fraudulence, interconnection, easy triggering, great destruction, and foresee ability, hazard source is especially important for construction site safety management of MCP.

Definition and characteristics of construction hazard source. Definition of hazard source is greatly different in different research fields. In terms of construction, construction hazard source referred to potential unsafe factors that might cause harm or disease, property loss, work environment destruction or combination of the above situations during the construction process. In construction field, dangerous accident is the core of engineering project safety management. Hazard source not only has 7 characteristics including diversity, concealment and interconnection, but also includes the following 4 features: strong harmfulness and extensive influence scope; complicated constitution reasons; high variability of component factors; multiple concurrences among hazard sources. Effectively identifying characteristics of construction hazard source is an important guarantee for improving safety of construction site as well as a necessary precondition for effectively controlling hazard source (Zhao 2011).

Components and transformation principle of hazard source. Hazard source is the root of dangerous accident. According to Heinrich accident theory, three requirements must be met in formation of accident: destruction factor; bearing factor; 3. condition for mutual influence between destruction factor and bearing factor. Occurrence principle of accident is presented in Figure 1.

Hazard source is the origin of accident and destruction ability is the basic condition of hazard source. Hazard sources that can generate destruction are objective carriers that must exist during construction operation, such as machinery,

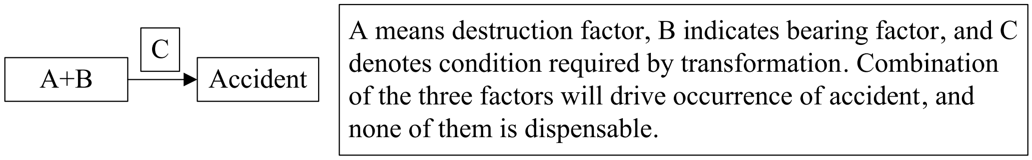

Figure 1.Diagram of accident formation.

materials and personnel. Three components of hazard source are existence condition, potential hazard and transformation condition. Hazard source possesses physical and chemical existence conditions as well as accident transformation risk. Under the condition of triggering man-made and natural factors, accident fact will be caused. Therefore, organic combination of three hazard source components becomes the root of dangerous accident. The principle that hazard source transforms into accident is shown in Figure 2.

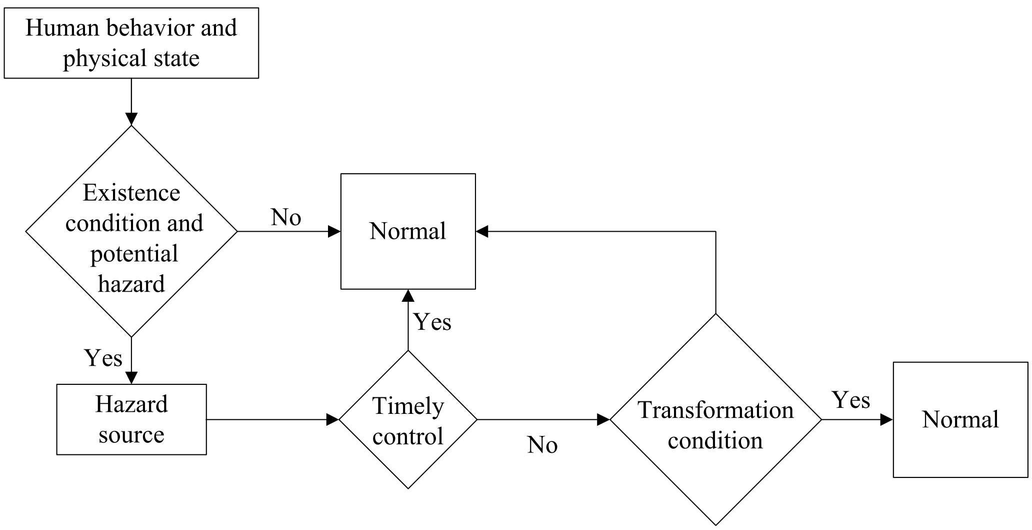

Figure 2.Diagram of hazard source transformation.

Classification of construction hazard source. Classification standards for hazard source are different in different fields and industries, and hazard source in construction industry can be divided into 6 categories according to danger and dangerous factors in production process: physical source, chemical source, psychological and physiological source, behavioral source, and other hazard source. The close relation between hazard source and danger & dangerous factors in production process can be fully reflected by classification of hazard source in construction industry. Li (2011) classified hazard source into absolute major hazard source, relative major hazard source, absolute common hazard source, and relative common hazard source; thus relative weight would be provided for hazard source control. Xu and Chen (1997) divided hazard source into Class I hazard source and Class II hazard source. Class I hazard source refers to energy and dangerous substance that might have incidental release; Class II hazard source is defined as the general term of various hazard sources that cause failure and destruction of measures that restrain Class I hazard source or restrict its energy. Thereby, the mutual collaboration function among hazard sources is shown.

Based on accident cause, damage way, and definition, characteristics and classification of hazard source, by combining with different objective carriers to which hazard source at the construction site of our company is attached, hazard source is divided into 8 categories: high-place operation falling, mechanical injury, object strike, electrical damage, collapse, lifting harm, hazardous article and other hazard source. Among them, high-place operation falling includes limb operation, cave operation, climb operation, dangling operation, service platform operation, and cross-operation. Through classification for construction hazard source, design is carried out for construction site monitoring system on the basis of modern information technology. It is beneficial to application of engineering project and improvement of MCP management. Besides, hazard source can be predicted and eliminated timely and accurately, and safety of operation environment will be increased.

OVERVIEW ABOUT CONSTRUCTION SITE MONITORING SYSTEM

At present, application of video monitoring at construction site becomes increasingly extensive and it is the physical basis of conducting 24-hour real-time monitoring in important departments or places at the construction site. Effective data and sound and image information can be acquired by relevant departments through real-time monitoring, and the process of unexpected anomalous events will be timely monitored and memorized.

System analysis. (1) Demand analysis. Real-time monitoring should be carried out at the construction site, so as to realize long-distance safety management for construction site. Important links and key departments must be monitored, detailed situations of various regions at the construction site should be grasped, and the production schedule needs to be tracked. Based on monitoring system, potential safety hazard at construction site can be identified in advance and the whole process of construction operation will be under control.

(2) Design thought. Network digital camera technology based on IP protocol is adopted in video monitoring system of construction. Through the networking mode of wired or wireless network, by combining with the automatic early warning function of monitoring system, safety monitoring and management can be realized at near-end and far-end of construction site.

(3) Design principle. Video monitoring system at construction site is designed on the basis of integrated and intelligent computer system by following the principle of “advanced technology, reliability, good expansibility, easy management and reasonable investment”.

(4) Design basis. Planning and design of construction video monitoring system is conducted according to relevant standards and norms of the state and industry, including relevant documents like *Industry Label of The Ministry of Public Security of the People’s Republic of China* (GA70-94), *Technical Specifications of Video Monitoring Secure System* (GA/T367-2001), *Technical Code for Regulation of Civil Closed Circuit Monitoring TV System* (GB50198-94), *Code for Design of*

Industrial Television System (GBJ115-87), and *Code for Engineering Design of Generic Cabling System for Building and Campus* (GB/T50311-2000).

System structure. Video monitoring system is composed of three parts including "front-end acquisition system", "signal transmission system" and "control system". Surveillance camera will be installed at various construction sites of front-end acquisition system; signal transmission system mainly includes video signal transmission line and equipment; control system covers terminal display equipment, video equipment and control equipment. The quantity of surveillance cameras is decided by the area of construction site. Reasonable and effective application of gun, dome and high-speed dome surveillance camera will not only reduce cost invested by the enterprise, but also guarantee safety production and management at construction site. The overall structure of video monitoring at construction site is presented in Figure 3.

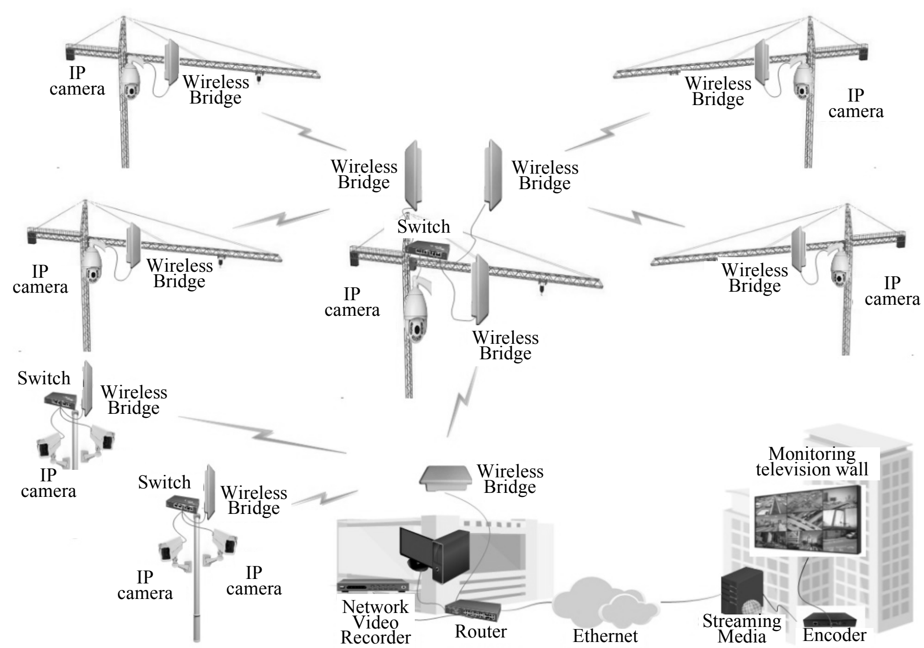

Figure 3.Overall structure chart of video monitoring at construction site.

(1) Front-end acquisition system. Front-end video data acquisition is mainly accomplished by internet protocol camera. Like human "eyes", it will catch external signal and feed it back to monitoring center. Internet protocol camera is a new generation of camera based on combination of network technology and traditional camera. Web server software is internally installed in the camera, and the camera image can be sent to end-users through local area network, internet or wireless network. However, front-end video data acquisition system is not equipped with data storage function.

(2) Signal transmission system. Due to the limitations at construction site like difficult wiring, high cost and inability of secondary recycling, the traditional

coaxial-cable signal transmission method cannot meet the requirements of construction site. However, transmission between or among two or multiple networks can be realized by the bridging mode based on wireless network technology. At the construction site, 5.8GHz wireless bridge is often used as main channel for transmission, which can effectively avoid interference and guarantee surveillance video data transmission.

(3) Control system. In monitoring field, control system includes monitoring television wall and net-hard-disk video recorder. Monitoring television wall is a super screen television wall composed of one or multiple television units; special monitor is adopted as its display equipment and steel plate wall of spraying plastics with forced ventilation and cooling device is installed. Therefore, real-time monitoring can be realized for unusual conditions of the monitoring target. Net-hard-disk video recorder is responsible for butt joint with internet protocol camera and video encoder; meanwhile, digital video bit stream transmitted on network can be stored and managed. Therefore, distributed architecture superiority brought about by networking will be realized. Net-hard-disk video recorder is the core for centralized management of all internet protocol cameras. It has not only broken away from bonding of computer hardware and tediousness of software installation but also realized watching, playback, storage, management and early warning of multiple internet protocol cameras.

Monitoring point planning. Monitoring layout at construction site is affected by special environment, so its point planning and design thought is different from conventional point planning. Therefore, it is very important to carry out reasonable and feasible video monitoring system deployment according to the life cycle of engineering project by combining with its special environmental attribute.

(1) Installation site of monitoring point. Comprehensiveness and non-repeatability of monitoring should be considered during selection of monitoring point, and optimum cost performance must be realized. Therefore, monitoring point should be arranged in fixed positions with wide vision such as tower crane and gate of the project.

(2) Monitoring point arrangement principle. A high requirement is often raised for monitoring system planning at construction site. Monitoring system planning of construction is equipped with refinement and tightness characteristics, so monitoring system planning of construction should follow three principles covering all-dimensional coverage without dead angle, complementation of wired and wireless network, and combination of multiple kinds of front-end equipment.

(3) Quantity of installed monitoring points. Under the restriction of three factors including engineering project schedule, construction area and cost performance of monitoring, quantity of monitoring points can be summarized as follows: 2 in a construction area within 10,000m^2; 3 in a construction area within 10,000m^2 – 30,000m^2; 4 in a construction area within 30,000m^2 – 50,000m^2; 5 in a construction area within 50,000m^2 – 100,000m^2. Moreover, the monitoring points can be added or reduced properly according to number of entrances and material warehouses.

Intelligent early warning. Intelligent early warning is one of the embedded functions of network video recorder and its core is intelligent image recognition technology. The image sequence acquired by camera can be automatically analyzed under the situation of no human intervention, and target positioning, identification and tracking at construction site will be realized. Meanwhile, behaviors of the target will be analyzed and judged, and early warning can be initiatively provided. Therefore, it can not only complete daily management but also make response to abnormal or unexpected events. Now, the common early warning function includes intrusion detection, entry detection, departure detection, appearance detection, disappearance detection, object move detection, flame detection, smog detection, shelter detection, movement detection, and automatic tracking.

MONITORING SYSTEM APPLICATION AND HAZARD SOURCE CONTROL DURING CONSTRUCTION

As an organic system, construction engineering project covers a lot of hazard sources. By combining with informatization development demands, through panorama monitoring for working condition and real-time trend in various regions of the project by utilizing monitoring system, hazard sources in different positions of the construction site can be identified. Moreover, hazard sources can be evaluated according to the established target and hazard source control standards, and real-time and efficient control and prevention will be realized for hazard sources at construction site. In this way, accident rate at the construction site can be reduced, and thus human resources, material resources and financial resources of the project will be saved.

Hazard source identification and application based on monitoring system. Hazard source is the energy subject of accident. Gregory Carter and Simon D. Smith considered that hazard source identification was very important for increasing construction safety management level (Carter and Smith 2006). Otherwise, the risk will go wild. With the help of monitoring system tools, according to the panoramic monitoring image and video feedback of monitoring system, practical hazard source in engineering project is identified, its transformation process, conditions and trigger factors are analyzed, and the hazard is contained in bud. Identification process of hazard source is full of tightness. In our company, hazard source of engineering project is identified based on intuitive experience method and system safety analysis method. Comprehensiveness of hazard source should be analyzed and identified by combining with previous empirical analysis and safety engineering evaluation method, and four principles of hazard source covering generality, specialty, scientificity and systematicness must be followed, so as to provide guarantee for construction operation safety of engineering project. Monitoring system and construction site comparison as shown in Figure 4 and Figure 5.

Hazard source control and prevention based on monitoring system. Hazard source control is the core of hazard source management system. Hazard source should be controlled and eliminated according to engineering technology and safety management method and hazard source risk must be avoided, so as to prevent the hazard source from being triggered and causing accidents as well as personnel, property and construction progress loss. Engineering safety management should be realized by utilizing information means. Hazard source control process is presented in Figure 6.

Figure 4.Monitoring system diagram.

1.Steel pipe can not attach the wall vertically , or it's easy to slip and hurt the around people and objects.
2.The movable plate wall bearing capacity is small, the weight will lead to the collapse of the wall attachment.

Figure 5.The construction site map.

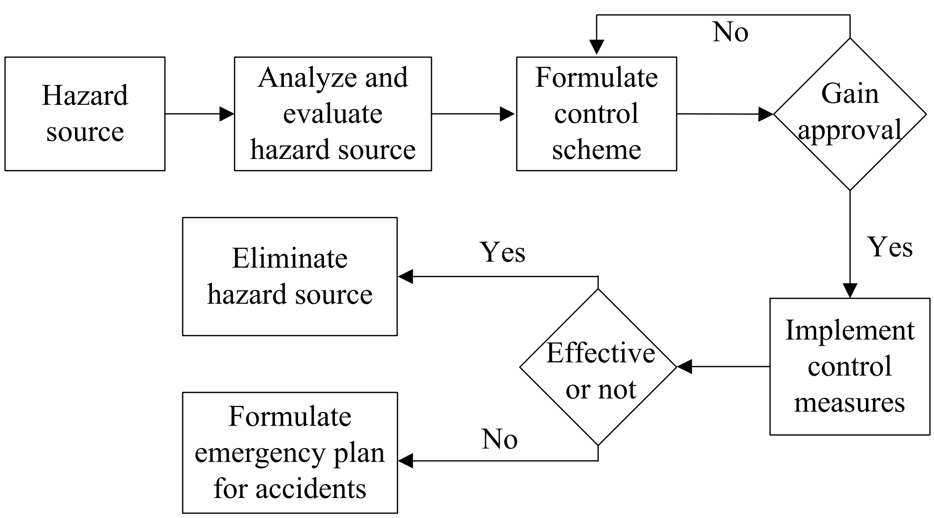

Figure 6.Flow diagram of hazard source control.

(1) General principle, timely review principle and accident prevention principle are followed in hazard source control based on monitoring system, aiming to eliminate and reduce risk, combine prevention with control, and construct project without hazard and accident.

(2) At present, fundamental method of hazard source control includes technology control, management control and human behavior management. The three control methods are combined together and supplement each other. Hazard source control system is formed by combining with monitoring system, so as to provide basis and method for hazard source control of our company, reduce accident rate of the project, and improve project safety. Specific measures of hazard source control based on monitoring system are shown in Table1.

Table 1.Measures of Hazard Source Control Based on Monitoring System.

Serial number	Hazard source	Control measure
1	People's unsafe behavior	(1) "Three-violation" phenomenon of violating command, operation against rules and violating labor discipline should be stopped; (2) Safety education and training must be strengthened.
2	High-altitude falling	(1) High-altitude constructors and device must reach requirements of relevant laws and regulations; (2) Personnel safety technology and device safety protection measures should be qualified; (3) Cave entrance and border prevention measures must pass acceptance inspection.
3	Mechanical injury	(1) Large machinery can be put into service only after its installation, debugging and acceptance check meet the criterion; (2) Drainage ditch and water well must be arranged for large machinery foundation according to requirements, so as to guarantee smooth water flow; the foundation should be inspected according to relevant regulations before installation, and it must be qualified according to the inspection; (3) Equipment that needs signal device must be equipped with signal device, and it should not be dismantled at will; (4) Safe distance should be arranged between machines, so as to guarantee safety of cross-operation; (5) Equipment without proper safety facilities should not be put into service.
4	Fire hazard	(1) Flame operation scheme should be formulated and flame operation certificate must be handled before initiation; specially-assigned person should be sent to the site for supervision; (2) Fire protection leading group must be established in project department; (3) High-power electrical appliance is prohibited in regions like office and dormitory;

Table 1.(Continued).

Serial number	Hazard source	Control measure
4	Fire hazard	(4) Each region should be equipped with enough and effective fire-fighting equipment, and obvious safety warning sign and fire control propaganda sign must be set up; (5) Outdated fire equipment should not be used; (6) Temporary firefighting pipe should be installed in small high-rise and high-rise buildings.
5	Collapse accident	(1) Special construction scheme must be formulated for installation and dismounting of scaffold, and it should be executed strictly according to relevant standards; (2) Earth excavation, side depth, foundation trench, rock slope, and stacking on foundation pile hole must meet relevant requirements; (3) Retaining wall should be constructed in time for artificial dig-hole pile according to standards; there should be two certificates for portable house and it must pass acceptance inspection (4) Smooth water drainage should be guaranteed during rain period, and necessary flood and debris flow protection measures must be taken for projects near the mountain and river.
6	Electrical damage	(1) Special electricity scheme should be formulated, special scheme disclosure must be completed, and there should be professional electricians; (2) Three-level safety education should be conducted for constructors before operation; (3) Safety protection articles must be correctly used; (4) Construction electricity installation, electrical facility configuration, and circuit laying must meet relevant standards and pass acceptance inspection of quality safety management department and supervising units; (5) Periodic maintenance must be carried out for electricity.

CONCLUSION AND PROSPECT

Owing to application of monitoring system in construction project, our constructional engineering hazard source has transformed from traditional scattered management to refine management. By combining with existing problems of construction project hazard source management and information technology management means, information management level of our construction engineering project will be improved and engineering project safety management can be enhanced. In construction site hazard source management based on monitoring system, the innovation management method of combining construction engineering project with advanced modern information technology is adopted, so as to realize information, standard and perfect management of construction engineering project hazard source. Thus, safety of project construction work can be improved, accident rate can be reduced, and construction enterprises will transform to safety and information development.

Many limitations are still presented by system application at this stage, such as insufficient system intelligence degree and limited application condition. In the future, intelligent hazard source identification functions will be realized by the system. In another word, virtual hazard source scene will be input into the system, scene at practical construction operation site will be collected, the acquired scene will be compared with the system scene, and existence of hazard source will be judged, thus alarm apparatus of the system will be triggered and intelligent hazard source identification can be realized. Meanwhile, construction monitoring system will tend to be more automatic and intelligent, and serve construction engineering project better. Therefore, construction engineering project safety management can be improved to a larger extent and construction enterprises will be promoted to step toward a new era of safety and intelligence.

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Green Building Materials Management Based on BIM Technology

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Abstract

According to the management problem of green building materials and BIM advantages under the background of the development of green building, the green building materials management system was framed based on BIM, combing with life cycle assessment theory, and at last safety monitoring management system with RFID and BIM of construction site was built. This study shows that, the BIM technology advantages and the building materials features fit well, the safety monitoring management system achieves the real-time visualization, information automation, and multi-collaborative participation, which can effectively promote the development of green building.

INTRODUCTION

In recent years, the world is facing problems, such as global warming, the requirement of sustainable development, and financial crisis, which all demand every country to push green building policy, and the green buildings are being built all over the world. The development of green buildings was the necessity factors of constructing resource-conserving and environment-friendly society. Green building materials is material foundation of green building, which played an important role on the green building development. The priority task of green building is building materials greening, and ensure it has characteristics like health, economic, energy saving, comfort, and environmental protection. Therefore, it is important to develop and promote the use of building materials. It is the inevitable developing trend of using green building materials on construction in the future, which proposed higher management requirements of green building materials with the construction industry development to greening, co-ordinate, refinement, and informatization.

Building Information Modeling (BIM) is an emerging technology in which digital information models are employed in a virtual space to achieve high-quality and efficient construction and management throughout the life cycle of a facility. BIM can also generate and maintain information produced during the whole life cycle of a building project-from design to maintenance-and can be applied to various fields (Wang et al. 2013). The digitized and parameterized characteristics of BIM enable project designers to fully analyze the influences of the environment and energy, and the parametric design facilitates the production of highly accurate results and instant feedback to changing variables when construction personnel encounter complex geometric designs (Zhang and Hu 2011; Chen and Luo 2014; Roh et al. 2011; Cheng and Teizer 2013).

BIM is most frequently perceived as a tool for visualizing and coordinating during architecture, engineering, and construction work, and it avoiding omissions and errors, supporting scheduling, safety, cost and quality management, and improving productivity on construction projects (Zhang et al. 2013; Bynum et al. 2013). However, there are no best practice studies that demonstrate management application of greening building materials.

The objective of this research was to develop a comprehensive, informative and practical BIM-based application for the purpose of green building materials management and to analysis the advantage of BIM technology. Also, the research proposed the management structure and implementation process with using BIM technology and RFID technology. Then, a green building materials model was integrated into a virtualized BIM-based application to evaluate the building materials degree and responsibility assignments in the whole life cycle process of green buildings.

CHARACTERISTICS OF GREEN BUILDING MATERIALS MANAGEMEN

Green building materials. In the 1970s, developed countries firstly began to investigate the harmful of building materials on human health. In the 1990s, developing green building materials was as an important content of sustainable development strategy in “21st century agenda in China”. In 1992, the definition of green building materials was proposed by the international academic circles, which is conducive to human health and minimum environment load during the process of raw materials exploration, manufacture, running, recycling and waste treatment etc. To this end, green building materials should be designed and operated to minimize pollution sources. Green building materials is the material foundation of green building. Therefore, it is significant of management on green building materials to create the green buildings.

Life cycle management characteristic of green building materials. Life cycle management method of green building materials in green building projects, and it involves green building materials information management of design, manufacture, running, and maintenance. Therefore, higher requirements of green building materials were proposed during construction process of green building projects. Firstly, the green building materials producer provided the customers with different degree of green building materials and its products based on the green building materials standards, through green degree management of the green building materials production process (Matipa et al. 2010). It is difficult for traditional extensive construction materials management model to meet the demands of green building materials management, due to the wide varieties of building materials as well as different production and management mode of producers and suppliers. According to the management status, green building materials should be realized fine management in advance. Furthermore, the green building materials and products shall be selected based on the needs of customers, thus the communication and coordination management among the various project participants were more important. A large amount of information with construction and green materials was needed to be provided to the property, after completion inspection and acceptance, in order to maintenance and replacement of the green building materials in green building project. In view of the management particularity of green building materials in construction project management, and combining with LCA theory, the characteristics of green building materials management can be concluded as visibility, refinement, collaborative, and traceability (see Figure 1).

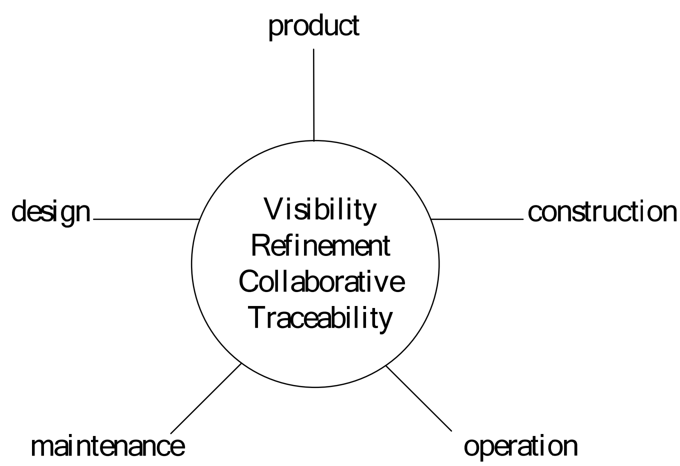

Figure 1.Management characteristic of green building materials.

ADVANTAGE OF GREEN BUILDING MATERIAL MANAGEMENT ON BIM TECHNOLOGY

Green building materials management of green building project was need higher demands on 3D visualization, refinement management, collaborative management, and information traceability of project management (Vladimir et al. 2006). It is convenient for different participants to obtain effective information of green building materials based on BIM technology, during the various stages of planning, design, procurement, construction and operation, to realize the refinement management and collaborative management of building materials. In order to research BIM technology used in green building materials management, the advantage of green building material management combined with BIM technology was analysis as bellows:

3D visualization. As we all known, 3D model can effectively provide personalized design, 3D model information of green building materials and construction plan simulation of green building materials. The green building project needed higher intuitive three-dimensional model on door model design, green building materials order and construction scheme. BIM technology can provide intuitive 3D model and construction simulation 3D model of green building materials, which can meet the demands of 3D visualization management of green building materials in green building project.

Collaborative management. The different participants of building owners, design units, construction units, and building materials producers managed collaboratively in the process of green building project construction, and the green building project development formed an industrial chain. In design stage, owner, construction units, and green building materials producers participate in the green building design research, to meet owner personalized value requirements, construction technology solutions and green building material production plans. Green building project needed higher collaborative management of green building materials with different participants on the whole building materials industry chain. BIM technology can provide effective green building material management information and coordinate different participants during the green building project construction.

Refinement management. A large number of green building materials were need during the green building project construction. However, the traditional building materials management method was difficult to achieve refinement management level. Therefore, it was necessary to establish green building materials database during the process of design, construction, operation, and maintenance, in order to different participants can inquiry, order, use, and produce accurately and in time, also to realize refinement management of requirement and utilization. The use of BIM has provided a means of increasing building materials management quality. It can establish green building materials database, and realize refinement management during the produce, operation, and maintenance of green building materials. At the same time, it can share the information and better coordination between documents and the entire team, thus minimizes conflicts and reduce errors.

Traceability. In operation stage, owner can carry out green building materials with maintenance, replacement and adjustment, based on the needs of using function. It is important for green building project maintenance with green building materials production information, materials function parameter information, and engineering construction plan history information (Zhang and Hu 2011). BIM technology can detailed engineering green building construction and green building material information. Furthermore, it can record engineering change in detail, and evaluate the green building materials on timely, which can provide the effective traceability of construction project information for the operation and maintenance of green building project and green building materials.

MATERIAL MANAGEMENT SYSTEMS WITH BIM TECHNOLOGY

Green building material management systems. Information standardization transformation is the foundation of green building materials information management system operation in green building projects. In view of the advantage and collaboration between the BIM technology and requirement of green building materials, green building material management systems was built on Industry Foundation Classes. Green building material management systems model was divided into management, data exchange, BIM model layer and data layer on Industry Foundation Classes, as seen in Figure 2.

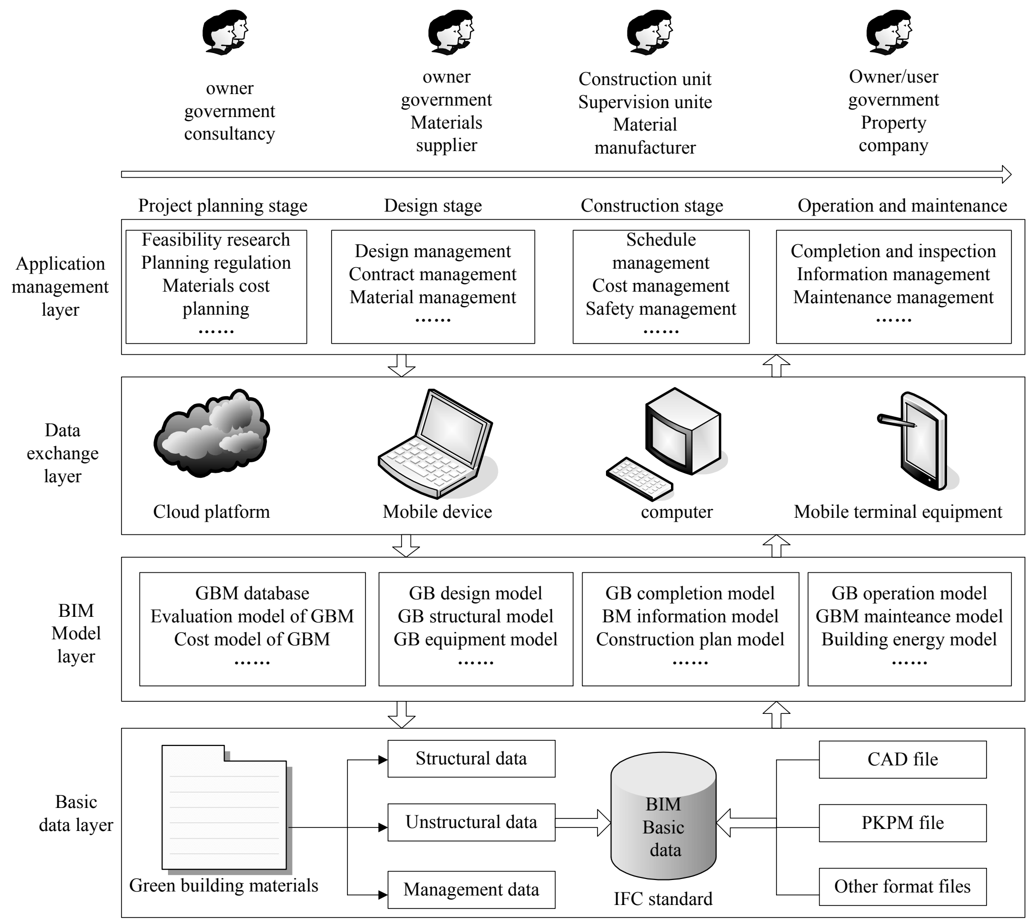

Figure 2.Green building material management system based on BIM.

(1) Application management layer. Application management layer managed green building project model, design model, construction model and green building materials management model with BIM technology, as well as history information traceability and maintenance information management in the process of green building project operation and maintenance stage. All participants can extract the green building material information based 3D model parameters with BIM technology, realize the information sharing and communication in time, integrate the management resources, and support the green building project management in the whole life cycles of green building.

(2) Data exchange layer. Data exchange layer mainly realized the function of data transmission and management based on the BIM technology and terminal

equipment. The collaborative management of green building materials was realized by BIM technology in the whole life cycles of green building. “Cloud” service platform was built on area network or the internet, to realize information sharing and management of green building materials. In addition, terminal equipment, such as notebook computers and mobile phones provide the hardware support.

(3) BIM model layer. BIM model layer mainly constructed management core BIM model of green building materials in green building project. The owner, design unit and construction unit needs to order green building materials and its products, determine the detailed construction technology plan, and compare different completion simulation model before construction during green building construction process. Therefore, BIM model of green building materials management more focus on the green building materials database construction, green building materials 3D model, and construction technology plan simulation model. According to the demands of green building materials management in green building project, core BIM model was built in this model layer, which met the green building material management in the whole life cycle of green building project.

(4) Basic data layer. Basic data layer mainly realized the model data transition and management from different software on IFC documents. BIM technology model managed the green building materials in the whole life cycles in green building project, which required BIM technology model information application and transformation in different platform. Therefore, unified file format was the basis of the green building materials management systems. The materials production and function information as well as green building materials evaluation information, and architecture and structure design model information were storage and converted by IFC format in the green building materials life cycles, in order to realize unified management of BIM data on the same platform. BIM building materials information database provided documents for the operation and maintenance after the project completion. This also provided reference on other projects, and eventually formed larger BIM database that improve overall level of green building materials for enterprise, industry and the national green building project management.

Implementation of green building materials management system. Radio Frequency Identification (RFID) is a non-contact automatic identification technology, which usually used for data collection. The green building materials parameter information was added into BIM in the design stage, through application program interface with BIM platform for information exchange, on the advantage of automation, information and paperless in RFID. RFID tags were used to scan and collect information in the design process, and combined with BIM technology, so as to realize the visualization of green building materials, components and construction projects and form BIM database by automatic storage. The green building materials was adhered corresponding RFID tags after finished, and the RFID tags were added into information parameter of green building materials in advance. Then, information of green building materials were scanned and collected by read/write device, in order to realize green building materials management in green building project construction process, as seen in Figure 3.

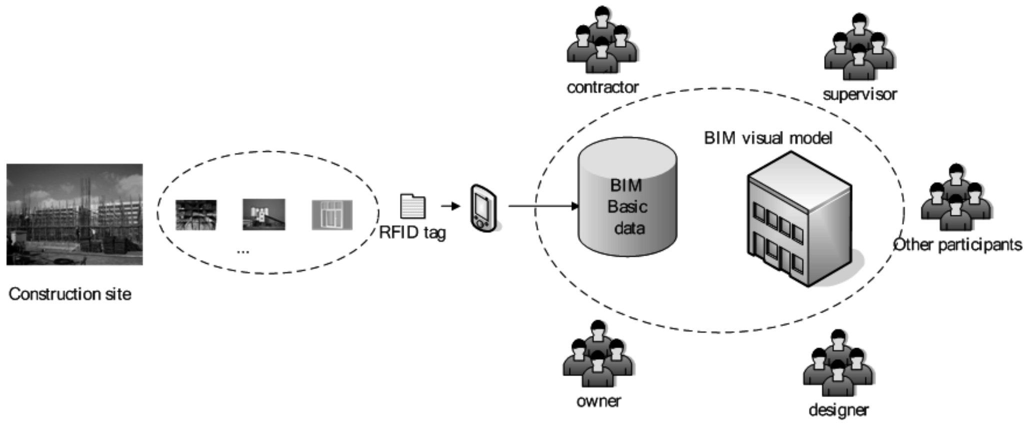

Figure 3.Building materials management system implementation based on RFID and BIM.

CONCLUSIONS

BIM combining with green building is the development trend of construction industry in the future. BIM technology can effectively promote the development of green building and implementation, and it will break through the bottleneck of the whole life cycle management of green building project. The green building material management introduced BIM technology and RFID technology can effectively improve the management level of green building materials and realize refinement management and collaboration management in life cycles of green building materials. In addition, BIM database was applied in enterprise and industry formed the national green building material database, and it can promote green building material management level.

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Research on the Construction of a Comprehensive Performance Evaluation Index System of an Integrated Construction Supply Chain

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Abstract

With the further development of the research on construction supply chain management theory, it has become one of the main content about construction supply chain management to evaluate its performance objectively and accurately based on its characteristics. This paper studies and discusses the theory and methods of construction supply chain management by combining the supply chain management which is an advanced management mode and the characteristics of construction industry. And then we construct the comprehensive performance evaluation indexes system of integrated construction supply chain for the research status of construction supply chain performance evaluation. The indexes system can assist the quantitative analysis for the integrated construction supply chain performance evaluation. This paper provides support for the implementation of supply chain performance evaluation, aiming at the purpose of reducing the construction supply chain costs.

INTRODUCTION

For the construction supply chain in our country, it involves the choice range of evaluation index that from which aspects to evaluate the performance of construction supply chain in order to respect its comprehensive strength completely and comprehensively. When constructing the comprehensive performance evaluation indexes system of integrated construction supply chain, it is reasonable to refer to four mature control factors in the project management including cost, quality, schedule and safety according to the actual situation of construction industry in our country at present and the present situation of the construction enterprise. It is necessary to measure the operational state of the supply chain and evaluate its operational performance based on the measurement results for the purpose of evaluating the benefit from the implementation of the supply chain. According to the basic characteristics and target of supply chain management operation mechanism, the following aspects should be considered emphatically when constructing the comprehensive performance evaluation indexes system of integrated construction supply chain (Li et al. 2007, Hao and Qiao 2006).

(1) Evaluating the operational results of the supply chain. Mainly considering

the competition between supply chain and supply chain, understanding and mastering the operational status of the whole construction supply chain, finding out the problems existing in the supply chain operations and taking measures to correct them timely.

(2) Evaluating each member of the enterprise in the supply chain. Mainly considering supply chain enterprise incentive conditions for its members, each member enterprise efficiency and performance, maintaining coordination and cooperation or not, promoting the smooth operation of supply chain or not and so on. The purpose of it is to attract outstanding enterprises to join in and eliminate the bad business.

(3) Evaluating the cooperation relations between supply chain enterprises. Mainly considering the satisfaction degree between upstream and downstream enterprises of construction supply chain, satisfied with the quality of products and services provided or not, the quality of partnership, and evaluating the value of partnership from the perspective of customer satisfaction.

PERFORMANCE EVALUATION INDEXES SYSTEM CONSTRUCTING ANALYSIS

The deficiency of supply chain performance evaluation indexes at present. Supply chain management is a overall pattern that connecting the suppliers, manufacturers, distributors and the end users through the feed-forward information flow and feedback material flow and information flow. Construction supply chain management has a large difference with the existing enterprise management model. As a result, the existing performance evaluation is not fully applicable to the performance evaluation of the supply chain, which mainly reflects in the following points (Li 2009, Liu and Zhao 2008).

(1) Simplification of evaluation index and content, which cannot reflect the situation of supply chain performance fully. When selecting the evaluation angle, the previous research often tends to on side (such as financial, customer satisfaction, process, retailers, suppliers, etc.) and cannot grasp and assess the whole supply chain. The Balanced Scorecard (BSC) studies the supply chain performance evaluation from the perspectives of customer perspective, supply chain internal process, future research development, and supply chain financial value. But the actual operation is often stereotyped and it is difficult to choose different evaluation index and content according to the actual situation of enterprises. In addition, the traditional performance evaluation methods are often combined with qualitative analysis and quantitative calculation. Although it is more comprehensively study the supply chain performance, qualitative analysis is often difficult to get the ideal results in the Actual operating performance appraisal.

(2) Ignoring the evaluation for supply chain uncertainty. Although the whole supply chain is an interests community, the enterprises in supply chain is just independent business entities, who have their respective operation strategy, target market, technical level, operation level and enterprise culture. All of it will increase the uncertainty in the supply chain operation. Throughout the current research on supply chain performance evaluation are almost neglected the uncertainty of supply chain. Even if there has one, it is carried out independently, but not be included in the supply chain performance evaluation.

(3) Ignoring the evaluation for supply chain structure itself. The traditional research has pay attention to the evaluation for supply chain operation effect, but often ignores the assessment of structure. In fact, for a supply chain, the structure is the foundation of its operation, and the quality of the structure determines the frequency of system information transmission and uncertain status occurrence, which has very important significance for supply chain management.

(4) During the process of performance evaluation, too much attention is paid to the commercial benefit of supply chain, but the supply chain environmental performance evaluation is ignored. The concept of ecological supply chain which stresses to increase environmental factors in supply chain management was put forward in the 1970s, and it was only a minor aspect of logistics management as proposed study. The previous studies put too much attention to the commercial benefit but ignore the evaluation for supply chain environmental performance. With the increasingly serious resource depletion and environmental pollution, a green revolution is being launched around the world, so the production and manufacturing areas urgently required the formation of green supply chain. When evaluating supply chain performance, environmental management must be aware in supply chain. In one hand, by doing this can produce significant business benefits, and on the other hand, it can produce social benefits and environmental benefits and help enterprises to enhance competitiveness and strategic management ability.

The indexes selection and determination the relationship between indexes required not only solid theoretical foundations but also a wealth of experience. So the process of establishing the index system should be a combination of qualitative analysis and quantitative calculation.

Index system primary election and improve. Scientific index system is the premise condition for obtaining the correct evaluation selection conclusion. However, the primary election index system is not scientific due to the subjective factors or ability of builders. So the primary election index system must be taken scientific tests, including single test and overall test (Jin 2007).

Single test is testing the feasibility and correctness of each index. Feasibility refers to the ability to obtain the numerical index. Those who cannot or difficult to obtain accurate data index, or even if we can get it but with high cost are not feasible. Correctness refers to the index calculation methods, scope, and content correct or not. Overall test mainly test the importance, necessity and completeness of each index in the entire index system.

(1) Importance Test. Importance is to keep those important indexes and exclude the indexes insignificant to the evaluation results. Delphi method is always used to taking anonymous comments for primary election index system. So set a hypothesis that a certain level has M indexes, and P experts take the evaluation. For the review opinions, doing the statistical analysis from three aspects (Yu and Huang 2009).

a. Concentration Degree. Represented with $\tilde{E}_i$

$$\tilde{E}_i = \frac{1}{P}\sum_{j=1}^{5} E_j n_{ij} \tag{1}$$

$\tilde{E}_i$: concentration degree of i-th index expert's review opinions

E_j :value of the i-th index as the j-th importance degree (the importance degree is always divided into five points, as to j=1, 2, 3, 4, 5, representing most important, very important, important, general, not important)

n_{ij} : the number of experts ranking the i-th index as the j-th importance degree

$\tilde{E}_i$ size determines the size of index important degree, reflecting the expectation evaluation of P experts.

b. Dispersion Degree. Represented with δ meaning the standard deviation

$$\delta_i = \sqrt{\frac{1}{p-1}\sum_{j=1}^{5} n_{ij} \cdot (E_j - \tilde{E}_i)^2} \tag{2}$$

δ_i: the dispersion degree of the i-th index importance degree evaluation taken by experts. If $\delta_i > 0.63$, the next round consultation can be taken.

c. Coordination Degree. Represented with variation coefficient V and coordination coefficient K.

$$V_i = \delta_i \big/ \tilde{E}_j \tag{3}$$

V: the coordination degree of the i-th index overall evaluation from experts.

$$K = \frac{12}{P^2(M^3 - M)}\sum_{i=1}^{M}(\tilde{E}_j - \bar{E})^2 \tag{4}$$

K: the coordination degree of a certain level indexes overall evaluation from experts.

$\overline{E}$ is the mean of all indexes concentration degree, so

$$\overline{E} = \frac{1}{M}\sum_{i=1}^{M}\tilde{E}_j \tag{5}$$

δ_i become smaller and K become larger, naming experts' advice is more coordinated. The comprehensive analysis for $\tilde{E}_i$, δ_i, K determine to take the next round consultation or not. If satisficed, determining to keep which indexes and delete which indexes based on $\tilde{E}_i$ and δ_i of each index. Finally, the evaluation indexes system can be determined (Cui 2005).

(2) Necessity test. Necessity is to judge all the indexes of the statistical index system essential or not, and whether having redundancy phenomenon or not. Correlation coefficient method is always available to test. Usually there is a certain degree of correlation between the evaluations indexes, which making information reflected by the observation data overlap. So, the correlation analysis for indexes system is necessary. The concrete ways is as follows: Calculating the indexes correlation coefficient r_{ij}. And then, determining a critical value M of correlation coefficient based on the actual problems. If $r_{ij} \geq M$, the small weight index X_i or

X_j can be deleted. But if $r_{ij} > M$, both the index X_i and index X_j need to keep.

(3) Completeness test. Completeness is to judge statistical index system reflect the evaluation purpose and task initially described fully and exhaustively or not. Usually qualitative analysis is available to judge it.

QUANTITATIVE ANALYSIS OF INDEX SYSTEM

This article will take the indexes in integrated supply chain performance evaluation index system for quantitative analysis. And the reason for the quantitative analysis for integrated supply chain performance evaluation index is as follows:

(1) The need of integrated supply chain performance continuous improvement: The management process of integrated supply chain system and its subsystems consists of four parts: planning, procurement, production (including the system of internal trade and logistics transfer) and delivery. The idea of continuous improvement requires that each management process should be carried out quantitative performance evaluation. Only by doing this, can we solve the practical problems such as which process needs to be improved, how much is the gap with the target and how to improve performance (Ishii and Sugeno 1985).

(2) The need of collaborative planning， forecasting and replenishment: Collaborative planning，forecasting and replenishment (CPFR) is a new strategy for supply chain partnership. The original purpose of this strategy is to improve the partnership of suppliers and retailers, improve the accuracy of predictions, and finally improve supply chain efficiency, reduce inventory and improve consumer satisfaction. Thus, the foundation of CPFR is quantification analysis method.

(3) The need of reducing application costs: Integrated supply chain performance evaluation system is usually a complex system composed of dozens of evaluation indexes. Data collection, processing and analysis needs to consume a large amount of manpower, material and financial resources, and by doing this increasing the operating costs of the supply chain. If the indexes selected are not easy to quantify, the evaluation results lack credibility and evaluation costs also increase greatly.

ESTABLISHMENT OF INTEGRATED CONSTRUCTION SUPPLY CHAIN EVALUATION SYSTEM

Indexes sources. The supply chain performance evaluation from both qualitative and quantitative aspects. Qualitative performance evaluation indexes include customer satisfaction degree, flexibility, information flow and logistics integration, effective risk management and supplier performance. Quantitative performance evaluation is divided into two categories: one is the indexes based on the cost, and the other is the indexes based customer response [8]. The indexes come from four aspects including supply, process management, delivery, demand management. The indexes listed consist of supply reliability, time in advance, process reliability, the time required, completion planned, perfect order fulfillment rate, replenishment lead time, transport days, SC total inventory costs and total cycle time.

However, SCC proposed eleven indexes measuring the SC performance in the SCOR model, including delivery condition, ordering satisfaction condition (such as satisfaction rate and the lead time meeting the order), perfect order fulfillment rate, SC response time, production flexibility, total cost of logistics management, the additional value productivity, insuring cost, cash flow turnover time, supply inventory turnover days and asset turnover. A good performance evaluation system must be able to measure the three evaluation levels: the resources (R), the output (O) and the elasticity (S). For the reason that the each level has different objectives, each level contains at least one evaluation index and the three levels are related to each other and influence each other.

This article believes that the choice of indexes should achieve a balance in many aspects, and only by this, can the good performance evaluation system be established. A good performance evaluation system includes not only the indexes reflecting the short-term and long-term goals, internal and external levels, but also the equilibrium of leading indexes and lagging indexes, quantitative indexes and qualitative indexes. The article evaluates the comprehensive performance from five aspects and twenty indexes combined with the characteristics of construction industry supply chain, namely financial and cost level, development ability level, supplier level, customers` satisfaction degree level and elastic level. Table 1 shows the specific evaluation indexes.

Table 1.Integrated Construction Supply Chain Performance Evaluation Indexes System.

	Evaluation level	Performance evaluation indexes system
Integrated supply chain index system	Financial and cost level	Supply chain management costs
		Distribution costs
		Inventories costs
		Return on total assets
		R&D investment return rate
	Development ability level	The percentage of new products sales revenue
		Transaction cost
		Trust degree
		Delivery on time
	Supplier level	Stock out probability
		Product quality
		Number of suppliers
	Customers' satisfaction degree level	Order fulfillment rate
		Transport error number
		Customer response time
		Rate of delivery on time
	Elastic level	Capacity elasticity
		Transportation elasticity
		Mixed elasticity
		New products elasticity

Financial and cost level. Both financial level indexes and cost level indexes are quantitative; as a result, the analyzing would be more convenience. In this level:

(1) Supply Chain Management Costs: The cost is operation and maintenance costs of the entire supply chain. The costs of different sizes supply chain have a big difference. And so the transaction costs should be further standardized for comparability. Then taking the total assets of enterprises in the supply chain divided by the transaction costs throughout the supply chain.

(2) Distribution Costs: Distribution costs include transport cost and treatment cost. Some suppliers have multiple sales distribution centers in the country, so the transport cost here should involve the costs of suppliers' internal coordination and scheduling.

(3) Inventories Costs: Inventories costs includes inventory investment costs, obsolete inventory costs, WIP (Working In Process) cost and the finished product cost.

(4) Return on total assets: It is an index to measure supply chain enterprises income. Generally, this index represents the ratio of net income / total assets.

Development ability level. Development ability and potential plays a supported role in supply chain. The evaluation of development ability level mainly includes information sharing and innovation and learning. Information sharing is the foundation of the entire supply chain operating. The member enterprises of the supply chain can cooperation only based on the shared platform. And the long-term competitive advantage throughout the supply chain depends on organizational learning and innovation ability. This ability is the power source for the development of supply chain.

(1) Information sharing: Supply chain management is a kind of platform management, which also shows the importance of information sharing. The concrete can be evaluated from two aspects: trust degree and transaction cost.

Trust degree: The mutual trust degree and interdependent level between the enterprises in supply chain, and the proportion of transactions in their turnover.

Transaction cost: The time and cost needed by each trading.

(2) Innovation and learning: Innovation and learning is considered to be one of the most important ways to gain a competitive edge for enterprises. Enterprises keep learning and innovating to launch new products and services, reduce operating costs, improve the efficiency of enterprise management, expand the market, find new value-added opportunities and keep the enterprise growth. The two indexes can be used to evaluate namely R&D investment return rate and the percentage of new products sales revenue.

R&D investment return rate: The proportion of R&D income and sales income. The percentage of new products sales revenue: The Ratio of enterprises to use new product quantity and the amount of product. This index reflects the ability of enterprise to launch or introducing new products according to the demand of market.

Supplier level. In construction supply chain, the evaluation of suppliers is included in the evaluation of the supply chain. Building materials suppliers should belong to the supply chain upstream enterprise, but they are at the mercy of the downstream enterprise general contractors. In other words, building materials suppliers are in the dominated position in supply chain. So choosing their indexes mainly come from the enterprise internal. This paper selects the indexes which are closed to the enterprises in the supply chain including delivery on time, stock out probability, product quality and number of suppliers.

(1) Delivery on time: A lot of building materials has a strong timeliness, so the index delivery on time is very important. This index is also an important basis for the general contractor selecting suppliers.

(2) Stock out probability: Stock out probability is the ratio of enterprises stock out in the total number of trading. For the seasonality and uncertainty feature of construction enterprises, the chance of shortages is relatively large in construction supply chain.

(3) Product quality: Product quality means all suppliers` product quality. For the long-term cooperation relationship, the competition between suppliers and its business development in multiple supply chains, the products will be more professional and the species of it will be relatively concentrated.

(4) Number of suppliers: This index means the number of suppliers in supply chain. One supply chain contains multiple suppliers, and there is a relationship between competition and cooperation with each other. Generally speaking, it is unreasonable that the number is too much or too little.

Customers' satisfaction degree level. Customers' satisfaction degree is the degree of customers` satisfaction for the products or service. And the degree can come from both the internal customers and external customers. Customers' satisfaction degree can be divided into three stages: the degree of satisfaction with the pre-transaction, the degree of satisfaction with the product or service distribution and the degree of service satisfaction after sales.

(1) Order fulfillment rate: Named the ratio of orders immediately to meet. This index contains the target order Satisfaction rate and average Satisfaction rate.

(2) Transport error number: Measuring the number of incorrect shipping.

(3) Customer response time: Measuring the time that from the customer taking an order to delivered to customers.

(4) Rate of delivery on time: Measuring the delivery performance of order and product. This index contains products delay time, orders average delay rate, orders average earlier rate and orders average punctual rate.

Elastic level. Elastic evaluation level measures the uncertainty that how the system responses. And also it measures the ability that supply chain system responding to change in uncertain environment. The evaluation standard is the ability to response to a changing environment. The indexes in this level shows as follows:

(1) Capacity elasticity: The ability changing the level of output products.

(2) Transportation elasticity: The ability changing the delivery date planned.

(3) Mixed elasticity: The ability changing the production of different products.

(4) New products elasticity: The ability importing and producing new products.

A supply chain management has the following several advantages: reducing the number of work, reducing loss of sales, reducing the order delay, increasing customer satisfaction, having the ability to respond to changes in the demand like seasonal factors, having the ability to respond to low manufacturing performance like machine fault, having the ability to respond to low suppliers performance and low delivery performance.

CONCLUSION

Supply chain management is to manage and control a certain type of value creative activity with the "supply" relationship in enterprise level and cross-enterprise collaboration level, which just is what the current construction enterprise management inadequate or lack of attention. At present, the construction supply chain management has attracted extensive concern of the academia and the business abroad. If construction companies want improve their supply chain management level, they must standardize their work processes and take optimized control for each link in the chain relied on the effective tools. It is an eternal subject to construction companies that maintaining its own advantages, reducing costs and improving performance further. So the research on construction of integrated construction supply chain and its performance evaluation is particularly urgent. This article has important theoretical value and practical significance for the research on this area.

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General Contract Management Based on BIM5D

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Abstract

This paper briefly introduces the concept of BIM5D technology and its application status of Chinese construction industry, which is in association with the practical general contracting management experience concerning with more than 20 BIM demonstration construction projects encompassing Guangzhou Chow Tai Fook Finance Center (Guangzhou East Tower), Guangzhou Zhujiang Newtown J2-5 parcel office buildings, Guiyang Zhongtian Weilaifangzhou (Future Ark), and Dongguan Vanke Residential Industrialization Base that are under our firm's construction. Specifically, the paper discusses the guiding function of BIM application based on Glodon BIM5D platform encompassing collision check, deepening design, drawing management, engineering quantity calculation, simulation scheme, schedule management, and cost management over general contracting management. Also, some suggestions have been given for future BIM application.

PREFACE

General contracting management of construction project is a dynamic progress that is highly complex. There is complicated and dynamic relation among construction procedures and duration, costs, and other resources, along with considerable uncertainty and randomness. Therefore, not only does construction project management need to consider the uniqueness of the architecture, but also the construction duration, costs, resources and other constraints. Looking for a dynamic balance among three management indicators of schedule, costs and quality is a complex management activity through the whole construction process, which has the characteristics of great information volume, rapidly changing information and complicated design factors. Thus, the informationization management based on BIM technology has a great potential value on application over construction general contracting management field.

Based on tridimensional engineering data model integrated with varies related engineering construction project information, conventional BIM technology model combines all information of geometry, physics, function and performance that is associated to the engineering construction project and it represents the entity and function of the construction project in digitization form. BIM4D, based on the tridimensional construction information model, moves forward and adds in a time dimension, so that the 3D static model becomes flexible on a time shaft and is suitable for dynamic research. The BIM4D model makes the dynamic integrated management of schedule, human resource, materials and facilities able to be simulated in visualization during the constructing stage. BIM4D place an emphasis on simulating the constructability and the availability of other reformed schemes at the constructing period, however they neglect the costs of management and budget of the project, which is against the goal of management at the constructing period. Whereas the study for BIM5D construction information model and cost management not only increases operating efficiency, improves feasibility of alteration and claims, but provides information for cost management, contract management and precaution function as well, which, as a consequence, decreases the possibility of loss caused by mistaken cost management and, hence, avoids unnecessary waste on human resource and materials. Therefore, establishing an integrated information platform with BIM5D technology and conducting a dynamic and real-time management towards engineering construction general contract is fairly important.

CONCEPT OF BIM5D TECHNOLOGY

BIM technology is a significant computer application technology after the emergence of CAD technology in the construction field, which is a brand new concept for construction management. As a development trend for the infomationization of construction industry, this technology involves a series of technical innovation and revolution from planning and theory of design to execution and maintenance of the technology. Mainly relying on modeling software and other application software, BIM technology absorbs various related information of the construction project and becomes a tridimensional, dynamic and real-time construction information model that aims at improving the efficiency and capability of project management of each engineering construction participant during the whole life cycle. On this basis, our firm puts forward the BIM5D technology, one that integrates "schedule information" and "cost information" into tridimensional geometric model, which becomes a new technology that makes a five-dimensional construction information model by "tridimensional geometric model + schedule information + cost information".

APPLICATION STATUS FOR BIM5D TECHNOLOGY

To put the core concept of BIM technology into practice, it cannot settle a matter at one go when it needs not only supports from application software and application standard, but also operating regulation revolution from the industry. Therefore, BIM technology is still under development. Today, application of BIM technology in the US and other developed countries take a leading position in the world when China starts up late but is catching up quickly. Due to the characteristics and ability of visualization, coordination, simulation, optimization and visualization, BIM technology provides construction company with visualized method for information integration and management. Gradually, BIM technology has been applied in construction project management however comes with some constraints and only in a few or some specific stages do project participants apply BIM technology. There are still certain aspects of project management in BIM5D technology application that need to improve. Currently, majority of the construction projects are construction general contract, where property owner, designer, constructor and operator are separate, hence every stage has not been effectively integrated as a design and construction integration. Moreover, the construction market is underdeveloped, the structure and mechanism are not well organized and there is lack of talents. All these status causes problems for companies to apply the BIM5D project management technology. Even so, BIM technology has proved to bring obvious expected benefits and it has been a popular topic in construction field, which drives the BIM technology to move forward to its core concept (Chen and Wang 2012).

The construction industry is a connecting bond in the engineering construction. During the construction stage, constructors need to arrange for a great deal of labors, materials and facilities to fulfill the construction design objective, and then hand over the property to operation and maintenance party. As an innovative and important means of Chinese construction industry, BIM5D technology improves the construction and management skills of construction executive. The application and extension of this technology in construction industry have a great impact on technical development and industrial transformation and upgrading, and therefore accelerate the development of the construction industry.

In recent years, for better developing the BIM technology, improving management skills on construction project, applying delicacy management, and consequently achieving a profitable result, our firm has applied BIM technology to projects of Guangzhou Chow Tai Fook Finance Center (Guangzhou East Tower), Guangzhou Zhujiang Newtown J2-5 parcel office buildings, Guiyang Zhongtian Weilaifangzhou (Future Ark), Dongguan Vanke Residential Industrialization Base and 20 other complex super high-rise construction projects. We have succeeded in obtaining economic and social benefits to a certain extent, as well as the management experience in applying BIM5D technology to manage complicated engineering project.

To satisfy the needs to develop BIM5D technology, our firm has set up two servers in headquarter. One server is used to remotely control the Glodon BIM5D platform, and another is used to deal with varies data on the platform. Thereby, the firm has its individual cloud structure, which is able to serve over 20 projects at the same time. About personnel structure, there is a three-layer management structure of headquarter BIM station – divisional BIM station – project BIM execution group. Also, the firm equips each BIM management member with high-configuration computer and professional BIM software for the sake of well operation of BIM technology.

GLODON BIM5D PLATFORM

Glodon BIM5D platform is construction project management software that is based on BIM5D technology, which is developed by Glodon Company and our firm for the purpose of overall construction process of the project. The platform integrates schedule, budget, resource, constructor and other key information through BIM model and simulates the construction process. It provides core data such as interface segmentation, resource consummation and technical requirement for stages of construction materials, commerce, schedule, production, etc. Efficiency of communication and decision-making has been improved; also the cost of time and money has been reduced. Therefore, it helps to achieve the goal of higher project management quality. This platform has been applied to Guangzhou Chow Tai Fook Finance Center (Guangzhou East Tower) Dongguan Vanke Residential Industrialization Base and other projects. During the application process, the project is considered as a carrier, which sets up unified modeling standards for civil engineering, steel structure, electromechanics, ensuring that each professional tridimensional model has been led into BIM platform and accurately compounds as an integration model, and ultimately turns into an ‘overall profession and deepening design BIM model’. According to the needs for the development of 5D virtual construction technology and for the project management of our firm, study and application of BIM5D technology have been highlighted at the project execution stage and construction process. Among these phases, construction schedule, cost and resource information have been correlated into the tridimensional model, which helps to conduct a real-time dynamic control over project cost and schedule and hence improves efficiency and level of management.

Following comes with a specific introduction to the application of BIM based on the use of BIM5D technology implemented for aspects of collision check, deepening design, drawing management, engineering quantity calculation, simulation scheme, schedule management and cost management over the construction general contracting management.

BASIC APPLICATION OF BIM

BIM is known as Building Information Modeling and BIM model is the foundation of every BIM management application (Eastman et al. 2008). Similar to other BIM modeling software, it has to set up complete modeling rules for model attributes of each profession’s (such as civil engineering, steel structure, electromechanics, curtain wall) members in order to conduct a unified management.

MULTI-PROFESSION COLLISION CHECK

In those large and complex construction projects, due to the large amount and complex layout of the facility pipelines, it is easy to cause collision problem among pipelines and among pipeline and other members, which brings trouble to constructor and affects the interior net height of the architecture. Collision among models can be classified as hard collision and soft collision. Hard collision refers to the collision among entities, when soft collision does not indicate any real collision among entities but the distance or space does not meet the construction standards. For example, when two pipes are set up parallelly, considering the requirement for installation and insulation, there must be a specific distance between them. If the distance is not enough, the design is not reasonable even there is no collision. Collision problem usually take place among facility pipelines and among pipeline and other construction members during the installation.

After leading in and integrating each profession model into Glodon BIM5D platform, operate collision check and a report will be quickly and accurately produced to show the result and point out the conflicts among each profession design, which reasonably avoids collision among electrical and mechanical pipelines. The platform enables the collision check among different profession design and the intelligent warning as well. Also, it is able to produce report for reserved holes, which is of great help to reduce the situation of rework and hopefully shorten the project duration (see Figure 1).

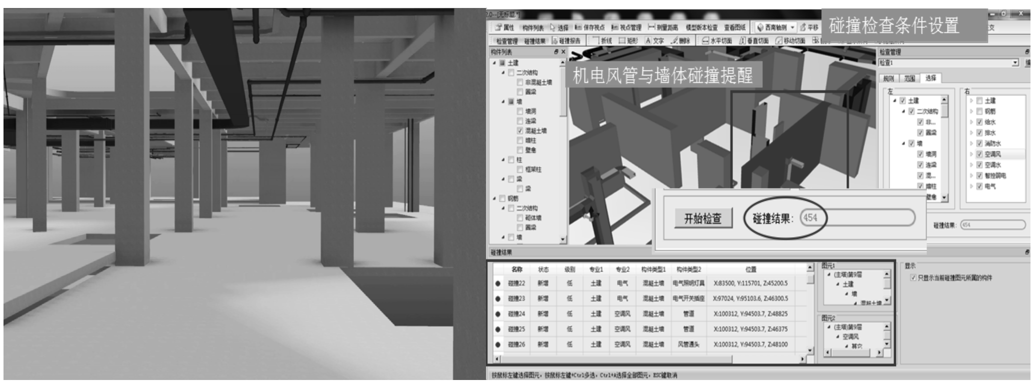

Figure 1.Multi-profession collision check.

DEEPENING DESIGN

With the rapid development of architectural decoration industry, requirement for design becomes fastidious and there is fierce competition in the market. Time spent on design is rather short and quite a few details are neglected by designers, which makes a less satisfied result. To solve this problem, it requires construction execution department to make the tender drawing or the original construction drawing provided by construction engineering department more detailed, complete and optimized, by which a reformed construction drawing is able to be put into practical construction.

Through the multi-profession model developed by Revit and Glodon BIM5D platform, a complete BIM model can be produced. Management staff can figure out the unreasonable or conflict point once it takes place and report the problem to design department on time for improvement, which makes less conflicts and rework.

DRAWING MANAGEMENT

For a construction engineering project, drawing management is a very important aspect as it is the most fundamental basis of engineering construction. In large engineering project, there is great volume of drawings and it is a time-consuming work for staff to look for drawings, which makes it inconvenient for daily operation. Besides, an engineering project includes various professions (such as structure, construction, electro mechanics, curtain and wall, landscaping, etc.), and drawing management becomes difficult when there are drawings gathered from different professions.

In the Glodon BIM5D platform, users can lead in drawing from different professions as a batch and associate the drawing with tridimensional model. By doing so, it is easy for users to read and apply the drawings, and drawings can be classified under systematic management. Different information for each specific version of the drawing (including palaver records for changes on design) can be displayed in the platform and the latest version of the drawing is shown automatically. Meanwhile, users can set up time alarm for the submission of drawing investigation and early warning in the submission schedule, and they can review the investigation progress as well as receive the early warning at any time, which reduces the burden of management staff (see Figure 2).

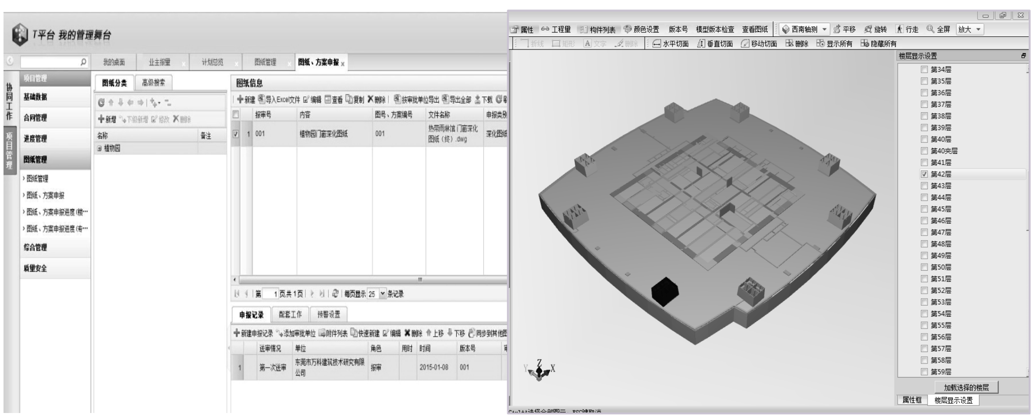

Figure 2.Drawing management.

SCHEME SIMULATION

In the conventional construction project, scheme developers can only show the spatial relationship of the members with plan and elevation. Once they need to change the scheme, it takes lots of efforts to conduct the spatial switching action between plan and elevation, and it is easy to make mistakes. Furthermore, there can be complicated situations at the construction field. Considering the constraints of people's thinking, they might not be able to completely take into account every situation. Therefore, some unreasonable issues may take place and delay the construction period (Kamat and Martinez 2001).

Glodon BIM5D system has succeeded in implementing the construction scheme simulating function, which imitates the complex construction procedures and specific schemes in the construction project, helping project staff to understand and analyze the project scheme visually through reading the model. The availability of visualization for the project increases, so that problems are easier to be found out, discussed and reformed before starting the construction, which increases the operation efficiency. When developing a scheme, technical staffs input the model and various data information of the project into software, and they can adjust the size, position, type and other attributions of the members in time. Once there is unreasonable situation, scheme can be timely adjusted and avoid delay for construction duration caused by design defect.

ENGINEERING QUANTITY CALCULATION

Engineering quantity calculation is a basic dimension in developing the engineering budget, which is of great workload, complicated, time-consuming and meticulous. It accounts for about 50% to 70% of the workload to develop a complete engineering project, and the accuracy and efficiency of the calculation will directly impact on the quality and speed of the budget. Improving the engineering quantity calculation method is of great significance to increase general budget quality, accelerate general budget speed, reduce workload of budgeting staff and enhance investigation and its transparency (see Figure 3).

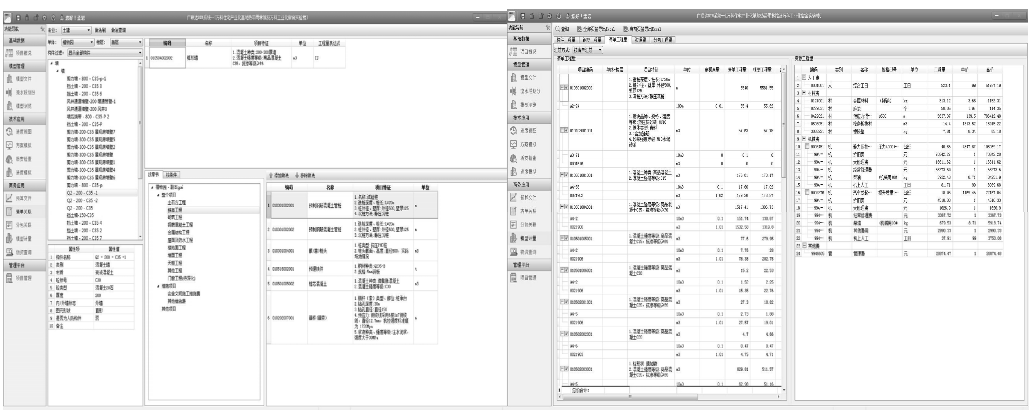

Figure 3.Engineering quantity calculation.

The set up of the Glodon BIM5D quantity calculation model is based on an accurate and complete Revit construction model and a corresponding CAD deepening design drawing. Only can BIM5D quantity calculation model established on this basis be considered as pre-construction model of entity engineering, which ensures the authenticity, accuracy and ability of sharing for engineering quantity.

SCHEDULE MANAGEMENT

In engineering project management, schedule and cost are two aspects that must be strictly control. Schedule management refers to coordinate every project participants to conduct each construction activity as required and according to the schedule plan. Participants need to reasonably make plans and arrangements for the resources to ensure the project to be completed on time. The reasonability of the construction schedule arrangement directly affects the cost and quality of the engineering project.

Glodon BIM5D system studies the 4D simulation technology that is based on tridimensional model, which takes the implementability and practicability of the construction planning management as prerequisites. The system mainly encompasses planning analysis, daily report and feedback, working face examination, schedule visualization, early warning on schedule, etc. Glodon BIM5D system uses working library to develop schedule plan and it has built up the function of entity working library and assorted working library. This function not only improves the schedule developing efficiency, but accumulates data as well, which increases the data resource for the firm. The function can also label the task with related words of attributes in short time and in batches, which improves the planning efficiency. Moreover, the function can conduct variance analysis for the planning to remind technical staffs to take test and adjustment effectively for the reasonability of the planning. BIM5D system combines the schedule with tridimensional model, where management staff can integrate the model with schedule, cost and contract information through a series of rule-correlation actions. Visualized schedule information can be clearly acquired from the visual schedule part. The system will also compare the actual construction situation with the planning schedule, and then indicates the risk of being late for those tasks that have not yet started. At the same time, the system will automatically notice the designated staff (see Figure 4).

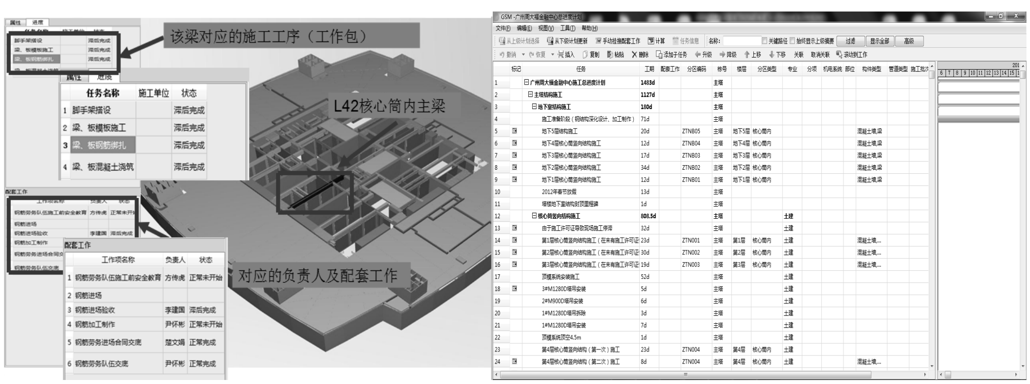

Figure 4.Schedule management.

With the working face management, management staffs can review operation record and working face status at any point of time. They can also flexibly redefine working face, divide each plan and elevation face into individual management area and manage the schedule, drawing, contract, subcontract management and other information in each area separately. Besides, the system provides working face with handover management, where each subcontract needs to submit the current construction status of working face through words and pictures after completing its job. This makes the working face management of general contracting more systematic over each subcontract, reduces conflicts at the spot, increases fineness of the general contracting management and deepens the depth of it (see Figure 5).

Figure 5.Schedule management.

COST MANAGEMENT

Cost management, as an important part in project management, is a process to manage the actual project cost within the target planning range and maximize profits through various effective actions on the basis that the engineering quality and schedule arrangement meet the requirements of the contract. It exists in every section of the construction project management and is the key aspect of the engineering project management (Chen and Dong 2014). Enhancing the cost management on engineering project displays the comprehensive strength of the company and it is an effective way to increase enterprise competitiveness.

Glodon BIM5D system produces actual, accurate and sharable engineering quantity based on an accurate multi-profession quantity calculation model, which provides data supports for material procurement, cost analysis and general control of the project. Glodon BIM5D system integrates civil engineering model, rebar model, electromechanical model and other models into one complete BIM quantity calculation model, which includes geometric and engineering quantity data for all members. Management staffs will need to correlate BIM model with GBQ engineering quantity list by manual or automatic operation, develop a complete BIM commercial model, and separately segment construction working flow into the model, and then the information for engineering quantity, engineering pricing and resource plan can be extracted. In addition, management staffs can share the BIM commercial model on the BIM5D commercial management platform for each project department to acquire geometric, engineering quantity and cost data according to its needs, which reduce the workload for management staffs and improves efficiency.

Cost analysis is a significant section in cost management for engineering project. On Glodon BIM5D platform, cost analysis function embraces cost, schedule and other information, which develops a real-time and dynamic cost analysis. After correlating the engineering quantity calculation list with tridimensional model, users can obtain information of budgeted cost and controlled quantity for main resource, which helps to better control the actual cost. Furthermore, when inputting the income from the first party as well as the project payment from each profession segment, a data analysis can be produced by comparing the project budget; income and expenditure, through which commercial staffs are provided with useful data support (see Figure 6).

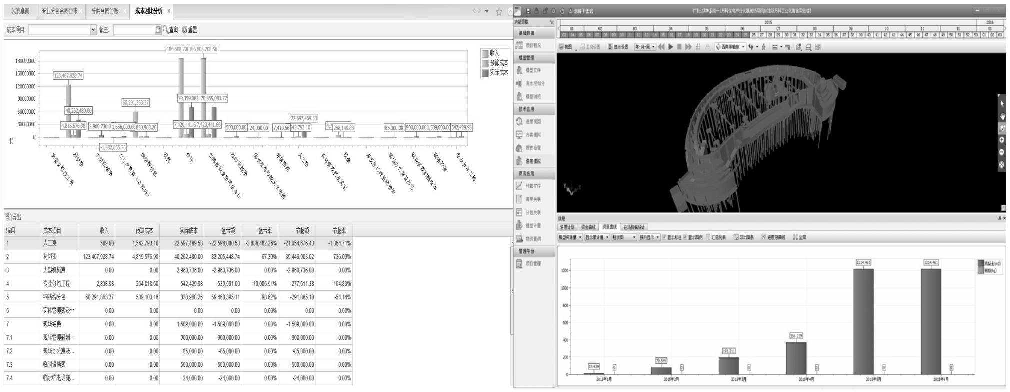

Figure 6.Cost management.

CONCLUSION

In conclusion, BIM5D technology is a new technology that is able to lead the construction industry to a higher level, and the application of this technology will bring immeasurable impact to the general contracting management model of construction industry. As a new approach of project management at the constructing stage, the characteristics of its visualization, quantification and digitalization improve the integrated delivery ability of the projects; provide timely, effective and authentic data support for project informatization management; enhance the function of communication, cooperation and pre-control for project management; increase the project management skills and productivity. However, we concede that the BIM5D technology is not yet mature, for example, the data base set up by some companies does not fulfill its guiding function on field management; the BIM5D application software is immature, which lacks a unified message interchange format; lack of professional or experienced BIM experts along with other problems. Therefore, we need a long process of exploration and development to continually figure out the value brought by BIM5D technology. We need to change the mode of production and management, promote the BIM5D technology into construction management, figure out difficulties during the application process and develop an integrated planning when conducting it step by step, in order to increase the productivity, management skills and enterprise's core competitiveness.

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Analysis and Design of the Safety Management Information System of an Existing Urban Building

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Abstract

To improve the management efficiency of existing urban building and reduce the incidence of accidents, this paper analyzes and designs the safety management information system of existing urban building. First of all, the object-oriented method is utilized to analyze the data structure of the spatial and attribute data, which are related to the construction safety. Second of all, the framework of the safety management information system of existing urban building is designed from the perspective of the integration of the system and the GIS service. The system structure, database, function module, key technology, safety early warning system and etc. are studied here. Based on the safety management information system of existing urban building, the intelligent management of buildings is promoted. Meanwhile, it provides a brand new idea for the information construction of urban buildings.

INTRODUCTION

The safety of existing urban buildings, as an integral part of urban safety, not only impinges on the life safety of urban dwellers but also impacts social harmony and stability (Ameziane 2000). Shanghai, as a major metropolis, boasts well-controlled building safety, yet it also suffers from some problems. On the one hand, Shanghai has a large number of existing buildings, which were built in drastically different times. By 2013, the total area of urban buildings has exceeded 1.106 billion square meters, of which residential buildings accounted for 589 million square meters (SMHGBAB 2014). Nonstandard renovation and remodeling as well as the construction at nearby sites pose severe threats to the safety of surrounding buildings (Wirral 2001; Wang et al. 2006). On the other hand, there is a large amount of data about existing buildings, which are in the charge of several administrative departments. Without a centralized information management platform, it is rather difficult to collect and sort out information of existing buildings. Many documents are lost, which can cause great troubles when emergency happens. Apparently, in light of the large number of existing buildings, it is necessary to establish a management information system aiming the building safety (Wang et al. 2004; Yu et al. 2010).

In recent years, some developed countries, such as America, Germany, Japan and etc. have made attempts at digitalizing building management. However, due to their differences in management system from China, these countries rarely build a national level or municipal level information system geared towards safety management of buildings. The domestic research on the building safety information management is still at the starting stage, and the achievements are relatively less. In practice, some cities in China have already had some experience. For example, the systems such as Housing Management Information Platform of Beijing, Housing Information Database of Shenzhen, Information System of Historical and Cultural Resources of Old City Zone in Xi'an, Safety Information Management System of Dangerous Buildings of Wulong County in Chongqing, Integrated GIS of Hong Kong and etc. have been established or under-construction. But most of these systems only focus on small part of buildings. Thus, the management scope is small, and the systems are mainly used to manage the health records management, not for dynamic supervision. Comparatively, Shanghai Municipal Housing Guarantee and Building Administration Bureau have done a great deal of work and have scored some achievements. For instance, Shanghai has established some information systems, including Real Estate Property Right Management Information System, Housing Guarantee Management System, Commercial Housing Maintenance Fund Management System, etc. However, these systems are merely focused on one or several steps in the housing management process. Thus, their functions are still very limited.

Based on the needs of the building safety management, the Safety Management Information System of Existing Urban Building is established, in which the Information Database is set as the core. As a powerful instrument, the Housing Management Department can utilize the system to not only track and monitor existing buildings in real time and provide early warnings in time to avoid accidents, but also enhance the level and efficiency of urban building management by improving the accuracy and objectivity of data analysis.

OVERALL DESIGN OF SYSTEM

The aim of the Safety Management Information System of Existing Urban Building based on GIS technology is to provide a digitalized, visualized and diversified management tool for safety management of urban buildings. The auxiliary building safety management includes Information Database of Existing Urban Buildings, query and analysis of building-related data as well as safety early warning. The design of the system pays attention to the connection of the graphic and attribute of the buildings. Thus, the system offers building safety management staff user-friendly experience and an auxiliary intelligence decision-making technique.

The main users of the system are the municipal housing management departments, therefore, the design of the system focus on two aspects, such as information management and assistant decision-making. In terms of information management, the content of the information includes various types, e.g. space entity of buildings, protection architectures and etc.; the ways of expression contains the text, pictures, report, map, multimedia and other types; the management functions includes information input, modify, organize, browse, backup, retrieval, extraction, output. In terms of assistant decision-making, the design of the system should consider the safety early warning, the warning process, bidirectional query retrieval, statistical reports and thematic map generation, model of application analysis, spatial analysis model, and etc.

Design of system architecture. Based on the public geographic information data and its API, the system adopts the spatial database management and the image processing techniques to monitor buildings. In other words, the map has been taken as a basic platform to display and analyze buildings. The model of the system is a combination of C/S and B/S. The system front adopts client-side technology Flash to demonstrate the visual effects of mapping applications. Through the business class interface, the basic map, building information and safety service forms can be managed comprehensively. Additionally, the system is equipped with multi-user access control and thus can ensure the security of data through user and rights management.

According to application requirements, the overall system architecture is made up of four layers: basic environment layer, data support layer, application support layer and business application layer. Among them, the business application layer is intended to provide the access to data analysis of basic information of buildings. Packages of functions including query, analysis and GIS application, which are not directly related to business but are frequently used in building management, are provided for the business layer system through the way of interface, message driven bean or Web Service. The functions of lower layers are packaged in accordance with business requirements so that basic functions such as the integration-display of spatial graphic and attribute information, GIS application, information publishing and data analysis can be achieved on the basis of the database. Furthermore, functions such as safety early warning and life-cycle management can be realized. The system architecture design is shown in Figure 1:

The basis and core of the system is the Information Database of Existing Urban Buildings, which includes building outline, building structure and equipment, construction information, usage information, detection information, repair and reconstruction information and preserved building information. Managing buildings based on maps, the system acquires information about the building codes and the accurate location of buildings. The building code, as a thread, runs through every process in building management. Through an interactive relationship with maps, the system is able to display two-dimensional and three-dimensional information of buildings.

Design of system functions. The system functions revolves around the functions of building management department, which mainly comprises information management and decision aids. Therefore, system modules are designed for functions such as input and output of building information, query and statistics, data analysis, early warning modeling, data updates, system maintenance and management, see Figure 1:

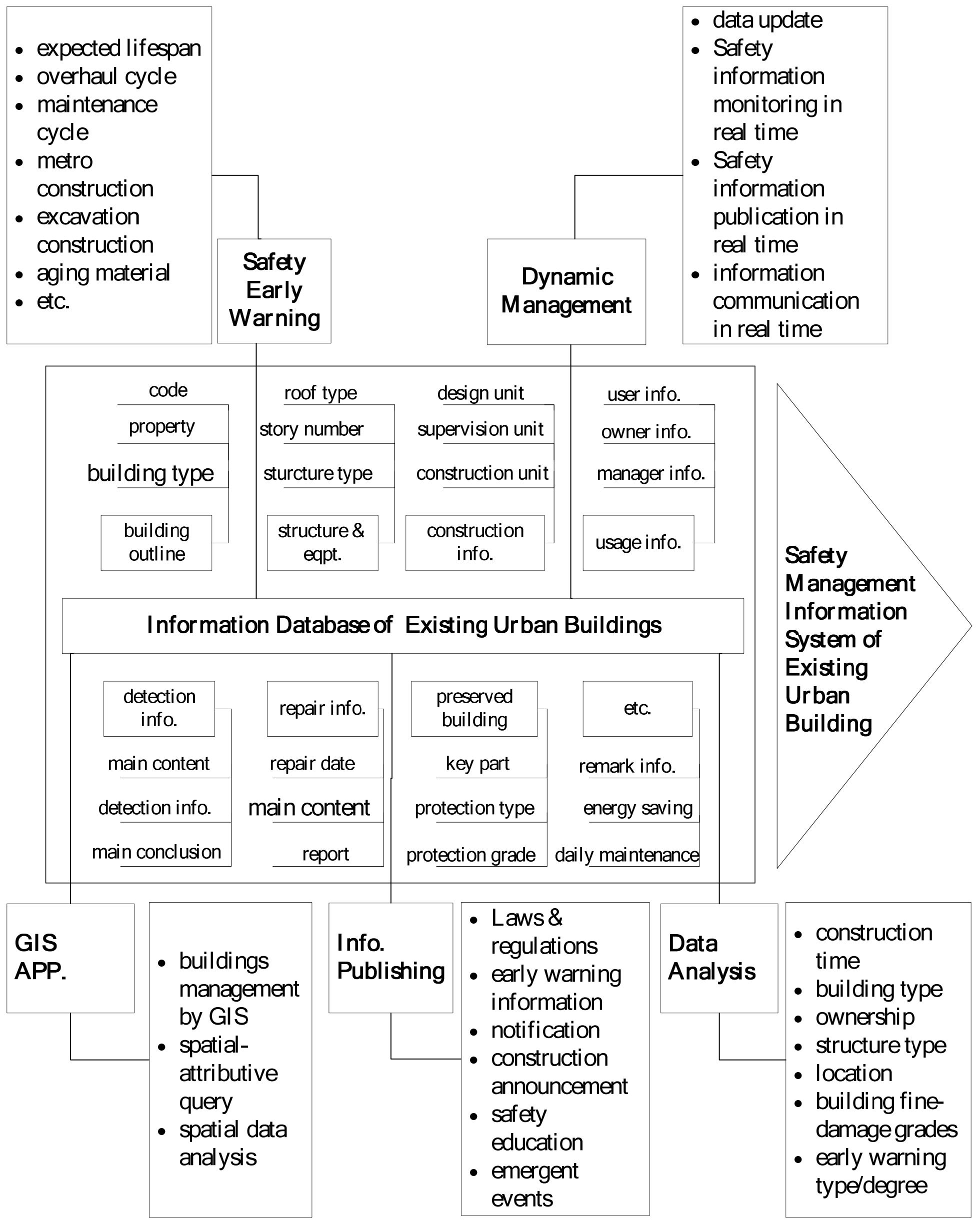

Figure 1.Block diagram of the safety information system for existing urban buildings.

(1) General functions of GIS, such as map browsing, navigation, graphical measurement and GIS queries, etc.

(2) Building information data maintenance, such as adding, editing or deleting buildings.

(3) Safety early warning. For buildings with safety risk, the system highlights their positions on the map and classifies various warnings by different degrees. Meanwhile, in accordance with the corresponding degree of early warning indicators, the system will send out early warning information in a multimedia approach with illustrations and sounds and create a thematic map.

(4) Data analysis. Including data query and statistical analysis. For example, the system will cross-check, collect and sort out information by such standards as the time when the building was built, the damage conditions and the early warning degrees.

(5) Notice. For publishing and viewing notifications, including general information, advice, policy documents, construction information, safety early warning information, emergency information and etc.

(6) System management. Adjust and maintain safety analysis algorithm, customize the configuration of parameters dictionary, change and adjust system data interfaces, manage users' roles and rights through management functions of back-office system.

(7) Mobile Client Applications. In addition to the computer terminal, a mobile client application is also developed for query of building information and dissemination of early warning information. All information operated on the mobile can be interacted with the computer terminal in real-time.

DESIGN OF SAFETY EARLY WARNING MANAGEMENT SYSTEM FOR EXISTING URBAN BUILDINGS

Safety early warning management system consists of early warning categorization, rulemaking, degrees classification and working process. Its components and processes are shown in Figure 2.

Model architecture of the system is: through the information network, the information associated with buildings enters into the management system. After storage, processing, screening and inference, the type and degree of early warning is determined. The output result is then compared with early warning rules in order to estimate the risk of future accidents and to decide whether to issue a warning as well as which degree of early warning should be issued (Zhong 2010). After a series of processing including reporting, feedback, publishing and releasing, countermeasures are provided beforehand based on the discrimination results.

In accordance with the early warning needs of different types of buildings, safety early warnings are sort out and divided into three categories:

(1) Early warnings triggered due to exceeding time limits, which include exceeding the expected lifespan of buildings, the overhaul cycle and the maintenance cycle.

(2) Early warnings triggered due to the influences of a nearby construction site, which include metro construction, municipal pipe network construction, excavation and other constructions.

(3) Early warnings of secondary disasters triggered by force majeure, which include destructive renovation, aging facilities and equipment and etc.

On this basis, corresponding early warning models and rules are designed for each type of early warning and mechanisms are developed for the system to work:

(1) Each type of early warning corresponds to four basic parameters: early warning indicators (the content that will be displayed in the output terminal), early warning threshold, raising early warning threshold or releasing early warning threshold.

(2) The degrees of early warnings fall into four categories and from the highest to the lowest are respectively identified by blue, yellow, orange, red, among which the red alert signifies the highest degree of warning, namely the most serious safety problem. In the case of a red alert, relevant departments will be organized to work on a solution or deal with the emergency immediately.

(3) When a certain parameter in a building reaches the early warning threshold, the corresponding point on the map will be highlighted in corresponding color, which will prompt a response in the database and a thematic map will be created. When several warning messages are triggered on the same building, only the highest degree of warning will be indicated.

(4) When informed about the warning information, administrators will take corresponding measures (testing or repairing, etc.) and after obtaining relevant feedback, they can raise or lower the warning threshold or simply lift the alert.

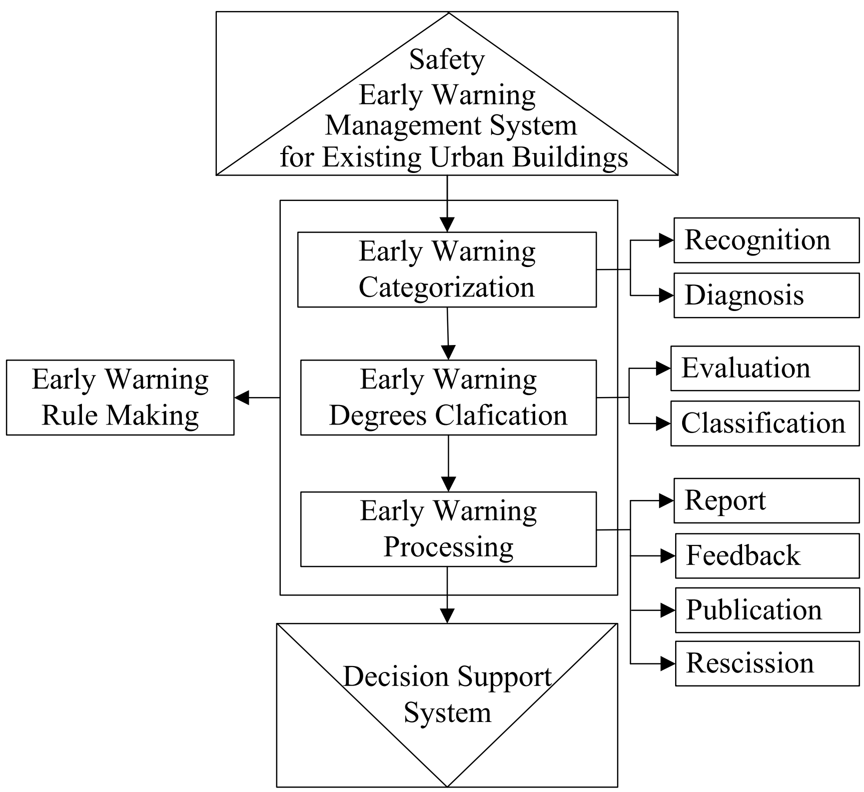

Figure 2.Components and processes of safety early warning management system for existing urban buildings.

CONCLUSION

The introduction of GIS technology into the safety management of existing urban buildings is a breakthrough in traditional management methods. Building management departments, with the assistance of the GIS-based building safety information system, can collect timely, accurate and comprehensive dynamic building information. Thus, the management model in which buildings are managed by GIS can truly be established.

The design of Safety Management Information System of Existing Urban Building is based on the Information Database of Existing Urban Buildings. The system keeps tracks of the basic information of buildings and develops corresponding basic functions and business functions on this basis. The establishment of the system not only digitalizes information archives of buildings, but also realizes real-time tracking and monitoring of building safety information, which will nip every safety threat in the bud. Safety Management Information System of Existing Urban Building through digital, intelligence and networks makes housing management less sophisticated, more transparent and efficient, thereby reducing the number of accidents and improving management efficiency.

ACKNOWLEDGEMENT

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Automated PPE Misuse Identification and Assessment for Safety Performance Enhancement

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Abstract

The misuse (including nonuse) of personal protective equipment (PPE) directly catalyzes the changes from incidents to critical accidents and diseases. The main control over PPE use is visual inspections, which is time-consuming and its effectiveness depends largely on the observer's safety knowledge and experience, which often results in omissions or bias. To solve this problem, this study introduces a novel approach towards automated remote monitoring and assessing how the PPEs are worn. The real time location system (RTLS) and virtual construction are developed for worker's location tracking to decide whether the worker should wear helmet and give a warning, while the silicone single-point sensor is designed to show whether the PPE is used properly for further behavior assessment. The process of data synchronization and fusion of location coordinates and pressure data is described in detail and the system is tested in an open area experiment to prove its feasibility.

INTRODUCTION

According to Occupational Safety and Health Council (OSHC), PPE means any protective equipment that protects users from being exposed to a potentially hazardous environment. Undoubtedly, using PPE is a factor which would be positively correlated to safety performance on construction sites and became one of the most important factors affecting safety performance (Sawacha et al. 1999). Unluckily, PPE misuse is often neglected because current assessment is mainly focused on visible outcomes such as critical injuries and accidents, and it is hard to identify hazardous behaviors in time. PPE misuse records are mainly kept by self-reporting, which is inhibited by a blame culture for error, time-consuming paperwork, and lack of feedback on how the information reported has been used (Vander And Kanse 2004). To solve these problems, current activities mainly involve modifying PPE use behavior through safety regulations and training (Kaskutas et al. 2013), and improving safety attitude through better organizational safety culture (Fung et al. 2012). These methods are useful but do have disadvantageous such as: being unable to remedy the limitations of human vision and ability to detect all surrounding danger sources; largely relying on wandering inspection and lagged (outcome) measurement, which leads to biases and fails to provide feedback to change unsafe behaviors in time.

To realize efficient behavior inspection, many technologies like Mobile passive Radio Frequency Identification (RFID) was applied to perform automatic site access, time recording, and completeness control (Kelm et al. 2013). And there was cyber physical system set up for real-time PPEs monitoring by keeping the PPEs in close range (Barro-Torres et al. 2012) But regretfully, these similar methods and technologies have three weaknesses: cannot ensure workers use PPEs properly since being close to the body does not mean use; or do not take conditions into consideration where different kinds of PPEs are needed, and the wearable devices are heavy and uncomfortable.

METHODOLOGY

All these PPE misuse behaviors are reminded by warnings and assessed according to the later responses represented. Only if the worker enters the danger zone without PPE, the alarm will be given for reminding. Then if the worker still doesn't wear the PPE after a certain response time, this behavior will be recognized as a misuse behavior. At the beginning of the decision cycle, danger zone where need to wear PPE is identified based on a full discussion with experienced project managers and safety officers such that:

$$F \overset{\Delta}{=} \left\{ \left(x_1, x_2, x_3\right) \in R^3 \middle| \bigcap_{i=1}^{m} N_i X \le n_i \right\}; X = \left(x_1, x_2, x_3\right), i = 1, 2, \cdots, m \tag{1}$$

where $\left(x_1, x_2, x_3\right)$ are the coordinates of points in the danger zone, and the danger zones can be designed as a space, a plane, a line or a dot. Workers are informed through training of the danger zones and this training can be used to improve safety by directing attention to PPE misuse. In the inspection and assessment phase, traditional manual observations and subjective judgments are substituted by automated misuse warning and response assessment:

$$g\left(Y, t\right) = \begin{cases} 1; & Y \in F, P\left(Y\right) = 0 \\ 0; & else \end{cases} \tag{2}$$

where the worker's real-time location Y and helmet pressure $P\left(Y\right)$ are measured by positioning and sending technologies and recorded in a database. If the worker enters a danger zone ($Y \in F$) without a helmet ($P\left(Y\right) = 0$), a misuse warning rings out as in-time feedback to workers. After this warning, the unqualified behavior is identified by:

$$g\left(Z,t+\Delta t\right)=\begin{cases}1; & Z\in F, P\left(Z\right)=0\\ 0; & else\end{cases} \tag{3}$$

where Δt denotes the response time after the warning. In this phase, there are two kinds of corresponding activities: a) if the worker is still located in danger zone ($Z\in F$) PPE ($P\left(Z\right)=0$), this behavior is recognized as a misuse response; but b) if the worker leaves the danger zone ($Z\notin F$) or takes on the PPE ($P\left(Z\right)=1$), this response is regarded as a safe behavior.

The timestamps are encoded into float numbers by seconds starting from the beginning of each experiment. For three kinds of data shown in Figure 1, video time is regarded as the ground truth, and it is assumed that the propagation of time difference consists of two parts: initial time shift and continuous time shift:

$$\Delta t_i=\Delta t_0+\alpha t_{sensor};\ \ \Delta t_i=t_{video,i}-t_{sensor,i} \tag{4}$$

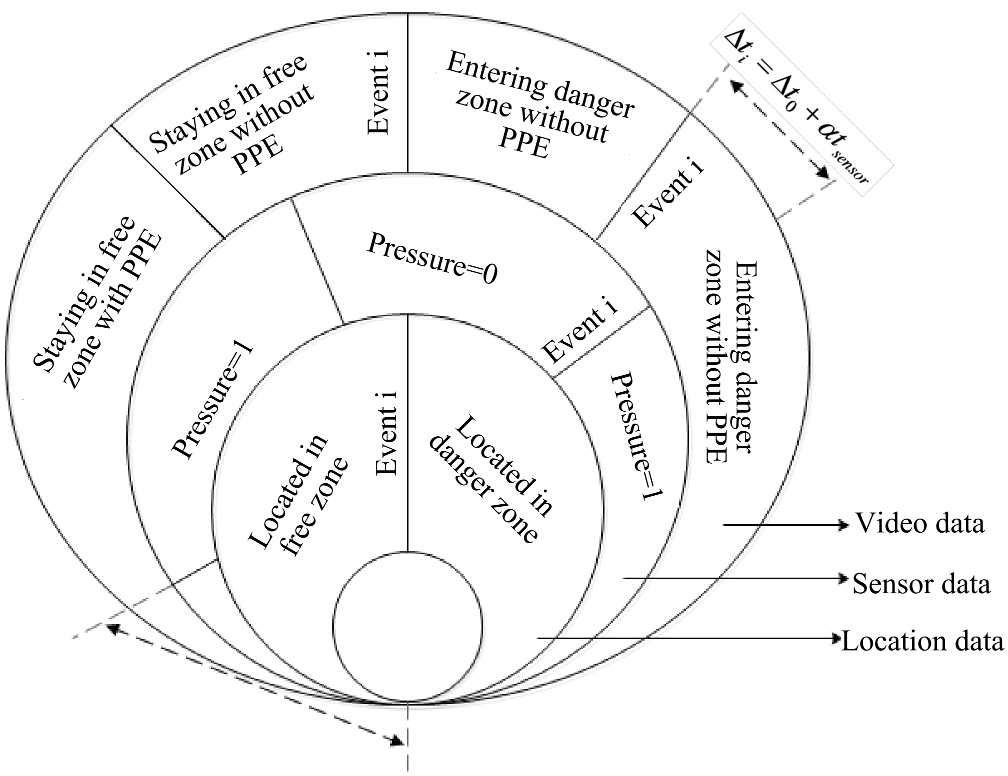


Figure 1.Time lines of multiple data.

Where Δt_i means time lag between sensor and video when a specific event i occurs. An event refers to taking on/off PPE or moving between free and danger zones. Term $t_{video,i}$ is the video time when event i (e.g., enter a danger zone without PPE) is observed. While term $t_{video,i}$ is the event i time recorded by sensor's clock. When $i=0$, t_i refers to the initial status of location system and sensor when they start recording data, then Δt_0 represents the initial time shift between sensor and video recordings. In addition, αt_{sensor} refers to the built-in drifting time of sensor, where α is time adjustment factor correcting the second from sensor to be equal to the video. A positive α means the sensor clock runs slower than video clock while the negative one indicates the opposite situation. To calculate the parameters α and Δt_0. The linear time lag propagation algorithm is applied on a set of random events, which is shown as:

$$\alpha = \frac{\sum\left(t_{sensor,i} - \bar{t}_{sensor}\right)\left[\Delta t_i - \left(\bar{t}_{video} - \bar{t}_{sensor}\right)\right]}{\sum\left(t_{sensor,i} - \bar{t}_{sensor}\right)^2} \tag{5}$$

Once the time lag propagation parameters are determined, the time of sensor and video can be synchronized:

$$\hat{t}_j = \Delta t_0 + \left(1+\alpha\right) t_{sensor,j}; \quad \varepsilon = t_{video,i} - \hat{t}_j \tag{6}$$

Where $\hat{t}_j$ predicts time on the corresponding video timeline. Event j is recorded from the sensor at sensor time $t_{sensor,j}$ and ε means predicted error.

SYSTEM ARCHITECTURE AND APPLIED TECHNOLOGIES

This multi-user on-line supporting system, which is named as PPEs Use Management System (PUMS), consists of three parts: Real Time Location System, Virtual Construction System and PPEs Sensing System shown in Figure 2. Real Time Location System applies tags and reference anchors in detecting and sending the ranging information through wireless signals. And Virtual Construction System is responsible for measuring the relative 3D positions of workers and their surrounding danger sources/zones, and recording real-time 3D movements of workers and moving equipment. Meanwhile, PPEs Sensing System is developed for sensing, collecting, transferring and saving the PPE use status. If deemed necessary by PUMS, warnings will be sent to alert workers through tags installed on their helmets.

The PUMS comes true by help of four main parts shown in Figure 3: End nodes, repeater/checkpoint and coordinator. End nodes are the critical part of the system which is worn by workers and responsible for gathering information about PPEs and location. These devices are composed by a central unit microcontroller to regulate the behavior of the device, a pressure button sensor for pressure information collection and a radio module for location detecting and transmitting information. After the data is collected, the repeater or checkpoint will help the end nodes connect with coordinator wirelessly. At last, the coordinator will collect, store and synchronize the data from pressure sensor and location. It is also responsible for node configuration and activating alarm.

Specifically, Chirp Spread Spectrum (CSS) technology is employed for ranging, which estimates physical distance between two devices by Time of Flight (TOF) of radio frequency signals. CSS is a spread spectrum technique defined in the

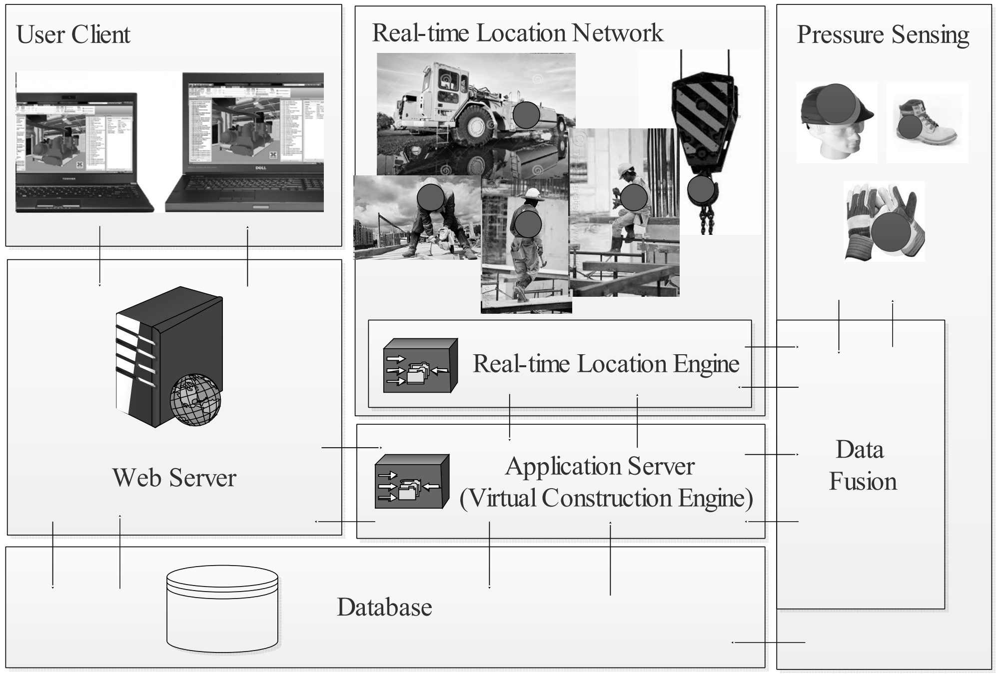


Figure 2.General architecture of PUMS.

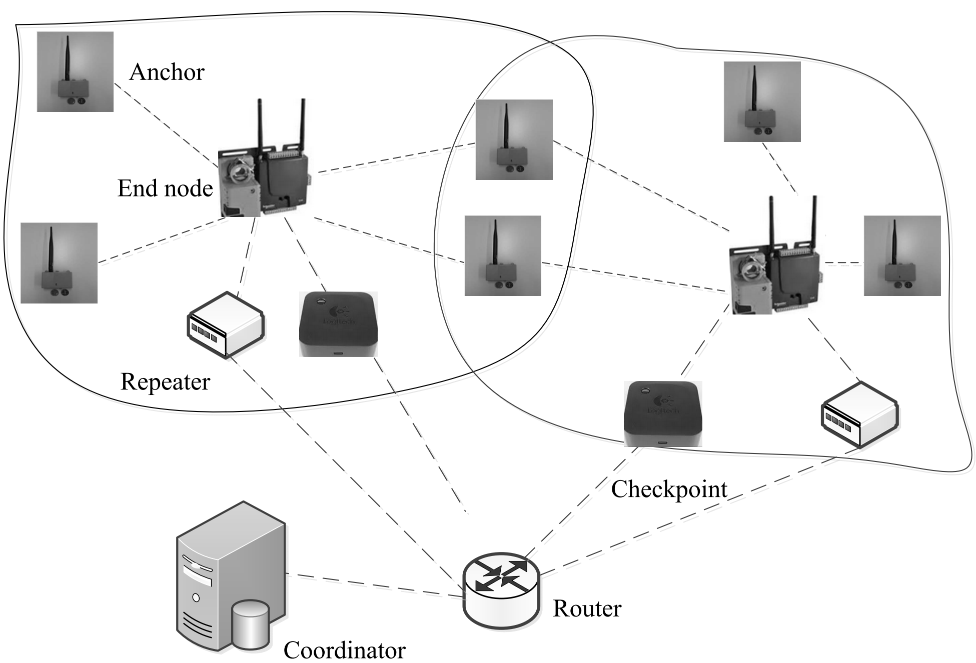


Figure 3.System deployment.

standard IEEE 802. 15. 4a (Cho and Kim 2010) and uses wideband linear frequency modulated chirp pulses to encode information which is relatively less time-consuming, robust against disturbances, against multipath fading, low power consumption and easy to implement in silicon. Based on price/responsiveness ratios and their capacity to resist harsh conditions of construction, silicone single-point sensor is initially selected to detect if PPE is being worn by the site workers. PPEs Sensing System is developed for integrating sensor technologies and wireless communication, as indicated in Figure 4. Sensors automatically track real-time behavioral data on whether real-time behavioral data indicating whether workers are wearing the required PPEs and transmitting through Bluetooth technology.

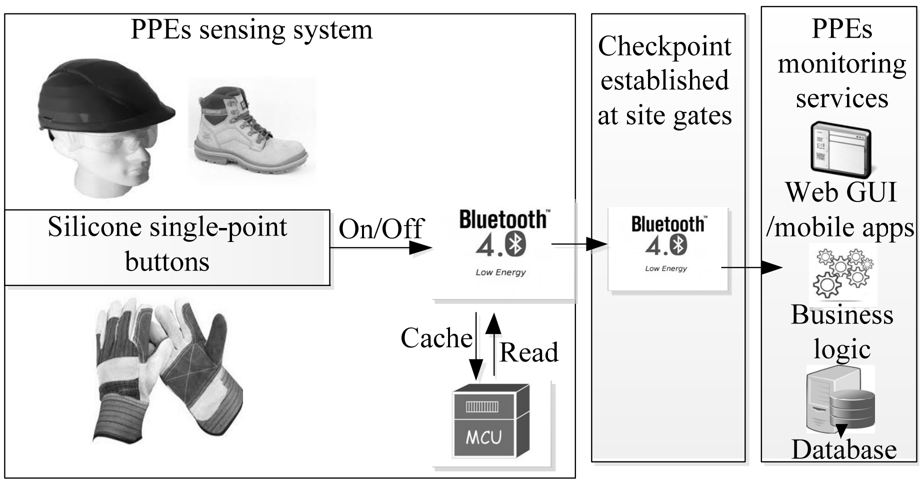


Figure 4.Sensing system architecture.

EXPERIMENT

Since PPE misuse behaviors involve multiple scenarios and complicated operations, this study selects safety helmet in the primary experiment because the head is the most critical area of a human body and severe trauma to the head can lead to death or long-term disability. Helmets not only prevent the skull from being perforated but also dampen the force of the impact object transmitted to the wearer (Long et al. 2013). It can be effective in reducing both head accelerations and compressive neck forces for large construction objects in vertical impacts (Suderman et al. 2014).

Experiment setting. The experiment was designed at the North Court of Hong Kong Poly Technic University to simulate construction tasks. This open test site is surrounded by many tall buildings and has many stairs, which is incident-prone and similar to the real construction site. Two research staffs, named as Tag 1, Tag 2, shown in Figure 5, were selected from Construction Virtual Prototype Laboratory as the tracking objectives and were required to act many scenarios on the test site and this test was conducted from 1 PM to 3 PM.

According to The US Department of Labor's Occupational Safety and Health Administration (OSHA) requires employees to wear head protection if: objects might fall from above and strike them on the head; they might bump their heads against fixed objects; or, there is a possibility of accidental head contact with electrical hazards. As a result, two danger zones were identified in system: danger zone 1 (DZ1) was a macro slope with many stairs and danger zone 2 (DZ 2) was between two buildings. The parameters of the danger sources were recorded on a map or virtual model such as in figure 5, including the danger type and the shape, radius and location of the danger zone. And then the anchors were added on map with their coordinates as location references. For real time tracking, tags fixed on helmets were utilized to track the location of workers. The tags were then matched with the personal information of the workers, such as work type and permission to work in the danger zone. Through careful calculation and prolonged discussion among those involved, the response time to the warning signal was set as 3 seconds.

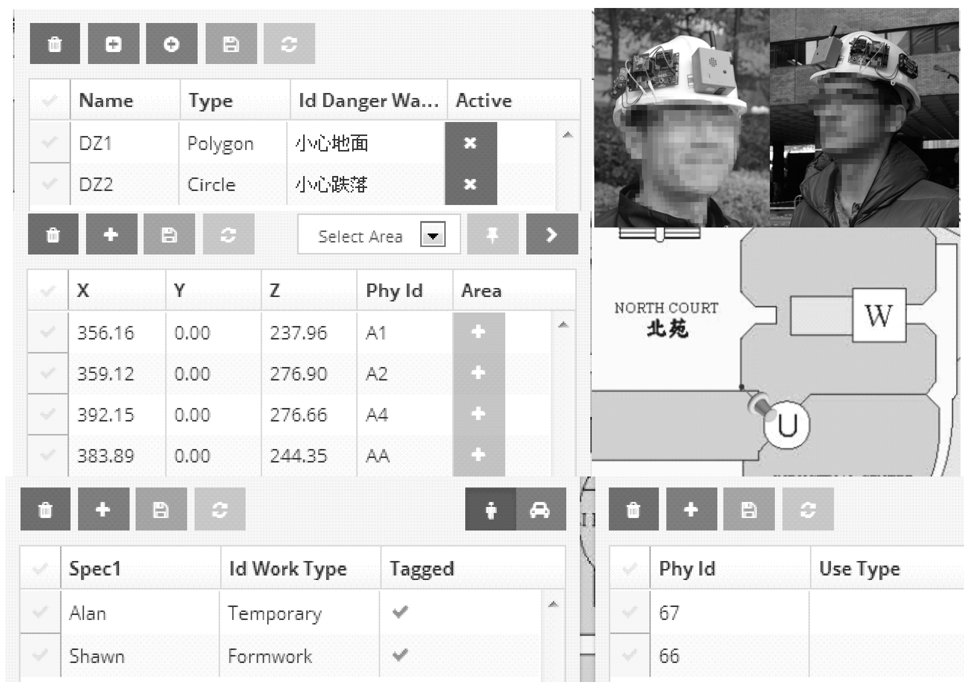
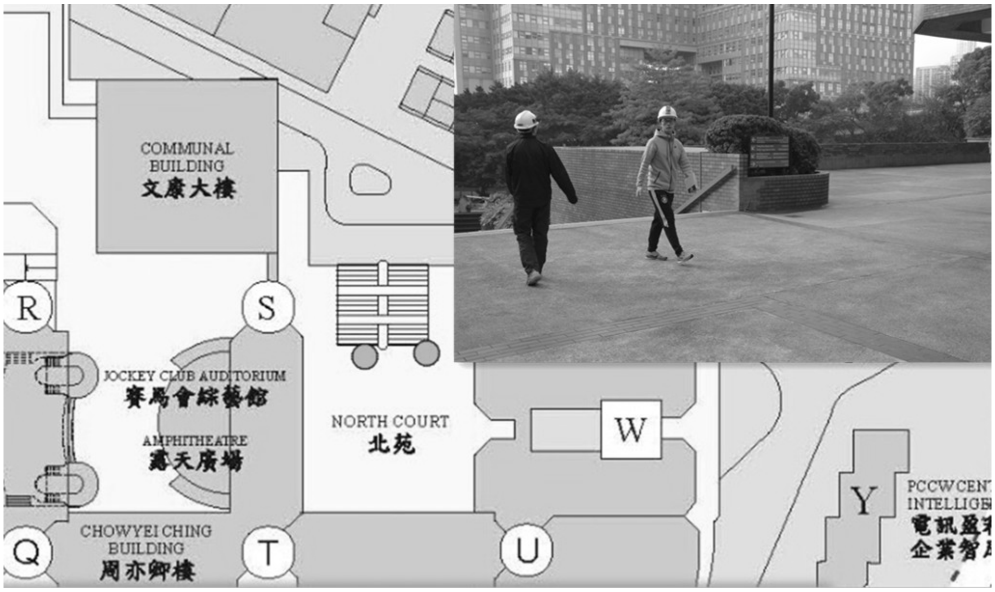


Figure 5.Endnote devices and experiment deployment.

Data analysis. The real time location of the work site was calculated and synchronized on the virtual map as shown in Figure 6(a), where the green spots indicate the movement of tag carriers. Meanwhile, the status of helmet use was synchronized and shown on computer, which is illustrated as Figure 6(b). The synchronized movement, the real-time coordinates of both the tag carriers, and helmet use status were recorded in the database as video, (X, Y, Z) and 0/1 respectively. Since the signals can be distorted by occasional outliers, a Robust Kalman Filter was applied to reject outlier measurements shown Figure 7. Since there had been no similar cases previously, two representative scenarios were chosen as examples for the response analysis. As indicated by the results shown in Figure 8, the first misuse warning was triggered by being in danger zone without helmet and the carrier ignored the danger warning. This was identified by the system and recorded as unsafe behavior. In another case, the carrier put on the helmet within 3 seconds of the warning and this it was therefore not recorded as a misuse behavior.



(a)

Helmet Phy Id	Time On	Time Off
6DE98E9D667C	09:10:49.000 26/03/2015	09:10:52.000 26/03/2015
6DE98E9D667C	09:11:09.000 26/03/2015	09:11:23.000 26/03/2015
6DE98E9D667C	16:05:55.000 23/03/2015	16:05:57.000 23/03/2015
6DE98E9D667C	16:06:50.000 23/03/2015	16:06:53.000 23/03/2015
6DE98E9D667C	16:07:41.000 23/03/2015	16:07:45.000 23/03/2015
6DE98E9D667C	15:26:20.000 13/03/2015	15:27:30.000 13/03/2015
6DE98E9D667C	15:25:17.000 13/03/2015	15:25:49.000 13/03/2015
6DE98E9D667C	15:20:09.000 13/03/2015	15:20:33.000 13/03/2015
6DE98E9D667C	15:18:41.000 13/03/2015	15:18:55.000 13/03/2015

(b)

Figure 6.The synchronization and visualization of locations and pressures.

A total of 91 helmet misuse records occurred during the trial time and were recorded in database for further personal safety performance assessment. These are shown in Figure 9(a) in terms of the warning times of each tag carrier in different danger zones during various working times. Danger zone 1 (DZ1) was associated with much more warnings than DZ2. And Tag carrier 2 (TAG2) had much more warnings, which suggests that safety managers should pay special attention to this worker and provide him with more reminders and instructions. What's more, the misuse warnings can be compared chronologically like Figure 9(b) to investigate the effects of in-time feedback and interventions on safety performance.

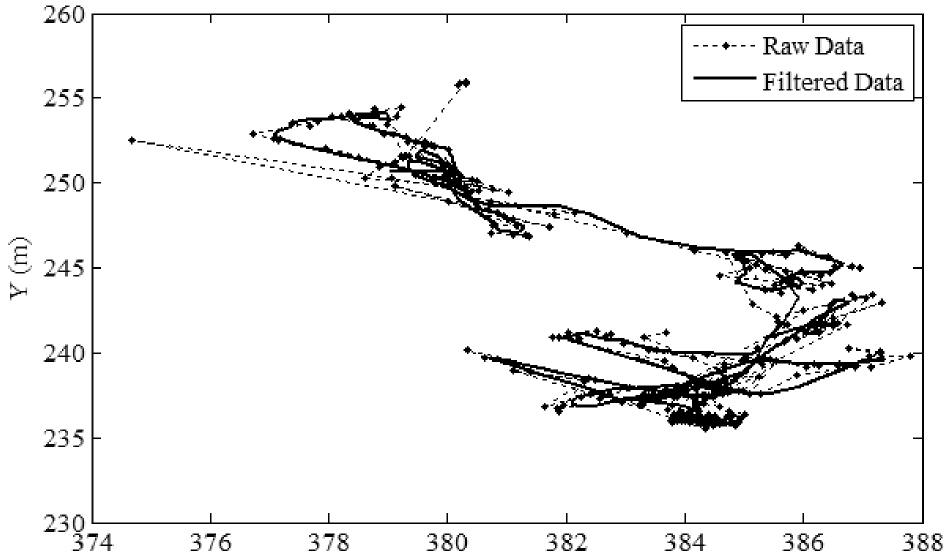


Figure 7.The Robust Kalman filter example.

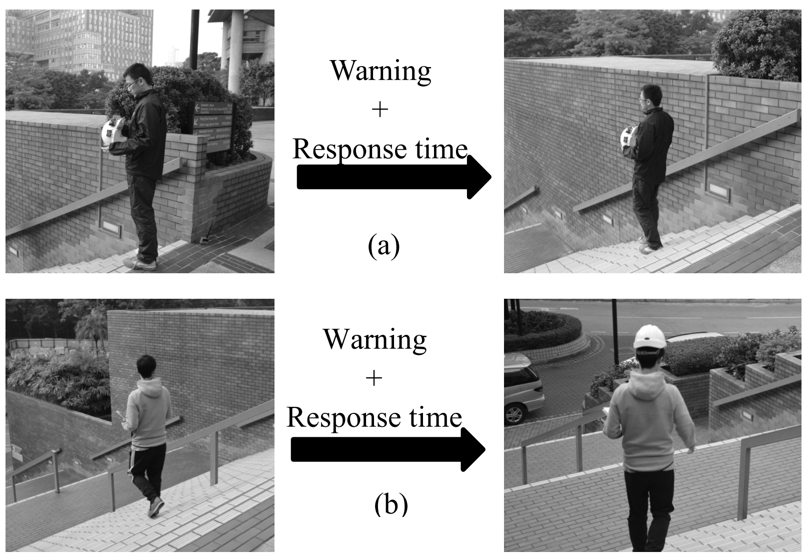
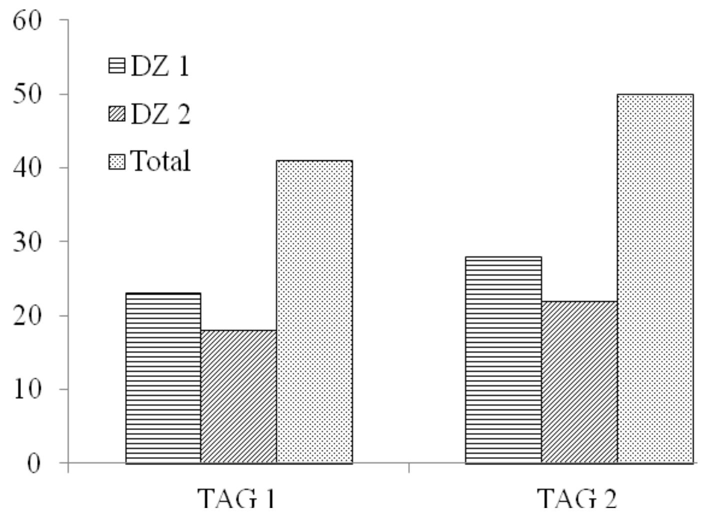


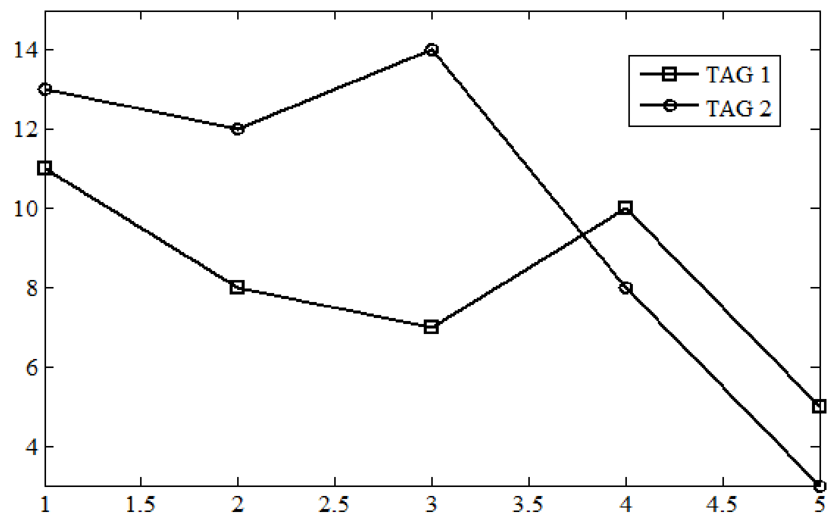
Figure 8.Helmet misuse behavior assessment.

CONCLUSIONS

Traditional PPEs use management methods have failed to be widely effective because it is highly dependent on a manual and experienced inspection process, and lacks accurate personal assessment and timely feedback. This paper solves this problem by providing an effective approach to automatically identifying PPEs misuse behaviors with integrating positioning technology and pressure sensor, and assesses the personal safety performance of workers according their response to danger warnings. This involved the development of a supporting multi-user platform to obtain the real-time position of workers in relation to virtual hazardous zones. A controlled open field experiment study was conducted that verified its ability to identify PPEs misuse behavior in specific condition, issue timely warnings and capture worker responses. The warning and response data were then analyzed to assess individual safety performance and locations over time for effective safety behavior improvement.



(a)



(b)

Figure 9.Statistical analysis results.

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Collaborative Construction Schedule and Management Based on BIM Theory

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Abstract

Schedule has affirmed the importance of construction management study, which has decision meaning for advance the modern engineering construction management. Challenge in these settings pertains to the need to cooperate the schedules with modeling by using BIM theory, so that the most of construction resources capacity is fully committed. To probe into these critical factors, this study will analyze the effects of construction schedule and collaborate it, so as to speed up construction information management. Our central contribution is to illuminate how schedule can cooperate with modeling based on BIM theory and help us to management.

INTRODUCTION

In the past decades, there has been a growing interest of the construction sectors in using Building Information Modeling (BIM) due to many benefits in design, planning, organization, management and construction of modern buildings. Building Information Modeling (BIM) is the foundation of information technology for modern construction projects (Nepal et al. 2008; Leite et al. 2011; Eastman et al. 2011; Bryde et al. 2013). Recent technology advances in BIM and Big Data makes construction techniques and management improved. Our aim here is to systemize the complex construction process and quantity of information as much as possible, and serves the BIM platform development.

There is no doubt but that scheduling and modeling are the most important factors in BIM system development, which effects on the scheduling include project planning, task-object programming, work packaging, schedule allocation and adjustment. Management and construction are the resources of modeling. With Building Information Modeling theory's backing, this study set up a construction schedule and management theory to the practice, as shown in Figure 1.

Planning, programming, packaging, allocation and adjustment for work, tasks and resources efficiency in buildings motivate the Architecture, Engineering, Construction, and Facility Management (FM). And make schedule survives in modeling, which could be made in high level in BIM: Building information modeling, building information models and building information management, based on BIM synergy. At last, it benefits ato manage construction resources efficiently (Akbarnezhad et al. 2013).

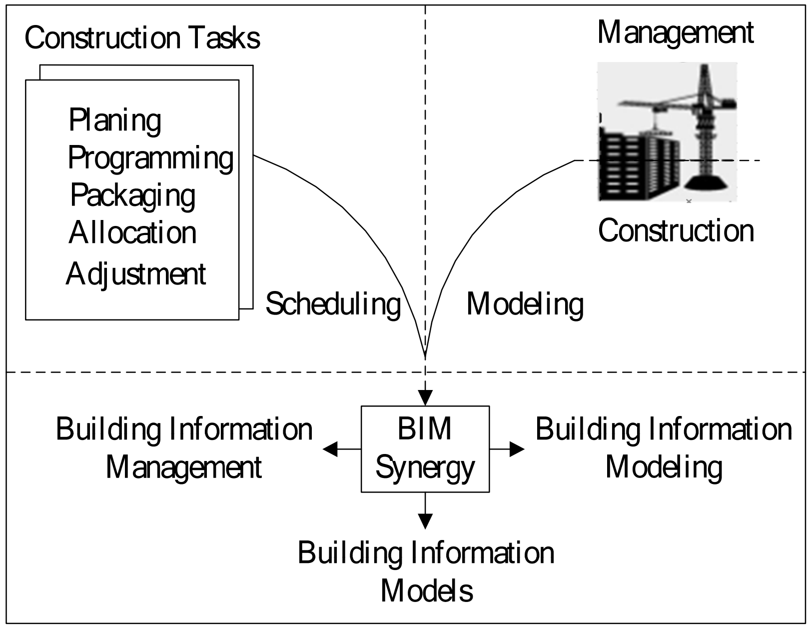

Figure 1.Framework of collaborative construction schedule and management base on BIM synergy.

Careful abroad studies about construction scheduling have been devoted to the macroscopic. But true, most of have always developed the problem from microscopic observation. And the development of BIM theory and technology is still a newly arising, and its science is far from complete maturity. This is truly researcher should change different research way which is different from the microscopic observation, and it has been an emergent task for us, because successful theoretical as well as application orientated researches with respect to macroscopic and microscopic perspective are necessary.

This paper aims to firstly analysis critical construction schedules of the BIM creation in existing buildings, and secondly at the schedules optimization based on BIM theory. The research results are useful for building professionals, BIM developers and construction project management involved in the implementation of BIM theory. The following analysis will study construction schedule in broader view to assure common understanding of all major consideration. Besides that, two major modeling are described.

CORE CONSTRUTION SCHEDULES IN BIM IMPLEMENTATION

Project planning always influences the schedule of construction, which could show the critical path both on BIM platform and reality construction. In this study, here Figure 2 is a summary of the most important construction schedules in BIM implementation.

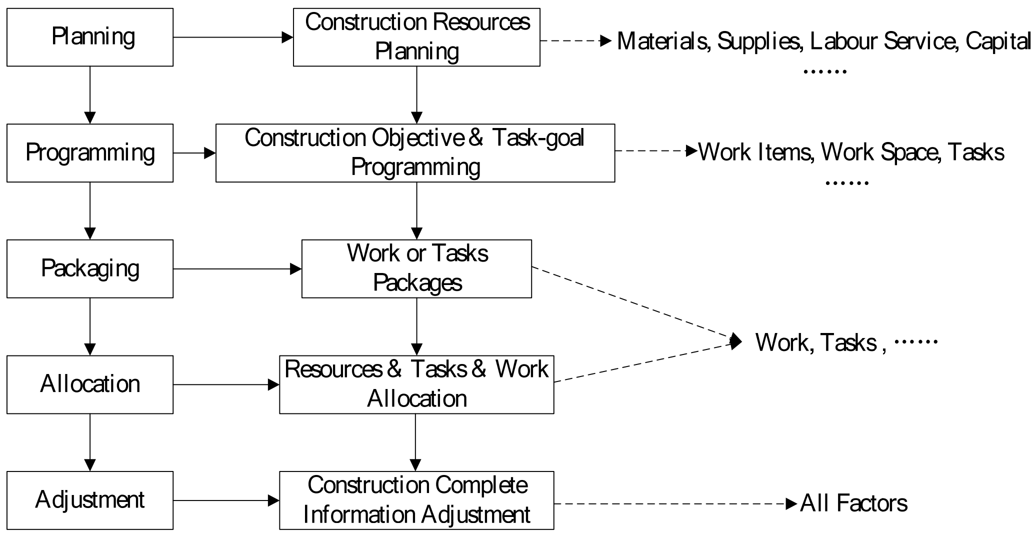

Figure 2.The core factors of construction schedules in BIM implementation.

Combination of the above analysis, let's look at each one of these critical factors in more details in the following paragraphs:

Planning. From Wikipedia, planning is the process of thinking about and organizing the activities required to achieve a desired goal (Allmendinger and Gunder 2005). This article, it specifically means "Construction Resources Planning".

Programming. The patterns which about critical tasks solution and engineering management through experience ("programming"), and that can service to achieving specific goals in construction. So it specifically means "Construction Objective & task-goal Programming".

Packaging. Which means that necessary construction work should be parceled up into a number of work or task packages, so that can help us to budget and control the construction work or tasks.

Allocation. It specifically means resources and tasks allocation in construction. It is a part of construction resources or tasks management. In construction project management, resources or tasks allocation is the scheduling of activities and the resources or process required by those activities while taking into consideration both the resources availability and the project time planning. There are a number of approaches to solving construction resources, tasks or work allocation problems e.g. resources, tasks and work can be allocated using a manual approaches, an algorithmic approaches, or a combination of both.

Adjustment. Resources, tasks or work are regulated with, adapted to and set in all steps of construction. In this study, which means manager should adjust all factors of schedules, such as Construction Resources Planning, Construction Objective &

Task-goal Programming, Construction Work or Tasks packaging, and Construction Resources & tasks & Work allocation.

In this section, core construction schedules are described, which is the one of most important factors when BIM implementation. And following parts will study the relationship between construction schedules and reality construction.

SYNERGISTIC INTERACTION BETWEEN CORE CONSTRUTION SCHEDULES IN BIM AND CONSTRUCTION

As we know, the definition of BIM can be study in narrow and broader views. In a narrow sense, Building Information Modeling (BIM) is defined as "shared digital representation of physical and functional characteristics of any built object which forms a reliable basis for decisions". Which originate from product models are widely applied in the construction, petrochemical, automotive or ship building industry (Cerovsek 2011; Borrmann and Rank 2009).

BIM can be made several interpretations possible: building information model, building information modeling and building information management. As building information modeling initially was intended to support building design and construction processes by Virtual Design & Construction (VDC), which is the term used by Contractors to virtually construct a building and does generally address schedules, management logistics and construction, etc., as good as BIM is synergy with models, modeling and management, it is only optimizing a sub-schedule such as planning, programming, packaging, allocation and adjustment for work, process and resources.

Besides above, as development of BIM theory and technology in modern world, the function of BIM is fully responsible for construction projects quality management, scheduling, safety control and so forth. BIM system function could be installation not only in quantities calculated that includes the construction work of earth, steel, piping, doors, windows, concrete and other parts, but also costs control and comparison with budget which is one of the most important constituents of construction project management. So this study associate the essential construction schedules with BIM such as construction resources planning, construction objective & task-goal programming, and construction work or tasks packaging, construction resources & tasks & work allocation, and so forth. All the details see Figure 3.

Further analysis will confirm the synergistic interaction between construction schedule and BIM, key-factors are following:

Construction resources planning (CRP). This is defined as method in effective planning of construction resources both of reality building and BIM application. Ideally, it addresses operational construction planning in units, financial planning, and has a simulation capability to answer "what-if" questions and extension of closed-loop in building processes or BIM system implication. Besides, it is a role software of the building information-Integrated System in BIM theory. All construction resources are the sources of all building information and the gathered places of concealed profits.

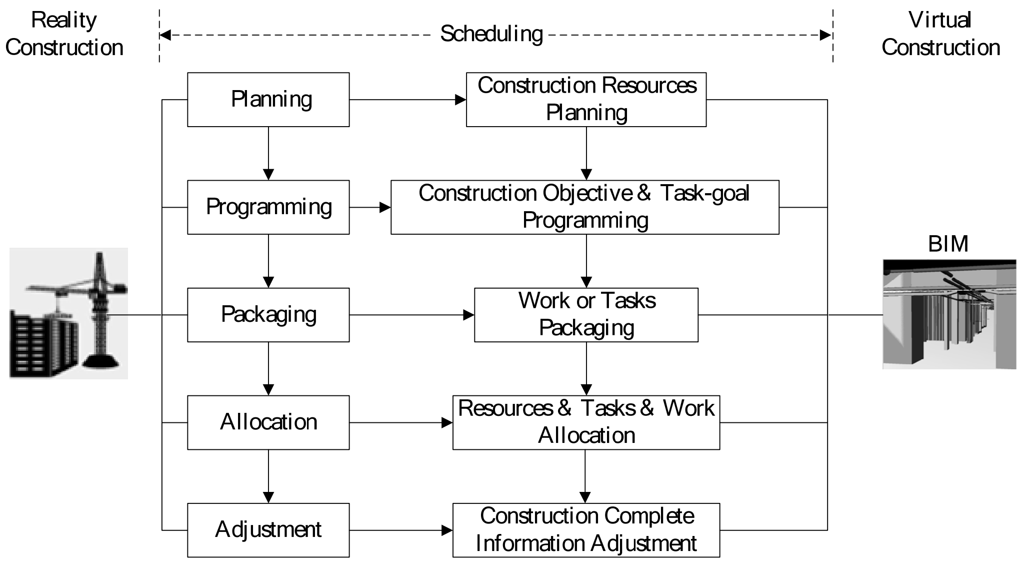

Figure 3.Essential construction schedules with BIM.

Construction objective & task-goal programming (COT-GP). It is approaches or strategies which mobilize and schedule the all available construction resources to support the real-project or in BIM system implementation. It's a connection between the construction resources or its information ("construction subjective"), processes and goal ("task-goal") through construction experience ("programming") and that these can be changed to achieve specific goals in construction project.

Construction work or tasks packaging (CWTP). The necessary work should be parceled up into a number of work packages, which involves the various links and aspects of many different specialized construction work and project tasks. Especially in BIM system implementation, construction work and tasks are packed in database so that supports Building information models, building information modeling and management. Which makes BIM can be installation project computation of quantity and costs according to construction work and tasks. At the same time helped to forward the construction project development.

Construction resources & work & tasks allocation (CRWTA). Construction Resources & Work & Tasks allocation is used to assign the available resources in an effective, economic and strategic way. It is a part of construction project management. In construction project management, resources & work & tasks allocation is the scheduling of activities and required by those activities while taking into consideration both the Resources & Work & Tasks availability and the construction project time, especially for total life cycle BIM implementation.

Construction complete information adjustment (CCIA). During construction, problems often arise which require schedule changes with the specific construction project planning and programming, the initial construction strategies in CRP, COT-GP, CWTP and CRWTA should be adjusted to achieve the optimal construction process step by step, until relative goal is reached. Its continuous improvement will be carried out according to the whole construction process, so it's named Construction Complete Information Adjustment. As may see, whether BIM implementation or actual construction needs CCIA in today's modern construction world.

CONCLUSION

With the development of information and technology, the need for collaborative construction schedule and management base on BIM theory is inevitable. Over the past few years, international trend has shown that BIM theories in the construction already changed, which has development from the three dimensional to multi-dimensional, integration of multiple factors such as schedule, cost and labor, and so forth.

Through analysis and comparative research mentioned above, the paper finds that as the BIM theory and technology development, it is necessary to systematize the essential construction schedules such as Construction Resources Planning, Construction Objective & Task-goal Programming, and Construction Work or Tasks Packaging, Construction Resources & Work & Tasks Allocation, and so forth. And make them organized with BIM theories. At last, all jobs that have been done will be a great boost to the construction management science and BIM theories development.

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Research on Precast Concrete Structures with BIM Involving Information on Structural Details and Behaviors

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ABSTRACT

Building Information Model (BIM) is considered as a promising means to facilitate the application of precast concrete (PC). Ordinary BIMs involve the information on geometry, materials, manufacturing details, quantities and so on, which are determined after designing. However, the component details and mechanical behaviors of PC structures, which are usually ignored in the BIM during designing, could profoundly affect the final structural forms. In this paper, several different precast beam-to-column connections applied in China were modeled as the basic components with BIM software, and similar precast moment-resisting frame models were designed with these connections meeting requirements of building codes. Finally they were compared in terms of quantity and total cost. Conclusions came that it was important to build the structural system library of PC including the information of component details and mechanical behaviors in BIM.

INTRODUCTION

Building information modeling (BIM) is a conceptual technology of generating and managing all information related to buildings to transform the paradigm of the construction industry from traditional 2D-based graphic drawing information system to 3D object-oriented information systems (Jeong et al. 2009). It encompasses 3D parametric modeling of buildings and components with geometric or non-geometric attributes of functional, semantic or topologic information (Wong and Yang 2010). For instance, functional information provide scheduling information such as costs, quantities or time consumption, semantic attributes refer to e.g. information like aggregation, connectivity, intersection or containment, and topologic information can be e.g. components' locations, adjacency, co planarity or perpendicularity (Volk et al. 2014). For the intrinsic characteristics of BIM, its adoption is increasingly becoming widespread as a basic technical approach to support interactive and automated design and engineering, data storage and editing to facilitate design, procurement, fabrication, and erection (Laiserin 2002).

As is known that precast concrete structures is advantageous in quality control, speed of construction and cost efficiency, it is becoming increasingly popular in the construction industry of both developed and developing countries. Not like the conventional cast-in-site structures, precast concrete structures comprise of prefabricated components which are installed together to form an integrated structures. In other words, precast concrete structures are assemblies of discrete components that are well suited to object-oriented modeling (Barak et al. 2009). Thus, BIM is being utilized in design, manufacture and construction life cycle of precast concrete structures (Sacks et al. 2005).

In the traditional Architectural, Engineering and Construction (AEC) industry, architectural and structural constitution of buildings are generally designed by architects and structural engineers, but contractors have little influence on those. However, in precast concrete domain, different contractors, who are usually responsible for both prefabricating and erecting, provide different precast concrete structural systems that are defined by different component details and mechanical behaviors. With the help of BIM, component libraries are built by practitioners involving the information on geometry, materials, manufacturing details, and quantities and so on. But the precast structural system libraries in BIM with the information on component details and mechanical behaviors are missed.

In this paper, three precast beam-to-column connections, of different detailing and structural behaviors, for moment-resisting frames were introduced and modeled as the basic component library by Tekla Structures. A simple frame from a real engineering project was chosen as the prototype to build three BIM models with the three different beam-to-column connections. The difference of the three models was discussed, and quantities were compared as well as total costs.

BASIC BEAM-TO-COLUMN CONNECTIONS

As the upgrading of industries continues and skilled labors become more and more expensive in China, precast concrete structures are increasingly used recently. There are three kinds of precast concrete moment-resisting frame systems mainly applied in China, i.e. Ruentex system, Scope system and PPAS system (Guan 2014).

Ruentex system. The precast concrete frame of Ruentex system, developed by Ruentex Group, absorbs different aspects of precast concrete technology in Europe, Japan and China’s Taiwan region. It consists of precast concrete columns, composite slabs and beams, in-situ concrete shear wall which are connected by pouring cast-in-place concrete after erection (Yin et al. 2012).

The precast composite beams are prefabricated with the bottom longitudinal reinforcement bars protruding from the beam ends into the joint core, the ends of theses bars are forced to form 90-degree hooks for anchorage. The columns are precast with grout sleeves to connect each longitudinal reinforcement bar of lower columns. After the installation of precast columns and beams, the continuous top reinforcement bars through the joints and along the composite beams are fixed into the system, and then the cast-in-place concrete is poured to form the beam-to-column connection (see Figure 1). In order to avoid the obstruction of reinforcement bars in the joint cores, the reinforcement bars of a column are placed in the four corners and the ones of different beams must be interlaced precisely during prefabrication.

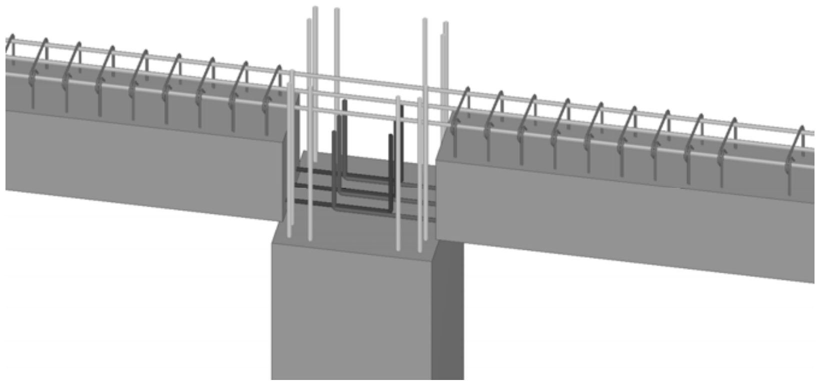


Figure 1.Details of beam-to-column connection in Ruentex system.

Scope system. Scope system was introduced and ameliorated by Nanjing Dadi Construction Group from PPB Group International Inc. in France. It is a precast prestressed concrete frame system constituted by precast concrete columns, precast prestressed concrete beams, composite slabs and cast-in-place concrete connecting precast components (Liu 2013).

The precast concrete columns can be manufactured with continuous elevation leaving a free space in the connection zones; they can also be prefabricated with a length of a storey, in which case the columns are connected by grout sleeves. The pretension strands are utilized as bottom longitudinal bars of precast beams with U-shape cross sections at both ends. The precast beams were connected to precast column through two U shaped conventional deformed bars and cast-in-place concrete for the joint and beam U-shape hollow (see Figure 2).

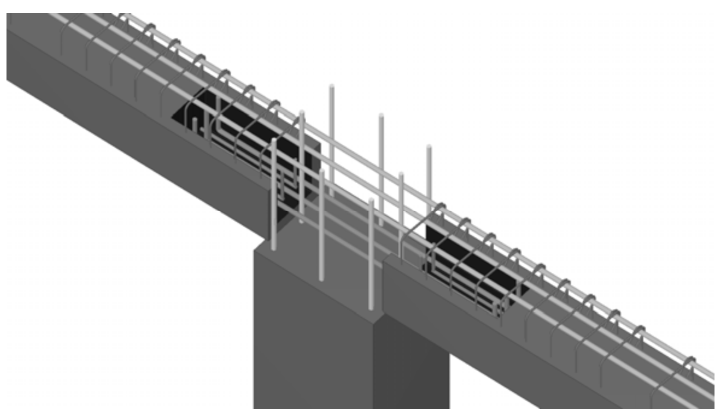


Figure 2.Details of beam-to-column connection in Scope system.

PPAS system. PPAS system was developed by the Huahui Construction

Technology Co., Ltd. cooperating with universities such as Tsinghua University, Southeast University and Zhejiang University. It is also a precast prestressed concrete frame system of high cost effectiveness on the basis of Chinese situation and Japanese prestressing assembly technology of precast concrete (Wang 2012).

The precast column are prefabricated with embedded steel parts in the connection region, and short channel steels are placed into the ends of pretensioned precast beams, which extrude into the joint core to connect the embedded steel parts in columns. The continuity of this kind of beam-to-column connection is achieved by connecting the embedded steel parts, anchoring the prestressing strands into the connection region and pouring cast-in-place concrete (see Figure 3).

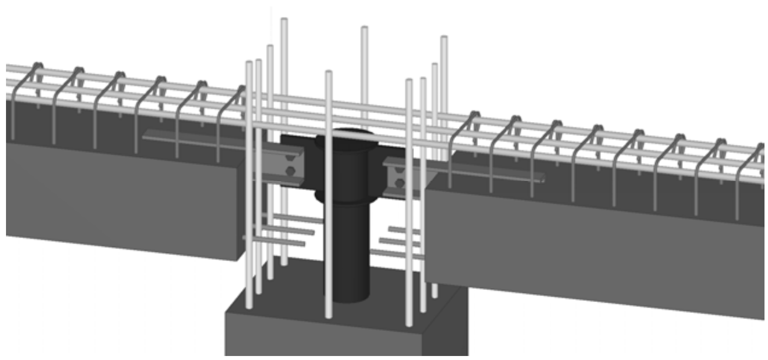
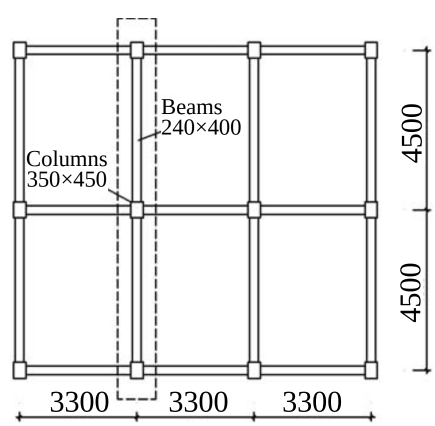


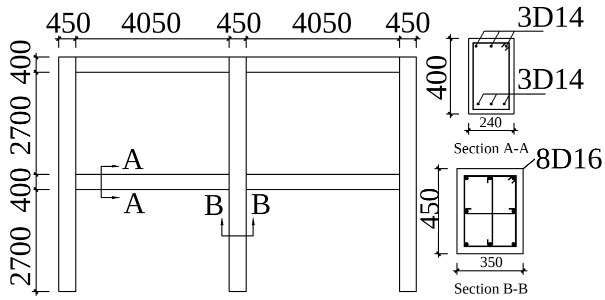
Figure 3.Details of beam-to-column connection in PPAS system.

PRECAST CONCRETE FRAME MODELING

In order to analysis the difference between the precast concrete frame structures with different types of beam-to-column connections, three BIM models of a two-story, two-bay frame were built with the introduced beam-to-column connections. The selected frame model derived from a prototype monolithic frame building, which was a rectangular, six-story building in Jiangyin, China. Figure 4 shows the plan and elevation of the building, as well as the crossing sections and reinforcement details of components.



(a) Plan of the prototype frame structure.



(b) Elevation of the selected prototype frame.

Figure 4.The prototype frame structures.

On the basis of the prototype frame, all the precast concrete frame models were analyzed by structural software and designed to carry the same loads satisfying the requirement of the Chinese Code for design of concrete structures. Figure 5-Figures 7 illustrate the Tekla model of the three precast concrete frame models, highlighting the reinforcement details.

As for the need to distribute the column longitudinal reinforcement bars in the corners of the column, the column section of Ruentex system transformed into 450×450, and reinforcements were changed to 12 D 14. The beam sections of Scope system and PPAS system were reduced to 240×350 because the loading-carry capacity of pretension beams with smaller sections was enough for the same vertical loads. In terms of PPAS system, the column longitudinal reinforcement bars in the side, where the beams connected the column, transformed into 2 D 16 + 2 D 12 leaving space for embedded connecting steel parts.

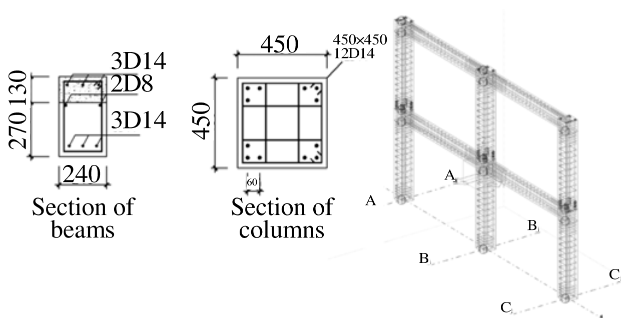


Figure 5.The precast concrete frame modeling of Ruentex system.

DISCUSSION OF QUANTITIES AND COSTS

Table 1 illustrates the quantities and costs of the three precast frame models. The quantities were obtained by Tekla software, and the costs were calculated on the basis of construction market in Jiangsu, China. It can be seen that the quantities of concrete and deformed bars in Ruentex system were the largest for the increased sections of columns. The strands were used in Scope system and PPAS system, which added costs of strands to the systems but reduced the amount of concrete and deformed bars. Embedded steel parts were adopted only in PPAS system, which increased the cost. As to the total cost, the model of Ruentex system ranked first and the one of Scope system cost the least.

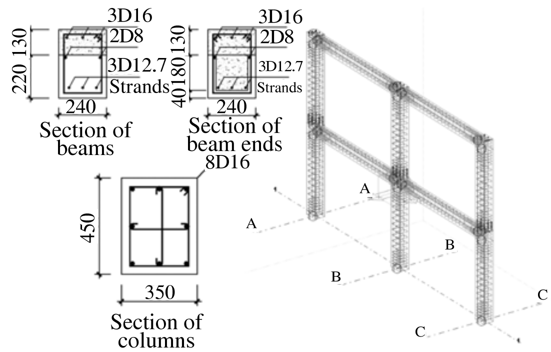


Figure 6.The precast concrete frame modeling of Scope system.

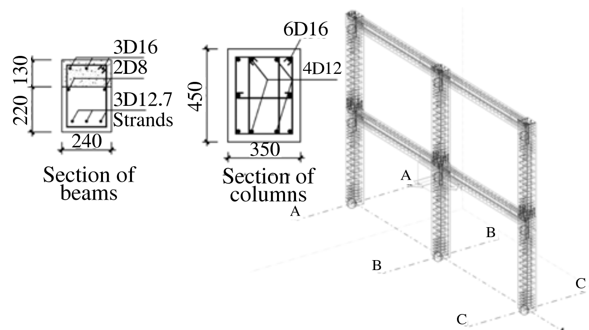


Figure 7.The precast concrete frame modeling of PPAS system.

Table 1.Quantities and Costs of Precast Frame Models.

Precast frame systems	Ruentex system		Scope system		PPAS system	
	Quantities	Costs	Quantities	Costs	Quantities	Costs
Deformed bars (Cast-in-site)	39	251	54	350	51	330
Deformed bars (Precast)	173	976	92	516	125	705
Strands	0	0	11	72	11	72
Concrete (Cast-in-site)	2466	514	2310	481	2319	483
Concrete (Precast)	10808	2240	8392	1743	8384	1735
Grouting sleeves	36	648	24	432	30	540
Grouting materials	30	175	24	138	26	148
Embedded steel parts					128	613
Total		4805		3733		4627

CONCLUSIONS

Building information modeling technology has been widely used in AEC industry and is very advantageous in precast concrete industry. In real practice, the design and construction of precast concrete structures are restricted by the precast concrete structure systems that contractors are capable to provide.

After the comparison of the discussed precast concrete frame models, results showed that the quantities and costs of different precast concrete structure systems were quite different, although they were designed to carry the same loads. It could be concluded that the details and structural behaviors of precast concrete structures have a great influence on the whole process of AEC practices.

Although quite a lot of component libraries of precast concrete structures have been built in much BIM software, the most important is the structural system library of precast concrete, which should be built by practitioners in AEC industry soon.

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Study of a Self-Help House Decoration Mode Based on BIM

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Abstract

When E-commerce and Building Information Modeling can be used together, it will produce a new mode of self-help house decoration. This paper systematically analyses the disadvantages of the traditional house decoration and introduces the self-help house decoration mode, including its implementation process and structure framework. Than it analyses the new decoration mode and summarizes the advantages and disadvantages of the mode, finally, try to find solutions to overcome the obstacles in realizing it.

INTRODUCTION

With the development of social productivity, the housing industry is faced with the transition from extensive mode to intensive mode. House decoration, as an important part of the housing industry, must also be combined with the advanced mode of production, making changes to the way of intensive development. People's demand for house has been gradually improved, including not only safety performance and function of the residence, but also beautiful, personalized, comfortable requirements. At present, the mainly style of residential delivery in our country is still to deliver the semi-finished room, the shortcomings of the second decoration mode, in which customers decorate their houses by themselves, prompts the government to develop integration of architectural decoration. However, due to increasing costs, bad influence of customers personalized demands and the fact that design, construction and decoration are divided into several parts, the implementation of integrated building renovation encounters a bottleneck. In 2001, our country has carried out the experimental work of full renovation of real estate in Beijing, Shanghai and other cities. In 2002, further increased residential building renovation efforts have been put to execute. Ministry of Housing Industrialization Promotion Center issued detail rules of commodity residential renovation all at once in the same year. After a period of development, the entire renovation of commercial housing has made considerable progress, but the problems are also evident. The most prominent problem is the full-scale renovation of real estate and consumer demand for personalized standardization leads to contradictions.

There are so many factors related to the integration of building renovation that we can separate them into several categories: social factors including real estate, construction, economy, and culture and so on, persons involved in the real estate developers, designers, architects, consumers, even environmental protection, sustainable and other factors. In the premise of considering so many factors and satisfying all stakeholders needs, the convenient way of information exchange has become a key factor in promoting the integration of building renovation. Building Information Modeling (BIM), as a means of information technology in the construction industry, can solve the problem of information interaction and improve efficiency and quality of information exchange to facilitate the various stakeholders on many renovated building factors consensus and to manage projects scientifically, transparently and efficiently. Internet mind emphasizes that customer first and experience is king. The core pursuit of booming e-commerce industry is customer satisfaction, which provides a good learning experience for residential building renovation integration. Application of BIM technology and sophisticated e-commerce industry supply the chance and technical support for consumers to participate in the front-end residential design, thus consumers' personalized demand for house can be satisfied. Consumers can also buy inexpensive decoration materials through the e-commerce platform.

THE TRADITIONAL PROBLEMS OF RESIDENTIAL RENOVATION MODE

The traditional pattern of residential renovation is that real estate developers provide rough housing, leaving the renovation work to consumers. Although, to some extent, the traditional mode changes the housing environment, improves residential comfort, also satisfies the consumer demand for personalized houses in greatest degree, it causes a lot of problems:

Consumers should spend a lot of time and efforts in decorating their house. While they may find that their houses far from what they want at last in this way. Most consumers do not have the appropriate expertise. Therefore they do not have the ability to comparison decoration designs, to select decoration companies with professional qualifications, to purchase suitable decoration materials or to oversight decoration process.

The body design of building and interior decoration are usually finished by different companies. There are problems in effective interface because different designers have various design concepts. The conflicts between two designs may cause much more time and money consuming. Sometimes designs without examination and approval by qualified companies can do harm to the structure. For example, some load-bearing walls are removed just to change the spatial distribution and the equipment pipelines are tamper. These changes undermine the integrity of the house and have a bad influence of mechanical properties of building. It not only leaves security risks but also makes barriers for building maintenance, even shortens the life of the building (Yang et al. 2012). Meanwhile, some designers focus only on the visual effects of the design, ignores ergonomics, relevant standards and consumer demands, which should be put into the first place.

It is difficult for consumers to find problems from abstract two-dimensional drawings, not to mention that consumers make suggestions to the designers, which leads to frequent changes in the decorating process.

There are so many renovated companies with different technical levels. The employees of these companies also have greatly various professional qualities (Wei 2014). Most employees are migrant workers without professional training or assessment. It is impossible for them to use standard construction methods or to make sure decoration done with high quality. While, there is a large number of on-site manual wet operations heavily dependent on the quality of the decoration technical level of workers in the traditional renovation pattern, which means that quality is difficult to be guaranteed. The process of house renovation requires a great deal of equipment and the construction site is often confusing, thus, mismanagement easily leads to accidents. When decoration quality problems occur, it is difficult for consumers to protect their legitimate interests, which may increase economic disputes.

The lack of decoration materials quality assurance is also a key factor (Shao 2013). There are two different ways to get the needed materials. One way is that consumers commission decoration companies to purchase these materials, another is to select all by themselves in traditional decoration mode. If decoration companies are commission to purchase materials, it will give chance for the companies and material suppliers to play cheat on consumers to get more unfair income. When consumers choose materials by themselves, it is almost impossible for them to tell good materials with high quality from thousands of different kinds ones, which is just the first step to buy inexpensive materials. As we all know, the quality of decoration materials are directly related to the properties of the house. Some non-qualified materials can release bad gases, which are harmful to human health. So in order to ensure the safety of residential, we must use qualified materials. While the decoration materials market is so mixed that people, who are lack of professional knowledge and current market conditions, can hardly get the proper materials at appropriate intervals (Chen 2014).

Renovated regulation and quality acceptance are ineffective. Due to the characteristic of the scattered projects, most consumers take their own ways to monitor. Few consumers have the professional management experience so that they cannot reduce the slacking of construction workers and waste of decoration materials, or make corrective recommendations to change unreasonable design and settle other issues happening during the process. Meanwhile, duration and cost of decoration are usually out of control. After completing the renovation, there are no professional organizations which are responsible for the quality inspections. Consumers only judge the quality of work by what they see (Shan et al. 2013), which leaves consumers themselves the hidden substandard quality problems.

The traditional mode also has adverse impact on the surrounding environment. During the approach of renovation, it is unavoidable to make noise, which will greatly destroy the living environment and disturb the normal life of other residents. A large amount of construction waste and sewage in the renovation process also has bad influence on clean living environment. In addition, community safety is also affected by the complex composition of workers.

THE BOTTLENECK OF FULLY FURNISHED ROOM MODE

Given the problems in traditional residential renovation mode, we are making efforts to promote the construction and decoration of residential integration process. There have been more and more full-decorated apartments on the market. Fully furnished house refers to that all the fixed surface of the functional space is paved or painted and the basic kitchen and bathroom equipment is fully installed. Compared with the traditional mode, the fully furnished room has obvious advantages. The real estate developers who supply fully furnished house reflect that their business concept is the pursuit of customer satisfaction. Renovation program is designed by the professional ones and different designers of the main body and decoration can communicate effectively with each other. In this way, there will be an integrated design to ensure its aesthetics, rationality and comfort. Decoration industry can form into such a large-scale operation that professionals can make a living by its supervision and management. It can not only regulate the industry, but also reduce the cost of decoration materials and construction losses (Zhu 2013). In the integrated renovation process, real estate developers organize material supply and industrial production. And they are also responsible for the quality of decoration. It is the development trend of the housing industry to provide consumers fully furnished room. It is also a good way to promote the shift from extensive development of building renovation industry to intensive development. Although it has so many advantages, there are also some difficulties in the current process of implementation.

Consumers show few approvals toward the fully furnished house. It has a long history to deliver rough house on the housing market, consumers get used to the traditional mode. Consumers know little about the fully furnished mode, which is the barrier for consumers to accept it. And in their mind, they can decorate their house according to their own needs and choose the most suitable renovation program if they buy rough houses. There are two programs in the current full renovation. One is the apartment style decoration, which means the whole decoration process without the participation of consumers. What consumers need to do is to complete the transaction because other work is entirely finished by real estate developers. The other is to select from a series of menus given by developers, from which consumers can choose some combinations according to their own needs (Pan and Zhang 2003). In both of the two modes, consumers have to make a great concession and compromise, since there are quite prominent conflicts between the individual needs and industrialization. In addition, the residential renovation process is entirely completed by real estate developers. There is no promise that developers will give the concessions, which they get from scale procurement of decoration materials and large scale renovation process, to consumers. In other words, the management and the supervision of the decoration are not transparent, which makes consumers can not fully believe that they can get fully furnished real estate through this mode.

Developers are low power to give impetus to the new mode. Currently, rough house not only has quite good sales, but also can reduce their work. And it does little to help sales growth to do decoration. Instead, due to higher house price after renovation, the same type of real estate may be at a disadvantage in the competition. Developers should provide more services in the fully decorated mode, but it is not so sure that they can get corresponding reward. What's worse, developers are at the first position to be responsible for the quality of decoration. In fact, fully furnished real estate will extend the development cycle and increase costs caused by more taxes, more administrative expense and other factors. From the standpoint of risk aversion and corporate profits, real estate developers are more willing to provide rough house, rather than fully decorated real estate.

The lack of supporting management measures also limits the development of the new decoration mode. Fully furnished room is not yet a mature business model, such as gaps in the quality inspection. There is no corresponding organization that will inspect quality of fully furnished real estate in accordance with established quality acceptance criteria. The purchase contract of the fully furnished real estate is provided by developers. Thus, the legitimate rights and interests of consumers is difficult to be guaranteed. The contract terms about the decoration are usually so blur that consumer can not accurately know the decoration standards and the quality of the materials to be used in the decoration. In fact, these terms are lack of substantial guiding force. Meanwhile, there is no clear regulation that makes specifications for developers' behavior during the renovation process, which makes big loopholes in material tests, construction methods selection and daily management. All these factors make contribution to quality problems and costs increasing (Wei 2014). The disputes arising from these between consumers and developers cannot use the terms of the contract or standard to define.

THE SELF-HELP DECORATION MODE BASED ON BIM

At first, there should be a clear definition of the self-help decoration mode based on BIM: it refers to s new decoration mode, which supported by BIM and e-commerce, that consumers can participate in the front-end of residential design, complete residential renovation design, which will be checked and modified by designers, and material purchase in a one-stop. The traditional decoration mode and the fully decoration mode have advantages and disadvantages. With the support of e-commerce, the self-help decoration mode can set the two former modes strengths together and provide solutions to their total shortcomings. The core pursuit of the self-help mode is consumer satisfaction. In this mode, what developers need to do is to help consumers decorate their own houses according to their wishes in the most efficient way. Consumers can get the information of progress of renovation, cost, quality and other engineering aspects through terminals. Ultimately, consumers can be assured to live their ideal residential. Nowadays, people have much more pressure from work and life so that they do not have a chunk of time and enough effort spending in decorating house. While, there is no doubt that people's demands for house are quite different with the improvement of living standards. What people need is not only a beautiful comfortable place to live, but also a masterpiece to show their own culture taste and personality. The decoration of the house should reflect the life aspects of its owners and also be in line with the concept of living a low-carbon life and sustainable development. The self-help decoration mode based on BIM can effectively reconcile this contradiction so that consumers can complete the renovation of residential through information terminals in their spare time. Figure 1 shows flowcharts of the self-help decoration mode.

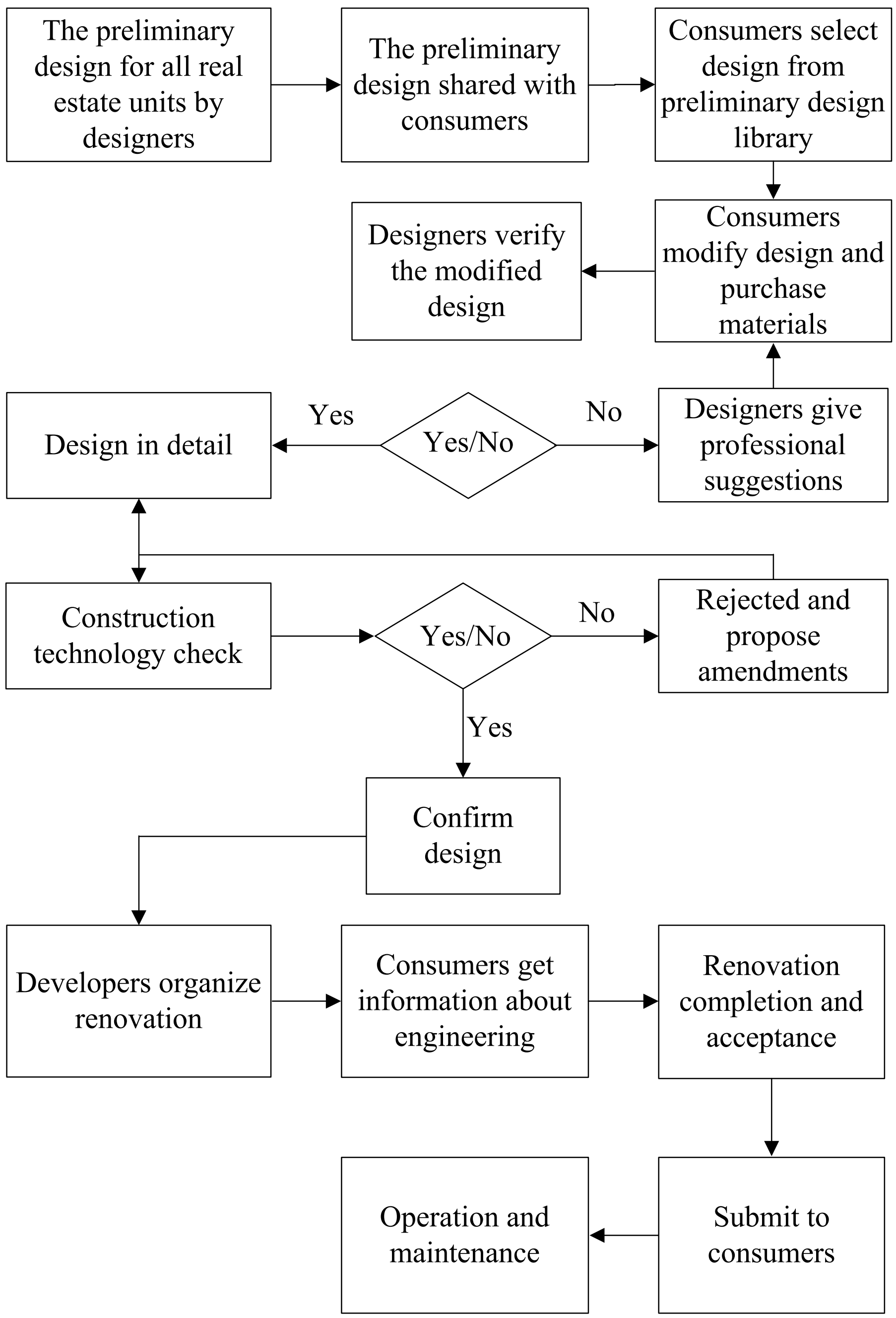

Figure 1.Flowcharts of the self-help decoration mode.

As we all know, BIM can provide three-dimensional architectural models. In the new decoration mode base on BIM, design effects rendering and visualization of three-dimensional component model library makes design become such a simple thing that consumers can use software to express their own ideal residential design to the designer. After reducing the professional threshold of interior design, it allows consumers and designers communicating without barriers. Meanwhile, it is more convenient for consumers compare and select satisfying programs because of the function to render three-dimensional effects immediately. Since BIM provides information platform, consumers can directly and figuratively discuss the design in detail, eventually forming a design which can not only meet the consumer demands but also comply with the requirements of professional norms (Wang et al. 2013).

The components and materials in the BIM component library come with some parameter information, not only the length, width and height. Combined with e-commerce, they can also has information on morphology, origin and price, which enables consumers to complete their design considering the relevant factors in price, the logistics of time and product reviews. Consumers can complete design and purchasing material at one stop, which achieves the most satisfied design at a minimum cost of time and effort. With quantities automatic statistical function supplied by BIM, consumers can directly obtain the total cost of renovation, which allows consumers adjusting the total cost in their affordable range (Tong and Wang 2014).

Supported by BIM technology, the process of design is simplified and the correlation characteristic of the related software can significantly enhance the working efficiency. Therefore, designers can focus on the design itself and provide solutions to consumers design one by one. After getting the consumers personalized revised program, designers check the modified sites and the associated sites only, combined with ergonomic, building architecture and the knowledge of other aspects. Then designers give the professional revisions to consumers in detail. Because of the characteristic of parametric model, most of the work is done by software itself, designers only judge whether it is reasonable and modify some parameters. The parametric model also enables designers to design more than surface design and comfort design. The deeper residential design has a wide range of work, including energy, environmental quality and dynamic design. Energy consuming residential is in line with the requirements of society to promote low carbon lifestyle. Designers can ensure that the quality of residential environment after decorating will meet the housing needs and national standards so that consumers can be assured of the security. The demands of consumers in different ages may be various, the dynamic design solution allow consumers considering different needs of every stage at the beginning. Consumers make simple modifications under the program, then their changing residential demands will be met.

Relying on the three-dimensional dynamic virtual function provided by BIM technology, designers can design the construction scheme in detail. Checked by professional staff, the construction technology and the program are more likely to be scientific and reasonable. To some degree, it can make sure the quality and the efficiency of the renovation. After the completion of designing and materials selection, relevant staff can optimize the construction sequence according to the arrival time of materials and make a more accurate estimate about material consumption. In this way, consumers can get meaningful progress schedule and material consumption plans. At the same time, it is easy to realize fine management, which can reduce or eliminate wasting materials and delaying duration.

With the information platform, it is convenient for the participating parties of the decoration to exchange their information. In the process of the renovation, workers can feedback the decorated progress to consumers in real-time. Compared with the original construction schedule, consumers can know clearly about the decorating process. When project changes occur, relevant parties can reach a consensus in time to reduce the impact on the renovation project.

After obtaining consumers' feedback, property management personnel can find the reasons quickly and accurately with the help of the database, which makes conditions to solve problems in time. In addition, consumers can make a claim under the records in the database. Since decoration materials have different service life, consumers can replace the life exhausted materials, preventing the problem occurrence.

THE OBSTACLES IN REALIZING THE SELF-HELP DECORATION MODE

The self-help decoration mode has elusive advantages. However, there are also many unavoidable obstacles in the process to promote the new mode.

There are barriers in the process of BIM technology application. When BIM is applied to construction industry, it goes not so smoothly, which is due to hardware factors, lack of professionals and cost factors. In order to realize the new mode, software needs to make progress, which should apply ergonomics, building architecture and other applicable rules of interior design. So the software can provide professional and reasonable preliminary proposals, which ensures that consumers can modify programs efficiently.

There are new terms increasing costs, including database construction, information input, routine maintenance, updating and staff training. It will eliminate the cost advantage of the self-help decoration mode if the increased costs are passed onto the consumers. If afforded by developers, the new mode will lose an important force to promote its application.

Credibility of e-commerce also has influence. Although e-commerce has entered a mature period, the industry is facing serious problems. Among them, the most prominent one is the issue of integrity. Consumers buy materials through e-commerce, which is dependent on the integrity of others, including material suppliers to provide quality qualified products and other consumers to provide objective evaluations. Only in this way, consumers can reduce the possibility that is misled by false and wrong information and buy cheap materials, which is the key factor to exert the new decoration mode's advantages. If consumers buy interior materials, it will take a lot of time to return goods and make claims and will also result in an inevitable impact on the decorating process.

The blank of government regulates. The design modified by consumers based on preliminary design and the eventually formed design by designers may cause conflicts of intellectual property rights, which the law is not clearly defined. It is defined in law that the pre-sale of real estate can be carried out only after the project is started. While, designers provide service before the start of project in the self-help decoration mode. If consumers default, it is difficult to ask consumers to pay for this part of labor. There is no department which is responsible for the quality inspection of decoration. And the relevant quality standard is far from forming a system. There is no provision to regulate renovation process, which can reduce the problems during decorating.

CONCLUSIONS

The self-help decoration mode can not only meet the requirements of social production to increase productivity, but also help consumers live ideal residential. The development of the new renovation mode needs a joint force, which comes from consumers, developers, designers and government. It is a new thing that needs to withstand the test of practice and gets improved in the exploration.

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Developing an RFID-Based Man–Tool Safety Management System on a Construction Site

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Abstract

Within a complex and volatile construction context, a real time safety monitoring method featured by solving management retard problem is in need for effective prevention and control of onsite accidents. This paper aims on analyzing critical safety factors performed by hand-held construction tools and onsite labor behaviors, establishing man-tool safety management indicators system, and using neural network model to assess safety indicators (except the Boolean-type indicators). Meanwhile based on onsite safety inspection procedures, the neural network safety decision-making model is integrated with RFID technology so that five subsystems (respectively man-tool identification subsystem, safety status information transmission subsystem, real time inspection subsystem, information management subsystem and safety alert subsystem) constitute a complete Man-Tool Monitoring and Management System, as to ensure accuracy and efficiency of onsite safety management.

INTRODUCTION

Construction industry is labor-intensive with high risk of causing onsite accidents and negative impact on social environment. The main source of onsite accidents is related to scaffolding and machinery operations. China is going in for plenty of large-scale construction projects and registering a steady rise in Gross Product of Construction Industry, in which a variety of high-tech construction machines and tools are used on construction sites. There is no doubt the entailed complexity will lead to more complicated building context and more construction hazards.

Construction site is full of high-altitude and complicated construction operations, and construction safety problems are always caused by potential dangerous factors. By many case studies on construction accidents, the main sources of construction hazards can be categorized into three aspects: (1) individual behaviors, which include traineeship, habit, faith, education level, cultural backgrounds, social attitude and physiological features of the labor; (2) working environment, which consists of attitude of managers, foreman and workmate as well as the company policy; (3) material elements such as operating conditions, large or small scaled machines, poisonous materials and protection devices (Barrie and Paulson 1992). In fact, safety culture is hard to establish within complex building scenarios, it is necessary to establish a scientific evaluation and control system through technological, behavioral management and project managerial methods. By combining characteristics of onsite construction technology and management, “4M1E” evaluation method is more comprehensive as to establish evaluation index containing “manpower, machine, material, method and environment” elements (Tian 2014). Based on these critical safety elements, Analytical Hierarchy Process and Fuzzy math theory are often applied to conduct quantitative analysis. The Fuzzy Analytical Hierarchy Process aims on determining safety status of a working system through the level of Faulty Behavior Risk (Zheng and Ma 2014), while the accuracy of evaluation using these methods is influenced by the experts’ experience with subjectivity. With the introduction of the momentum factor in the Neural Network Model, it can be more effective find the unsafe factors too accurately in the construction (Li 2014). This paper will focus on a neural network method application on controlling and managing the safety elements as to prevent the occurrence of failure behaviors.

With development of real time monitoring technologies, it is possible to apply more advanced these high-tech tools on construction sites as to break the bottleneck of construction safety management creating a Zero-hazard working environment. It is essential to know in time if the labor behaviors are abnormal. Traditional management systems currently used are radio intercom system, security patrol system, camera surveillance system and GPS satellite positioning system. However, these systems have some limitations, such as errors in determining the location of the worker and ineffective seamless information transmission. It’s necessary to automate the management with technical support and it’s better to achieve real-time security monitoring and continuous tracking of position and operations of labor wearing a detectable tag (Lee et al. 2009). RFID (Radio Frequency Identification) technology is able to realize the functions of monitoring regional activities seamlessly to prevent onsite accidents, which consists five parts namely RFID tags, readers, data communications systems, early warning systems and management server. RFID systems can automatically and immediately alerts accidents and help inspection personnel dispatch rescue people to assist injured labor, which also saves a lot of time for handling accidents (Wu et al. 2010). In order to reduce the risk of the construction accident, priority should be given to the creation of a “smart” construction environment. As a result, this paper is to propose a real-time monitoring technology applied to safety management, involving the use of data communications technology, sensor technology, high-performance computing systems, such as technology, making the construction site under real-time security control and accidents early warning scenario.

ESTABLSIHING ONSITE MAN-TOOL SAFETY INDICATORS

Analysis of safety elements related to onsite man-tool behaviors. Since the majority of accidents are caused by the unsafe condition of the labor operations, both the elements of construction machinery status and labor practices should be considered. Among all construction equipment, the hand-held power tools are the most commonly used in the construction of the various sub-segment of the construction of the building with a large number of species and widely distributed, such as impact drill, nail gun, angle grinder, hand-held saws, hand-held blender, etc, However such hand-held tools require frequent usage under complex operating conditions. Often their electrical insulation and power lines can be easily damaged and then cause accidents. In addition, these powered tools are often clenched by labors. Once meeting water leakage, the labor may get electric shock when seizing the charged machine body. To simplify the research object, this paper will only focus on the hand-held electric construction equipment. With different functions, different hand-held tools have their own unique safety checkpoint. For general protection part, general inspection and equipment load tests can be done in advance before the tools are put into use. And for critical part, there is need to ensure strict compliance with safety requirements, including preventing rain leakage, fire and explosion. These potential hazards of key control checkpoints must be avoided during the construction process. On the other hand, safety factors of labor are more essential regarding labor's professional level, physiological and psychological state and level of wearing protection device. Before entering the operating field, it is imperative to check whether labors are in good mental state, whether they can concentrate on the job with enough energy, whether they are fatigue and hungry, whether they appropriately wear insulated gloves, insulated clothing and other protection devices. Meanwhile during the working process, these checkpoints of labor are also inspected continuously by site managers. To conclude, both the labor behaviors and checkpoints of hand-held equipment are the main aspects of the security status to be discussed in this paper.

Defining the man-tool safety evaluation indicators. This paper defines a man-tool safety evaluation factor system (see Table 1). Onsite safety managers enter safety state of man-tool data into central management system for the daily management. These data are categorized in the form of the stipulated indicators, sourcing from maintenance records, routine inspection record, investigation of onsite staff, technical tests of tools, safety education record. The safety evaluation index already obtained contains Boolean indicators, discrete and continuous indicators. Boolean indicators include general checkpoints and key checkpoints with zero tolerance for disqualification; also indicator of whether labor is wearing the designated protection device is Boolean type. These items only have two values: passed and banned. So Boolean-type indicators are not suitable to be analyzed by neural network sample training, and the remaining index will be quantized and put into neural network evaluation model for analysis. Discrete indicators consist of basic performance of construction tools and professional level of labor. Discrete index also should be distinguished from use due to the objective or subjective values. Continuity indicators have values the can be continuously changed. These indicators include the level of performance of a labor, labor psychological states and physiological parameters.

In order to quantify the input indicators for training the neural network model, the initial safety data should be processed separately due to its type. First, remove all of the Boolean variables, and classify remaining variables as cost type and benefit type then unify them using standard 0-1 transformation formula. Evaluation results with better safety situations come from small value of cost-type indicators (i.e. using years of tools and the level of harsh weather) and higher value of benefit-type indicators (i.e. daily maintenance level and general performance of tools).

Table 1.Man-Tool Safety Evaluation Indicators Distribution Table.

Target	1st class indicator	2nd class indicator	3rd class indicator
man-tool safety	Equipment status	General checkpoints	Equipment structure checkpoints
			Equipment protection shields checkpoints
			No-load test checkpoints
		Key checkpoints	Matching degree of equipment in its working position
			Protection checkpoints against fire and explosion
			Special checkpoints
		Environmental checkpoints	The hazard level of working condition
			The level of harsh weather
		Managerial checkpoints	General performance
			Delivery quality
			Daily maintenance level
	Labor status	Professional level	Operation capability
			Previous working experience
		Physiological and psychological checkpoints	Physical state (blood pressure, etc.)
			Degree of fatigue
		Protection level	Personal awareness of protection
			Level of wearing protective device

SAFETY EVALUATION OF MAN-TOOL STATUS BASED ON BP NEURAL NETWORK MODEL

Description of back propagation neural network model. Traditional means to evaluate the onsite safety are expert scoring method by setting the standard for comparison, which is more subjective with limitations. Therefore, this paper uses neural network model as a more systematic and scientific way to train samples for evaluating each safety indicator and obtain an objective and reasonable evaluation result. The method calculates the gradient of a loss function with respects to all the weights in the network. The gradient is fed to the optimization method which in turn uses it to update the weights, in an attempt to minimize the loss function. Suppose the network has n inputs and m outputs, hidden lawyer has s neurons, the mid layer output is b_j, the unit threshold of mid layer is θ_j, the unit threshold of output layer is θ_k, the transfer function of mid layer is f_1, the transfer function of output layer is f_2, then it can obtain the network output y_k and network expectation output t_k by a series of relations, the output of mid layer jth unit is:

$$b_j = f_1\left(\sum_{i=1}^{n} w_{ij} * x_i - \theta_j\right) \tag{1}$$

Through the output of mid layer, it can calculate the output of output layer:

$$y_k = f_2\left(\sum_{j=1}^{s} w_{jk} * b_j - \theta_k\right) \tag{2}$$

The network training is the weight and the threshold value continual readjustment process, until it can cause network's error reducing to a minimum value or reaching the steps of pre-training. Then take the targeted sample as input, it can get the result of evaluation and prediction (Wen et al. 2000).

Applying BP NN method into case study. The number of input node in neural network is set to 10. Each node represents respectively the hazard level of working condition, the level of harsh weather, general performance, delivery quality, daily maintenance level, operation capability, previous working experience, and physical state, degree of fatigue and personal awareness of protection. Sample data is from interviews and field surveys of 15 Chinese construction companies' safety inspection and monitoring stations. The values of qualitative safety indicators are given by safety management expert with the evaluating score ranging from 1 to 5, and the other quantitative indicators use their own attribute values. After standardization of the input sample data, the input matrix (10 rows representing indicators * 15 columns representing samples) is shown in Table 2. Meanwhile the number of output node in the neural network is set to 1, the node indicates the safety level including the safe status, warning status and to-be-controlled status, corresponding to score 0, 1, 2. By giving each sample an output value reflecting its safety level, the output matrix is shown in Table 3. Matlab software provides its BP neural network toolboxes, making it feasible to train 11 samples out of total 15 samples, two samples are trained as a validation set and 1 sample for test set. Through five iterations, the result shows a mean square error with a value of 3.57×10^{-16}. The validation sample reaches the minimum mean square error, as shown in Figure 1. Due to the small quantity of samples, the sample training process does not make the neural network adjust to the best fit, and it shows a best validation performance at epoch 1. But it does not affect the qualitative assessment of the overall model. Under normal circumstances, there is a need to compare actual output value with trained output value in order to get the error. By modifying the hidden layer weights and thresholds, an optimal trained model will be obtained. In practical application, by using the trained neural network model and entering the man-tool indicator values, the safety level will be forecasted to the onsite manager and corresponded actions should be taken to cope with "to-be-controlled" and "warning" safety level.

RFID-BASED ONSITE MAN-TOOL SAFETY MANAGEMENT PROCEDURE ANALYSIS

Traditionally, safety managers monitor the onsite operations by their working experiences, which is not only time-consuming but also is restricted to personal memory, and management capability, resulting in safety management execution omission. Hence, it is better to develop a real-time RFID safety management system

Table 2.Input Matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
x_7	0.208	0.029	0.043	0.030	0.172	0.094	0.028	0.063	0.148	0.143	0.103	0.111	0.094	0.036	0.143
x_8	0.125	0.088	0.087	0.121	0.138	0.094	0.139	0.125	0.037	0.179	0.069	0.083	0.031	0.071	0.114
x_9	0.042	0.118	0.217	0.061	0.138	0.156	0.111	0.125	0.037	0.179	0.034	0.139	0.156	0.143	0.143
x_{10}	0.042	0.147	0.130	0.152	0.103	0.125	0.056	0.156	0.148	0.071	0.034	0.028	0.156	0.071	0.143
x_{11}	0.042	0.118	0.087	0.030	0.103	0.125	0.139	0.125	0.111	0.036	0.138	0.056	0.094	0.107	0.086
x_{12}	0.208	0.059	0.087	0.091	0.034	0.063	0.139	0.031	0.111	0.071	0.172	0.111	0.063	0.179	0.057
x_{13}	0.042	0.088	0.130	0.152	0.138	0.031	0.111	0.125	0.148	0.107	0.103	0.139	0.156	0.036	0.029
x_{14}	0.125	0.118	0.043	0.121	0.034	0.125	0.139	0.094	0.037	0.036	0.172	0.139	0.125	0.107	0.086
x_{15}	0.083	0.088	0.130	0.091	0.069	0.063	0.056	0.031	0.111	0.107	0.069	0.056	0.031	0.179	0.086
x_{16}	0.083	0.147	0.043	0.152	0.069	0.125	0.083	0.125	0.111	0.071	0.103	0.139	0.094	0.071	0.114

Table 3.Output Matrix.

Sample No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Value of safety level	0	0	0	0	1	0	2	0	0	1	0	2	1	0	1

which can carry out automatic monitoring procedures instead of subjective personal judgments. The overall management procedure is shown in Figure 2. Before entering the working positions, labors are asked to check their identification and finish registration of personal operation related records on the database, the database and RFID monitoring system together constitute a virtual server management. When labors pass through this checkpoint, they will get the appropriate corresponding construction tools, protective devices with RFID tags and then enter the designated work area. During the working process, on-site inspector will use a hand-held RFID reader to a particular working area as to monitor those tagged workers if they are at the right position doing designated work. Man-tool safety information is transmitted via wireless technology to the back-end servers which is used for decision-making, determining if the man-tool status meets safety standards. The backend system will inform the site inspector result of safety level by sending safety evaluation results via wireless technology. If the result is “warning” or “to-be-controlled” safety level, the inspector

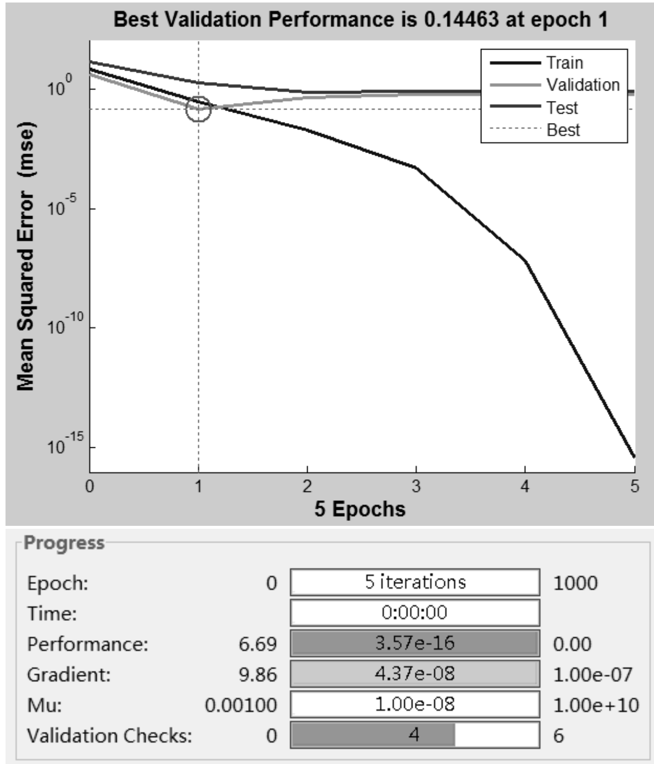

Figure 1.Sample training results in BP neural network.

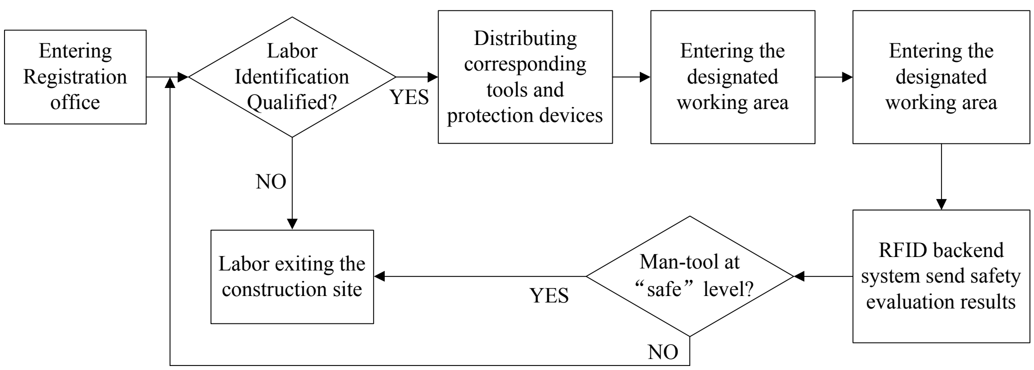

Figure 2.RFID-based onsite man-tool safety management procedure.

will prevent the labor to stop his ongoing operations or correct his operations, however if inspector receives message showing a safe level, the site inspector will be informed to monitor the labor in the next work area. The main features of RFID-based safety management system is to help determine quickly if the labor is working in designated areas with the right tools, also the high efficiency is enjoyed by using real-time monitoring technology. When labors leave the designated working area, they need return to the registration office updating the whole day operations information which will be stored in central management system as historical labor safety records.

RFID-BASED ONSITE MAN-TOOL SAFETY MANAGEMENT SYSTEM ARCHITECTURE

Man-tool identification subsystem. The identification subsystem aims to give users permission to access to labor's personal information such as electronic tag number, as well as the authority to change labor information. The logging interface will display detailed login time, date, and the total running time of the safety monitoring systems which provides a set of forms of information inquiry. The identification subsystem also takes charge of recording the labor attendance as to facilitate the site managers in convenience to know the information about labor working attendance states. By entering specific date, the subsystem will check automatically labor information including electronic tag number, working area, corresponding tools category, labor's physical and psychological condition, technical disclosure record of the work area, permission of entering the construction field. Note that the labor RFID tag is the key associate of the subsystem when updating the label information before entering checkpoint, especially labor personal physical and mental state and harsh weather conditions have to be updated daily. The working areas include the vertical transportation construction area, foundation construction area, scaffolding construction area, the framework engineering area. Hand-held tools usually consist of small power-driven tools, welding machines. Instead of traditional manual counting, the identification subsystem provides a more objective, easy and efficient way for management staff to access to onsite labor attendance information.

Real time inspection subsystem. The inspection subsystem includes RFID tags, handheld RFID readers and wireless communications unit. The RFID reader reads the encoded information on passive tags to monitor the ongoing operations of workers, this signal can control wireless communications unit via specific protocol, enabling the man-tool status information transmitted timely and accurately to the safety status information transmission subsystem.

Safety status information transmission subsystem. The information transmission subsystem contains central processing unit, wireless communication unit and the base station. The central processing unit will follow the two-way wireless communication protocol to control the wireless communication unit when receiving man-tool safety data given by real time inspection subsystem. Usually these data are transmitted to the router mode in the form of wireless data packet, and then transmitted to the communication base stations. The base station communication network will upload the data to the server which aims on processing all the adopted information. Reader and air interface protocol is transparent to the applications and the application interface of RFID data protocol is based on ASN.1, which provides the programming languages independent from applications, operating systems and command structure between the tag reader and tag drivers. Meanwhile, with ISO/IEC standard (Roberts 2006), it is convenient to share man-tool safety monitoring data between application systems and the RFID reader.

Information management subsystem. Information management subsystem consists of a server computer, network gateway, of which the main task is to receive and update man-tool safety data adopted from real time inspection subsystem. It supports functions of distributed processing of data, multi-threaded data query and optimized data query and online transaction processing. The subsystem usually uses FoxPro, Clipper and Paradox for data processing, or it will choose Microsoft SQL Server, Oracle Server, Sybase SQL Server and Informix Server with a lower processing requirement.

Safety alert subsystem. Safety alert subsystem is constituted by a server computer, network gateway, wireless communications unit, aiming on analyzing the man-tool safety information received from the information management subsystem. The analysis is based on the decision-making process as discussed in BP neural network safety evaluation, which is to determine if there is a risk of accident occurrence (i.e. labor working at wrong position with the wrong designated hand-held machines). If there is an inconformity between the labor RFID tag code and the site category code, the safety evaluation result ("warning" or "to-be controlled" level in this situation) made by the server will be sent to a site inspector and a quick solution will be taken to prevent the risk of danger.

CONCLUSION

The increasing complexity of the construction environment bring more risks to the onsite labor safety, hence it is necessary to break the existing bottleneck of construction safety management effectiveness and efficiency. RFID technology proposes a new method to assist real time safety management. Based on defining the safety checkpoints and evaluation indicators of hand-held construction equipment and labor behavior, the paper conducts an evaluation analysis of BP neural network by training 15 man-tool safety status samples and then combining this decision-making model with RFID technology as to achieve virtual real-time safety inspection. The integrated RFID based man-tool safety management system consists of man-tool identification subsystem, real time inspection subsystem, safety status information transmission subsystem, information management subsystem and safety alert subsystem, as to help site managers perform safety inspection quickly in the way of enabling tracking the location and identification of the labor in real time as wells as providing the accurate safety data transmission effectively and efficiently.

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Collaborative Management Based on BIM

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Abstract

In the field of construction project, collaborative management has been paid more and more attention by all the participants. Compared with the traditional way, BIM has lots of advantages in collaborative management. The paper first analyzes that BIM is how to realize collaborative management in the whole life cycle of construction project, including the collaborative management of planning stage, design stage, construction stage, operation stage, the different participants and professions of construction project. And then, it analyzes the advantages of collaborative management based on BIM technology in construction project.

INTRODUCTION

With the question caused by "islands of information" being more and more prominent in the field of construction project, all the participants of construction project are more aware of the importance of collaborative management. However, the traditional construction project management tools can't synergistically manage the elements of construction project (Huang et al. 2014). The emergence of BIM (Building Information Model) brings the revolution of construction project management from another point of view, the changes that BIM brings are as follows: from the two-dimensional (here in after referred to as 2D) design to the three-dimensional (here in after referred to as 3D) design, from the line drawing to the component arrangement, from simple geometric representation to the full information model integration, from the discrete fractional design to the overall design of the whole process based on the same model, from the delivery of a single design to the whole life cycle support of building, from the project being done individually for each craft to the project being done synergistically for each craft. Therefore, BIM and collaborative management are interdependent and inseparable, collaborative management is the core of BIM, BIM is a specific application of collaborative management (Li and Zhang 2013). It can be said that BIM will provide technical support for collaborative management in construction project and enhance the effectiveness of collaborative management greatly (Huang 2014). BIM brings not only technology, but also the workflow, usage of the particular trade and management mode (Wang 2012).

Although the different participants in construction project pay attention to the idea of collaborative management very seriously, people's understanding is not unified in the meaning, content and development of collaborative management. The collaborative management that we are talking about at present, to a large extent, refers to a management form based on computer net (Li and Guan 2012). It is by means of the reasonable arrangement and combination of local power to finish a job and a project, including the collaborative management of planning stage, design stage, construction stage, operation stage, the different participants and professions of construction project (Man and Li 2012).

THE COLLABORATIVE MANAGEMENT OF DESIGN STAGE

In the traditional design method of two-dimensional CAD, the drawings don't have the automatic correlation function between each element. If you want to change one element, other elements on the premise of the element need changing one by one. Therefore, the volume of workload will be quite large and mistakes are liable to occur. BIM parametric design solves the above problems. In BIM model, the parameter changes that caused by the move, deletion and size change of one component will lead to the relevant changes of the relevant components parameters in the same view. Besides, the changes in one view can be propagated to all other views in parameterized and bidirectional way so as to ensure the consistency of all views. Don't need to modify all views one by one. BIM technology achieves a real synergy among all the components and all the views in order to improve the efficiency and quality of work. The floor plan of the basic wall and the three-dimensional view of steel structure and basic wall is shown in Figure 1. If the parameters of the basic wall change, the parameters of the basic wall will make the correlative changes.

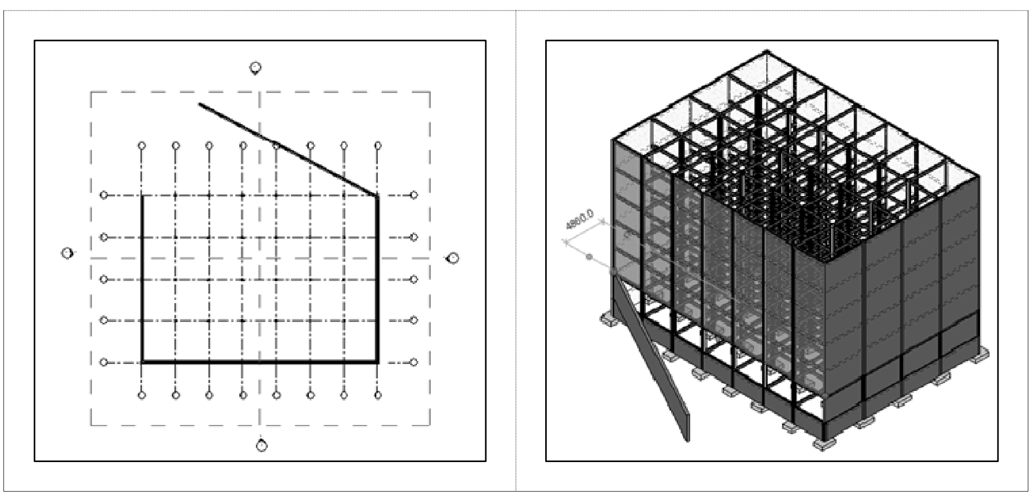

Figure 1.The floor plan of the basic wall and the three-dimensional view of basic wall.

Due to the poor information communication among technical staff and the limits of the human brain, the design that uses the two-dimensional CAD technology is easy to cause collisions among components. By means of BIM technology, we can make different professional technical staff gather together. In a virtual three-dimensional environment, jointly research and analyze BIM visualization model to find the collisions among components, then adjust and optimize the collisions points through the integration of the professional competence. BIM technology makes the real synergy come true among different professions. Therefore, it can reduce the collisions among building elements and improve the quality of work.

In traditional two-dimensional CAD model, building model is displayed in the form of plan, elevation, and profile. It is difficult to understand for non-professionals and easily makes all the parties involved in construction project inconsistent in the project understanding. BIM visual design solves the above problem. Visualization BIM model based on three-dimensional digital technology provides the simulation and analysis platform for all the parties involved in the construction project. Each party can intuitively understand the intention of the design party, so as to reach an agreement on the project understanding. BIM technology makes all the parties involved in construction project form the real synergy, so as to improve the efficiency and quality of communication. The BIM technology based on profession synergy and participant synergy is shown in Figure 2.

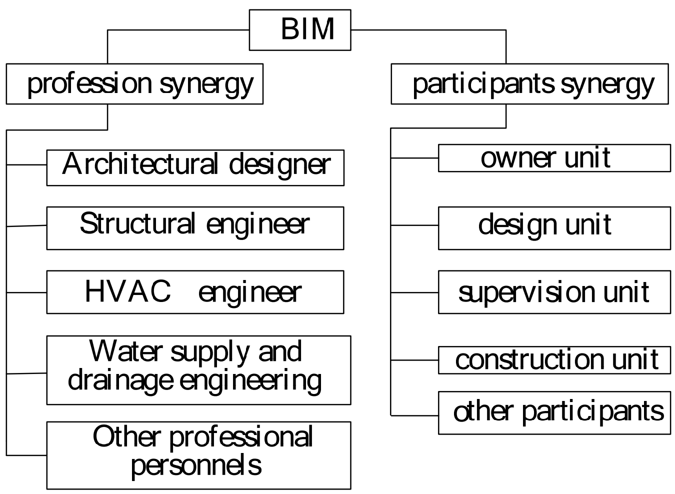

Figure 2.The BIM technology based on profession synergy and participant synergy.

THE COLLABORATIVE MANAGEMENT OF CONSTRUCTION STAGE

During the construction stage of the project, the use of BIM technology also enables collaborative management. First of all, in a virtual 3D environment, construction unit can communicate with design about the confusion of the construction drawing and the problems of the construction drawing found in the construction process. The construction unit can promptly remove barriers and reduce unnecessary losses so as to improve efficiency and quality of engineering construction (Su 2013). Secondly, with the three-dimensional BIM information technology (hereinafter referred to as BIM3D) can also be used for simulation and analysis of the construction site layout and construction link. Project managers can intuitively know about the time node of each construction link and the construction procedure, and then define the responsibilities of each construction worker (Li et al. 2012). To a large extent, it improves the efficiency of the engineering construction. The visualization construction site of a building project is shown in Figure 3 (Li et al. 2010).

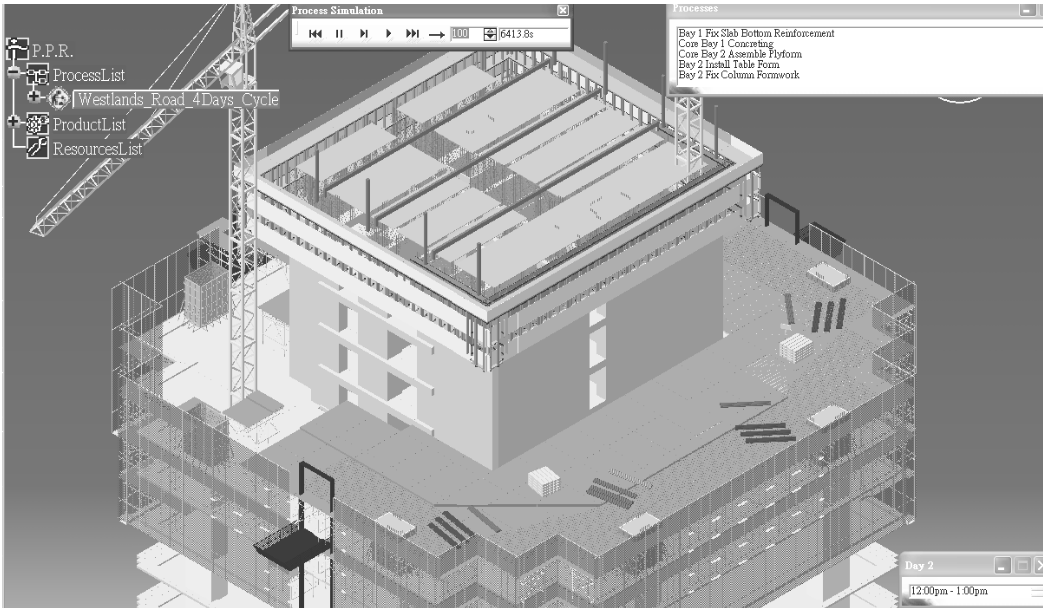

Figure 3.The visualization construction site of a building project.

The traditional project schedule management tools and project cost analysis tools were independent each other, it is difficult to cooperate with the three-dimensional space information of building. At present, although most of the BIM software is BIM3D which is usually called the three-dimensional BIM information technology, some BIM software have extended to the 5D, which increases the dimension of time and cost. Space information, time information and cost information are integrated in a visual 5D model (Li et al. 2012). Not only can visually see the construction site activities, but also can accurately understand the actual progress and cost of engineering construction. Thus, the project manager can adjust the construction plans in a timely way to avoid schedule delays or cost overruns. However, the engineering project management goal is to find the best solutions among cost, schedule and quality, so as to shorten construction period, guarantee quality, reduce cost. Therefore, for engineering project management, time, cost and quality not only restrict each other, but also are coordinated, indivisible. Therefore, in order to achieve true collaborative management, BIM technology should add quality dimension on the basis of BIM5D and extend the latest five-dimension to the future six-dimension(Li et al. 2012; Chen and Luo 2014). Only in this way, can BIM technology be a perfect technology and manage engineering projects comprehensively and collaboratively. The BIM's development process and the cooperative mechanism in BIM6D are shown in Figure4.

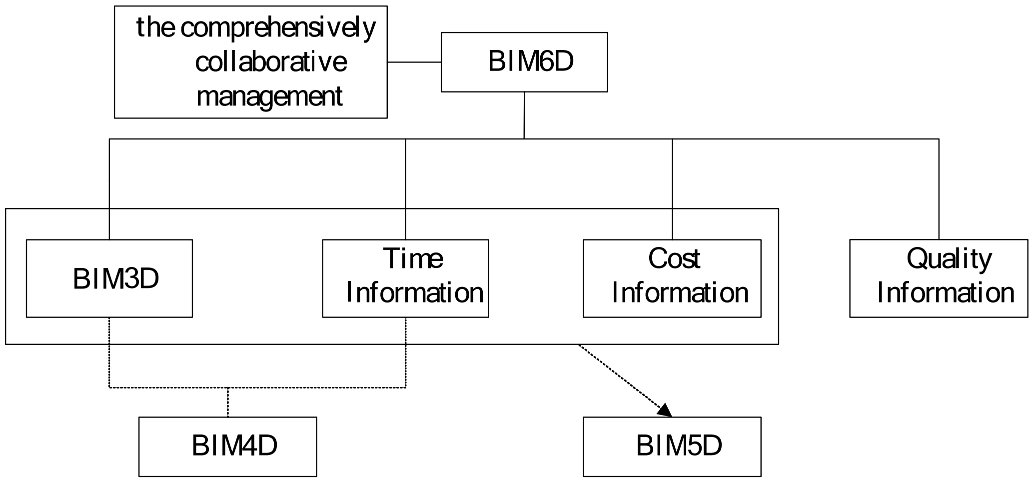

Figure 4.The BIM's development process and the cooperative mechanism in BIM6D.

THE COLLABORATIVE MANAGEMENT OF OPERATION STAGE

In the handover link after the completion of construction project, the property management department not only needs to get design drawings and completion drawings, but also needs to gain the data that is able to reflect device status and the installation and use of materials. However, the current conventional technology can't achieve the requirements of the property management department. By the BIM technology, the property management department can organically integrate the building spatial information with the device parameter information. If BIM technology combine with the property management information system (here in after referred to as PMIS), it can take full advantage of spatial orientation and data record, make maintenance plan reasonably, assign specific maintenance work to a specific person to reduce the probability of appearing unexpected situations in the use course of the building. The combination of the BIM technology and the corresponding hazard analysis and simulation software can analyze the disaster warning in the construction project operation stage to enhance the security capabilities of the project and ensure the safety of the life and property of people. Before disaster, BIM technology can simulate the process of the disaster; analyze the causes of the disaster, so as to make the measures of avoiding the disaster and the emergency plan of evacuation and rescue support after the disaster. After the disaster, BIM model can provide rescue workers with the complete information at the emergency position, which will effectively improve the level of rescue workers coping with emergency. The building automation system can timely gain the information about the status of buildings and equipment. The combination of BIM and the building automation system can make BIM model clearly show the location of the emergency situation inside the building and the most appropriate line to the emergency position. It is helpful for rescuers to make the right site disposal and improve the effectiveness of emergency action. The synergy of BIM technology and other information systems and software is shown in Figure 5.

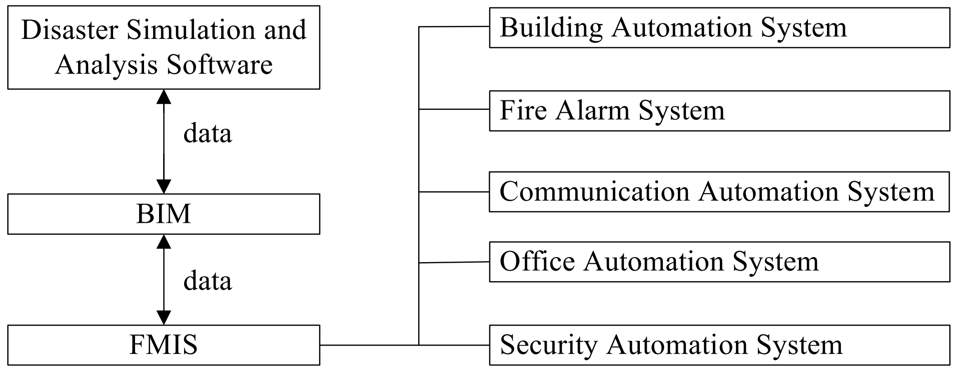

Figure 5.The synergy of BIM technology and other information systems and software.

CONCLUSIONS

The essence of BIM is the collaborative management, including the synergy among participants, the synergy among information systems, the synergy among professions based on BIM technology platform, and the synergy among the internal elements of BIM. With time going on, the development of BIM technology in collaborative management will increasingly perfect. Meanwhile, collaborative management based on BIM technology not only will further promote the application of BIM technology in the field of construction project, but also will bring new development in construction project and enhance the informationization level of construction project (Guo 2007). Collaborative management and BIM technology will depend on and promote each other, and go toward a better future.

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Research on Creating a Construction and Demolishment Waste Recycling System

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Abstract

Construction waste has been a prominent problem throughout the world, causing depletion of landfill space, the resource waste and environmental problems. In view of current background of the rapid reduction of non-renewable resources and the huge energy consumption in construction industry, based on the theory of material cycle, this paper has made a detailed study on recycling of C&D waste. To do so, we analyzed the components of the construction waste recycling system, summarized recycle process that consist of pre-sorting, reuse directly or regeneration, established a construction and demolish waste recycling system. Who involve in the recycle process? What type of products can be reuse directly and what type of products should pre-sort and regeneration. How to maximize the use of waste and improve resource utilization? These three issues form the main content of this article.

INTRODUCTION

In recent years, a large number of buildings are demolished, which are in the use of less than 20 years or even less. These phenomenons are very universal in Chain. There is a huge amount of waste in the process of urban construction and development. The case that building millions of house and demolish in large scale is particularly serious in Chain. The demolish of old buildings account for 40% of new construction area each year. The buildings in European have an average life expectancy of 80 years. However, the average lifespan of a building in Chain is less than 30 years, well under the Chinese advised level of 50.According to “Code for Design of Civil Building”, the lifespan of important buildings and high-rise building is 100 years, and the lifespan of usual building is 50 to 100 years. While a large number of buildings that using less than 30 years are demolished in the process of urban renewal, showing that these buildings are still in the design life of were removed. Short-lived building is a prominent issue in our country. It is not only a waste of resources and energy but also compounded the pollution woes that threatened the human environment. It is contrary to sustainable development and contrary to the spirit of resource-saving and environment-friendly.

The development of city construction and large-scale demolish bring a large number of construction and demolish waste (C&D wastes), which cause rapid depletion of landfill space available and bring about an increasing demand for natural aggregates, thereby inflicting ecological and environmental damages on the earth (Lu et al. 2006). A significant challenge facing the construction industry is management of construction and demolition (C&D) waste. An alternative to disposal C&D waste is recycling and reusing (Schwerin et al. 2013). To address this need, this paper aims to collate the available literature on C&D waste. The concept of C&D waste will be explained and then collated information will be applied as the basis to analysis the composition of C&D waste and create the recycling system of C&D waste.

THE COMPOSITION OF THE CONSTRUCTION WASTE RECYCLING SYSTEM

The system of sustainable construction governs three main elements: subject, object and carrier. Waste recycle industry is an integrated industrial chain, including collection, classification, transportation, deconstruction and treatment of final wastes, as well as production and preparation of regeneration materials, reproduction and other links.

The subject of system. The subject of construction waste recycling system is companies or individuals which directly or indirectly involved in the cycle logistics of construction. The subject consists of construction material vendor, construction company and C&D waste disposal company. There are construction company, C&D waste recycler, construction materials production enterprise, product sales, waste treatment enterprise, demolition company, equipment manufacturing enterprises and government departments. The government departments play a central role in the system through a variety of policies to support and encourage the organizations within the industry.

(1) Construction material vendor. Construction material vendor is the providers of construction resources, including construction materials production enterprise in the field of manufacturing industry and product sales in the field of wholesale and retail trade. Construction materials production enterprise use renewable building materials to produce recycled materials by renewable technologies, making the waste become available resource. The enterprises consist of steel producers, cement producers, concrete producers, brick manufacturers, etc.

(2) Construction company. Construction Company is the enterprise which is specialized in construction, renovation, equipment installation, wiring pipeline project and the other related activities, including construction and installation company, decoration companies, pipeline equipment installation company and the other companies.

(3) C&D waste disposal company. C&D waste recycler is responsible for recycling construction waste from the construction site and the demolished buildings, crushing, cleaning and sorting the waste. And waste treatment enterprise take charge of filling, incinerating and disposal the worthless construction waste that are harmful or cannot deal with.

The object of system. The object of construction waste recycling system is resources in the various stages of the recycle. The resource consists of three parts: construction materials or components, construction waste and renewable building materials.

(1) Building Materials and Construction Components. The materials used in architecture are building materials. Building materials can be divided into structural materials, decoration materials and special materials. Structural materials include wood, bamboo, stone, cement, concrete, metal, brick, ceramic, glass, plastic, composite materials, etc. Decorative materials include a variety of coatings, paints, coatings, veneers, etc. Special material includes water, moisture, corrosion, fire retardant, sound insulation, thermal insulation and sealing.

Construction components are mainly walls, columns, beams, floors, roof trusses and the other load-bearing elements of construction. Construction accessories are decorative parts, such as doors, windows, railings, plaid, detail decoration, etc.

(2) Construction and demolition waste. C&D waste arise in the process of construction, expansion, demolition and maintenance (Zhao et al. 2011). C&D waste can be classified into reuse wastes, regeneration wastes and unsuitable wastes, as seen in Table 1 (Tan 2004; Zhang et al. 2011).

(i) Reuse wastes are materials that can be recycled directly or are suitable for land reclamation through a simple process.

(ii) Regeneration wastes can be recovered and used as raw materials through a series of process.

(iii) Unsuitable wastes are infeasible for reuse in any activities.

Table 1.The Type and Components of C&D Waste.

The type of C&D waste	The major components of construction waste	The sources of construction waste
Reuse wastes	Waste concrete Waste gravel	Construction, demolish
	Waste brick	Construction, demolish
	Waste watts	Construction, demolish
	Temporary building	Board room scaffold
Regeneration wastes	Mass concrete	Demolish
	Waste steel	Demolish
	Waste wood	The remaining material of frame, decoration, packaging
	Waste plastics	Renovation, Insulation, Plumbing, Furniture and Facilities
	Waste glass	Demolish
	Scraps of paper	Cement bags, Packaging bags, Decorative wallpaper
Unsuitable wastes	Hazardous waste	Insulation, thermal insulation, fire-resistant material with asbestos

Carrier. To keep the recycling system operation well, apart from the subject elements and object elements, the system need equipment and facilities which are defined as carrier. It plays a role of supporting and communicating with other elements in the system, including facilities and regulations. Facilities are deem as the most important carrier in the construction waste recycling system, including transport vehicles, storage yard and the machines which are use in crushing, splitting, sorting C&D waste.

IMPLEMENTATION OF CONSTRUCTION WASTE RECYCLING SYSTEM

This paper analyzed the process that related enterprises recycle construction waste (see Figure 1). Construction company entrust the related waste disposal company to handle C&D waste. With the specialized methods and programs, C&D waste recycler recycles and sorts the waste, advance the using rate of the resource. Broadly speaking, there are two kind of waste: valuable waste and valueless waste. The valuable waste is divided into waste for reusing directly and waste for regeneration. The wastes that can reuse directly are delivered to construction company and reuse in the process of construction of new building. The wastes that cannot reuse directly are transported to construction materials production enterprise and regenerate with the specialized methods and programs. Regeneration products are sold to construction company in renewable building materials market. The valueless waste is delivered to waste treatment enterprise for harmless disposal. The whole process is accomplishment with equipment manufacturing enterprises, which provide specialized equipment.

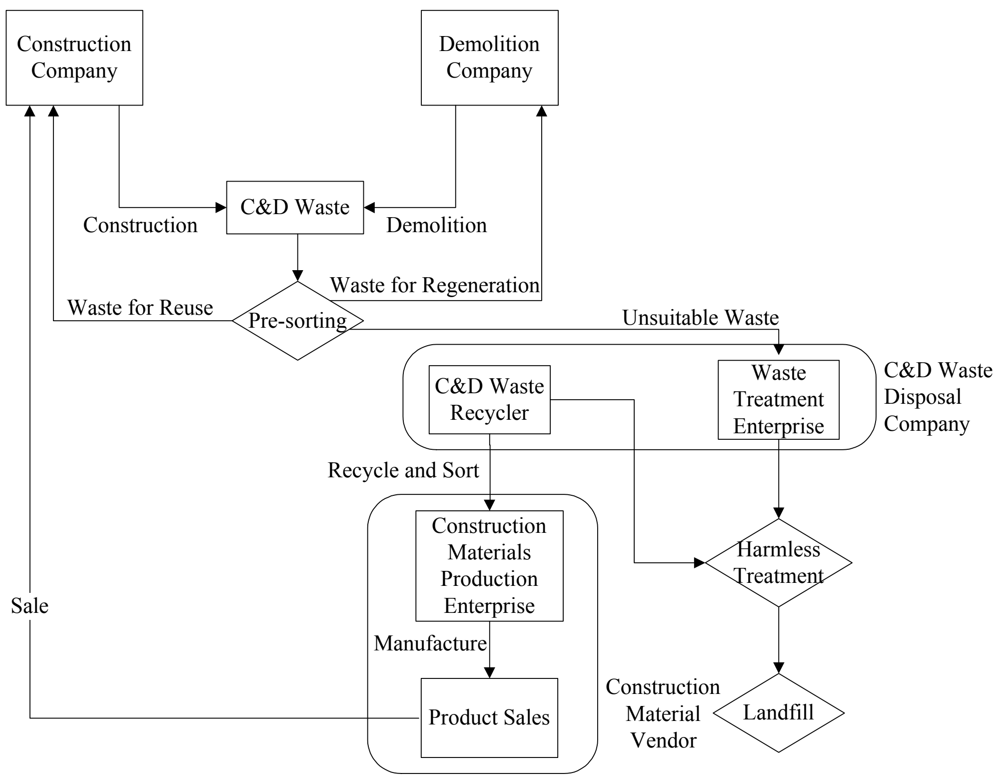

Figure 1.Construction waste recycling process.

Pre-sorting. C&D waste is a mixture of various materials; it should be pre-sorted in the process of recycling. Pre-sorting bring convenience to subsequent recycling companies for processing, while the wastes are divided into reuse materials, regeneration materials and unsuitable materials.

C&D waste resource utilization. The recycling approach for C&D waste including reusing directly and regeneration mostly. Recycling C&D waste not only solve the problem of rapid depletion landfill space available, saving the cost of garbage removal and disposal but also reduce the impact of construction waste on the environment and reduce the yield of sand and gravel, with a long-term environmental and economic benefits.

(1) Reuse directly. Some C&D waste can be used directly in the other construction projects through a simple process, such as integrated masonry and timber. This waste masonry can be directly applied to the new building if they meet the requirements of building materials. For example, some new buildings are designed to be simple and unique with old stone, old brick.

(2) Regeneration. Some waste can be recycled directly, while the other parts of waste (such as broken masonry, concrete and glass) need handle for re-utilization.

(i) Concrete. One means of recycling C&D waste is by crushing it into aggregates. There are steel, wood, plastic debris, glass, plaster and other impurities in waste concrete block (Huang et al. 2006). To ensure the quality of recycled concrete, measures must be taken to remove these impurities. Remove scrap steel, scrap wood and other impurities by manual methods and remove iron and impurities by electromagnetic separation. According to the particle size, the recycled aggregate can be divided into two types. Recycled aggregate particle size is related to the moisture content, density and the other factors in aggregate. After the secondary crushing of material, the particle size is required smaller than 40 millimeter. The recycled material whose particle size between 10 to 40 millimeter are called as recycled coarse aggregate, which are used in mixing recycled aggregate concrete. The recycled fine aggregate is the recycled material whose particle size smaller than 10 millimeter, which are mainly for the production of permeable material, recycled porous brick and concrete block, etc (Tan 2004). Depending on physical properties of the recycled aggregate, recycled aggregates can be used in a variety of construction applications and can reduce dependence on natural aggregates. Recycled concrete aggregate has been used in a variety of construction applications, including structural members; fill material and temporary roads (Zhang et al. 2011; Huang et al. 2006).

(ii) Brick. As a traditional building material, clay brick is widely used in old buildings. With the acceleration of urban construction and city renovation, more and older building of brick structure is torn down (He 2012). Large-scale demolitions bring a large amount of waste brick. How to deal with the waste brick is a serious problem. Reusing of waste brick can be used in the following aspects (Huang et al. 2006; He 2012).

Production of concrete blocks. Perforated and lightweight blocks can make with available broken bricks and broken mortar. The powder arising in the process of crushing brick can be used as an inert mineral powder on concrete. The power play a significant role in filling, improving the workability and the density of concrete, increasing the strength of the concrete.

Use for concrete aggregate. It is a good approach to use the waste brick as concrete aggregate after crushing. This concrete has better performance in construction.

Some aspects of the concrete aggregate even better than natural aggregate concrete.

Use in mortar. It will produce a large number of small particles or brick powder in the process of crushing waste brick into coarse aggregate concrete. Using the brick powder in concrete or mortar not only reduce the cost of producing mortars and save natural resources but also reduce the negative impact of waste emissions.

Use as green concrete lining material. Porous green concrete is a branch of green concrete of growth grass, which can be made with broken brick. These green building materials can resolve the problems of the environment brought by lining project, and recover and protect water surrounding.

(iii) Glass. Waste glass is mainly produced in process of demolition. According to information statistics, the waste glass accounted for 4% to 8% of the municipal solid waste. Waste glass is about 4.5 to 7 million each year in China (Li 2011).

Waste glass should be pretreated to separate the metal in the glass .The glass, which is mixed with aluminum and other metals, can be separated by an electrostatic separator drum. Usually the metal contained in the glass can be separate after more than 3 times. And use MHD sorting technology can get high purity of glass material which is used for reproduction (Tan 2004).

(iv) Steel. Scrap steel mainly come from reinforced concrete in the demolition of buildings. In order to reuse the scrap steel, recycle companies broken the concrete, sort the scrap steel by machinery or handmade and transported to the steel mill for steelmaking (Tan 2004).

(v) Wood. Construction waste wood is mainly from urban infrastructure, especially the transformation or demolish of the old buildings. The wood components include doors, windows, floors, beams, purloins, stairs and partitions, etc. Some experts estimate that the number of all kinds of waste wood materials can be reused is about eighty million m^3 in China. Waste wood can be used in the following aspects (Huang et al. 2006; He 2012).

Manufacture wood-based panels with waste wood, such as particleboard, MDF, particleboard plaster, cement particleboard, etc.

Waste wood can be utilized in pulping and paper-making.

Use to produce ethanol. After chipping, dissolving, fermentation, concentration, distillation and a series of processing, we can get industrial ethanol as a gasoline additive from waste wood.

CONCLUSION

Although the recycling system of construction and demolish waste is not perfect, such as the problem of lacking depth theoretical study and the difficult of promotion, we realize that recycling waste is benefit of humanity and generations. This paper aims to review the research advances in this field, propose the composition and implementation of construction and demolish waste recycling systems, summarize the methods of C&D waste resource utilization. With the construction and development of recycling economy and ecological civilization, this concept that meet the requirements of sustainable development is bound to be promoted and development.

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Technological Innovation in the Research and Application of Green Engineering

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Abstract

Nowadays, green construction has been an important means in science and technology work and enterprise management. This paper introduces a system of technological innovation in China Construction Fourth Engineering Division Corp. Ltd, which promotes the realization of green construction. In recent years, the company has identified the control targets of green construction, in the meanwhile, actively developed and applied technology, such as the plastic template, steel road, chamber room, plastic fence, board-support combination, BIM management, cold method for the fabrication of protective facilities, waste recycling, and eco-friendly multifunctional concrete, all of which have achieved environmental and economic benefits, and enhanced the quality and efficiency of enterprise management.

INTRODUCTION

In recent years, the company actively practices the Party 18's spirit of ecological development and the "green CSCEC" concept proposed by China State Construction Engineering Corporation, Ltd, making some achievement in green materials, green construction, and green buildings. Among those, green construction is the main business, and the company manages to reach a better realization of it. In order to realize green construction, the company establishes a management system to promote green construction which is based on promotion and application of traditional practical technology. The company increases investment on science and technology, strengthens the establishment of system on technology innovation, establishes a series of regulations to incentive new ideas, and engages in research and application in newly environmental technology. In that way, the company achieves the aim to protect the environment, conserve resources and energy, and reduce the cost, realizing the green construction and promoting the quality and efficiency of enterprise. This paper introduces what the company has done to promote green construction, including the goal setting, the system establishment, the regulation reform and the core technology in science and technology innovation.

MANAGEMENT OBJECTIVES

Significance of quantitative control. Green construction focuses on conservation and environmental protection, which centers on specific effects, and therefore must have corresponding quantitative indicators and data to control, shifting from qualities to quantities. There is no truly green construction without data.

Specific quantitative indicators. (1) Water-saving index. The allocation rate of water-saving products and metering device should be 100%, the reuse amount of recycling water should be no less than 40%, and water consumption in project under construction should not more than 6.0m^3 for each million dollar output value (MOHURD 2007). The amount of water is measured separately as to the office area, the living quarter and the work zone. The reclaimed water system and the groundwater circulation must install measuring device in inlets and outlets separately. Monthly ledger is a must to record actual water consumption and further analyze and control.

(2) Energy-saving index. The allocation rate of energy-saving lights in work zone and office area should not be less than 80% (MOHURD 2007). In the meanwhile, the energy power consumption should be not more than 70kWh for each ten thousand output value, and comprehensive energy index should not be more than 30kg standard coal for each ten thousand output value.

(3) Material-saving index. The attrition rate index of material should be as follows, reinforced≤1.5%, concrete, brick, mortar≤1% (reinforced volume to be deducted in concrete). The attrition rate index of turnover materials should be as follows, steel≤1%, fasteners≤2% (MOHURD 2007). And rate of adoption for material within 500 kilometers should not less than 70% (Chen 2014).

Attrition rate for construction material = (order quantity– actual quantity)/ actual quantity×100%;

Attrition rate for turnover material = (into site quantity–out site quantity)/ into site quantity×100%.

Attrition of other material is bound to reduce 30% than local quota attrition.

(4) Land-saving index. Land-saving index should be as follows, construction land rate for unit gross area≤7%, effective utilization rate of temporary facility land should be more than 90%, cost for temporary facility should not more than 1% of the total cost of the project, and usable area for each staff should not less than 2m^2 (MOHURD 2007).

(5) Eco-friendly index. Pollution is required to be zero. Water, gas, sound, slag, and light are controlled to realize the zero pollution. Control rate of wastewater and noise should be 100%. Noise from night site should be less than 55dB, from day site less than 70dB. Dust height in excavation stage should be less than 1.5m, in body stage 0.5m (MOHURD 2007). Total amount of construction waste should be less than 300 ton for each ten thousand square, and the recycle rate should be more than 50%.

SYSTEM ESTABLISHMENT

Talent team building on enterprise level. In order to ensure the effective development of technology innovation, it is a must to equip a number of technology and management power to the enterprise. The company has the following rules. At least three people are needed in the management positions for the secondary units in the company, such as deputy chief engineer, chief engineer and technical manager. And at least 6 people are needed in sectors for technology and research. For the third units in the company, management positions call for at least 2 people and technology and research sectors need at least 4 peoples. In order to ensure the smooth of technology and research of green construction, sufficient technical staff is in need according to the size and level of difficulty of the project.

Other talents. A technical centre, which is responsible for the research and development of new technologies, and a BIM workstation, which is for the promotion and research of BIM, has set up. Besides, the company owns a professional architectural design and research institution, which aims at development of green materials and energy-saving buildings. A professional construction and installation company is now engaged to development and production of new materials and equipments.

TECHNOLOGY INNOVATION SYSTEM

Science and technology fund. The main difficulty of technology innovation is the insufficient investment. If there is no corresponding financial, manpower, and material inputs, it is hard to ensure a special talent to do technical innovation work. To solve this issue and increase investment in science and technology, the company provides that all the secondary units shall first turn over 0.7% of the expected revenue as the research funding quarterly. All subordinate units shall hold activities to promote science and technology according to the requirements of production and management, and declare how much they cost every half year. Then the company allocate fund to the subordinate after examined. In this way, the less expenditure on science and technology, the less money return subordinate will get. It is an effective way to incentive technology innovation in the enterprise from top to bottom.

Internal patent. In order to promote technology innovation in the enterprise, and create a bunch of core technology, the company establishes a patent system internal. Everyone, who creates a technology innovation product that is beneficial to the enterprise, could apply for and get a patent after the acceptance of technology sector according to the Specification for internal patent. What's more, the company rewards 50,000 Yuan for each internal patent.

Science and technology dual optimization. The science and technology dual optimization refers to an optimization in project plan (including construction organization design) and the design drawings to reduce emission and cost. The aim of the dual is to increase economic benefits and encourage the enthusiasm of the staff. The company adds 10% of the revenue as the bonus to reward the active technical team and the rate of rewarding for the core is no less than 50%. The system of dual realizes the principle of distribution, and is a scientific incentive that could mobilize the enthusiasm of staff.

MAIN RESEARCH AND DEVELOPMENT OF INNOVATION

Plastic template. Following wood template, combination steel template and bamboo wood template, plastic template (seen in Figure 1 and Figure 2) is a new green environmental product which is made from rigid plastic such as polypropylene, mixed with reinforcement material such as glass fiber, sisal fiber and anti-aging addictives. It is a kind of engineer plastic laminated that could be cut, nailed, planed, welded, and repaired (Chen 2014).

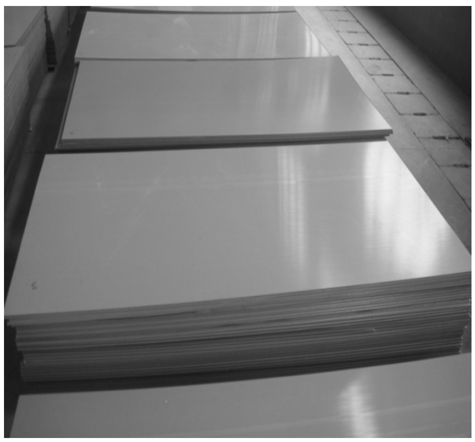

Figure 1.Plastic template.

Figure 2.Beams and slab formwork installation.

Compared with ordinary wood template, plastic template has the following advantages: The surface of plastic template is smooth, so the shaping effect of concrete is plain relatively; The plastic template is resilient, wear resistant and corrosion resistant; The ordinary wood template could only turnover 7 or 8 times, yet the plastic template could turnover 30 times or more; The plastic template could be recycled, which increase the profit and reduce the environmental pollution, in line with the sustainable strategies of the country (Chen 2014).

In the meanwhile, there are some disadvantages in plastic template: The plastic template is crisp in cold weather and break down easily when installed and removed; Concrete leaks easily between plastic template gaps, leading to a pitted skin; the stiffness and strength of plastic template is light, and elasticity modulus is between 1700 and 2100. So the load capacity of plastic template is weak and it strains easily, therefore needs a well control of the space.

Steel road. Steel road is newly technology developed in recent years. It made of steel that is 10mm or 20mm thick, which is a 2m×2m square in standard. Another size is a 2m×1m rectangle or plate of right-angled triangle plate with a 2m side length. The steel road is joined by bolts with 5mm gaps filled with asphalt, polyurethane and sand (Science and Technology Development 2014a), see Figure 3.

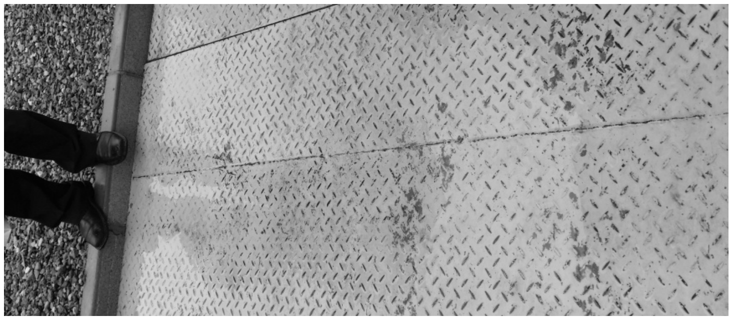

Figure 3.Steel road.

Compared with traditional concrete temporary road, the revolving steel road has the following advantages: According to the market survey, price of steel is lower and lower, so it is economic to adopt steel; Steel can hardly be destroyed for the well performance under stress; Steel has a longer service life and steel road could revolve more than 15 years; Steel road is more environmental for there being no building waste.

There are disadvantages of application of steel road: Steel is of high value, and a great deal of money is needed for the first investment. Procurement center is in charge of the centralized purchasing, and the construction project sector in charge of the tenancy from procurement center to reduce one time investment. The steel road shall bear a heavy capacity of vehicles. Thus it is required to design and control the thick, the joint and the base of the road to avoid the distortion or further short life.

CSCEC chamber rooms. Referring to traditional prefabricated house, CSCEC develop and promote a containerized site temporary building, which is called *CSCEC chamber room* (Seen in Figure 4 and Figure 5). This kind of containerized house can be assembled quickly with crane as it is standardized, recycled, and integrated when produced, having an advantage to a scale (Science and Technology Development 2014a).

Figure 4.Traditional prefabricated house.

Figure 5.CSCEC chamber room.

Compared with traditional prefabricated house, CSCEC chamber room has the following advantages: There is a series of standardized design for the chamber room, which is joined by bolts and rivets to ensure the recycling; The room is processed in the factory, ensuring the quality; The room is moved in a whole, and only some corner pieces are needed when installed on the site. Therefore, it fits the urgent project well; It does well to the environment for it can recycle for 15years or more, and no reinforced concrete is needed during the service life; It preserves heat well for the rock, which is the main material, is excellent in thermal insulation; The room is resistant to acid, alkali, and salt fog, therefore is suitable for all kinds of wet and corrosive environments. It is designed to have a service life of 15years, which has a good durability

What' more, CSCEC chamber room has the following disadvantages: Compared with traditional prefabricated house, the chamber room has a higher cost for the superior decoration materials it applies. Therefore, centralized leasing is adopted in the process; the cost for transportation is high for its mass volume. So it is more economical to transport within 500km range, and long distance transportation is inevitable.

Plastic fence. Plastic fence (Seen in Figure 6 and Figure 7) is a new green product, whose main components are thermoplastic, wood flour that extruded (Science and Technology Development 2014b). It is placed around the site to ensure safety and improve the level of civilized construction. It also beautifies the environment (Science and Technology Development 2014a).

Figure 6.Recycled fence assembling.

Figure 7.Recycled fence.

Compared to traditional fence, the plastic fence has the following advantages: It is environmental friendly. Plastic enclosure consists of columns, wall panels, upper and lower beams, columns and other components holder, whose component is simple, and is easy to handle. It does not produce too much construction waste, either; it assembles fast. It assembles in plates, and four workers can install 100m in a day, greatly increasing the speed of construction and reducing construction cost; it is economic. It turns over more than five times, which is low in cost, and high in recycling rates; it is durable. It can withstand sun and rain, and there is a strong anti-corrosion, no more maintenance needed.

Disadvantages are as follows: It is limited in decoration. The main material of plastic fence is plastic, and the main color is dark red. To do some specific design or decorations, the process is difficult and the cost is high; it is poor in resistant on the side. Plastic wall material is very light, and the general joints are concrete base and bolts. Wind resistance performance of the wall itself is bad, and therefore, the use of precast buried deep is applied in order to strengthen its concrete base to resist lateral force.

Combination of support and plate technology. A building excavation project uses the combination of support and plate technology in a CSCEC building in Hefei, which means that when the support system uses internal support, the system will be designed to support the central annular inner edge with a combination of structural panels. Located within the main structure of the ring stays in the middle, it adopts the practice of construction, except for the ring structure and the structure of the plate against the alternative support plate, to avoid the generation of the corresponding construction waste and labor consumption within the support removal process, making excavation stages support to become a permanent structure within the basement slab to form a whole (See in Figure 8 and Figure 9).

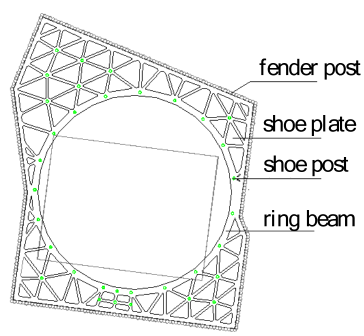

Figure 8.The support plan.

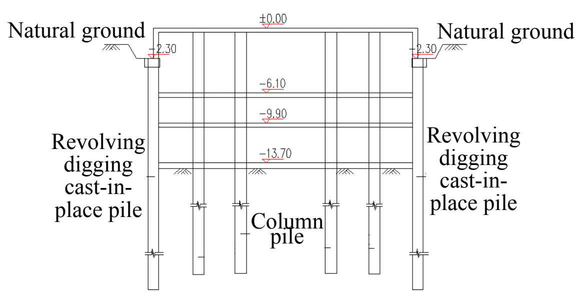

Figure 9.Support plate elevation.

The technology is to use the basement structural panels as the support plates, avoiding the issues when removing the support. In the meanwhile, it avoids the re-cast of structural panels, speeds up the construction schedule, and reduces costs, even with good economic returns. Supported by the inner periphery of the floor down from the construction, the construction work carried out under the support plate, which considerably solves the problems of demolition dust, noise and waste discharge, having a significant environmental effect.

The BIM detailed designing technology. The company's basic idea for BIM detailed designing is as follows. Use the BIM models to carry out the whole design of the project, including the general layout, the steel sample, the template sample, the template installation, the quantity calculation, the integrated mechanical and the electrical layout. The aim of the design is to reduce loss at a rate of 1%, and minimize the material loss to the fullest, achieving the lean construction (Linghu 2014).

The company plans to establish a BIM base for the simulation and visualization of construction safety and green buildings. The platform is designed to provide technical support and service for the major projects. At the same time, 20 BIM managers are bound to be brought up, and 2000 talents will be taught. 15 demonstration projects will set up and each unit is required to set up one. Each year, at least 10 million *yuan* increase is a must in the profits owned to the BIM platform, and 100 days are also saved. Next step is to consult with the government to seek for more demonstration projects with the help of BIM in the whole life service of buildings, to show the effects of BIM technology in management. It is planed that until the year of 2020, more than 80% of the technical workers have a good command of BIM technology and then BIM will be the core competition of the company.

Cold method of the fabrication of protective equipment. Cold worked protection facilities denote bolts, latches, etc to achieve tool-typed non-thermal installation to Security facilities. Tool typed security facilities take Standardized design manufacturing by factory. The overall looks clean and beautiful .achieving the turnover of Security facilities. At the same time, it reduces the pollution of construction. Cold worked means using embedded bolts, bushings, or L-type retractors when we pour concrete on floors. Mainly using Bolts to tighten, the site installation completely don't need the thermal tools like welding, electric drill and nibbler. Making the protection facilities cold worked achievable, meanwhile, with significant energy-saving features (Seen in Figure10 and Figure 11).

Figure 10.Elevator entrance limb protection.

Figure 11.Floor protection limb.

Compared with traditional protection facilities, the advantages of Cold worked protection facilities are: It can achieve energy saving under construction, using protection facilities cold working. No open flames, no welding, no drilling at construction sites. It also can reduce the consumption of chemical energy and related energy; it is easy to turnover. It uses protection facilities with cold working technology. Most connection in construction sites are bolting. It is adjustable. During installation it does not need the help of tools .no construction waste in dismantling process; Safe and reliable. Using embedded component, Install securities directly, easy to operate; with good appearance and civilization, available turnover of security facilities break through the gap of traditional protection facilities which have messy appearance of the image. Make the overall of project more concise, neat, and more effective. Intuitive show the safe and civilized image to the public.

Waste recycling technology. Surroundings of the site are analyzed to choose a proper centralized processing field and further layout according to the technical requirements. Building solid waste is collected, classified, crushed and sieved, then aggregates of different particle size will be got from fine sand, coarse sand, to gravel. These aggregates are used to backfill, to make road layer and to press cement bricks according to the design requirements. Then the cost reduces, waste turns to treasure and waste emission reduces too (Seen in Figure 12 and Figure 13).

Figure 12.Convergency fracturing.

Figure 13.Sieving.

The advantages of waste recycling are as follows: It protects the environment. This technical makes full use of the waste and reduce the emission of dustbin on site, achieving the aim of zero pollution; it turns waste to treasure. The building waste is resource in the wrong place, and is the second kind of resource. This kind of technical has an effect on the recycle of bricks, concrete, and other waste. On one hand, it reduces the cost of transportation and disposal; on the other hand, it saves a part of the material cost, and improving the effectiveness of projects.

Disadvantages are as follows: Waste recycling technology controls in the source, which has already been a disposal for waste. What's more important, the less waste is the final aim. As result, the company should pay more attention on the less emission of waste; waste recycling technology controls the dust. If the measure is not proper, then lots of dust will explosion on site, polluting the environment, during the disposal of waste; there is also risk in health. Some of the waste is toxic and the sieving process shall be controlled intelligently to ensure the health of workers.

Green multi-functional concrete. Mixed with beads, zeolite powder, silicon powder, green multi-functional concrete meets the needs of high-rise buildings for it has the characteristics of *high strength, high pumping, high firmness, low shrinkage, low heat, low cost, self-leveling, self-compacting, and self-maintenance* (Hereinafter referred to as the "three high three low three-autonomy"). And this concrete now has applied in Guangzhou West Tower, KingKey100, and Guangzhou East Tower, making the record of 440 meters high pumping C100 concrete and 510 meters high C120 concrete. High strength, free vibration and free maintenance, the concrete solves the problems in projects.

In conventional projects, the company seeks for more green function of ordinary concrete except for the high strength. On December 26th, 2013, a block of 200m^3 green multi-function concrete with *self-leveling, self-compacting, and self-maintenance* is laid for the first floor in a project of Vanke called Donghui. The concrete solved the problem of self-leveling and self- maintenance. On December 5th, a block of 160m^3 green multi-function concrete with *low shrinkage, self-compacting, and self-maintenance* is laid in the basement which is 80m high, solving the problem of projects. All the above shows the wide application prospects of green multi-functional concrete.

CONCLUSION

The aim of green construction is to realize environmental protection and conservation, to live up to the concept of global sustainable development (Zhao 2014), as well as to the basic requirement for construction enterprises. Green construction is the newly career of the company, for which we should make a plan and arrangement, increase investment and regulation reform, encourage and practice technology innovation, and develop and apply green construction technology which are environmental and beneficial to promote the green construction.

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Study on the Development Situation and Prospects for Green Construction

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Abstract

This article analyzed the operation mechanism, the developments situation and the existing problems of green construction from the aspects of policies, regulations, standards codes, construction technologies and engineering practices points of views. It also revealed the effectiveness of green construction for lower resources consumption, reducing pollution and protecting environments. The author proposed that new development trend of green construction based on the background of new urbanization, and recommended progress for accelerating the development of green construction.

In the architectural industry, green architecture is the exactly how the idea of sustainable development is put into practice. In fact, green construction remains a very important process for producing the green architectural products. Earlier in this century, following the reach of consensus over the concept of "Green Olympics", the architectural industry entered the new era dominated by the concept of green construction.

EVOLUTION AND MAJOR ACHIEVEMENTS OF GREEN CONSTUCTION

The concept of green construction in the architectural industry is developed from the idea of green architecture and green design introduced from the western developed states. However, the limits in terms of the investment and construction management system in China indeed contributed to the division of the concept of green construction into two parts, the design part and the construction part (Chen et al. 2010). Yet, architectural design and engineering construction indeed belong respectively to the design unit and construction unit, implying that no strong associations exist between these two. Thus, it is reasonable that the green design and green construction will experience different development stages.

Developments and features of the green design. There are several conceptual stages for the development of the concept of green design in China's architectural industry, which include the budding stage (from 1978 to 1992), the slowly growing stage (from 1993 to 2006), and the rapidly developing stage (from 2007 till now). In terms of the government administration, in order to better promote the development of the concepts of green architecture and green design and the work of energy conservation, the government enforced a series of measures, including setting up the Green Architecture Innovation Prize, Green Architecture Demonstration Project (2007), organizing green architecture design and formulating the criteria to rate the green buildings. By the end of 2013, there had been 1260 green architecture evaluation sign projects. Specifically, there had been 480 one-star green architecture project signs, 530 two-star ones and 312 three-star ones. Statistically, the number of green architecture signs surged rapidly in recent 6 years (illustrated in Figure 1).

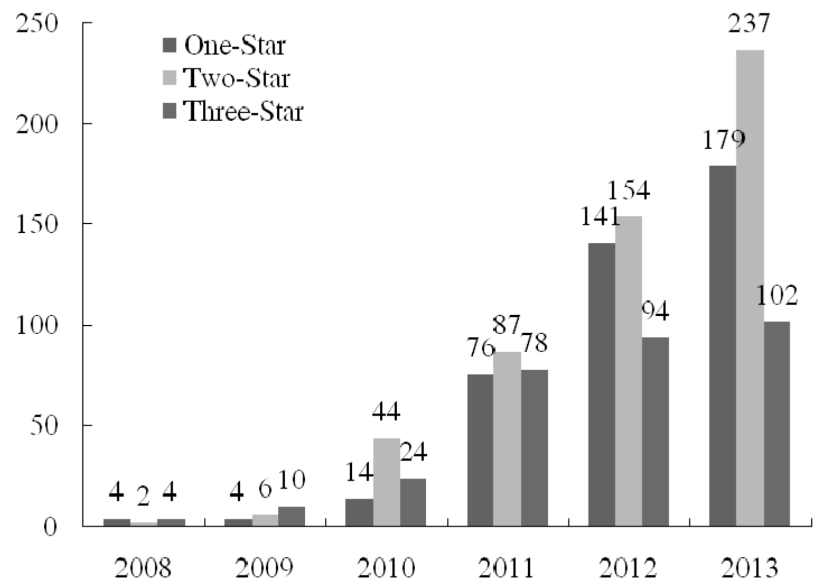

Figure 1.The number of green architecture evaluation sign projects.

From the perspective of regional distribution, the number of green architecture evaluation sign projects of 6 coastal areas such as Jiangsu, Guangdong, Shandong, Shanghai, Hebei, Tianjin etc. is far ahead, accounting for as high as 58%, and Hubei, Zhejiang, Beijing, Fujian etc. also grow significantly. In 2013, the top ten provinces in green architecture sign projects identified as Shandong, Guangdong, Tianjin, Hebei, Jiangsu, Henan, Shanghai, Hubei, Shaanxi, Anhui, Beijing (Illustrated in Figure 2).

From the perspective of industry distribution of green architecture evaluation sign projects, 2013, in the Top 518 green architecture signs, the number of the residential buildings is 287, accounting for 55%, public buildings, 221, 43%, industrial buildings, 10, accounting for 2% (see Figure 3).

Thus, green architecture design and criteria to rate the green buildings as a symbol, the development of China's green architecture design presents the following three characteristics: Firstly, it starts late but develop rapidly, suggesting that with the deepening of sustainable development concept, the pursuit of green architecture is increasingly becoming conscious behaviors and goals; the second is that the development and scale of the coastal areas of green design significantly speeds up than the central and western regions, which shows that regional imbalance of development in green design still exist; the third is green design attaches more attention in the residential construction field, which shows that people has paid more attention to their health and livable environment.

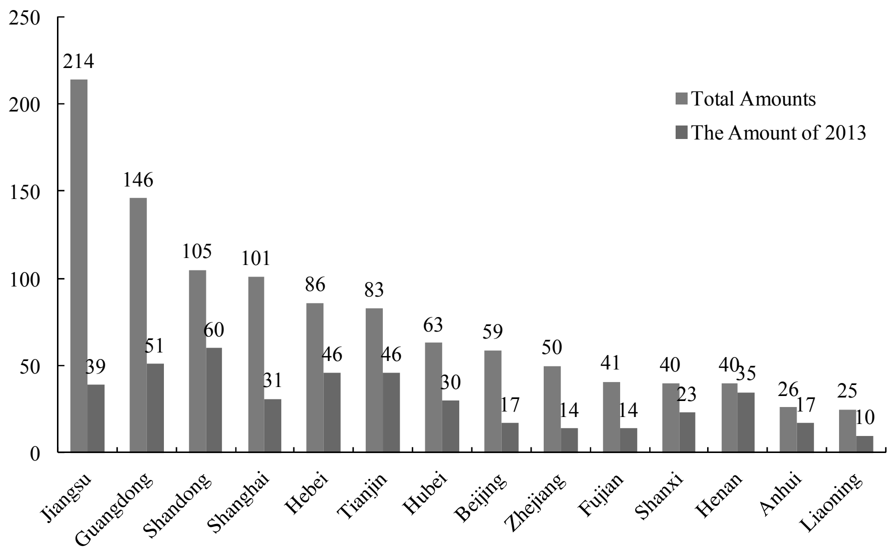

Figure 2.The regional distribution of green architecture evaluation sign projects.

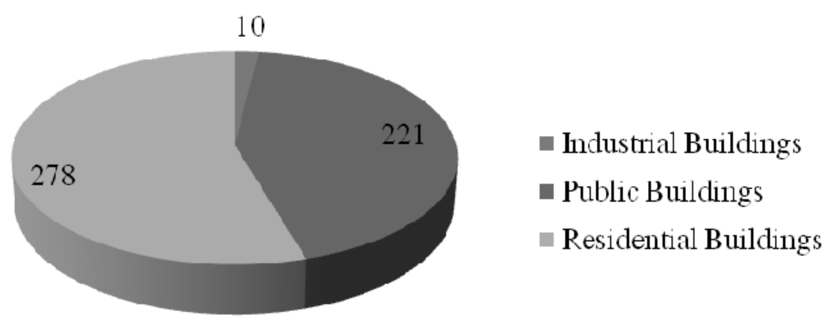

Figure 3.The industry distribution of green architecture evaluation sign projects.

Development and major achievements of green construction. The development of green construction is a little later than green design. The development of green construction can be divided into three stages, namely, concept introduction phase (2003 to 2007): bounded by proposing the slogan "Green Olympics", it indicates that architecture industry has changed from only attaches great importance to the civilization of construction sites and the energy-efficient to the comprehensive cognition and energy saving, emission reduction, environmental protection; system establishment phase (2007 to 2010): The Ministry of Construction issued the "Green Construction Guidelines" as a symbol, which identifies the principle of green construction, content, a general framework and key points, puts forward to develop new technology, new equipment, new materials, new technology and carry out green construction demonstration projects; growth and development stage (2010-present), the implementation of "the national green construction demonstration projects management method of architecture industry" makes green activities of construction demonstration projects to become the vehicle of leading construction enterprises to take green development into practices (Akadiri and Olomolaiye 2012).

At present, the achievements of implementing green construction in china's architecture industry are mainly in the following five aspects. Firstly, it is to establish the concept of green construction. People pay more attention to carry out "energy conservation, land, water saving, material saving and environmental protection" in the process of construction. Secondly, it is to establish a sound standard specification of green construction (Akadiri and Olomolaiye 2012). China has successively issued "Green construction Code" (GB/T 50905-2014) etc. Thirdly, it has made an important breakthrough to promote and implement green construction demonstration projects. From 2011 on, it has been officially announced three batches of 370 green construction demonstration projects (see Figure 4), which has played a significant role of demonstration and leading. Fourthly, it is to establish China Construction Industry Association Green Construction Committee, specifically responsible for promoting the work of green construction. Fifthly, actively carry out the competition of meeting the standard of energy conservation of construction projects and inspire the owners and construction enterprises initiatively to promote green construction, effectively promoted green construction to expand to larger range.

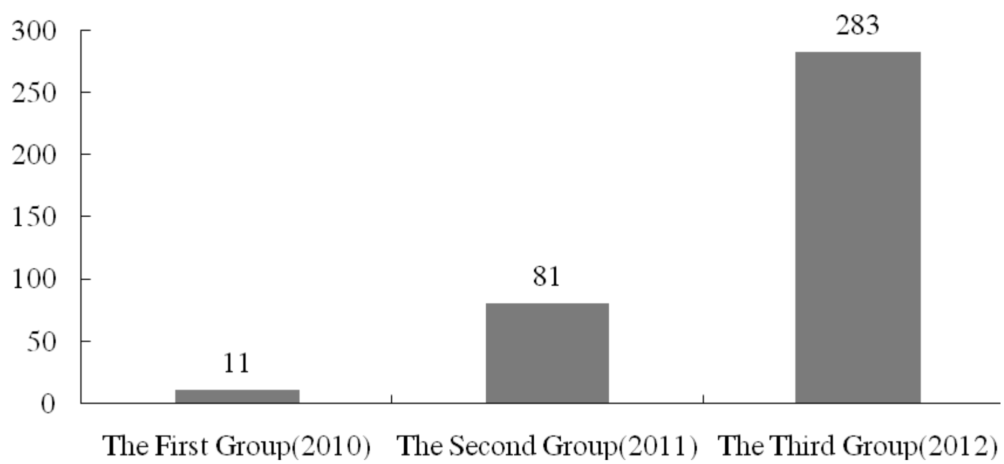

Figure 4.The number of green construction demonstration projects.

THE ARCHITECTURE MODEL AND OPERATION MECHANISIM OF GREEN CONSTRUCTION

Green construction synthesizes the circular economy theory and cleaner production principle. In the course of construction, guided by the concept of sustainable development, green construction is the activity to save energy sources and protect environment markedly through scientific management and technological progress, and meanwhile to produce green building productions that not only guarantee the safety and quality but also meet user's demand and national standard (Wu and You 2014). As green construction activity facing the construction products' complete life-cycle and involving cooperation of main interest and responsibility body in products value chain, green construction is a systematic engineering construction activity (Henry and Frascaria-Lacoste 2012).

System model of green construction activities. The framework of green construction system model is shown in Figure 5. In this system model, the main parts of green construction activities include government, industry association, end users, project developers, designers, contractors, supervisor, operation business, etc., covering projects' whole life circle from the opportunity research stage, the design phase, the construction phase to the operation and maintenance phase, and corresponding to each phase, the related responsibility subjects' activities are green planning, green procurement, green design, green construction, green operation and maintenance, green consumption. The textural body of building products is green building material, while green technology is needed to change the drawings into reality (Kibert 2008).

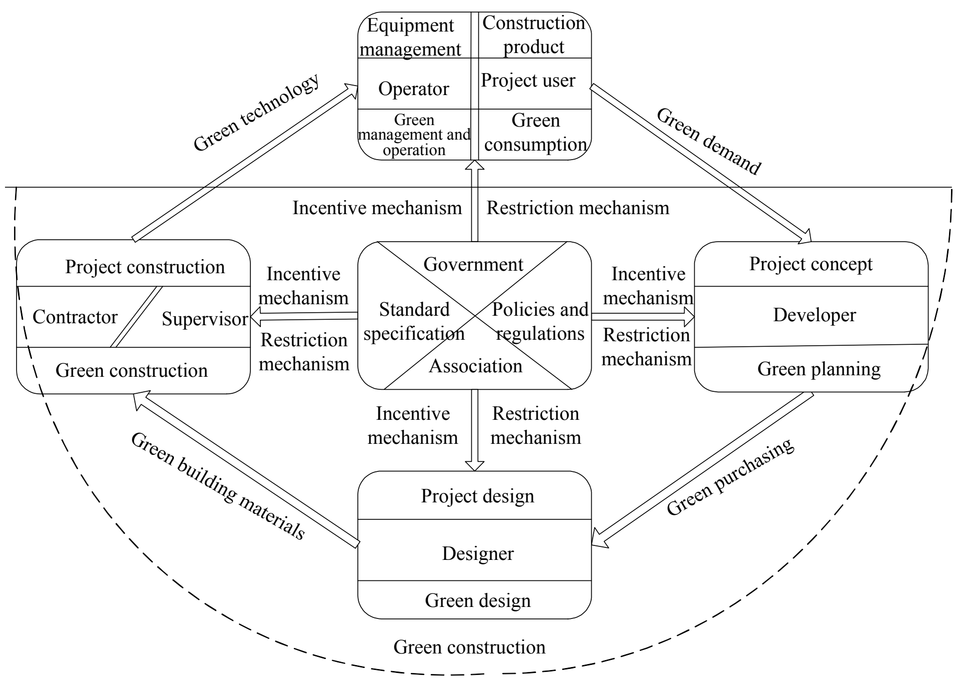

Figure 5.Schematic diagram of green construction's architecture model and operation mechanism.

The operational process of green construction. Green construction system model in Figure 5 also shows the basic process of project construction.

If take residential products for example, green building is the goal of people's life, also the ultimate consumption product for residence. Therefore, the pursuit of green building is the green consumption demand for human, which will surely starts the housing market supply. Green consumption is the logical starting point for the operation mechanism of green construction (Lim et al. 2014).

Residential developer is the main supplier for residential market. In order to meet the needs of green building products by residential customers, the developers will surely find ways to meet customer needs and achieve green building features in project planning, and this is green planning. Green planning includes: (1) make specific description of the main purposes of the project, its mixed use or goal; (2) determine the project orientation; (3) determine the composition of the system; (4) determine the project quality standard, investment estimation, and the construction period; (5) identify and select the best financing options; (6) determine the project target control; (7) study the feasibility of technology, finance, economy, environment, society and other aspects.

After determining the project functions, objectives, and building programs, the developer should purchase the main body and resources in the following construction phase (Qi and You 2006). According to the requirements of green planning, the procurement process must embody the following features of efficient application, resources conservation, reduced environmental pollution, and livable environment. The main content of green procurement is to choose consultants, designers, contractors, and material resources that meet the project objectives and requirements.

After determining the designer, the construction comes into green design stage. The basic requirement for green design is to minimize the consumption of non-renewable resources and pollution on the ecological environment through the integration of technology and materials, providing users with a healthy and comfortable working and living environment that is in harmony with nature.

Upon the completion of the project design, the project enters into the green construction phase that contractors are mainly responsible. Green construction is an important part of green building, also the process that changes the design into reality, including planning, implementation and acceptance phases. Only green construction technology development and application will help realize green construction. Green construction includes multiple levels of meaning: (1) in order to achieve the goal of green building; (2) in the method of scientific management and technical progress; (3) with the features of reducing consumption of resources and protecting environment; (4) emphasizing minimizing the pollution emissions and making most of resources during construction; (5) adhere to the principle of people-oriented, emphasizing improving the working environment, and reducing labor intensity (Paul and Taylor 2008).

Procurement of construction materials and equipment should be based on national and local government green procurement policies, to select green materials and equipment, including qualified green supplier's evaluation and choice, and to carry out planning, transportation, and storage work for materials and equipment. When choosing green building material, we should firstly take into consideration of production technology, and select reusable, non-toxic, non-polluting, non-radioactive products, that are made of agricultural or municipal solid waste; or building materials with high insulation properties which are water-saving and material-saving. Green construction machinery or equipment should be of high efficiency, low energy consumption, with more turnaround times, occupying less space, and with high safety property. When purchasing green building equipment, we should give priority to engineering equipment that is with high energy efficiency, low energy consumption, and low pollution.

Green construction assessment is an important part of green construction. Require green construction assessment take construction process as an object, and make clear the regulations in the aspects of system construction, content planning, innovation and application of "Four New Techniques", training, continuous improvement, file record etc.

Green construction technology is technological means to realize green building and support green construction activities. Include: (1) environmental protection technology; (2) energy saving and utilization technology; (3) Saving material and material resources utilization technology; (4) water conservation and water resources utilization technology; (5) land and land resources protection technology etc (Paul and Taylor 2008).

After construction project completed and delivered, contractor's main responsibility agreed in the contract has been completed, then the project is into the operation and maintenance phase, where operator is the key of construction activities. At the same time, the actual users of the project itself become the main consumer of finished buildings. As the green consumer of residential products based on green building and green operation and maintenance, behavior of the occupants themselves also have a direct impact on the realization of sales functions of green construction product.

In the system model of green construction, the government and associations are in a very important position. In terms of the government, it is essential part to implement green construction. Due to the externality of environment problems, without the government's obligation, under normal circumstances, the relevant interest subject will not choose green construction on the consideration of economic interests, so rely entirely on market regulation mechanism cannot effectively solve environmental problems in construction process. Therefore, the implementation of green construction requires government on behalf of the public interest, and by using legal and administrative means rationally to strengthen the construction of incentive and restraint mechanisms, at last become the driving force to promote green construction under the multiple limits of policy enforcement, community supervision, goal-oriented, etc.

CASE STUDIES AND EFFECT OF THE GREEN CONSTRUCTION ENGINEERING

Currently, there are an increasing number of the engineering projects in form of green buildings underway. Upon the maturity of the unibody construction technology, the integration of the concepts of green design and green construction not only becomes possible, but also is being processed (Ries et al. 2006). The following sections will be dedicated to three case studies related to green construction pattern and its effect.

Zhoukou stadium in Henan. The total project duration lasted for 23 months, with 330 million RMB invested. The BT financing construction pattern has been employed which would be constructed according to the green construction methods that integrate the investment, green design and green construction ideas.

With the employment of green construction, the Zhoukou Stadium produced the excellent economic and social benefits. For instance, the employment of the assembling pile foundation technology shortened the duration of the project and reduced the cost by 20%. Also, the adoption of the green design technology over the working drawing effectively saved the budget by 5% and increased the water-saving rate to over 10% and the electricity conservation rate to 15%. Besides, the local material use rate was larger than 90% while the recycling rate for the construction garbage reached 31%.

The cigarettes factor in Hangzhou. The cigarettes factor in Hangzhou contributed a green workshop pattern. The project employed over 90 energy-saving and environmentally friendly technologies to reduce the total energy consumption.

The employment of the green construction idea allowed the project to produce significant economic and environment benefits. For instance, the afforested areas on the rooftop reached 42 thousand m^2. The total energy-saving rate was 18.53% while the annual saved electricity fee was 5.527 million RMB. Besides, 238.6 thousand tons of tap water could be conserved per year, which saved 982 thousand RMB. The adoption of the condensate water recycling technology allowed this project to recollect 240 tons of condensate water. As a result, there are 5357.9 tons of CO_2, 161.2 tons of SO_2, and 80.6 tons of NO_x being reduced. The emission of the processed waste water will contribute to reduce 42.5 tons of CODcr, 74.2 tons of SS, 2.0 tons of petroleum, and 1.36 tons of NH3-N.

T30A hotel project in Changsha, Hunan. T30A Hotel incorporated some positive explorations in terms of the seismic resistance, energy conservation, purification, duration, materials efficiency, recyclable construction materials, formaldehyde-, lead-, and radiation-free asbestos materials, dust-, waste-water- and garbage-free construction. During the construction of the hotel, the seismic resistance technology based on the “steel structure + diagonal bracing + light weight” was invented, which could realize the Degree Nine Seismic Resistance effect in condition that the amount of steels was reduced by 10-20% and that of the concrete was down by 80-90%. Over 30 energy conservation technologies, including the heat preservation with thick external walls, multiple-layered windows, new wind-heat recycling, and electricity generation by descending of elevators and the water-conservation toilets, have been employed to quintuple the energy saving effect. Besides, a 3-level filter combined system was capable of purifying the air at the super low cost with twentyfold effect. The use of the industrial construction method allowed the labor demand by the on-site assembling to only account for 70% of the labor use of the entire project. The industrial degree reached 93% while the construction wastes were less than 1% of others. During the construction, there was only the on-site assembling, without any welding, cutting and on-site pouring. The project construction was fire-, water- and dust-free. This project is a typical example of the employment of the green construction concept for the pre-made assembling buildings, which effectively reduced the on-site environmental pollutions, shortened the project duration. As a result, the 100-meter building was finished construction within 15 days.

THE FUTURE PROSPECTS OF GREEN CONSTRUCT

The future prospects of green construction. In March 2014, China officially issued “National New-type Urbanization Plan 2014-2020” in which with much coverage proposed more stringent requirements for products quality, green urban construction, real estate, and rebuilding the Shantytowns (Xiao and Luo 2013). Construction industry shoulder the historic mission of energy saving and green development. In the background of the new urbanization, green construction should combine the following aspects well in the future etc.

Green construction combined with developing circular economy. In accordance with the “3R principle” of circular economy, we can carry out green construction activities of multi-dimensions in “3C level”. 3R principle refers to Reduce, Reuse, Recycle. 3C level refers to the minor cycle, the medium cycle and the major cycle (You 2005).

While take the advantage of 3R principle, the minor cycles can carry out within the construction development enterprises, design enterprises, construction enterprises, building materials enterprises; After the screening, part of construction wastes of construction companies can be used as foundation’s filling stuff. Bye using the 3R principle, medium cycle system may carry out between different types of cross-industry enterprises, thus form the “ecological chain” between industries. Major circle can be set in two ways, one is from the perspective of resource utilization efficiency, reuse various construction wastes and demolition wastes into recycled materials, and the second is apply 3R principles systematically into design, construction, use and demolition of construction products of whole life circle (Zuo and Zhao 2014).

The combination of the green construction and industrialized construction. Development of green construction technology is bound to combine with the direction of architectural industrialization. Industrialized construction is use modern industrial mode of mass production instead of the handicraft mode to construct building products (Scofield 2009). Use industrial mode of production can accelerate construction speed, improve the working environment, improve labor productivity, reduce labor intensity, reduce resource consumption, improve construction quality, guarantee safety in production, eliminate the discharge of pollutants (Wu 2014). Only with the combination of the green construction and industrialized construction can maintain long-term vitality.

In the era of knowledge economy, green construction needs to be supported by strong information technology to keep up with the times. In recent years, emergent information technologies come forth continuously, such as BIM, cloud computing, virtual reality, mobile technology, collaborative environment and big date. They have increasingly effect on project construction and management. Especially information technology can greatly improve the whole project construction process optimization, integration benefit, constructability of construction project, safety, professional cooperativity, precision of dymanic target control and degree of “intelligent management”. With modern information technology, the actual effect of green construction will be better.

The combination of green construction and improve green productivity of construction enterprises. Green construction needs construction enterprises management ability. For example, general contracting enterprises not only need the corresponding design capacity, but also consider complex factors in both design process and construction process and cultivate interdisciplinary talents with management and technology (Robichaud and Anantatmula 2010). Through pushing green construction, green construction ability and green competitive ability of construction enterprises can be improve, and pushing construction enterprises turn traditional productivity to green productivity.

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Assessment on the Carbon Emissions of Buildings with a Study Case

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Abstract

More and more attention has paid to the greenhouse gas around the world. It has been a problem for each country to reduce the carbon emission, so it is with China. Carbon emission in building products accounts for a large share in the whole emission from all aspects. Therefore, the building industry is reckoned highly energy consuming. It is significant to calculate the carbon emission of buildings to find solutions. This paper establish a calculate model, which is also applied in a case study in local, to calculate the carbon emission of buildings in the whole life cycle, including material preparation, construction installation, operation, and abandonment phase. Hence, the result of this study can be of reference on the reduction measures taken in different stages in the life cycle.

INTRODUCTION

On November 23, 2013, the United Nations Framework Convention on climate change for the 19th meeting of the parties, and the ninth meeting of the parties in Warsaw, came to an end. After two weeks of tough negotiations and heated argument, delegates finally signed agreements on climate funds, compensation for damage and other focus issues. Although the outcome is not satisfactory, and China said that energy conservation is the inherent requirement of sustainable development of China. Regardless of the unsatisfied progress, China will unswervingly follow the Green and low-carbon development path.

According to a research by Intergovernmental Panel on Climate Change, the building industry consumes 40% of global energy and release 36% carbon dioxide (IPCC 2007). Take the EU for example, as the fourth largest source, residential buildings release 77% of the total building carbon emissions, accounting for 10% of the total emission amount. In the United States, together with personal traffic, residential buildings release 49% of the total emission in society (Salon et al. 2010). In the United Arab, residential buildings consume 45.9% of the energy (Radhi 2009). In China, construction phase of residential buildings releases 7% of the total carbon emission of the whole life cycle, and the cogeneration 42% which is related to building industry. To conclude, residential buildings account for a large share in carbon emission (Chen et al. 2005). In the meanwhile, residential buildings use 45.9% of the total energy means the carbon emissions proportion is high (Su and Zhang 2008).

It is a consensus that reducing carbon emissions could ease the problem of global warming. Carbon emission in building products accounts for a large share in the whole emission from all aspect. Therefore, the building industry is reckoned highly energy consuming. It is of great significance for the energy conservation of the country to calculate the carbon emissions. This paper establish a calculate model, which is also applied in a case study in local, to calculate the carbon emission of buildings in the whole life cycle, including material preparation, construction installation, operation, and abandonment phase.

CARBON EMISSIONS CALCULATION MODEL FOR THE WHOLE LIFE CYCLE

The whole life cycle of buildings can be divided into four phases, which are material preparation, construction installation, operation, and abandonment phase. Hence, the total emission is as below.

$$P = P_1 + P_2 + P_3 + P_4 - P_5 \tag{1}$$

Among them:

P : Carbon emission released in the whole life cycle (kg);

P_1 : Carbon emission released in material preparation phase (kg);

P_2 : Carbon emission released in construction installation phase (kg);

P_3 : Carbon emission released in operation phase (kg);

P_4 : Carbon emission released in abandonment phase (kg);

P_5 : Carbon absorption by the plant (kg).

Carbon emission released in material preparation phase. Carbon emission released in material preparation phase is as below.

$$P_1 = P_{11} + P_{12} \tag{2}$$

Among them:

P_1 : Carbon emission released in material preparation phase (kg);

P_{11} : Carbon emission released in material mining and manufacture (kg);

P_{12} : Carbon emission released in material transportation (kg).

(1) Carbon emission released in material mining and manufacture:

$$P_{11} = \sum_k v_k \times Q_k \times (1 - \alpha_k) \tag{3}$$

Among them:

v_k : Carbon emission coefficient for the k^{th} building material;

Q_k : Amount for the k^{th} building materials (t or m^2, m^3);

α_k : Recovery coefficient for the k^{th} building material;

(2) Carbon emission released in material transportation:

$$P_{12} = \sum_{k,t} Q_k P_{kt} L_{kt} \tag{4}$$

Among them:

Q_k : Amount for the k^{th} building materials (t or m^2, m^3);

P_{kt} : Carbon emission per mass or volume for the t^{th} means of transportation (kg);

L_{kt} : Distance for the k^{th} building material the t^{th} means of transportation (km).

Carbon emission in construction installation phase. Carbon emission in construction installation phase:

$$P_2 = P_{21} + P_{22} \tag{5}$$

Among them:

P_{21} : Carbon emission caused by fuel (kg);

P_{22} : Carbon emission caused by power (kg).

Carbon emission in construction installation is mainly caused by energy consumption, which is calculated to get the carbon emission.

Carbon emission caused by fuel:

$$P_{21} = \sum_k e_k \times q_k \tag{6}$$

Among them:

e_k : Carbon emission coefficient for the k^{th} fuel;

q_k : Amount for the k^{th} fuel, mainly for coal, oil and gas (kg, L, m^3).

There are two calculations for the power. The first one is to accumulative daily power consumption, obtaining the carbon emissions. The second is to according to the specific equipment.

Carbon emission caused by power:

$$P_{22} = \sum_i E \times e_e \tag{7}$$

Among them:

E : Power consumption (kWh);

e_e : Carbon emission coefficient for the electricity.

Carbon emission released in operation phase. Carbon emission caused in operation phase mainly comes from heating systems, cooling systems, and water heating systems. Heating systems include small boiler room, family self-heating equipment, and central heating. And cooling systems include home air conditioners, central air conditioning and other large-scale forms.

Carbon emission released in operation phase:

$$P_3 = \sum_k e_k \times q \times n \tag{8}$$

Among them:

e_k: Carbon emission coefficient for the k^{th} energy ($kgCO_2/kg$, $kgCO_2/L$, kgCO2/m^3);

q : Energy consumption for the k^{th} energy per year (kg/a, L/a, m^3/a);

n : Operation time of the buildings (a).

Carbon emission released in abandonment phase. Carbon emission released in abandonment phase.

$$P_4 = P_u + P_v + P_w \tag{9}$$

P_u : Carbon emission caused by transportation of building waste (kg);

P_v : Carbon emission caused by construction equipment in building demolition (kg);

P_w: Carbon emission caused by power in building demolition (kg).

(1) Calculation formula for P_u:

$$P_u = \sum_i \sum_j Q_i \eta_j L_{i,j} \tag{10}$$

Among them:

Q_i : Amount of the i^{th} waste (kg， m^3 or m^2);

η_j : Carbon emission for the i^{th} waste by the j^{th} means of transportation per mass and distance ($kgCO_2/t\cdot km$);

$L_{i,j}$: The distance for the i^{th} waste by means of the j^{th} transportation (km).

(2) Calculation formula for P_v:

$$P_v = \sum_k e_k \times q_k \tag{11}$$

Among them:

e_k: Carbon emission coefficient for the k^{th} energy(kg CO_2/kg, kg CO_2/L, kg CO_2/m^3);

q_k : Amount for the k^{th} fuel, mainly for coal, oil and gas(kg, L, m^3).

(3) Calculation formula for P_w:

$$P_w = E \times e_e \tag{12}$$

Among them:

E : Power consumption in the building demolition phase (k·Wh);

e_e : Carbon emission coefficient for the electricity.

Carbon absorption by the plant.

$$P_5 = A \times K \tag{13}$$

Among them:

A : Size of the plant (m^2);

K : Carbon absorption in operation phase per size of plant (kg).

COEFFICIENT OF CARBON EMISSION

Equipment used in manufacture of the raw material mainly is power equipment, and loading, unloading materials are completed by means of transportation. Coefficient of carbon emission caused by manufacture of raw material by unit is as below, seen in Table 1.

Table 1.Coefficient of Carbon Emission Caused by Manufacture of Raw Material.

Items of material	Coefficient of carbon emission
Stone	2.142 kgCO_2eq/t
Log	146.3 kg CO_2eq/m^3
Lime	2191 kg CO_2eq/t
Sandstone	2.329E-02 kg CO_2eq/kg
Clay	7.653E-04 kg CO_2eq/kg
Plaster	192.9 kg CO_2eq/t
Water	0.2592 kg CO_2eq/m^3

Semi-finished and finished goods refer to products made from energy and raw materials, which can be transported directly to the field and formed into the body of the building. According to research by Gao (2012), coefficient of carbon emission caused by manufacture of Semi-finished and finished goods by unit is as below, seen in Table 2.

Table 2.Coefficient of Carbon Emission Caused by Manufacture of Semi-Finished and Finished Goods.

Items of material	Coefficient of carbon emission
P.I.52.5 cement	1.35E+03 kg CO_2eq/t
P.O.42.5 cement	1.18E+03 kg CO_2eq/t
P.S.32.5 cement	8.38E+02 kg CO_2eq/t
Heavy section	2.80E+03 kg CO_2eq/t
Steel products for medium and small sized	2.32E+03 kg CO_2eq/t
Medium wire steel	2.30E+03 kg CO_2eq/t
Hot rolled strip	2.43E+03 kg CO_2eq/t
Cold rolled strip	2.94E+03 kg CO_2eq/t
C30(32.5)	2.51E+02 kg CO_2eq/m^3
C40(42.5)	3.65E+02kg CO_2eq/m^3
C50(52.5)	4.47E+02 kg CO_2eq/m^3
C60(52.5)	5.27E+02 kg CO_2eq/m^3
C80(52.5)	6.61E+02 kg CO_2eq/m^3
C100(52.5)	7.27E+02 kg CO_2eq/m^3
Aluminum profile	29.85t CO_2eq/t
Autoclaved flyash-lime brick	9.15E-01 kg CO_2eq/piece
Burnt clay brick	2.20E-01 kg CO_2eq/piece

Table 2.(Continued).

Items of material	Coefficient of carbon emission
Aerated concrete block	5.34E-01 kg CO_2eq/piece
Architectural pottery	1.48E+01 kg CO_2eq/m^2
Ceramic sanitary ware	3.12E+01 kg CO_2eq/piece
Architectural pottery	7.38E+02kg CO_2eq/t
Ceramic sanitary ware	2.08E+03kg CO_2eq/t
Quartz Glass sand mining	2.10E+02kg CO_2eq/t
Soda Ash Manufacture of glass	3.39E+03kg CO_2eq/t
Flat Glass Processing glass	4.31E+03kg CO_2eq/t
PVC pipe	4.65E+03kg CO_2eq/t
EPS cellular plastics thermal insulation materials	3.29E+03kg CO_2eq/t

In China traffic statistical yearbook, consumption level of energy are listed before the year of 2007, and coefficient of carbon emissions caused by transportation are seen in Table 3.

Table 3.Coefficient of Carbon Emission Caused by Transportation.

Items	Coefficient of carbon emission
Beeliner	1.10E+02kg CO_2eq/10^6t·km
Gasoline truck	2.990E+01kg CO_2eq/100t·km
Diesel truck	2.270E+01kg CO_2eq/100t·km
Water transportation	5.24E+01kg CO_2eq/1000t·km
Air transportation	7.43E-01 kg CO_2eq/t·km

According to Assessment Methodology and Empirical Analysis of Embodied Carbon Footprint of Building Construction by Gao (2012), greenhouse gas emissions data in this study caused by gasoline, coefficient of carbon emission caused by energy are seen in Table 4.

Table 4.Coefficient of Carbon Emission Caused by Energy.

Items	Coefficient of carbon emission
Coal	2.9kg CO_2eq/kg
Petrol	3.36kg CO_2eq/kg
Gas oil	3.78kg CO_2eq/kg
Power	kg CO_2eq/k·Wh

CASE STUDY

Case introduction. People's hospital project, with a total construction area of 34901.72 square meters, the floor construction area is 32691.82m^2, and underground construction area is 1682.35m^2. Subject fifteen floors on the ground, three layer podium, underground, building a total height of 61.45 meters, the building height: 5.4m basement, a layer of 5.4m, the second and third layer are 5.1m, equipment layer of 2.2m, four to 14 layer of 3.6m, roof room layer of 3.6m.

The building has a super flowing concrete form drilled foundation, and a frame-wall structure. This basement floor, beams and concrete walls and upper floor are long, so we use concrete reinforcement to resistant temperature stress. The wall block is filled with ceramic hollow and outside maintenance with high insulation block. The reasonable service life is 50 years, and the seismic intensity of 6 degrees.

Computation procedure. (1) Materials preparation phase. According to the architectural design drawings, bill of quantities and the material approach plan in construction plan, Amount of building material and relevant carbon emission in material preparation phase seen in Table 5.

Table 5.Amount of Building Material and Relevant Carbon Emission in Material Preparation Phase.

Items	Coefficient of carbon emission	Amount	Carbon emission
Stone	2.142 $kgCO_2eq/t$	29400	59826.06 $kgCO_2$
Clop	146.3 kCO_2eq/m^3	90.093	12521.58 $kgCO_2$
lime	2191 $kgCO_2eq/t$	127.9	266217.5 $kgCO_2$
Sandstone	2.329E-02 $kgCO_2eq/kg$	21300000	471273.2 $kgCO_2$
Plaster	192.9 $kgCO_2eq/t$	637	116733.4 $kgCO_2$
Water	0.2592 $kgCO_2eq/m^3$	7786.5	1917.348 $kgCO_2$
cement	1180 $kgCO_2eq/t$	9403	10540763$kgCO_2$
heavy section	2800 $kgCO_2eq/t$	2530	6729800 $kgCO_2$
Steel products for medium and small sized	2320 $kgCO_2eq/t$	25.88	57039.52 $kgCO_2$
C40 (42.5)	365 $kgCO_2eq/m^3$	46.973	16287.89 $kgCO_2$
autoclaved flash-lime brick	9.15E-01 kg $CO_2eq/block$	626000	544150.5 $kgCO_2$
Burnt clay brick	0.220 $kgCO_2eq/block$	4580	957.22kg CO_2
Aerated concrete block	0.534 $kgCO_2eq/block$	2952	1497.55 $kgCO_2$
Soda Ash Manufacture of glass	3390 $kgCO_2eq/t$	1.548	4985.334 $kgCO_2$
PVC pipe	4650 $kgCO_2eq/t$	14.384	63541.32 $kgCO_2$
EPS cellular plastics thermal insulation materials	3.29E+03 $kgCO_2eq/t$	2.790	8720.145 $kgCO_2$
Sum			18896231$kgCO_2$

As to the carbon emissions of building materials transportation phase, according to the established model for analysis, this paper assume the mean distance is 150km, where the railway 100km, highway 50km for the transport distances is difficult to determine in specific building materials. Then carbon emission caused by transportation in building material preparation phase seen in Table 6.

Table 6.Carbon Emission Caused by Transportation in Building Material Preparation Phase.

Items	Coefficient of carbon emission	Amount	Carbon emission
Engine	1.10E+02 $kgCO_2eq/10^6t \cdot km$	100km, 71711t	7.89E+08 $kgCO_2$
Gasoline truck	2.990E+01 $kgCO_2eq/100t \cdot km$	50km, 25276t	3.78E+07 $kgCO_2$
Diesel truck	2.270E+01 $kgCO_2eq/100t \cdot km$	50km, 43479t	4.93E+07 $kgCO_2$
Sum			8.76E+08 $kgCO_2$

So carbon emission in building material phase is:

$P_1 = 18896231 + 8.76E + 08 = 894896231 \text{kgCO}_2$

(2) Construction installation phase. This phase carbon emissions mainly consider construction phase (site). Construction site of carbon emissions, due to the lack of site-specific data, this paper use the energy estimation method, calculate in accordance with Chapter III model. The carbon emission in construction installation phase seen in Table 7.

Table 7.Carbon Emission in Construction Installation Phase.

Items	Coefficient of carbon emission	Amount	Carbon emission
Petrol	3.36 $kgCO_2eq/kg$	20.287 kg	68.16432 $kgCO_2$
Gas oil	3.78 $kgCO_2eq/kg$	12.885 kg	48.7053 $kgCO_2$
Power	1.36 $kgCO_2eq/ k \cdot Wh$	403.9 k·Wh	549.304 $kgCO_2$
Sum			666.17 $kgCO_2$

(3) Operation phase. As a lack of database, part of the carbon source doesn`t count in. This paper only statistic the carbon emission in heating, air conditioning, hot water and light energy, ignoring carbon emission caused by construction equipment, water treatment and refrigerant leakage.

Considering that energy consumption during operation phase cannot be statistics accurately, this paper refers to the relevant literature, such as Life Cycle Energy Consumption and CO_2 Emissions of Buildings: An Overview and Case Studies in Beijing by Peng (2012). We assume that the energy consumption in this case is 138kWh/㎡ each year, and the adjustment coefficient is1.3 for this hospital is in cold area. When the project reasonable service life is 50 years, then the carbon emission is: 138 $k \cdot Wh \times 1.3 \times 1.36\ kgCO_2eq/\ k \cdot Wh \times 34901.72\ m^2 \times 50 = 425773062.6\ kgCO_2$.

(4) Abandonment phase. The actual energy consumption data are not readily available dismantling stage, very few cases of previous studies can really relate to the removal process. This phase includes construction waste transport carbon emissions, carbon emission energy construction building demolition, building material recycling carbon emissions. In view of the current research on building materials recovery is still not sufficient, and some building materials in the calculation of the carbon emission factor has been taken into account recoveries, so this paper no longer

considers building materials recycled carbon emissions. Quality of construction waste is calculated in accordance with 80% of the total mass of the building materials, the use of road transport mode of transport, taking an average distance of 30km. Unified electricity consumption can be measured, taking 50% of the construction of electricity. Building waste emissions are seen in Table 8.

Table 8.Carbon Emission in Building Abundant Phase.

Items	Coefficient of carbon emission	Amount	Carbon emission
Gasoline truck	2.990E+01 $kgCO_2eq/100t \cdot km$	30km, 57368.8t	5.15E+07 $kgCO_2$
Power	1.36 $kgCO_2eq/k \cdot Wh$	200 $k \cdot Wh$	272 $kgCO_2$
Sum			5.15E+07 $kgCO_2$

(5) Carbon absorption by the plant. Considering that the case is in cold area where there are four seasons per year, the carbon absorption is negligible.

(6) Results of the case. From that, the total carbon emission in this case is 9.47E+08 $kgCO_2$. Carbon emission in each phase seen in in Table 9.

Table 9.Emission Rate in Different Phases.

Life Cycle Phase	Carbon Emission	Rate
Building material preparation	8.95E+08	65.2%
Construction installation phase	666.17	0.00%
Operation phase	4.26 E+08	31.0%
Abundant phase	5.15E+07	0.38%
Sum	9.47E+08 $kgCO_2$	100%

CONCLUSION

The case in this paper analyzes the carbon emission in the whole life cycle of buildings, and only to find that material preparation phase releases the most carbon. Thus, measures could be taken to reduce carbon emission in this phase to protect the environment.

In this study the following points can be supplemented and improved in subsequent studies. First of all, in the calculation procedure for carbon emission in the whole life cycle in the case, the building materials mainly bound to structure materials, whose statistics come from detailed list in the contrast. In the future, we should compute and make contrast with the statistics as the procedure moves on. In the meanwhile, when computing the carbon emission during construction installation and demolition phase, the model just make an evaluation according to some research findings for the lack of statistics. It will be more accurate if the statistics could be collected in the field.

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Research on the Comprehensive Environmental Performance Assessment System for Green Data Centers

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Abstract

Recent years, much more attention has been paid to green data centers for their high energy consumption, high emission and growing market demand. The paper studied the BREEAM and LEED systematically to explore characteristics of assessment systems for the green data centers. Then compared to the assessment versions of ordinary new constructions, BREEAM and LEED Data Centers adjust primarily two aspects for the energy consumption characteristic: energy indicators and weights. The conclusion with recommendations is to establish comprehensive environmental performance assessment systems for green data centers in China by setting energy indicator contents and weights, which combines with the design principles and characteristics of indicators based on Evaluation Standard for Green Building (short for ESGB, GB/T50378-2014), the Evaluation Standard for Green Building is the national green building assessment system in China.

INTRODUCTION

With exhaustion of non-renewable resources and progressive deterioration of environmental pollution, energy conservation as well as environmental protection has become a hot issue concerned by all industries. Energy consumed by construction industry accounts for over 30% energy consumed by the whole society. Green buildings are gradually paid more and more attention to. With the features of saving resources, protecting environment and reducing pollution, Green buildings have become the development trend of global construction industry (Yu 2011).

Along with the rapid development of information industry and the arrival of large data times, data centers are the building space where store and manage kinds of data storage equipments, processing equipments and other related equipments. And the quantities increase rapidly currently (Meyers 2012). Based on the statistics made by American Gartner consulting company, by the end of 2010, there are 3.39 million data centers around the world. These data centers mainly distributed in America (960, 000) and Western Europe (480, 000), accounting for half total quantity. And there are about 270, 000 data centers in our country. General, the energy consumption per unit area of data center is dozens of times higher than that of the ordinary public building. In 2011, the power is close to 50 billion KWh which are consumed by data centers in our country. Up to 2015, the total energy consumed by these data centers is expected to be 100 billion KWh, which is equal to the Three Gorges Hydro-power Station's annual output. As well as carbon emissions produced by these data centers will account for 2.6% of the whole society carbon emissions. Therefore, improving data centers' energy efficiency level and reducing its burden against the environment has become a focused issue of the information industry and building industry (Eduard et al. 2015).

It is a hot research issue that by using evaluation standard for green building judging green degree of a data center in the field of green buildings. Currently, the research on comprehensive environmental performance evaluation systems for data centers is in an exploring stage. BREEAM and LEED have set data centers as evaluated object, and investigated comprehensive environmental performance, making data centers adopt green and energy-saving measures and technologies for reducing energy consumption and emissions, and providing a healthy and comfortable working environment for staff (Victor et al. 2015).

Practices of green buildings abroad show that data centers with BREEAM or LEED certifications can reduce energy consumption and carbon emissions effectively (Marija et al. 2014). For example, the British Geological Survey data center, obtaining the BREEAM outstanding certification with the score of 73.98%.Compared to traditional data centers, BGS DC decreased carbon emissions by 22% (Quan et al. 2012). This paper will analyze indicators of BREEAM and LEED DC. Then, summary the general characteristics and provide some basis for developing the version of ESGB for data center.

BREEAM DATA CENTRE ANALYZING

BREEAM Data Centre (BREEAM DC) was issued in 2010, and it defines data center as that any space contain banks of data storage equipments (i.e. servers), plus any associated support spaces (e.g. switch rooms, UPS rooms). The primary function of the building must be the physical or virtual storage, management, and dissemination of data and information. The data halls and any related plant space should make up a significant majority (>75%) of the floor area of the building.

BREEAM DC altogether assesses ten kinds of indicators, such as management, health &wellbeing, energy, transport, water, materials, waste, land use & ecology, pollution and innovation.

According to functions and characteristics of data centers, BREEAM DC made a major adjustment in assessment contents. These adjustments are concentrated at two sides: one is the changes of assessment contents, mainly manifested in the energy indicator; the other is the changes of weights, which are influenced by associated function areas and assessment stages.

Changes of assessment contents. Compared with the version of BREEAM NC, BREEAM DC's assessment contents are still involved in management, health &

wellbeing, energy, transport, water, materials, waste, and so on. Its changes are mainly embodied on the energy indicator, and other indicators do not change obviously. For the energy indicator, BREEAM DC totally investigated 7 aspects, which respectively are "Reduction of CO_2 Emissions", "Sub-metering of Substantial Energy Uses", "External Lighting", "Low or Zero Carbon Technologies", "Lifts, Transport CO_2" and "Procurement of Sustainable IT Equipment". Then the paper is going to analysis item by item.

First of all, the scores of "Reduction of CO_2 Emissions" index are the maximum, accounting for 48.4% of the total energy indicator' scores. It has two sides of assessment criteria: one is CO_2 index (EPC Rating), which is the main basis for evaluating energy consumption of the operational stage; the other is Power Usage Effectiveness (PUE) predicted, which can effectively measure the level of energy efficiency. Combining CO_2 index with PUE changes the past mode of only considering CO_2 index for this indicator. When the interval of CO_2 index is determined, the scores of "Reduction of CO_2 Emissions" increase as the PUE decreases. When the CO_2 index >63 or PUE >1.9, the score is 0. When the CO_2 index is between 0-25, the PUE is ≤1.2, there will be extra scores. Taking the British Geological Survey data center as an example, whose CO_2 index is less than 25 (in 25-0), and PUE is 1.34, it obtains 11 points. Specific scores are shown in Table 1:

Table 1."Reduction of CO_2 Emissions" Indicator' Specific Scores Setting.

Scores	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	+1	+1
PUE	1.9	1.8	1.7	1.65	1.6	1.55	1.50	1.45	1.40	1.35	1.3	1.28	1.26	1.24	1.22	1.2	1.1
			63-41					40-26						25-0			

"Sub-metering of Substantial Energy Uses" indicator demand to dynamically monitor energy consumption of all major systems, covering the UPS systems, and the uninterrupted operation of IT and cooling systems. For the high energy consumption systems, implementation of "Low or Zero Carbon Technologies" and "Procurement of Sustainable IT Equipment" indicator can improve the level of energy efficiency, and reduce energy consumption, then reduce PUE and CO_2 index.

Paying particular attention to the assessment of energy indicators, and combined with data centers' functions and characteristics, BREEAM DC assesses health &wellbeing, transport, water and other environmental performance.

Changes of indicator weights. Compared with the version of BREEAM NC, REEAM DC increases 18% for the weight of energy indicator, and 2.5% for the weight of water indicator. The adjustments has two aspects of reasons: one is that IT equipments, refrigeration and air conditioning systems continuously operate consuming large energy; the other is that refrigeration and air conditioning systems running healthily need large water circulation. In contrast, health &wellbeing, transport, materials, waste, and some other indicators' weights go down. The details are shown in Figure 1.

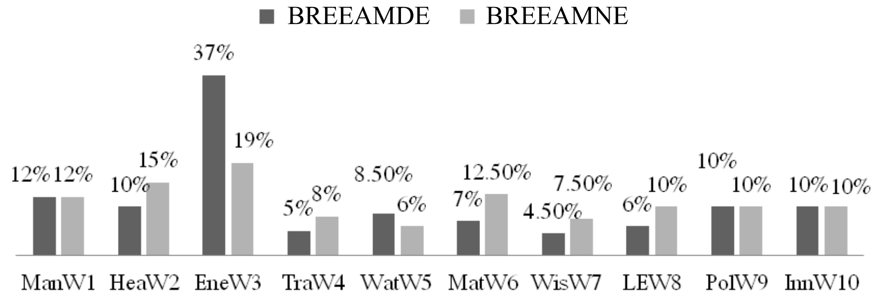

Figure 1.BREEAM DC and NC' indicator weights.

When evaluate the data center with no associated function areas, the weights of health &wellbeing and transport indicators decrease to zero. To display energy exhaust characteristic of data centers with no associated function areas, when evaluate the buildings in new, extension or retrofit stages, energy indicator' weight increase to 44.5% from 37%, as well as land use & ecology' increases by 7%. Indicators' weights of Date centers with no associated function areas or large associated function areas are shown in Figure 2.

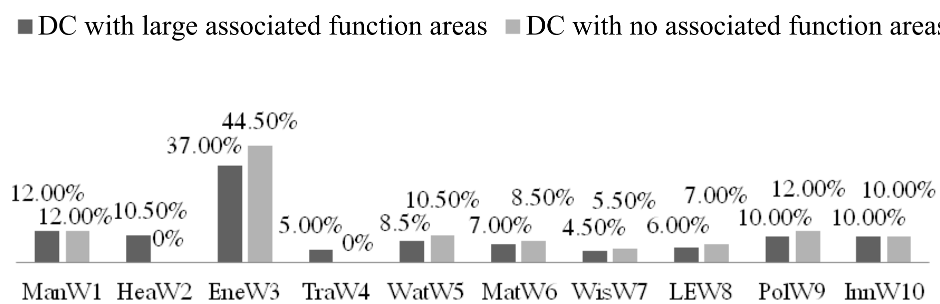

Figure 2.BREEAM DC' indicator weights.

For out bursting DC' using function and operating characteristic, BREEAM flexibly adjust relative weights of indicators. The whole energy efficiency and its use efficiency of the projects which obtained authentications improve obviously.

LEEDV4.0-DATA CENTER ANALYZING

LEEDv4.0 (Ricardo 2014) is published in 2012，and it set version of LEEDv4.0- BD+ C (building design + construct) for evaluating new data centers, LEED DC for short. It defines data centers that buildings are used for store IT equipments for the storage and processing of data.

Compared with versions of evaluating general new buildings, contents and weights of LEED DC are of no difference. The paper will study it when analyze the energy indicators comparatively below, and not analyze individually any more.

EVALUATION STANDARD FOR GREEN BUILDING ANALYZING

The ESGB (GB/T 50378-2014) implemented in 2015 classify the evaluation objects widely. The weights and contents of evaluation are not adjusted for the data center's function and feature. Then the paper will analyze the version of BREEAM and LEED DC, and design the frame of ESGB DC based on ESGB.

BREEAM DC, LEED DC AND ESGB COMPARATIVE ANALYSIS

Indicators for energy. Analysis on related energy indicators of BREEAM, LEED DC and ESGB is shown on Table 2.

(1) Energy efficiency level. BREEAM and LEED DC both set indicators to evaluate energy efficiency level of DCs. Which are respectively "Reduction of CO2 Emissions" and "Optimize energy performance"? And they are the key investigated contents, as well as their scores account for more than 50% of each energy indicator' total scores. Primary differences of them are mainly manifested in evaluation basis. BREEAM DC sets dual evaluation basis, combining PUE with CO_2 index. This mode did not only consider the energy efficiency, but also considers environmental impact from CO_2 Emissions. LEED DC comparatively analyses on energy efficiency of evaluation objects and benchmark buildings, investigating the improvement degree of energy efficiency for evaluation objects and endowed with scores.

ESGB has not systematically set energy efficiency indicator. In view there are not unified yardstick for buildings' CO_2 Emissions currently in China, using CO_2 Emissions to evaluate DC energy efficiency is unable to realize. ESGB could refer that BREEAM uses PUE for evaluation, or that LEED assesses improvement degree of energy efficiency, weights set during the range of 45%-55%.

(2) Subentry metering for energy. BREEAM and LEED DC both set indicators to evaluate Subentry metering for energy. The former's weight is 7.14%, and its evaluation basis cover equipments and systems metered, as well as requirement of building management systems to monitor and control energy consumption; the latter's weight is 3.03%, and it make a regulation that any individual energy end uses that represent 10% or more of the total annual consumption of the building, which is convenient for making measures to improve energy utilization of high-energy consumption equipments and systems. ESGB sets it as a control term without definitely limit about metering objects. Therefore, ESGB DC could draw lessons from LEED to define the scope of subentry metering, and keep in preservation as a control term.

(3) Lighting. BREEAM DC and ESGB set indicators for evaluating system. The former mainly evaluates outdoor lighting system according to lighting effect of different regions and applications. And it requires building automatic regulating lighting system; The latter mainly evaluates indoor lighting, which limits design and power of lighting facilities. Combined with characteristics of continuously operation and small office, ESGB DC could focus on two sides to assess lighting: one is building automatic regulating lighting system like BREEAM; the other is lasting evaluating contents and methods. Learned from BREEAM, its weight could range from 3%-5%.

(4) Low or Zero Carbon Technologies. BREEAM DC evaluate low or zero

Table 2.Second-grade Indicator for Energy.

No.	Contents	BREEAM DC (scores, 100%)	LEED DC (scores, 100%)	ESGB (scores, 100%)
Ene01	energy efficiency level	Reduction of CO_2 emissions (53.57%)	Optimize energy performance (54.55%)	/
Ene02	Subentry metering for energy	Sub-metering of substantial energy uses (7.14%)	Advanced energy metering (3.03%)	Subentry metering for metering
Ene03	Lighting	External lighting (3.57%)	/	Lighting (5%) and the value of lighting power density (8%)
Ene04	Low or zero carbon technologies	Low or zero carbon technologies (10.71%)	/	Take low carbon measures (15%)
Ene05	Lifts	Lifts (7.14%)	/	Lifts (3%)
Ene06	Transport CO_2	Transport CO_2 (10.71%)	/	/
Ene07	Procurement of sustainable IT equipment	Procurement of sustainable IT equipment (7.14%)	/	Energy efficiency (27%)
Ene08	Enhanced commissioning	/	Enhanced commissioning (18.18%)	/
Ene09	Demand response	/	Demand response (6.06%)	/
Ene10	Renewable energy	/	Renewable energy production (9.09%)	Use renewable energy (20%)
Ene11	Enhanced systems management	/	Enhanced refrigerant management (3.03%)	/
Ene12	Green power	/	Green power and carbon offsets (6.06%)	/
Ene13	Optimization design	/	/	Optimization design (6%)
Ene14	ventilation	/	/	ventilation (6%)
Ene15	Thermal performance	/	/	Thermal performance (10%)

carbon technologies based on investment recovery period, land use and feasibility. For make the assessment results accurately and accepted by stakeholders, it quantitatively calculates energy saved by using low or zero carbon technologies, and its weighting accounts for 10.71%; ESGB qualitatively investigate measures which help decrease energy of heating\ventilation\air conditioning systems. Although English low or zero carbon technologies are more advanced than ours, ESGB DC should not only take low carbon measures, but also calculates amount of energy saved by taking low carbon measures or using low carbon technologies(compared to traditional technologies), and its weight could range from 5% to 10%.

(5) Lifts. When BREEAM DC evaluating lifts, it emphasizes the design of quantity, size and location which are based on the shape and expected passenger flow of the building, and requires choosing low-energy lifts. Although this indicator is set, it only involves in energy consumption and lack considering about configuration rationally of lifts' location, quantity and size. No matter how many passenger flows are, lifts need to run continuously, and its usage frequency is much higher in large-scale DCs. Therefore, ESGB DC could neglect lifts indicator for small-sized DCs; but towards large-scale DCs, ESGB DC could comprehensively consider lifts' location, size and quantity to decrease energy burden and its weight ranges from 1% to 5%.

(6) CO_2 Emission for transportation. In the energy indicator, BREEAM DC sets "Transport CO2"indicator corresponding to concrete contents of transport indicator, taking carbon emissions from transport into consideration. Because the methods for accounting carbon emissions are not unified yet, ESGB DC could neglect this indicator currently.

(7) Sustainable IT equipment. In accordance with the "EU Code of Conduct on Data Centers" Best practice requirements, BREEAM DC sets "Procurement of Sustainable IT Equipment" indicator to reduce IT Equipments energy burden, covering UPS, BWS, PDUs, cooling systems, IT Equipments, generators and so on, its weight accounting for 7.14%; ESGB sets indicators to assess heating and air conditioning systems and electrical equipments, its weighting accounting for 27%. Combined with large quantities of IT equipments and drawn lessons from BREEAM, ESGB DC should strengthen evaluation on sustainability of management systems and IT equipments, and sets its weight between 10% and 15%.

(8) Enhanced commissioning and management. Compared with BREEAM DC and ESGB, to guarantee continuous operation and decrease effect from refrigerant, LEED DC sets "Enhanced commissioning and refrigerant management" indicators, investigating on the condition of commissioning plan, control and monitor, and calculating the environmental effect made by refrigerant quantitatively. For guarantee DCs to operate healthily, ESGB DC could set plan, control and monitor of commissioning systems as assessment contents, and the weight should range from 5% to 10%.

(9) Renewable energy. To decrease dependence to non-renewable energy, LEED DC sets renewable energy indicator with the weight of 9.09%, encouraging data centers to use renewable energy. And apply the formula for calculate percentage of renewable energy of total energy, and then endow scores. During recent years, for decreasing usage of non-renewable energy and the effect on environment, our country all along extends building-solar energy integration, to improve usage efficiency and effects of green renewable energy. Therefore, ESGB DC could set indicator to evaluate kinds of renewable energy and green degree,

then calculates its utilization ratio quantitatively. Learned from LEED, this indicator' weight ranges from 5% to 10%.

Formula: renewable energy utilization ratio (%) = Equal cost produced by renewable energy / cost for total energy annually

(10) Others. Besides the contents above, ESGB set an indicator in the energy indicator about optimizing design by combined with building shape and natural environment, covering ventilation, thermal performance and so on.

In view of the actual level of green buildings technologies' development and work for green building evaluation in the initial stage, the main energy saving measures, several related indicators of construction industry at present belongs to the promotion can be preserved, but in order to highlight the function and characteristics of the data centers, the weight can be reduced to 5%-10%.

Through above analysis，this paper sets integral Energy efficiency, Subentry metering for energy, lighting and so on as energy indicators. The details are show in Table 3.

Table 3.ESGB DC Energy Indicators' Context.

Indicator	Weights	Setting accordance	Assessment accordance
DC integral energy efficiency	45%-55%	BREEAM DC	PUE
Subentry metering for energy	/	BREEAM DC	definite the range of subentries
Lighting	1%-5%	BREEAM DC	Automatic regulating system for lighting; the value of lighting power density
Low or zero carbon technologies	5%-10%	BREEAM DC	Species of Technologies; analysis on feasibility and economic benefit; Reduction of energy per year
Lift	1%-5%	BREEAM DC	Position, quantity and capacity of lifts; feasibility analysis; energy efficiency level
Procurement of sustainable IT	10%-15%	BREEAM DC	energy and emission parameters of IT
Enhanced major systems management	5%-10%	LEED DC	Systems continuous operating of and managing
Renewable energy	5%-10%	LEED DC	Species and utilization of renewable energy
Optimization design	5%-10%	/	/

Weights. After the evaluation of BREEAM, LEED DC and ESGB, the weights of each evaluation standards are listed in Table 4. ESGB evaluates the IEQ, energy, water, materials, transportation (included in the indicators of land saving and outdoor environment) ground and so on. The distributions of weights are even except for the energy. On the fact of limitation of technology on our data centers, the energy consumption of data centers are as more than two times as those in America and England. The weight of energy saving and using should be improved to 30%-40% as BREEAM DC and the weights of indoor environment management, materials saving and using, land saving and outdoor environment can be reduced. There are many differences in climate, nature and economy for our country's size. In order to adjust to different regions in our country, the ESGB DC should set elastic weights.

Table 4.Comparative Analysis on Indicators' Weights.

BREEAM DC (indicator/weight)	LEED DC (indicator/weight)	ESGB (indicator/weight)
Management (12%)	/	Operation management (10%) Construction management (10%)
Health and wellbeing (10%)	Indoor environmental quality (13.79%)	Indoor environment management (15%)
Energy (37%)	Energy & atmosphere (28.45%)	Energy saving and energy using (23%)
Transport (5%)	Location & transportation (27.58%)	/
Water (8.5%)	Water efficiency (9.49%)	Water saving and water using (14%)
Materials (7%)	Material & resources (11.21%)	Material saving and material using (15%)
Land use and ecology (6%)	Sustainable sites (8.62%)	Land saving and outdoor environment (13%)
Pollution (10%)	/	/
Waste (4.5%)	/	/
/	Integrative process (0.86%)	/

CONCLUSION

The design of green data centers should take the development of technology and construction into consideration. The frame of ESGB DC energy saving should have the energy efficiency level since BREEAM and LEED DC both have the evaluations of energy efficiency and Subentry metering for energy. Then improve the indicators and evaluation basis and add feasible indicators to improve the evaluation provisions after learning from BREEAM and LEED DC's evaluation contents. In the end, this paper established the weight ranges of each energy indicators in ESGB DC and improved the weight of energy.

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Hall 3D Model of the Life Cycle Analysis of Green Buildings

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Abstract

With the idea of sustainable development is increasingly deeply rooted in the minds of people, Green building has received more and more attention in the construction industry. In this paper, Hall three dimensions structure was applied to study green buildings systematically. On the time dimension, this paper stands in the view of the whole life cycle of green buildings. In order to demonstrate the knowledge dimension of green construction systems clearly and comprehensively, and provide a kind of thinking processes at the same time, a large number of literatures were reviewed to discover the theory and methodology related to each project phase of green buildings. Finally, Hall three dimensions structure model was established in this paper to contribute to the further research about the green buildings.

INTRODUCTION

Comparatively speaking, the green building industry is an emerging one, which is about only fifty years long since Paolo Soleri put forward the concept of ecological construction in the 1960s. In 1969, American architect Ian-Lennox (2006) wrote the book *Design with Nature*, marking the official birth of ecological architecture. Then, in 1970s, Oil crisis made many kinds of building energy efficiency technology such as solar, geothermal, wind energy arose at the historic moment, since then energy saving buildings had become the forerunner of the development of the buildings. After about ten years, the World Conservation Union came up with the slogan of "sustainable development" for the first time, energy saving building system was established well gradually as well, which was widely used in Germany, Britain, France, Canada and other developed countries at the same time. Before long, United Nations Environment Program (UNEP 1987) released a report named *Our Common Future*, establishing the idea of sustainable development in 1987. In 1990, the first green building standards in the world was issued in Britain, after which America, HK, Taiwan and Canada released their own standards for green building in succession.

In China, it's since the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil in 1992, that the Chinese government had issued related guidelines and regulations that vigorously promoted the development of green buildings. In September of 2004, the start of "National Green Building Innovation Award" by Ministry of Construction marked Chinese green building development had entered the phase of comprehensive development. Then held in March 2005, the First International Intelligent and Green Building Techniques Conference companied with Technologies and Products Expo Seminar (once a year) announced the winning projects and units of "National Green Building Innovation Award". In 2006, Ministry of Housing and Urban-Rural Development issued a *Green building evaluation standard* (MOHURD 2006) and then in August 2007, it introduced *green building assessment technical regulations (try out)* (MOHURD 2007) and gradually completed the green building evaluation system suitable to Chinese situation.

With the introduction of green building policies in china, the continuous improvement of the standard system, the deepening of the green building implementation and increasing national financial support to the green building, green building in China in the next few years will continue to maintain rapid development momentum. By the end of 2013, 20% of new buildings in cities and towns have fulfilled the requirements of green building standards. Generally speaking, in comparison with other countries, the industry scale of green buildings in China is smaller; however have a great development space.

LIFE CYCLE OF GREEN BUILDINGS

Life cycle refers to the time that something experiences from produced to vanish. Life cycle of buildings emphasizes the meaning of building on time. Traditional architecture defines life cycle as procedure from the scheme, design, building, operation, maintenance to removing for the project. Green buildings extends starting point to the selection, transportation and production of raw materials, also extends the end points to the reuse and recycling of materials.

When it comes to the whole life cycle, based on different perspectives, we can conceive the definition differently. From the perspective of evaluation, life-cycle assessment (LCA) is an evaluation of the environmental load and energy consumption of goods and services during their total life cycle. From the perspective of the use function, it points to the periodic process from being put into service to that it can no longer be repaired or used. As for the Royal Institution of Chartered Surveyors, whole life cycle cost management mode is at a higher angle and longer time span to guide cost management during all the phase, in order to make total cost of the whole project to a minimum. Based on the viewpoint of management, Life Cycle Management of Construction Project is defined as follows: the activity of planning, organizing, coordinating and controlling for the construction project during its whole life cycle, in order to build feasible on economics and function.

THE CONSTRUCTION OF GREEN BUILDING SYSTEM

According to the ideas system engineering theory, green building process based on whole life cycle can be regarded as a system Hall three dimensions structure can be used here to demonstrate it, the hall three dimensions structure of green building is shown in Figure 1.

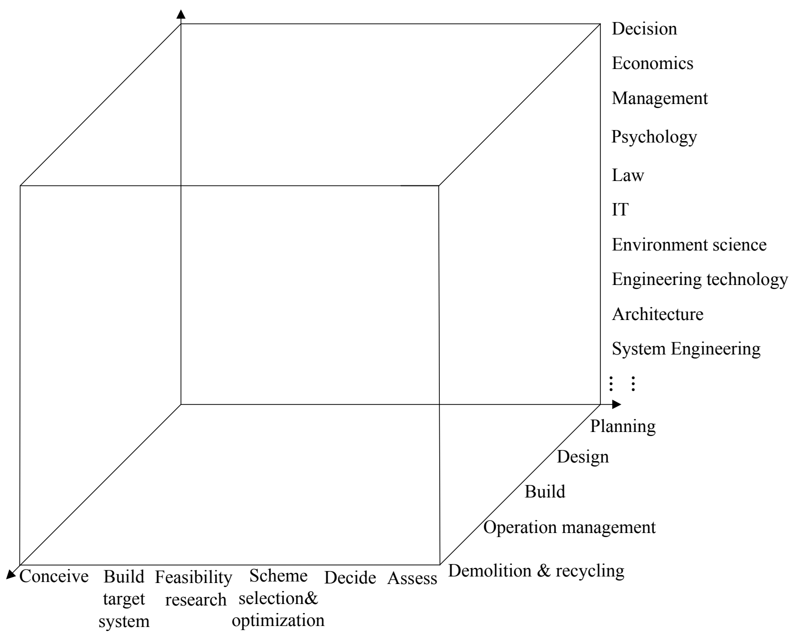

Figure 1.Hall three dimensions structure of green building.

Time dimension. In China, the whole life cycle of green building may include five phases as follows: planning, design, construction, operation and maintenance, scrap demolition and recycling, so the time dimension of Hall three dimensions structure about the green building system is determined on this basis. As for the selection of the green building materials, they should be taken into consideration in the planning and design stage.

For buildings, especially the green buildings, the stage of planning design determines nearly 80% of project value; it determines its construction scale, architectural space and function layout ect. Small to the choice of architecture space and building materials, so planning design phase determines the building more than 80% of the value. At present, what is hot topic about these phases is how to combine the architecture with ecological environment to achieve better benefit. Based on the current situation of the development of green building in China, He (2015) analyzed the principle which the ecological energy-saving design of green building needed to follow, and then proposed several strategies about the design. Zhao et al. (2015) not only presented his conception about environmentally friendly buildings through literature review, but also discussed the advantages and development prospects of architectural bionics.

Green construction mainly refers to the construction of green buildings, it should satisfy the conditions as follows: saving water, land, energy and material, finally environmental protection. Green construction in China mainly follows the *Green Construction Guideline* (Ministry of Construction 2007), in fact, in big construction companies, especially state-owned construction company, managers are paying more and more attention to the influence of green construction for the long-term development, inside the company there are also guidelines about the green construction. On the basis of *green construction guideline*, Ministry of Housing and Urban-Rural Development in China issued the *building green construction assessment standard* (MOHURD 2010). In management respect, Shi (2015) discussed how to innovate the construction management under the concept of green construction management. Han (2015) analyzed and discussed previous green building management model and then proposed a set of feasible solution, in which professional green consultancy and the owner both signed commission contract, and this model will become the future trend of green management. In terms of technology, Feng (2015) analyzed the status quo of the construction in our country, and also explored the technical difficulties, then put forward countermeasures for the quality improvement of construction.

When it comes to operation management stage, Wang and Cheng (2014) gave an analysis and research about editing *Green building Operation Management standard*, and also carried on a comparison between operating standards and green building evaluation standard, then designed operating standard framework. Mohammad and Zainol (2014) took Malaysia country as an example to study the cause of maintenance problems of green building in the process of operation. Cheng and Shen (2013) studied the content of the green building operation management, so that strategies to improve the level of green building operation are put forward. Guo and Shen (2014) suggested that we should treat green building operations management as a new subject to study. Liu and Zhang (2011) stated that testing and debugging, measurement and validation was respectively to ensure that the system and assembly of the construction satisfied the target and effective detection of building energy efficiency standards, they also studied their challenges and the development prospect when applied in the LEED, HK-BEAM and GBL these three green building assessment system certification process. Waste recycling should be taken into consideration in this phase, such as carbon emissions and heat emission in operating stage; Mohammad and Zahra's (2014) proposed using bioreactor to recycle wastewater in high-rise building.

Since green building is a new building types, at present there are few ones that reach dismantling recovery stage, so researches about this part are less, and mainly focused on technical aspects, Shi (2009) wrote his master's thesis about recycling and reusing in foreign buildings. Gong's (2010) doctoral thesis in Tianjin University studied the dismantling and recycling technology in our country. Some scholars abroad research building recycling management problems as well, Wilson and Araba (2008) in developing countries discussed did a related research about recycling by the informal sector.

Logic dimension. The logic dimension of Hole Structure can be described in this way: design of project idea and goal, feasibility study, project selection, evaluation and optimization, decision-making, implementation and evaluation after the project.

The content of the green building project design includes following two points:

(1) The nature of the project, such as the purpose, construction scale, level of social status, influence in the development of economy, the impact on the environment and so on;

(2) Project system's overall function, each single item, unit project and their respective function and connect with each other, planning about the coordination and coordination between internal system and external environment system.

Project's goals contact each other and restrict each other as well, so when considering the design of targets, we should not only consider results goals but also binding goals. To sum up, green construction emphasizes is the saving of land, water material and energy, finally environmental protection, then realize the unification of financial benefit, social benefit and environmental benefits.

Feasibility study on green building should not only on the economic value, but also on the reliability of technology. Currently, it focused on economic benefit analysis or incremental cost benefit analysis, such as Li (2014) in Dongbei University of Finance, Li (2007) in Chongqing University and so on. In addition there also exists technical and economic analysis, such as Sun (2009) in Jiangxi University of Technology analyzed the cost and benefits of the green building by using technical economics theory combining case green construction, quantified the costs or benefits both internal and external, and also proved the economic benefit of green building.

In the evaluation procedure, it mainly refers to evaluation system issued by the state, the current global green building evaluation system mainly includes the *green building evaluation standard* (GB50378), *Leadership in Energy and Environmental Design* (LEED) in United States, *Building Research Establishment Environmental Assessment Method* (BREEAM) in the UK, In addition, there are relevant guideline in Germany, Australia and so on, and *Green building evaluation standar*d in China in the latest edition will be taken effect in January 2015. What calls for special attention is that evaluation refers to more than one certain stage, for example, *Green building evaluation standar*d in China is divided into design evaluation and operation evaluation. Besides, China has enacted construction evaluation standard, for evaluation of the construction project, Li (2013) acquired a set of green construction assessment standards for the construction phase of the project combining with the construction practice of construction engineering based on comprehensive survey and present evaluation system of green building. In addition, analytic hierarchy process (AHP) and fuzzy comprehensive evaluation to are also have been used in some specific evaluation, and more detailed study in foreign countries, Xin and Moon (2014) developed an evaluation framework to analysis and evaluate environmental performance of the construction site.

Knowledge dimensions. Knowledge dimensions can conclude as followings: knowledge decision theory, economics, management, psychology, law, information technology, engineering, architecture, environmental science, system engineering.

The process of green building projects will involve the knowledge of different subjects, and different disciplines of applied knowledge are not independent, in many cases, in fact, they work together in a certain stage. In terms of law in China, for example, in different stage of the green building, there are different related documents, many universities have set off the building laws and regulations related courses. Besides in China, construction, cost and supervision engineer exam also involve related knowledge. In addition, you also must notice its links with the other two dimensions in the building system. Firstly, in the decision step, for instance, when selecting optimal solutions decision theory is used without doubt, but more than that, architecture and economic aspects of professional knowledge will also be applied. Yang and Ibuchim-Cyril (2013) studied the role of multi-objective decision support system in the green building materials selection. Secondly, in order to achieve the minimum cost and the maximum comprehensive benefit, project system's overall function, their respective function and interaction, building internal system and external environment system coordination should be considered in the construction planning stage, which involves environmental studies, system engineering theory environment, architecture and so on. What's more, project management will inevitably involve the management; in addition to that, because of rapid development of science and technology today, project management cannot be well completed without the support of information technology. For instance, building information modeling (BIM) is equipped with visualization, coordination, simulation and optimization and figuring out function, which can provide platform for all the participants comminuting effectively. Besides, it has been showed the advantage of BIM in realizing sustainable design: BIM can be applied to analyze the lighting effect, energy efficiency and sustainable materials and other performance of buildings, so that the lowest energy consumption could be achieved. More than this, with the control of ventilation and lighting, air distribution and visual psychological feelings can create comfortable and environmental-protection circumstance. To sum up, BIM concepts inject high-tech power for "green exploration" of buildings.

Relationship between three dimensions. The relationship between three dimensions of Green building system is closely related and should be fully considered during the process of green building project as shown in Figure 2. In the early stages of the project, Clients should consider all involved aspects of the system, which is very important in ensuring the engineering quality and controlling project cost.

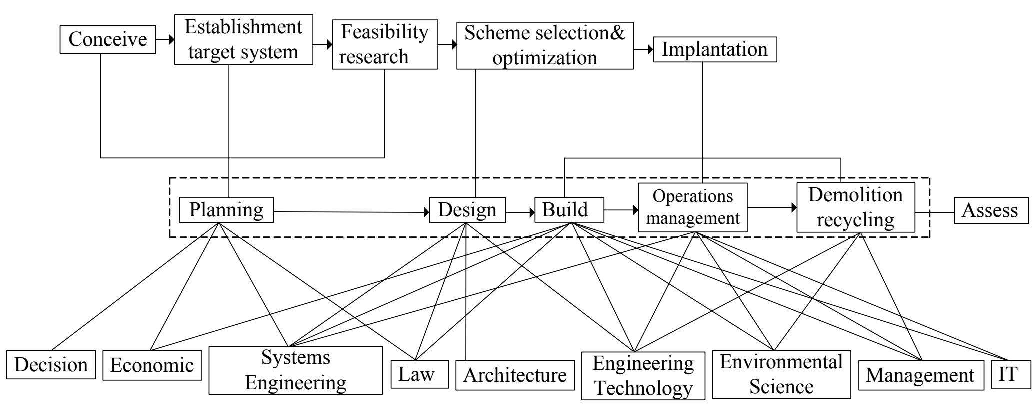

Figure 2.Relation between three dimensions.

CONCLUSION

In this paper, by means of literature review, the whole life cycle of green building system is described, which covers the process, including the project phases, logical step and the theory of knowledge. Then we determine the time dimension, logic dimension and the dimension of knowledge, ultimately present the whole life cycle of green building system by hall three dimensions structure, and finally, the relationship between the three dimensions, the establishment of the Hall 3D model will contribute to the following research of green building. In addition, the development states of the theoretical system can also be observed in this paper, from which the leading edge can be found and further studied.

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Research on Sustainability and Construction Firms: Current Status and Future Agenda

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Abstract

The rising significance of sustainable development in both international policy debate and the construction industry has triggered the emergence of increasing number of studies related to sustainability and construction corporations. How construction corporations respond to sustainability is of vital importance to enable sustainability transition of construction industries. However, there is lack of a systematic review of these studies. This paper critically reviews the existing body of knowledge on sustainability and construction corporations. Four common research themes are identified, namely corporate sustainability of construction firms, corporate social responsibility in construction firms, drivers of sustainability in construction firms, and barriers of sustainability in construction firms. It is found that the existing studies predominantly focus on providing description or explanation of the implementation situation of sustainability practices of construction firms, while largely overlook the strategies of promoting sustainability in construction firms. Future research opportunities are identified such as the relationships between sustainability and competitiveness of construction firms, and strategies of promoting sustainability in construction firms based on academic theories.

INTRODUCTION

The construction industry is involved in creating the physical assets which are the basis of virtually every aspect of development, and in the creation of much of the world's man-made capital (Spence and Mulligan 1995). Thus, this industry significantly influences our economy, society and environment. Economically, in almost every country in the world, the built environment normally constitutes more than half of total national capital investment (CIB 2002). Socially, the construction sector is the largest industrial employer in most countries, accounting to around 7% of the total employment worldwide (Horta et al. 2013). The labour-intensive nature of construction activities also presents opportunities for poverty alleviation (CIB 2002). Environmentally, the construction industry is one of the largest exploiters of resources and has huge impacts on the living and working environment (Bourdeau 1999; Spence and Mulligan 1995). The construction industry is a big contributor of many environmental problems such as loss of soil and agricultural land, loss of forests and wild lands, and air pollution, and it is also a major user of the world's non-renewable energy sources and minerals (Spence and Mulligan 1995).

Since the construction industry has such a huge impact on our economy, society and environment, the sustainability of this industry is of vital importance. World Conservation on Environment and Development (WCED) brought out a report in 1987, called Our Common Future, often referred to as the Brundtland Report. In this report, "sustainable development" was defined as *"development which meets the needs of the present without compromising the ability of future generations to meet their own needs"* (WCED 1987). Basically, the sustainability concept calls for achieving a balance among economy, society and environment. As the agents of the construction industry, the construction firms receive increasing attention from scholars. Even though increasing number of studies related to sustainability and construction firms have emerged in recent years, there is still lack of review of these studies. This paper aims to respond to this gap of knowledge, to clarify the current status of these studies and identify future research opportunities by reviewing existing studies on sustainability and construction corporations.

THE CONCEPT OF SUSTAINABILITY

The Brundtland Report stressed the importance of the integration of environmental decisions into central economic decision making. However, the simplicity of the sustainability definition in the Brundtland Report obscures underlying complexities and contradictions of sustainability. The vagueness of the concept has led to different responses and a wide variety of definitions. It has been estimated that some three hundred definitions of 'sustainability' and 'sustainable development' exist broadly either directly or indirectly (Santillo 2007)

It seems that sustainability is so complex that various concepts and interpretations emerged, which triggered scholars to identify the core components of sustainability. Recently White (2012) presented a thoughtful analysis of this issue by using word cloud technique to comprehensively study the similarities and frequencies of key words in various sustainability definitions. After careful selection, 103 definitions of sustainability were used and he discovered the top 10 most frequent key words in sustainability definitions are: environment, social, economic, life, system, nature, resources, human, development, and needs. The high frequencies of *environment*, *social* and *economic* indicate that most of these various definitions now acknowledge sustainability should include the economic, social and environmental dimensions. *Life*, *nature* and *resourc*es are high-frequency terms, reflecting the importance of the environmental dimension of sustainability. This is not surprising since people's increasing environmental awareness significantly contributes to the emergence of the sustainability concept. The presence of *human*, *development* and *needs* in the top 10 words indicates the central role of human beings in the sustainability concept. This is echoed by the Rio Declaration on Environment and Development, which lists 27 principles for sustainable development and the first principle is: "*Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature"* (United Nations 1992). Sustainability associates with meeting the needs of humankind, especially for future generations (White 2012). It seems that the core principles of sustainability can be summarized as: achieving balance among the environment, society and economy; and meeting needs of current and future generations thereby achieving long-term development of the human race.

COMMON RESEARCH THEMES ON SUSTAINABILITY AND CONSTRUCTION FIRMS

After the release of the Brundtland report, the concept of sustainable development is increasingly being applied as a corporate concept under the name of corporate sustainability (CS) (Steurer et al. 2005). Based on a systematic review, qualitative content analysis is adopted to analyze the literature, and four common research themes are identified to be related to sustainability and construction firms, namely CS of construction firms, corporate social responsibility (CSR) in construction firms, drivers of sustainability in construction firms, and barriers of sustainability in construction firms, as shown in Figure 1.

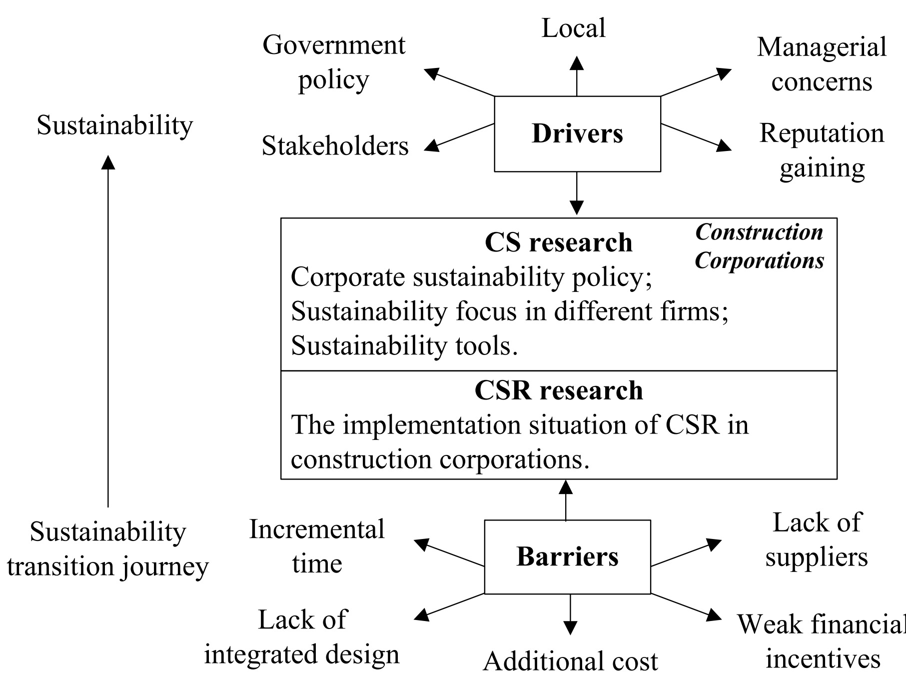

Figure 1.Common research themes on sustainability and construction firms.

CS research. This strand of research is limited. Zuo et al. (2012) used content analysis to investigate the sustainability policies of world's top international contractors and discovered sustainability policy development varies from case to case. The energy efficiency and conservation, greenhouse gas emission reduction and integration of renewable energy resources into projects are among the common themes of these sustainability policies disclosed by construction contractors (Zuo et al. 2012). Jones et al. (2010) discovered that sustainability appears to mean different things to different companies. The environmental pillar was the most frequently emphasized by the construction corporations engaged in industrial sector, including energy/utility owners, transportation equipment owners, industrial contractors and industrial design firms, while the social pillar of sustainability was found to be most frequently emphasized among commercial contractors and commercial design firms (Jones et al. 2010). Adrien and Laura (2010) presented a methodology and framework to assist construction firms in incorporating sustainability measures into their benchmarking efforts. Sarkis et al. (2012) introduced a decision model and framework for subcontractor selection and team formation in the built environment based on the triple bottom line approach. In a sentence, these works focus on what constitute sustainability of construction corporations and how to enhance the sustainability performance.

CSR research. Stephen (2010) provides a general overview of the origins, development and rise in the importance of CSR and demonstrates how CSR has been incorporated and implemented in the UK construction industry. He discovered that CSR may not be formally embedded in the mainstream construction industry. Similarly, Scott et al. (2013) investigated Ghanaian construction corporations and found out that profitable firms are able to respond to CSR commitments more than unprofitable firms. According to Petrovic‑lazarevic (2008), large construction companies develop CSR in order to maintain an image of being a good corporate citizen. His research also indicated that in order to be recognized as a socially responsible business, the corporations should: apply a corporate governance structure that takes working environment concerns into consideration; pay attention to occupational health and safety measures, and enhancing the relationships with suppliers. Othman (2009) investigated South African architectural design firms and discovered that the concept of CSR is perceived and applied by most of the respondents, although different forms of CSR practices are being implemented. The obstacles that hindered some design firms from adopting CSR are lack of integrating CSR in the internal governance of their firms, limited government incentives for supporting CSR and the negative perception of time, cost and energy constraints when CSR is adopted (Othman 2009). In conclusion, this strand of research focuses on investigating the implementation situation of CSR in construction corporations.

Barriers of sustainability. This strand of research is a newly emerged research area in recent years. Zainul Abidin (2010) investigated the level of awareness, knowledge and implementation of sustainability practices in Malaysia. It has been discovered in this study that only large developers are beginning to pay attention to sustainable implementation in their projects. Due to limited understanding and the concern about cost, many developers are still reluctant concerning the pursuit of sustainability (Zainul Abidin 2010). In Chile, Serpell et al. (2013) discovered that Chilean construction firms are in an early stage of achieving sustainable construction and their practices towards sustainability are highly dependent on the company's size and its core business. Main barriers includes the lack of financial incentives, lack of integrated design, and affordability (Serpell et al. 2013). Zhang et al. (2012) adopted case study approach to investigate the barriers hindering the implementation of extensive green roof features in Hong Kong and they found that lack of promotion and incentives from governments and the increase maintenance cost are the top barriers to the implementation. Zhang et al. (2011a) analysed the additional cost of three types of green buildings and found that the higher costs has hindered the extensive application of green technologies in China. Shi et al. (2013) adopted a questionnaire survey approach to investigate the status of green construction in China and the most critical barriers. Their study found that the three most critical barriers are "additional cost", "incremental time" and "limited availability of green suppliers and information".

Drivers of sustainability. Some scholars have also investigated the drivers of sustainability in construction corporations. Yip Robin and Poon (2009) provided a method, the T-model, to investigate and measure the extent of change of sustainable culture among participants in the construction industry of Hong Kong. This study showed the influential power of various stakeholder groups is a crucial factor that may change the sustainable outcome of the built assets, and stakeholders of the construction industry should make better use of their influential power to enhance the sustainability outcome of construction projects (Yip Robin and Poon 2009). Son et al. (2011) surveyed the constructors from the US and Korea and they found government policy and local environmental and social issues have a significant impact on the sustainability knowledge of constructors. Zhang et al. (2011b) examines the benefits and barriers in applying green strategies in the process of housing development and facilities management. They discovered that housing developers believe that the application of green technologies can contribute to reputation gaining, reduction in construction and operation cost, receiving favourable land prices, and more channels available for financing. The major barriers include higher cost for green appliance and higher cost in relation to customers' demand. Qi et al. (2010) proved that managerial concerns, government environmental regulations, and stakeholder pressures influence contractors' green construction strategy. It was found that managerial concerns and government regulatory pressures are the two most important driving forces of green construction. However, it appears that project stakeholder pressures don't have much significant effect on green construction practices (Qi et al. 2010).

DISCUSSIONS

To improve the sustainability performance of construction firms, the first step is to increase the acceptance degree of the sustainability concept in the industry. The studies on drivers and barriers of sustainability partly capture this key issue. However, knowing the drivers and barriers of promoting sustainability doesn't necessarily equal to knowing the ways to promote sustainability. For instance, Shi et al. (2013) argued that the three most critical barriers of green construction in China are “additional cost”, “incremental time” and “limited availability of green suppliers and information”. But why implementing green construction generates “additional cost” and “incremental time” and how to eliminate these barriers to promote sustainability are not systematically studied. In addition, even if the main focus is to identify drivers and barriers rather than strategies promoting sustainability, existing studies still have some deficiencies. A prominent deficiency is that few of these studies are underpinned by academic theories. Different scholars design different questionnaires to collect empirical information, but few scholars explain the underlying theories supporting these questionnaires. It also seems that different scholars find different key factors impacting the sustainability of the construction firms, such as government policy, additional costs, awareness, stakeholder pressure, local environmental and social issues, and affordability. Since so many factors have been found, how to understand the complex mechanisms impacting sustainability of the construction firms seems even more difficult. Thus, to respond to the deficiencies of the existing studies illustrated above, it is urgent to find an innovative approach which is capable of not only synthesizing all the different drivers and barriers to generate a complete understanding, but also proposing potential strategies to promote sustainability in the industry rather than theoretically arguing its drivers and barriers.

This paper proposes that the future research should focus on exploring the possible strategies to promote sustainability in the construction industry, based on academic theories. Questionnaires in the future research should be underpinned by theories such as strategy management, socio-technical transition theory or neo-institutional theory. Innovations can also be made in future research such as exploring the relationships between competitiveness and sustainability. Economic competitiveness is the current paradigm of business. The major obstacles of promoting sustainability in the construction industry come from the conflict between the current business paradigm-competitiveness paradigm, and the sustainability paradigm. In order to encourage corporations to start sustainability transitions, the relationships between competitiveness and sustainability, especially whether the implementation of corporate sustainability is detrimental to firms’ competitiveness, need to be understood.

CONCLUSION

The construction industry can significantly influence our economy, society and environment, and thus its sustainability is of vital importance. Increasing number of studies on sustainability and construction firms emerged, but there is lack of a review to critically analyse these studies. This paper offers such a review which identified four common research themes, namely CS of construction firms, CSR in construction firms, drivers of sustainability in construction firms, and barriers of sustainability in construction firms.

The results show that CS and CSR research focus on what CS or CSR means to construction firms, how construction firms performed in sustainability and how to improve their sustainability performance. But how to promote sustainability in construction firms is largely overlooked by CS and CSR research. The researches on drivers and barriers of sustainability partly capture this key issue, but few of these studies are underpinned by academic theories, and these studies still did not fully explore the strategies of promoting sustainability in construction industries. It is suggested that future research should be focused on exploring the possible strategies to promote sustainability in the construction industry, based on academic theories such as the socio-technical transition theory. Innovations can also be made in future research such as exploring the relationships between competitiveness and sustainability.

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Methods to Improve the Energy Utilization in Villages in Northern China

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Abstract

As an agricultural country, there are lots of land and people engaging in agricultural production in China, which occupy a large percentage of the total land and population. The energy consumed in village takes over forty percent of the total social energy, most of which is used in daily life. However, the energy used in village is facing the problem of poor efficiency and it is used extensively. Therefore, the improvement of the energy utilization becomes an important approach to improve the living standard of village people and the agricultural productivity. This paper analyzes the current situation of energy utilization in villages in northern China, based on the data of investigate and survey in a village there. Then, taking the village as an example, some methods are proposed to solve the problems in energy utilization.

INTRODUCTION

China is a developing country, with a large proportion of the rural population. Although China is in the process of urbanization and the proportion of China's urban population rose by 13.46 percent up to date of the sixth national census in 2010, there are more than 50.32 percent populations living in countries and the energy consumed in village takes over forty percent of the total social energy, most of which is used extensively in daily life (Wu 2012). As an important part of the country's energy system, the energy supply and consumption of the families in china's rural areas have a great impact on the development of the society, economy and ecological environment (Lv and Zhu 2011).

In order to obtain the specific circumstances of the current energy utilization in a north rural of China, we conducted an investigation on this village. The investigation totally lasted three days. There are 495 households in total. Because of the limited time, it's not realistic to take the investigation to all of them. Therefore, we adopted the method of random sampling. The sampled households were with different layers and economic situation, including general villagers and officers related. We sent out 130 questionnaires and got 120 useful questionnaires in total, which comes from 120 different households. The questionnaire distribution process is as follows. Firstly, design the questionnaire and make the questions contain enough information we need. Secondly, randomly identify the samples and make sure the households investigated are equally distributed in the village. Thirdly, send the questionnaires to the samples and then take back the questionnaires. Fourthly, conduct the data process and get the results we need.

There are four parts of the questionnaires. The first is the profile of the social economy, including the whole village population, the number of the families, the family income and the resident population. The second is the current situation of the resource, including the planting of the crop, the farming of the cattle and fowl and the use of solar energy. The third is the current situation of the energy demand, including for cooking, lighting, hot water, appliances, heating in winter and cooling in summer. And the last is the current situation of the energy consumption, including the energy type, the energy price and the consumption per year/month. The data is partly obtained according to the government, the investigation and the questionnaires. And the remainder data that can't be gained through the above ways is obtained by searching references and the statistical yearbook of the local county.

The remainder of this paper is divided into four parts. Firstly we introduce the general information of the village and analyze the energy utilization situation based on the data from the questionnaires. Secondly we do a detailed analysis of the problems in energy utilization of this village and point out the reasons of the problems. Then, we propose some methods to solve the problems in energy utilization, based on the resource situation and the energy supply-demand structure of this village. The last is the concluding remarks.

GENERAL INFORMATION AND THE ENERGY UTILIZATION SITUATION OF THE VILLAGE

The village investigated is in the northeast of China with frigid climate. The general information of this village is as follows: land area: 11805 mu (1 mu = 666.67 square meters); number of families: 495 households; total population: 1987 people; average personal income: 4691.18 RMB; total work population: 860 people; migrant stayers: 700 people (taking 81.4 percent of the total work population). The industry of this village mainly includes farm production, export of labor service, secondary and tertiary industries. Corn is the major crops planted in the village.

Through the investigation, it can be known that the living energy of this village contains heating in winter, cooling in summer, heating water, lighting, cooking and appliances power utilization. As the village has frigid climate, the energy demand is mainly for cooking and heating. The energy consumed for heating in winter can take up to 70 percent of the total energy consumption and the temperature indoor is the most concerned problem in the north village of China. At present, the mostly used heating method is ground brick bed combining coal stove. The temperature indoor in winter can be 14~17 centigrade degree in the village. However, the energy consumed for cooling in summer is nearly zero.

The species and supply modes of the energy consumption in the village are show in Table 1.

Table 1.Energy Consumption Situation.

Types of energy demand	Modes of supply	Types of used energy
Winter heating	Coal stove	Coal
	Ground brick bed	Coal, crop stalks
Summer cooling	Electric fan	Electricity
Lighting and electrical	Electric network	The average power structure
Cooking	Coal stove	Coal
	Gas stove	Liquefied gas
	Ground kettle	Crop stalks
Domestic hot water	Coal stove	Coal
	Solar water heater	Solar energy

Because of located in cold region, heating in winter mainly depends on ground brick bed, on which the villager's indoor activities, such as dining and sleeping are usually doing. The energy for cooking mainly comes from liquefied gas, coal and corn stalk and the equipment for cooking consist of coal stove, gas stove and ground kettle. A few families have solar water heater. However, the proportion of this kind of family is very little, only taking 13.3 percent of the total number of families. From the analysis result, the energy supply system can be described as Figure 1. According to the feature of the energy resource in the investigated village, the energy resource can be divided into conventional energy resource and clean renewable energy resource. Conventional energy resource crop stalks (direct combustion), coal, liquefied gas and electric power, and clean renewable energy resource consists of biomass energy (such as human and animal excreta), solar energy and geothermal energy and so on.

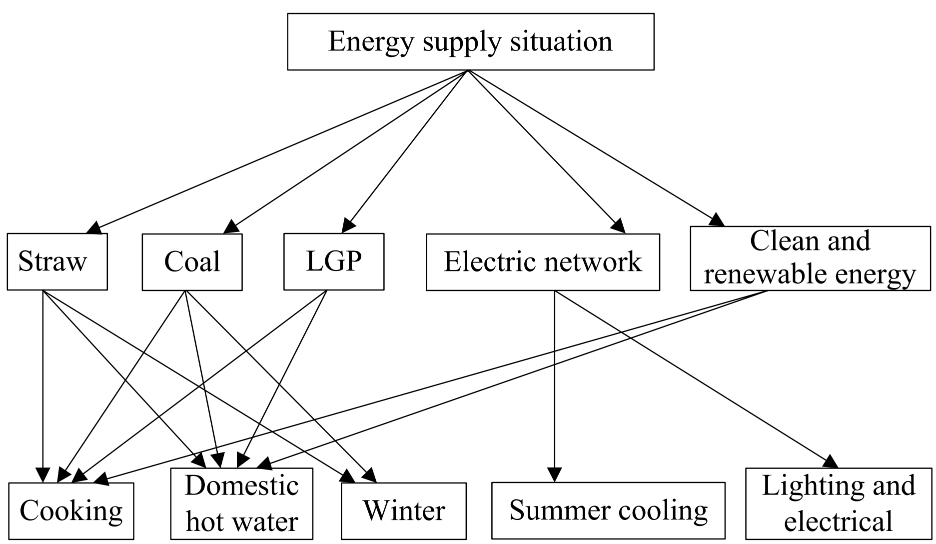

Figure 1.Energy supply situation.

ANALYSIS OF THE REASON AND IMPACT OF THE ENERGY UTILIZATION SITUATION

Summary analysis of the questionnaire data. The energy utilization situation and its reason can be obtained by carrying out some simple processing on the questionnaires.

Firstly, because of the village is located in cold region and the villagers are mostly Korean nationality, the decoration structure in their houses is close to the Korea style. Heating in winter mostly depends on ground brick bed, barely on central heating. Every family heat separately, which wastes lots of energy.

Secondly, the economic pattern of this village is very simple. The economic income is mainly from farming and migrant work. The business and service industry is not developed and there is few factory in this village. The cultivated area per people is not enough, which causes the income of the villagers is very little. The income per people is 4691.18 RMB. However, the people living in the village and doing the farm work gain less money compared with the people working outside the village. The population using clean energy only takes 13.33 percent. But in fact, there are 60 percent of people considering clean energy necessary and hoping to use clean energy (such as solar water heater). The economic insufficiency is an important factor restricting them using clean energy. Besides, when choosing cooking and heating fuel, 66.67 percent of people firstly consider of the price of the fuel and 22.33 percent of people firstly consider of the reliability of the fuel. However, only 9.97 percent of people will firstly concern whether the fuel has pollution on the environment. So, it can be seen that the economic insufficiency is the biggest factor restricting the utilization and promotion of the clean energy.

Thirdly, through the investigation, we find that in the households producing crop stalks, only 47.17 percent of them will make use of the crop stalks for cooking and heating. However, the other 52.83 percent will burn them directly in the field, though this thing is strictly prohibited by the government policies. With the mechanization of the agriculture, the crop stalks are smashed by the harvester and they are hard to transport. For convenience and cost reduction, most of people choose to burn them directly in the field, which will heavily pollute the environment. In our opinion, this phenomenon is largely due to the lack of environmental protection and energy saving consciousness of the villagers. And it also causes the wasting of resources to a large degree.

Analysis of the factors impacting the energy system of the village. The energy system is established by the interaction of many factors. Among those factors, there is not a direct function relationship. We call the relationship between the dependent variable and the independent variable as correlativity. The energy system of the village is very huge, consisting of energy supply distribution system, energy operating system and end system. And the energy system is impacted by many factors, such as population, resource condition, economic development level, climate condition, living habits, policies and so on (Hou et al. 2006). In this paper, we take the energy consumption per head (including the input cost on the energy system) to evaluate the energy system of the investigated village and conduct the analysis based on the investigation data. There are three parameters representing the scale of the village, including total population, number of households and population of each household. The economic level of the village is denoted by the income per capita and gross domestic product per capita. The thermo technical level will express the climate condition, typically including the heating degree days in winter. The local living habits are reflected by all energy use days of the year round. Besides, we take the consumption status of all kinds of energy as the symbol of the local resource condition. At the same time, as is known to all, climate is an important factor impacting the energy consumption (Yuan and Qian 2004) and the Degree-Days is a more sensitive indicator than the heating days (Zhang et al. 1992). In our research, the degree days are not used to estimate the energy consumption, only as the parameter to indicate the climate feature. Based on the principle illustrated above, we take the Ashrea standard on heating days and deal with the data with Matlab. Table 2 shows the correlation among the 21 factors impacting the energy system of the investigated village.

Table 2.Correlativity of Energy Consumption with Each Factor.

No.	Factor of influence	Correlation	No.	Factor of influence	Correlation
1	The whole village population	Middle	12	Lighting and appliances energy consumption	Middle
2	Income per people	Low	13	Cooking energy consumption	High
3	Number of households	Middle	14	Domestic hot water energy consumption	High
4	Population of each household	Middle	15	Coal	Middle
5	Heating Degree Days	High	16	Electric consumption	Middle
6	Outdoor design temperature for heating	High	17	Liquefied gas consumption	Middle
7	Heating days	High	18	Crop stalks consumption	Low
8	Cooling days	Low	19	Clean and renewable energy consumption	Low
9	Cooking days	None	20	Total energy consumption	Significant
10	Heating energy consumption in winter	Significant	21	Energy consumption proportion	High
11	Cooling energy consumption in summer	None			

It can be seen in Table 2 that among the 21 kinds of the energy consumption, the 10th one heating energy in winter is the biggest factor impacting the total energy consumption, where $|r| \geq 0.95$ means the significant correlation. The 20th one is the total energy consumption, and it indicates a significant correlation with itself, of course. Next are the 13th one cooking energy and the 14th one domestic hot water energy consumption. Besides, the parameters relative to climate condition, such as the 5th one the heating degree days and the 6th one the outdoor design temperature for heating all have big correlations with the total energy consumption. It shows that the climate condition is the biggest factors impacting the total energy consumption in the village. On the other hand, the correlations between the scale of the village, the resource condition and the total energy consumption are in the middle level, where $0.5 < |r| < 0.8$. The living habits, such as burning crop stalks as living energy, have the most unstable influence on the family total energy consumption, which can't be ignored as well. As we assume that the 9th one cooking days are not changed in a year, it's not correlative with other factors, where $r = 0$.

METHODS TO IMPROVE THE ENERGY SYSTEM

In this section, based on the main problems in the process of energy utilization and the factors impacting the energy consumption of the village, we propose some methods to improve the energy utilization efficiency of the village and reduce the pollution to the environment.

Improve the utilization efficiency of the ground brick bed. Cause of the significant correlation of the heating energy consumption in winter and the total energy consumption, we can improve the total energy utilization efficiency of the village by improving the heating energy utilization efficiency. Through the investigation, we found that the households all take the ground brick beds as the heating facilities. Therefore, we can take measures to improve the utilization efficiency of the ground brick bed, which can improve the total energy utilization efficiency indirectly. The ground brick bed is one kind of the healable brick bed, raising the temperature indoor by heating the surface of the brick bed with hot gas. The quantity of heat that the brick bed gets is tightly connected with the flow condition of the hot gas, and it's proportional to the residence time of the hot gas in the brick bed (Ma 2013). So the gas channel of the brick bed should be designed by following principles: extending the time that the hot gas flows in the gas channel and stabilizing the airflow. To improve the heating efficiency of the ground brick bed, smoke deflector can be added in the gas channel, which can also raise the temperature indoor (Zhang et al. 2009). In this way, more quantity of heat can be provided with the same amount of fuel, which means that the utilization efficiency of energy is improved.

Make use of straw gasification technology. As corn is the main crop planted in this village, many corn stalks will be produced every year. To avoid the waste of resource and pollution to environment, straw gasification technology should be adopted to make use of the corn stalks. By the straw gasification technology, burnable and clean gas can be generated, with which the villagers can cooking and heating (Yang et al. 2012). On the other hand, the straw gasification can reduce spend on fuel, which can improve the living quality of the villagers and reduce the pollution to the environment. On the other hand, traditional stoves have low efficiency on heating, not more than 10 percent, which will cause big loss of energy. In fact, the energy exchange efficiency with the straw gasification technology can be 70 to 75 percent and the heating efficiency of gas can be 50 to 60 percent. So, the total efficiency of straw gasification technology can be 35 to 45 percent. However, the best stoves burning stalks only have the efficiency with 12 to 15 percent. Generally, 1 kilogram stalks can produce 2 m^3 burning gas and the quantity of heat generated by 1 m^3 gas can be 4200 to 7560 J (Wang and Zhang 2008). So, it can be seen that some straw gas supply station can be build based on the actual demand condition of the village, providing the whole villagers with energy for cooking and heating. This method can not only improve the energy utilization efficiency, but also reduce the pollution to the environment.

Increase the utilization of solar energy. Increasing the utilization of solar energy is a very important measure to improve the energy system building of the village. As a kind of clean energy, the solar energy will not pollute the environment. The facilities to make use of solar energy include solar water heater, solar cooker, solar house and greenhouse, solar light and so on. The quantity of energy equal to 120 kilogram coal can be obtained by solar energy utilization facilities per square meter per year. For example, the solar water heater has the advantage of low power and money cost and it can provide hot water to villagers for daily life no matter what the season is. It's not only low consumed but also clean and convenient (Luo et al. 2008). In fact, in the majority areas of our China, the sunshine duration can be more than 2500 hours per year. Domestic solar water heater can offer no less than 200 liter 60~80℃ hot water, with no need for other resource. Moreover, the villagers also hope to use solar energy facilities, especially the solar water heater. In our opinion, the government should increase the construction of the solar energy facilities and offer some economic benefit to those villagers with economic difficulties.

The government should take some finical measures to lead the villagers to change the existing energy structure. In the process of the total energy consumption analysis, there is a high level correlation factor, which is called energy consumption proportion. It means that energy infrastructure construction play a very important role in changing the villagers' energy consumption structure (Xie 2011). Old and backward energy infrastructure is a vital factor restricting the change of the energy structure in the village. Therefore, to improve the energy structure in the village, the energy infrastructure construction must get more attention. The government should take timely and effective measures, such as offering more money and policy support, to encourage the villagers to improve their energy structure. In a word, the government should offer more material insurance to the villagers to their energy structure improvement.

CONCLUSIONS

In this paper, based on the investigation data, we firstly conduct some process and consolidation. Then, the energy utilization situation, including energy demand status, energy consumption status and energy supply status, is summed up, based on which three problems in the energy utilization in the village are found. They are as follows: i) The energy utilization efficiency is very low; ii) New-type energy is rarely used; iii) It is easy to pollute the environment. Then, we get the correlation between the total energy consumption and some impacting factors with Matlab. It shows that the heating energy consumption is a significant factor, and six factors, including heating degree days, the outdoor design temperature for heating, the heating days, cooking energy, domestic hot water energy consumption and energy consumption proportion, are the high level factors. At last, some methods are proposed based on the main problems of the energy utilization and the factors impacting the energy consumption, which can improve the energy utilization efficiency and reduce the pollution to the environment.

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Sustainable Building Design Optimization Using Building Information Modeling

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Abstract

The concept of sustainable building has been widespread in the construction industry to reduce the environmental impacts from buildings. Considering the whole life cycle of a building, design stage is crucial in deciding whether a project will be successful. Therefore, this study will propose a strategy which can optimize the building design schemes to improve their sustainability and save cost over their lifetime with help of the cooperation between building information modeling (BIM) and multi-objective particle swarm optimization (MOPSO). Case study proves that this strategy is effective and efficient, which can largely reduce the designers' workloads and improve the building performances.

INTRODUCTION

Climate change has become a serious global problem which draws more and more attention of people all over the world. Globally, buildings account for almost 40% of the total end use of energy, as well as 24% of total CO_2 emissions (Park and Hong 2011). So the construction industry as the third largest polluter of greenhouse gases has the responsibility of saving the environment. Estimation shows that the energy use in buildings can be cut by 60% till 2050 by the immediate action to transform the building sector (WBCSD 2013). As a result, improving the sustainability of buildings becomes an urgent task to be completed.

In the whole life cycle of a building, although design stage does not release any greenhouse gases, it decides nearly 70% of the environmental impact from a building (Rebitzer 2002). So in order to largely improve the sustainability of buildings as quick as possible, making a reasonable design is the most direct and effective way.

To the clients, cost of projects is one of the concerns during their decision making process. To reduce the cost as much as possible so as to earn more profits is the most important target of each client. Therefore, a reasonable building design must achieve sustainable and economic at the same time. This study proposes a method which can reduce both the environment impact and cost of building designs, in order to make them be accepted by the clients and contribute efforts to the environment health.

BIM

Since the environmental impact happens through the cradle-to-grave period, so taking the whole life cycle of a project into consideration is crucial to sustainable building designs. To deal with such large amount of information, BIM is a reliable and effective technology to apply. BIM has emerged in recent years and performs excellently in sustainable designs (Wang and Fan 2013). It has not only a database saving and providing necessary information for projects, but also comprises many important functions for building performance analysis. Therefore, investigations of sustainable building design become easier and systematic by mean of BIM. With the help of BIM, designers can predict the potential mistakes and inefficiencies and adjust the designs in time so as to reduce the lost and risk of failure of projects. Some researchers have proposed several frameworks to evaluate the effectiveness and the benefits of BIM (Jung and Joo 2011; Barlish and Sullivan 2012). These frameworks give instructions to designers and engineers about how to utilize BIM in a proper way. Besides, BIM can also be employed to facilitate the user activity simulation and evaluation for improving communications between designers and users, so as to ensure the design can satisfy the requirements of users (Shen et al. 2012). Currently, most of the researches have just used parts of the functions of BIM in sustainable building designs, e.g. material selections and thermal performance analysis. In this study, the functions of modeling, simulation, building performance analysis, and database in BIM will all be used and integrated in the sustainable building design process so as to achieve high efficiency and effectiveness.

OPTIMIZATION METHOD

The fundamental problem of optimization is to attain the best possible decision in any given set of circumstances (Walsh 1979). Considering that the aim of this study is to search for the trade-off between carbon emission and cost of buildings, a multi-objective optimization (MOO) method has to be applied. Usually, many optimal solutions will be generated to a MOO problem. These solutions are called non-dominated solutions. The set which contains all these non-dominated solutions in the searching space is called Pareto-optimal solution set in honor of Pareto (1896). Figure 1 shows the Pareto-optimal solutions in searching space. The curve formed by the points corresponding to the Pareto-optimal solutions is called Pareto-optimal front (Bui and Alam 2008).

There are many methods for dealing with MOO problems. Evolutionary algorithms (EA) are the most popular ones. In artificial intelligence, an EA is a genetic population-based metaheuristic optimization algorithm. It mimics natural evolutionary principles to search and optimize the potential solutions (Deb 2001). MOPSO is one of the popular elitism approaches in EAs. PSO is inspired by the social dynamics and emergent behavior that arises in socially organized colonies (Parsopoulos et al. 2004). This algorithm can be described as follows (Shi and Eberhart 1998):

If the position and velocity of the ith particle in the tth generation are denoted as x_t^i and v_t^i respectively, then in the next generation, its position x_{t+1}^i and velocity v_{t+1}^{i} can be displayed as:

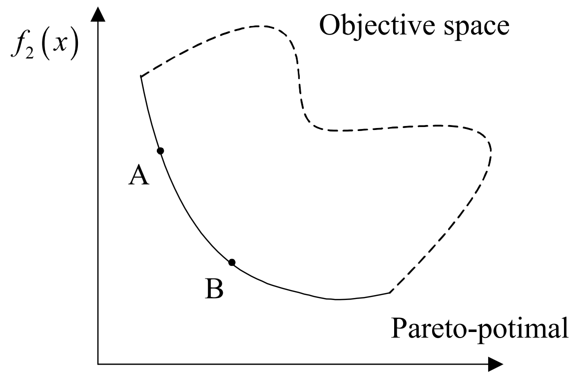

Figure 1.Representation of objective space and pareto-optimal front.

$$v_{t+1}^{i} = wv_t^i + c_1 r_1 \left(p_t^i - x_t^i \right) + c_2 r_2 \left(g_t^i - x_t^i \right) \tag{1}$$

$$x_{t+1}^{i} = x_t^i + v_{t+1}^{i} \tag{2}$$

where, $i = 1, 2, \ldots, S$; S is the size of the swarm; $t = 1, 2, \ldots, N$; N is the sum of the generations; c_1 and c_2 are two positive constants, calling cognitive and social parameters; r_1 and r_2 are two random functions in the range [0,1]; p_t^i is the personal best of the *i*th particle till the *t*th generation; g_t^i is the global best of all the swarms so far; and w is the inertia weight applied to control the impact of the previous history of velocities on the current velocity, in order to influence the trade-off between the global and local exploration abilities of the particles.

The way that the particles reach their desired objectives is making them learn from sharing information among all particles. The performance of each particle is measured in accordance with a predefined objective function $f(x)$, which is related to the problem to be solved (Shi and Eberhart 1998). In this study, the MOPSO is used to facilitate the design optimization.

BIM BASED BUILDING DESIGN OPTIMIZATION MODEL

The proposed BIM-based building design optimization model is composed of two sections. In the first section, building performance of each design is assessed and their energy consumptions are estimated. These data is delivered into the second section for design scheme optimization. The details of these two sections are elaborated as follows.

Building performance assessment. In the first section, the assessment process is operated based on a 3D model. In this study, BIM is applied to provide the 3D model platform, database, and simulation engine. Therefore, at the beginning, the initial design scheme has to be prepared to build the 3D model. Then information of the project such as location, climate, and surrounding environment has to be collected and put into this system to complete the environment preset. When all of the preparation is ready, the first section begins to work.

When a 3D model is formed, lighting performance of the building has to be assessed first. In order to make sure that all the design schemes meet the basic illumination standard, daylight factor (DF) is used to screen out the unqualified ones. According to many green building handbooks and researches (USGBC 2006; Reinhart and Fitz 2006), the standard of 2% of DF in a room is the basic sustainable level of daylight illumination. The simulation engine of BIM mimic the real world situation to estimate the DF in the building, and the ones of which DF are lower than 2% have to be deleted. Then the daylight autonomy (DA) of each qualified design is going to be examined to see how long in a year the daylight illumination can be used as the main light source in the building. The lowest illuminance is set to be 500 lux (Nabil and Mardaljevic 2005; Ihm et al. 2009). Then the rest work time in the building will be supported by artificial lightings. The result of DA_{500} is denoted as a percentage. Therefore, the artificial lighting support time can be calculated by Equation 3:

$$T_{el-1} = \left(1 - DA_{500}\right) \times T_{day} \times T_{hour} \tag{3}$$

where, T_{el-1} is the total amout of hours that artificial lights have to operate in a year; T_{day} is the number of working days per year; T_{hour} is the working hours per day.

Hence, the annual electricity requirement of lighting system (Q_{el-1}) within the analysis area can be computed by Equation 4:

$$Q_{el-1} = \sum_{n=1}^{N} \left(T_{el-1} \times P_{lit}\right)_n \tag{4}$$

where, $n = 1, 2, \ldots, N$ is the number of the artificial lights in the analysis area; P_{lit} is the power of each artificial light.

The number of the artificial lights in the testing area is calculated by the following equation:

$$n = \frac{E_{av} \times A}{u \times k \times \varphi} \tag{5}$$

wherer, E_{av} is the real average illumination of the tested work plane; A is the area (m^2) of the tested work plane; u is the utilization coefficient; k is the obscuration coefficient; φ is the luminous flux of one artificial light.

After lighting performance assessment, thermal performance of the building has to be examined. In this study, the efficiency of HVAC system is not considered, so it is assumed that the HVAC systems deployed in the buildings in this research do not have the capacity limitation so that the temperatures of the indoor environment are always kept at the fixed levels during their working time. At this stage, thermal performance is evaluated by the amount of electricity consumed by the HVAC system to maintain the thermal neutrality. After the simulation, annual electricity required by the thermal system (Q_{el-1}) can be calculated following Equation 6:

$$Q_{el-t} = \frac{Q_{cool}}{COP_{cool}} + \frac{Q_{heat}}{COP_{heat}} \tag{6}$$

where, Q_{cool} and Q_{heat} are the cooling and heating loads per year; COP_{cool} and

COP_{heat} are the coefficients of performances of the chiller and heat pump.

As a result, the total annual electricity demands of the building can be figured out by adding the energy consumptions of the subsystems together (see Equation 7):

$$Q_{el-s} = Q_{el-l} + Q_{el-t} = \sum_{n=1}^{N} \left(T_{el-1} \times P_{lit}\right) + \frac{Q_{cool}}{COP_{cool}} + \frac{Q_{heat}}{COP_{heat}} \quad (7)$$

Building design optimization. The building design optimization section begins with the reception of the annual electricity demands of the design scheme which is output from the first section. In the optimization section, there are two objectives: minimize the life cycle cost (LCC) and the life cycle carbon emission (LCCE). The two objective functions are summarized based on the decision variables. Since the aim of this study is to optimize building designs, so the decision variables are defined as important design factors which has close connection with building sustainability. After the comparisons of many design factors (Oral et al. 2004; Cheung et al. 2005; Reinhart and Fitz 2006; Tzempelikos et al. 2007; Yu et al. 2008; Tuhus-Dubrow and Krati 2010), five major factors are picked out as the decision variables, they are: wall types, window-to-wall ratio (WWR), glazing types, external sunshade (width), and building orientation. In this study, building orientation is defined as the angle between the east-west axis of the building and the North direction in this research. And it is a continuous variable with a value between 0 and 360.

Having decided the decision variables, the objective functions can also be worked out. Since both the two objectives are calculated in the range of the whole life cycle, the definition of life cycle in this study has to be made. Since that this study only focus on the performance of building design, so only the items relating to the building design will be considered. Moreover, there are many uncertainties existing in the repair, recycle and disposal of the materials, and the corresponding data of environmental impact are unavailable for many assemblies and building materials (Wang et al. 2005), the maintenance and demolition stage will not be considered in this research. As a result, the processes included in the life cycle are inclosed by the dash lines in Figure 2.

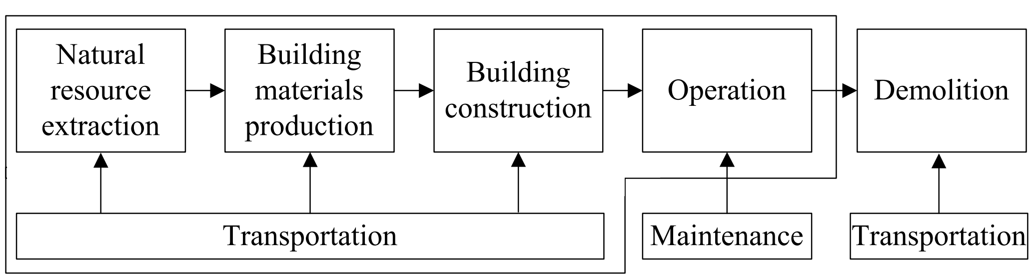

Figure 2.Life cycle of buildings.

For objective function one: LCC of the building design, the cost is composed of the construction cost and operation cost of the project. Since the two costs are calculated at different phases in the life cycle, both of them have to be converted into present values. The real interest rate (i) can be calculated by Equation 8 (Park and Hong 2011):

$$i = \frac{i_n + 1}{f + 1} - 1 \tag{8}$$

where, i_n is the normal interest rate; f is the inflation rate.

As a result, the real LCC should be expressed as:

$$LCC = C_{con} + \sum_{t=1}^{T} (Cop)_t \times (i+1)^{-t} \tag{9}$$

where, C_{con} is the construction cost of the building envelope design scheme; Cop is the operation cost of the building envelope design scheme; $t = 1, 2, \ldots, T$ is the total number of years in the whole life cycle of the building envelope.

Following the same rule, the second objective function contains carbon emission of construction stage (E_{con}) and that of the operation stage (E_{op}). Since only the quantities of the resources devoted into the building can be figured out, it is necessary to used carbon emission factor (CEF) to calculate their corresponding carbon emissions. CEF is the coefficient that represents the quantity of carbon dioxide and its equivalents emitted from one unit of a certain type of material. Then, the LCCE can be figured out using Equation 10:

$$LCCE = \sum_{i=1}^{I} Q_i \times f_i + t \times Q_{el-s} \times f_{el} \tag{10}$$

where, $i = 1, 2, \ldots, I$ is the number of the building material types; Q_i is the quantity of the *i*th material; f_i is the CEF of the *i*th material; f_{el} is the CEF of electricity.

In addition, the constraints are predefined as that the costs must be less than the predefined budgets of the construction cost and LCC.

After this series of actions, a set of optimal design solutions can be obtained. Decision makers can choose their favorite one as the final optima design scheme based on their specific requirements.

CASE STUDY

The case selected in this study is an office building located in New Territories, Hong Kong, with the gross floor area of 10,130m^2. This building has 7 floors and each floor has a large open office area. Figure 3 shows the outline of the typical floor. The closed rooms without window are shaped in dark color. The lamination of the closed rooms relies on the artificial lights，so they will not be considered in this study. The open office area is surrounded by windows and illuminated by natural light. The original building envelope has a full glass panel façade. Aluminum sunshades of 1200mm wide are installed around the periphery at the high level of each floor. The original design information is shown in Table 1.

The constraints of the five design factors and the possible choices of material and design are shown in Table 2. Among them, WWR, width of the sunshade, and the building orientation are continuous. The costs of the construction materials relating to the design factors include the material costs and the labor costs. Table 3 shows the average prices and the CEFs of the materials in Hong Kong.

The electricity tariff is 0.987 HK$/kWh and the CEF is 0.54 kgCO_2/kWh. All the artificial lights installed in this building are of T8 LED lights with the power consumption of 40W.

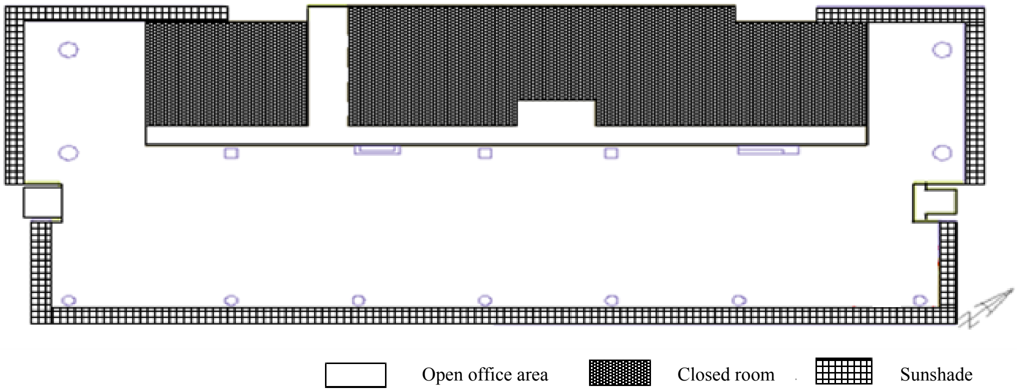

Figure 3.The outline of the floor area of the case building.

Table 1.The Original Design Information.

Design Factor	Content
Wall Type	150mm thick reinforced concrete wall
WWR	0.77
Glazing Type	10×12×10mm thick heat strengthened with low reflection low-E coated IGU glass with aluminum frame
External Sunshade	1.5mm thick, 1200mm wide extruded aluminum
Building Orientation	137

Table 2.The Constraints of the Decision Variables.

Design Factor	Alternative material/component
Wall Type	W_1: 150mm reinforced concrete wall W_2: 150mm aerated concrete block wall W_3: 150mm lightweight brick wall
WWR	0.1 to 0.8
Glazing Type	G_1: 10mm clear glazing with aluminum alloy frames G_2: double10mm clear glazing with aluminum alloy frames G_3:10mm low-E glazing + 12mm air gap + 10mm clear glazing with aluminum alloy frames G_4: 10mm tinted green glazing + 12mm air gap + 10mm clear glazing with aluminum alloy frames G_5: 10mm tinted green glazing + 12mm air gap + 10mm low-E glazing with aluminum alloy frames
External Sunshade (width)	0 to 1200mm (0: no sunshade)
Orientation	0 to 360

For the MOPSO program, the parameters are set as: inertia weight w is 0.8; the cognitive parameter c_1 and social parameter c_2 are both 1.49445; and the population is 20. The PC computer used for the analysis is running with the Intel Core2 Duo CPU using a 32-bit Windows 7 operating system. It took 50 hours to run 30 iterations of this program; and then the Pareto-optimal solution set with four optimal building design schemes is generated.

Table 3.The Unit Prices and CEFs of the Construction Materials.

Construction materials		Unit price (HK$/m^2)	CEF (kg CO_2/m^2)
Window	G_1	2260	160.84
	G_2	3141.06	205.03
	G_3	4091.81	208.18
	G_4	3776.38	206.20
	G_5	4516.32	209.35
Wall	W_1	417.36	131.79
	W_2	318.24	70.86
	W_3	392.16	252.47
Sunshade	23.63	227.34	

These optimized design schemes are all compared with the original design, and the details are presented in Table 4. Comparison shows that all the optimal solutions dominate the original design. In the aspect of construction cost, the Design 1 requires least cost; it can save 26.521% of the original cost. For the carbon emission reduction, Design 4 with 1284.620 tonnes of CO_2 emission is the lowest and it reduced 6.298% of that from the original one. These designs are non-dominated to each other, so the final decision has to be made by the project designer or owners based on the priorities of their preferences and the background of the specific project.

Table 4.Results Comparison.

Design Scheme	Decision Variables (a~e)					Objective 1 (f~g)		Objective 2 (h~i)	
	WT	WWR	Sunshade (mm)	GT	BO (°)	Cost (million HK$)	Cost Reduction (%)	CO_2 Emission (tones)	CO_2 Reduction (%)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
original	1	0.770	1200	3	137	4.404	--	1370.967	--
1	3	0.367	587	1	177	3.236	26.521	1535.864	-12.028
2	2	0.339	1121	4	160	3.269	25.772	1362.990	0.582
3	1	0.369	1061	4	142	3.361	23.683	1346.660	1.773
4	1	0.664	307	2	250	3.613	17.961	1284.620	6.298

For the precision of the results, three out of the five design factors can be considered as continuous; they are WWR, width of the sunshade, and building orientation. In most of the previous researches, these design factors are discrete, because these trial-and-error methods cannot calculate the continuous parameters. Hence, the common precision of these methods is to the tenths' unit. However, in this study, all the three factors can be set as continuous variables, so that the precision level can be preset as high as preferred. In addition, the search area is enlarged and more possible solutions are added into consideration by adopting the continuous factors.

CONCLUSION

Since the environment has been seriously polluted by greenhouse gases, the construction industry has to develop the sustainable building to save the earth. Although there are many ways to improve the sustainability of buildings, it is still difficult to make a reasonable sustainable building design which can reduce carbon emissions largely and systematically without increasing the cost of the project. The proposed building design optimization model takes the advantages of both BIM and MOPSO to solve the conflict between the cost and carbon emission of projects. This method can also be operated in a computer, so it largely releases the burden of designers. The result of case study proved that this method is reliable, and it can search for optimal design schemes with high efficiency. As a result, the workload of designers can be reduced and the mistakes caused by hand calculations.

There are also some problems of this method. First is that many other design factors are not considered in this method, so the search space is still not large enough. Second, the efficiency of information exchange between the simulation section and optimization section can be higher. These problems will be discussed and improved in the further studies.

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An Emergy Methodology of Operational Resources Analysis for Green Construction

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Abstract

The environmental impact of construction process is closely related to the operational resource arrangement of the construction scheme. At the viewpoint of green construction, this research focuses on the onsite construction phase from the preparation to the completion and acceptance. From the perspective of ecological economics, based on emergy theory and its methodology, a comprehensive analysis on the flows of the input-output capital, energy and material is done to the construction operational resources, i.e., manpower, material, and equipment. A framework of emergy analysis is setup connecting ecological and economical system of construction process. This research has theoretical and practical reference for the innovation of rethinking construction operational resources with the sense of green construction.

INTRODUCTION

Green construction is an inevitable trend of sustainable development of the construction industry in China, which also conforms to the urgent demand for the new green low carbon cycle development mode. The development of green construction technology and the adoption of advanced management methods bring extra benefits, but increase cost on the other hand (Kang et al. 2013). The traditional profit-oriented value orientation makes green construction difficult to be implemented within enterprises. To establish a new cost-value system for a good understanding of green construction is a significant issue currently. It is also the precondition of enterprises actively promoting green construction, accelerating the green development of construction industry in China.

The construction process involves various kinds of input, including construction operational resource as human resources, materials, and equipment, as well as their consumption of electricity, fuel, water, and capital, impacts the environment through the solid waste and emissions. The impact is closely related to resource allocation and construction process selection (Ahn and Lee 2013). The reasonable selection of materials and equipment by input-output analysis is significant to reduce the environmental pollution of construction activities (Estokova and Porhincak 2012; Jiang and Deng 2011).In what standards the economic and environmental benefits of construction resources can be evaluated for an optimal green construction scheme is the fundamental problem to be solved.

Emergy integrates ecological and economic systems. It realizes a unified quantitative system of material flow, energy flow, currency flow, sets up a bridge between the environment and the economy. The difficulty of evaluating energy in different forms can be easily solved using the same dimension *emergy* and *emergy/money ratio* (Odum 1988). It is of great significance on analyzing the relationship between natural resources and economic activities, promoting the rational use of resources, and brings about the economic-environment sustainable development to the utmost extent. At present, the emergy has become a research hotspot in the field of ecological economics, and emergy methodology as a basic tool of evaluating ecological-economic system are widely used in ecological environment system, economic system and industrial system (Diaz-Delgado et al. 2014; Chen et al. 2006). Emergy theory and its methodology can offer help on analyzing the relationships among construction process, resources and the environment to provide decision-making basis for the optimization of green construction scheme.

LITERATURE REVIEW

Since scholars recognize the impact of construction activities on ecological environment and propose the concept of sustainable construction industry, emergy analysis was employed in this field, including phases of design, material selection, evaluation, and waste treatment. Srinivasan et al. (2012) defined zero-energy buildings using emergy, and pointed out that the renewable emergy balance of building over life cycle can be used as basis of designing a zero-energy building. Han et al. (2014) analyzed eco efficiency of commercial building utilizing emery analysis on construction materials and manpower. With calculated emergy indicators they proposed that manufacturing process improvement and raw-material sources adjustment could make up the environmental impact due to the low utilization rate of renewable materials. Pulselli et al. (2007) employed emergy analysis in building from its construction phaseto operation and maintenance phase. The sustainability of building was evaluated through calculating emergy of material, technology and unit structure. Li et al. (2011) applied emergy analysis on comparing the eco efficiency of residential buildings of different types by calculating the emergy consumption of main building materials. Yuan et al. (2011) targeted construction waste and solid disposal. Emergy analysis was taken for assessment of the overall economical and social benefits of different recovery methods.

It can be concluded from past studies that the advantage of emergy theory and its methodology of connecting ecological and economic systems on studies related to sustainable building industry has been recognized by scholars. However, such studies focused on the energy consumption of green building operation, or waste treatment of building removal. Usually suggestions on improvement were put forward back to the design and material selection phase. Very few applications have been made to construction phase, during which the energy consumption and environmental impact cannot be ignored. Additionally, green construction stresses on the integration of environment and economy that emergy analysis method is quite applicable. Seen from the path of green building to green construction, the systematic emergy analysis of green construction process will be the trend of academic research.

METHODOLOGY

Emergy theory was established by H. T. Odumin 1980s. It was defined as a type of available energy that is consumed in direct and indirect transformations needed to make a product or service. In emergy analysis, all kinds of energy is evaluated and transformed into solar energy by different transformity, the unit is seJ. Systems diagrams are used to show the inputs, flow and storage of selected system (Odum 1996). As for the measurement of emergy caused by emissions of processes, it was suggested by Ulgiati and Brown (2002) that the environmental services required to dilute emissions is an unavoidable step for correct evaluation, which is how emergy of waste are assessed in this study.

EMERGY ANALYSIS FOR CONSTRUCTION RESOURCES

System boundary. This study focuses on the onsite construction phase from the preparation to the completion and acceptance. The system of construction resources includes three subsystems as manpower subsystem, material subsystem and equipment subsystem.

In construction manpower subsystem, the energy consumption is ignored because the energy value of human labor is quite little. We only focus on the capital flow and assess manpower input by labor cost.

For construction materials that include turnover materials, only the daily loss and waste are taken into account, while ignoring the materials as part of the main building. Energy used only for onsite material treatment is considered in equipment subsystem.

In construction equipment subsystem, we consider the unit equipment cost, consumption and cost of energy, e.g. fuel or electricity, exhaust gas, dust and other emissions.

Transformity. Odum gave the transformities of some kinds of energy when he firstly established the theory and its methodology. After decades of development, scholars broadened and perfected the transformity set. The transformity of commonly used energy, e.g. electricity, water, gas, and manpower, can be easily found in past studies. The emergy/money ratio that transforms money into emergy can be calculated by GDP and total emergy of a country.

Energy flow analysis. Energy flow here is a generalized term including material flow, energy flow and capital flow.

Emergy analysis framework. A framework of emergy analysis on construction operational resources can be proposed from the three subsystems as follows:

(1) Manpower subsystem analysis. Suppose there are m kinds of workers in a construction scheme. For workers of kind i, the unit price of manpower is set to be $C_{l,i}$(yuan/h), T_i hours are needed to complete certain construction activities, the cost of manpower i is $C_{l,i}T_i$, the total cost of manpower is $\sum_{i=1}^{m} C_{l,i}T_i$, the emergy system diagram is shown in Figure 1.

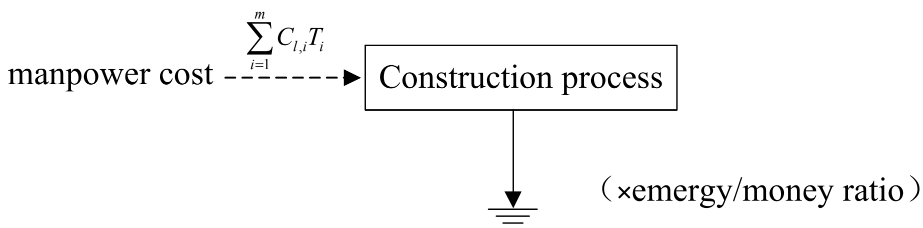

Figure 1.Emergy system diagram for manpower subsystem.

(2) Material subsystem analysis. As aforementioned system boundary, emergy consumed by raw materials comes from two parts as raw material cost (part of material loss), raw material (loss). Suppose there are r kinds of raw materials in this construction scheme. For raw material of kind i, the unit price is set to be $C_{r,i}$ (yuan/t), $Q_{r,i}$ tons are needed to complete the construction. If daily loss rate of material i is l_i, the cost of material i is $C_{r,i}Q_{r,i}l_i$, the total cost of raw materials (material loss)is $\sum_{i=1}^{r} C_{r,i}Q_{r,i}l_i$, the total loss of raw materials is $\sum_{i=1}^{r} Q_{r,i}l_i$.

For turnover material i, the total cost would be $\sum_{i=1}^{t} C_{t,i}Q_{t,i}$ when the unit price is $C_{t,i}$ (the unit price of renting or for daily depreciation with ownership) and the quantity is $Q_{t,i}$ tons.

For raw material i, if there are $w(m)_i$ kinds of waste, and em_jsej emergy are needed for environmental services required to dilute the waste j, the total emergy consumed for all raw materials are $\sum_{i=1}^{r}\sum_{j=1}^{w(m)_i} em_j$.

The emergy system diagram of material subsystem is shown in Figure 2.

(3)Equipment subsystem analysis. Suppose there are e kinds of equipment employed in this construction scheme. For equipment i, the unit price of renting it or for daily depreciation when owing it is set to be $C_{e,i}$ (yuan/h), $h_{e,i}$ hours are taken to use it, then the total cost of all equipment would be $\sum_{i=1}^{e} C_{e,i}h_{e,i}$.

For equipment i, f_i types of energy are consumed, if the unit price of energy j is $C_{e,j}$ (yuan/unit), M_j units energy are used to complete the construction with equipment *i,* the cost of energy are $\sum_{j=1}^{f_i} C_{e,j}M_j$. It will take $\sum_{i=1}^{e}\sum_{j=1}^{f_i} C_{e,j}M_j$ (yuan) for all equipment. The total amount of energy consumed is $\sum_{i=1}^{e}\sum_{j=1}^{f_i} M_j$.

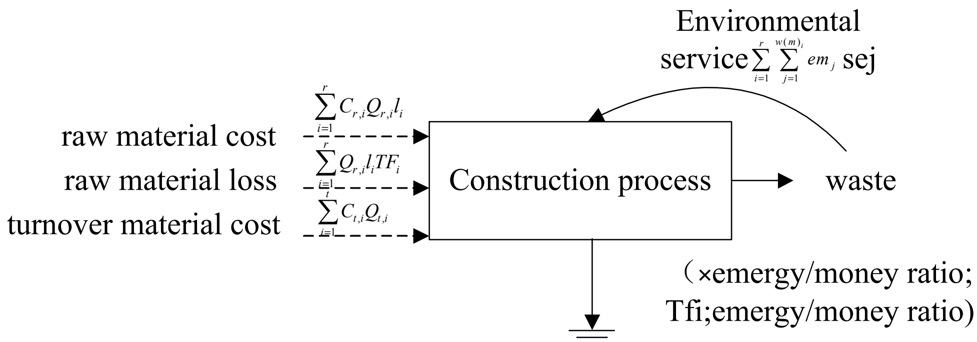

Figure 2.Emergy system diagram for material subsystem.

For equipment *i*, if there are *w(e)ᵢ* kinds of emissions, and em$_j$sejemergy are needed for environmental services required to dilute the emission *j*, the total emergy consumed for emissions of all equipment are $\sum_{i=1}^{e}\sum_{j=1}^{w(e)_i} em_j$.

The emergy system diagram of equipment subsystem is shown in Figure 3.

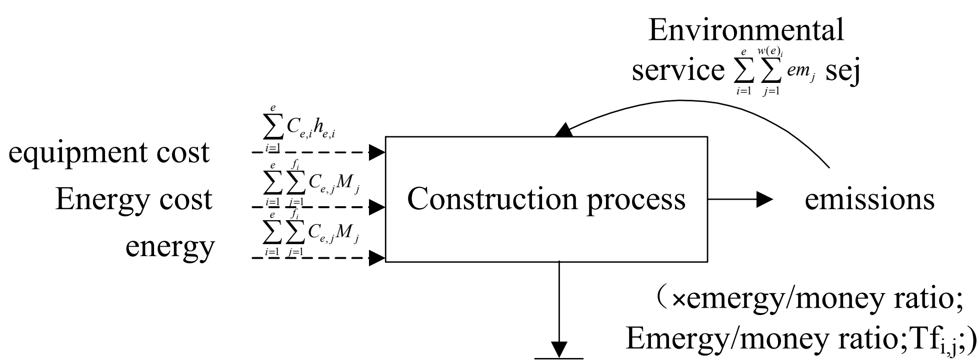

Figure 3.Emergy system diagram for equipment subsystem.

After analyzing the input and output of each subsystem in construction process, the emergy can be calculated with tranformity and emergy/money ratio. results can be found in the following Table 1. For a concrete construction scheme, after the input and output are defined in details, the emergy can be concluded by calculating each item in Table 1. Further analysis, such as sustainability of the system, can be done.

Table 1.Emergy Calculation Form of Construction Operational Resources System.

Item	Amount	Transformity	Emergy (sej)
Manpower cost	$\sum_{i=1}^{m} C_{l,i}T_i$	*em/m*	$\sum_{i=1}^{m} C_{l,i}T_i \times em/m$
Raw material cost	$\sum_{i=1}^{r} C_{r,i}Q_{r,i}l_i$	*em/m*	$\sum_{i=1}^{r} C_{r,i}Q_{r,i}l_i \times em/m$
Raw material daily loss	$Q_{r,i}l_i$	TF_i	$\sum_{i=1}^{r} Q_{r,i}l_iTF_i$
Turnover material cost	$\sum_{i=1}^{t} C_{t,i}Q_{t,i}$	*em/m*	$\sum_{i=1}^{t} C_{t,i}Q_{t,i} \times em/m$
Emergy for eliminating material waste	--	--	$\sum_{i=1}^{r} \sum_{j=1}^{w(m)_i} em_j$
Equipment cost	$\sum_{i=1}^{e} C_{e,i}h_{e,i}$	*em/m*	$\sum_{i=1}^{e} C_{e,i}h_{e,i} \times em/m$
Energy cost of equipment	$\sum_{i=1}^{e} \sum_{j=1}^{f_i} C_{e,j}M_j$	*em/m*	$\sum_{i=1}^{e} \sum_{j=1}^{f_i} C_{e,j}M_j \times em/m$
Energy consumed by equipment	$\sum_{i=1}^{e} \sum_{j=1}^{f_i} M_j$	$TF_{i,j}$	$\sum_{i=1}^{e} \sum_{j=1}^{f_i} M_jTF_{i,j}$
Emergy for eliminating equipment emission	--	--	$\sum_{i=1}^{e} \sum_{j=1}^{w(e)_i} em_j$

CONCLUSION

This study employs emergy theory and its methodology, a research method of economics in construction operational resource analysis, for its advantage in breaking through the barrier between different units of energies and money. The system boundary is set to be the onsite construction phase from the preparation to the completion and acceptance. Three subsystems are manpower subsystem, material subsystem and equipment subsystem. After analyzing the input and output of capital, energy, and material of each part, a framework of emergy analysis of construction process focusing on construction resources is proposed, with system diagram as visual explanation and detail calculation principles. Future works can be done on system analysis and assessment for green construction based on the framework established in this study.

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Research on Government Cultivation Behavior Based on Cultural Construction in the Building Energy Efficiency Services Market

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Abstract

The developing of building energy efficiency services market, as a key part of building energy efficiency, has been in-depth in China, but the market cultivation behavior of the government, as the main market promoter, have to be changed as a result of its function transformation reformation. In this paper, building energy efficiency services market government cultivation behavior model was set up based on the cultural construction. In this model, the disadvantages of single government cultivation behavior were analyzing and the mechanisms of cultural construction behavior of the government were researched by using game theories. The model explained that how to use culture to impact the market by the government, forming the interaction among the market, users and government, which could achieve the management aims of government, and proved that it could be one of effective government cultivation behaviors in this market.

INTRODUCTION

For the development of building energy efficiency services market, the government should not solve the cultivation problems in the energy efficiency service market solely on investment, because of the tremendous financial pressure of the incentives and supervision and the coordinative operation of whole social-economic system. At the same time, the users of building energy efficiency services is the ultimate aim of the government cultivation, whose behavioral selection would be one of the key factors in the development of the market, therefore, the government should pay attention to the knowledge propagation, awareness culture etc. of energy efficiency, which related with the public closely. The fundamental purpose of culture is that the demands of building energy efficiency services market is stimulated by the culture affection of understand, learn, and use of the services to promote the sustainable development of the market. The focus of this paper is to study how the government to solve the demands of the market by cultivating the culture of building energy efficiency services market.

THE PRINCIPLE OF THE CULTURAL FORMATION

The foundation of the cultural formation. The foundation includes policy stability, the knowledge learning endorsement, knowledge dissemination mechanism, culture advocate for building energy efficiency service build by government (Bierly and Hamalainen 1995; Hedberg 1981; Fiol and Lyles 1985).

The dissemination of the cultural. It is a dynamic process (see Figure 1) that the Learning and application of building energy efficiency services is promoted by the government. It is about the learning, timing, and inter-sectors, but also searching a new balance after absorbing new knowledge and applying new knowledge. By learning new knowledge, new ideas and actions are disseminated from individuals to the society, and cognitive types of individuals and groups are shown in Table 1. At the same time, the influence of the new knowledge, which would change the mode of behaviors and thinking, will spread from society to individuals, which is the core process of culture construction by the government based on building energy services market.

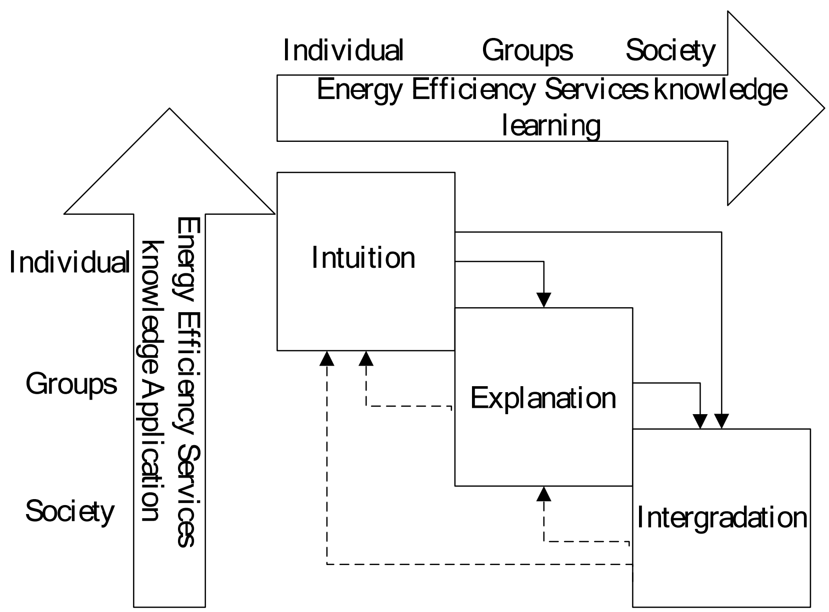

Figure 1.Knowledge dissemination process of building energy efficiency services.

Table 1.Existing Forms of Knowledge.

	Individual knowledge	Groups knowledge
Tacit Knowledge	Skills	Informal system
Explicit knowledge	Technology	formal system

The public behaviors to the culture. There are different kinds of behaviors to the same culture, and the partition is shown as Figure 2.

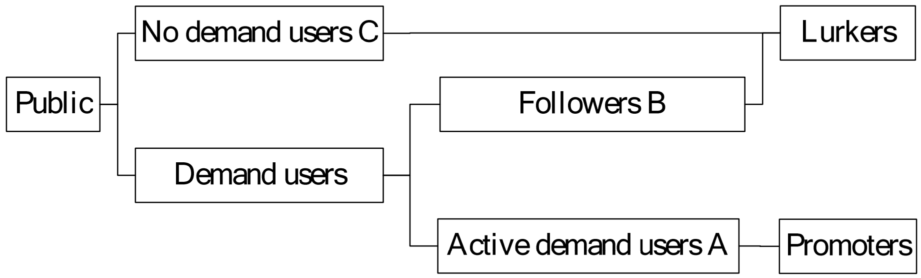

Figure 2.User demand classification and relationship in building energy efficiency services.

GOVERNMENT CULTIVATION BEHAVIOR MODEL CONSTRUCTION

Model assumptions. Through analysis of the previous section, the characteristics of no demand users have no interest in subsidy policy because of limited information and understanding of energy efficiency, and risk avoidance, and only when there is a real surplus of income to offset the risk, the users may change the attitude of the class. Therefore, the guidance of this type of user should establish the typical 'surplus' model as much as possible. The public is divided into two kinds: Active demand users A and no demand users C, who are limited rationality. Demonstration effect is shown by the knowledge and the popularization of active demand users. C copy the behavior of A when they see the real surplus. In this process, the cost would be c. When the popularization is succeed, A will continue the behavior, otherwise, A will lose a part of confidence. The discounted value would be $\mu(0 \le \mu \le 1)$. The possibility of A and C is P and Q, and the income of choosing the service is m. The government would give the users rewards I_1 for choosing the service, and otherwise would be punishment I_2 if there is demonstration from A (no demonstration no punishment). The government would give A rewards J.

At the same time, in order to consolidate the effect of the policy, the government still need to do further, so that additional assumptions are based on the model set by Sober et al. (1998), Sober and Wilson (1994), and the Improved model set by Zywieki (2000): for the culture, A is the promoters as compared to C, and negative demand users B and C are the lurkers. The promotion behavior of A could get income b for other style of users, but the cost could be c in which $b \succ c$. The payoff matrix is as Table 2.

Table 2.The Needs Strengthening Payoff Matrix of Building Energy Efficiency Service.

	Promotion A	Lurking S
Promotion A	$b-c, b-c$	$-c, b$
Lurking S	$b, -c$	$0, 0$

There are M public groups in the society, $f_i\ (i = 1, 2, \ldots, M)$ is the proportion of the number in the group i in the total number of the public, and $x_i\ (i = 1, 2, \ldots, M)$ is the proportion of the number of A in the group i, then, $\bar{x} = \sum_{i=1}^{M} f_i x_i$ is the proportion of the total number of the public. P is the interaction frequency in the group, and the interaction is more frequent, therefore $P \succ 0.5$. The interaction frequency among the groups is $1-P$.

Model description. The expectation of A is:

$$\begin{aligned} U_A &= P\left[Q\left(m+I_1+J-c\right)+\left(1-Q\right)\left(m+I_1+J-c-\mu J\right)\right]+\left(1-P\right)\cdot 0 \\ &= P\left[m+I_1+J-c-\left(1-Q\right)\mu J\right] \end{aligned} \quad (1)$$

$$\begin{aligned} U_C &= Q\left[P\left(m+I_1\right)+\left(1-P\right)\left(-I_2\right)\right]+\left(1-Q\right)\cdot 0 \\ &= Q\left[P\left(m+I_1\right)+\left(1-P\right)\left(-I_2\right)\right] \end{aligned} \quad (2)$$

The model is shown by Figure 3. The max expectation of A based on (1) is:

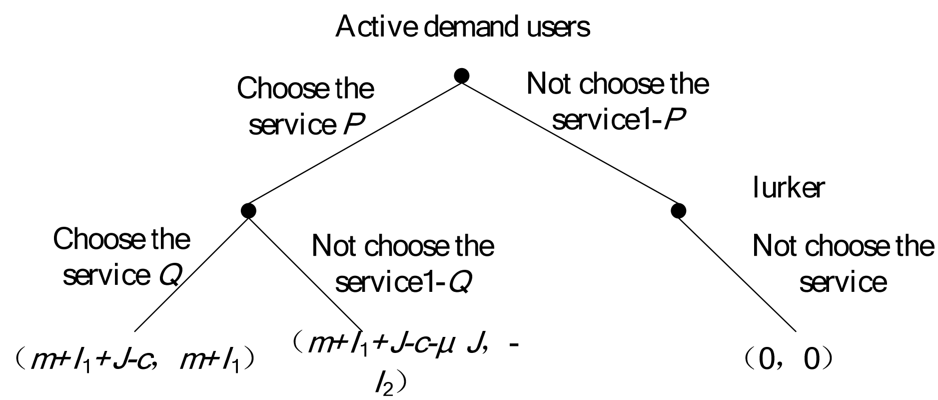

Figure 3.Transformation model demand for building energy efficiency services.

$$\max U_A = P\left[m+I_1+J-c-\left(1-Q\right)\mu J\right] \quad (3)$$

The Optimization above is that:

$$m+I_1+J-c-\left(1-Q\right)\mu J = 0, \quad (4)$$

In which we could get Q^*:

$$Q^* = \frac{m+I_1+J-c-\mu J}{\mu J}$$

The max expectation of C based on（4-13）is:

$$\max U_C = Q\left[P\left(m+I_1\right)+\left(1-P\right)\left(-I_2\right)\right] \quad (5)$$

The Optimization above is that:

$$P\left(m+I_1\right)+\left(1-P\right)\left(-I_2\right) = 0, \quad (6)$$

In which we could get P^*:

$$P^* = \frac{I_2}{m+I_1+I_2}$$

Therefore, $\left(P^*,Q^*\right)=\left(\frac{I_2}{m+I_1+I_2},\frac{m+I_1+J-c-\mu J}{\mu J}\right)$ is the Equilibrium of this model. To consolidate the effect of the policy, the research still needed to be done further. In the group i, the expectation of the behavior of promotion and waiting and seeing is:

$$U_{ij}=Px_iu_j+\left(1-P\right)\overline{x_i}u_j \tag{7}$$

In which, u_j is the benefits of the behavior above, $j=A$ or S.

$$\begin{cases} u_A=b-c, & j=A \\ u_B=b\quad, & j=B \end{cases} \tag{8}$$

The relevant parameters are put into the expectation, and the result could be:

$$\begin{aligned} U_{iA}&=Px_i\left(b-c\right)+\left(1-P\right)\sum_{i=1}^{m}f_i\cdot x_i\left(b-c\right) \\ U_{iS}&=Px_ib+\left(1-P\right)\sum_{i=1}^{m}f_i\cdot x_ib \end{aligned} \tag{9}$$

The average benefit of the group i is that:

$$\bar{U}_i=x_iU_{iA}+\left(1-x_i\right)U_{iS}=\left(Pb-c\right)x_i+\left(1-P\right)\sum_{i=1}^{m}f_i\cdot x_ib \tag{10}$$

Therefore, the average benefit of the public is that:

$$U=\sum_{i=1}^{m}f_i\cdot\bar{U}_i=\left(b-c\right)\sum_{i=1}^{m}f_i\cdot x_i \tag{11}$$

The society is changing all the time, so that the amount of promoters would be changing too. $f_i'\left(i=1,2,\dots,M\right)$ is defined to represent the proportion of the number in the group i in the total number of the public in the next period, which is influenced by the relative utility:

$$f_i'=f_i'\cdot\frac{\bar{U}_i}{U} \tag{12}$$

Δx_i is the changing proportion of the promotion behavior between the two periods in the group i. So that:

$$\Delta x_i=x_i'-x_i=\frac{cx_i\left(1-x_i\right)}{\bar{U}_i} \tag{13}$$

x_i' is the proportion of promoter in the group i of the next period, and in order to stabilize the scale of the groups, the relative benefits (rather than absolute benefits) are proportional to x_i' in this period, which is that $x_i'=x_i\cdot\frac{U_{iA}}{\bar{U}_i}$. So, the promoter proportion in the public is $\overline{x}'=\sum_{i=1}^{M}f_i'x_i'$. $\Delta\overline{x}$ is the promoters proportion changing between the two periods in the public.

$$\begin{aligned}\Delta x &= \overline{x}' - \overline{x} = \sum_{i=1}^{M} f_i' x_i' - \sum_{i=1}^{M} f_i x_i \\ &= \sum_{i=1}^{M} f_i' \cdot \frac{U_i}{U}\left(x_i + \Delta x_i\right) - \sum_{i=1}^{M} f_i x_i = \frac{1}{U}\left[\sum_{i=1}^{M} f_i \cdot \left(U_i - U\right) x_i + \sum_{i=1}^{M} f_i \cdot U_i \cdot \Delta x_i\right]\end{aligned} \tag{14}$$

For $\operatorname{cov}(U_i, x_i)$ and $E(U_i \Delta x_i)$:

$$\begin{aligned}\operatorname{cov}\left(U_i, x_i\right) &= \sum_{i=1}^{M} f_i \cdot \left(U_i - U\right)\left(x_i - \overline{x}\right) \\ &= \sum_{i=1}^{M} f_i \cdot \left(U_i - U\right) x_i - \sum_{i=1}^{M} f_i \cdot \left(U_i - U\right)\overline{x} = \sum_{i=1}^{M} f_i \cdot \left(U_i - U\right) x_i\end{aligned} \tag{15}$$

$$E\left(U_i \Delta x_i\right) = \sum_{i=1}^{M} f_i \cdot U_i \cdot \Delta x_i \tag{16}$$

Based above, $\Delta x = \dfrac{\operatorname{cov}\left(U_i, x_i\right) + E\left(U_i \Delta x_i\right)}{U}$, Which is *Price* Equation.

Therefore, the Δx could be calculated as fellow:

$$\begin{aligned}\Delta x &= \frac{\operatorname{cov}\left(U_i, x_i\right) + E\left(U_i \Delta x_i\right)}{U} \\ &= \frac{\sum_{i=1}^{m} f_i \cdot \left(\overline{U} - U\right)\left(x_i - \sum_{i=1}^{m} f_i \cdot x_i\right) + \sum_{i=1}^{m} f_i \cdot \overline{U} \Delta x_i}{U} \\ &= \frac{\left(Pb - c\right)\sum_{i=1}^{m} f_i \cdot \left(x_i - \sum_{i=1}^{m} f_i \cdot x_i\right)^2 - c\sum_{i=1}^{m} f_i \cdot x_i\left(1 - x_i\right)}{U}\end{aligned} \tag{17}$$

When $\Delta x \geq 0$, the proportion of promoters would be increasing in the public.

Model analysis. Based on the model above, the situations can be listed as follows.

$\dfrac{\partial Q^*}{\partial J} = \dfrac{c - m - I_1}{\mu J^2} \prec 0$, the government gave the users A to encourage their promotion behavior to increasing their benefits, but it may make the users C not choose the service due to the unbalance of the benefits. Further, too many benefits could make A adverse selection that could reach alliance and defraud the government reward fund, which could reduce the possibility to choose the service for C.

$\dfrac{\partial Q^*}{\partial \mu} = \dfrac{c - m - I_1 - J}{\mu^2 J} \prec 0$, it could be that when A more and more lose their faith to promote, C absolutely cannot be influenced by the promotion, which could reduce the possibility to choose the service for C.

$\dfrac{\partial Q^*}{\partial c} = \dfrac{-1}{\mu J} \prec 0$, when the cost of promotions is increasing, the difficulties of that are increasing, the benefits and faith of A would be reduced, which could reduce the possibility to choose the service for C.

$\frac{\partial \Delta x}{\partial c} = -\frac{\sum_{i=1}^{m} f_i \cdot \left(x_i - \sum_{i=1}^{m} f_i \cdot x_i \right)^2 + \sum_{i=1}^{m} f_i \cdot x_i (1 - x_i)}{\bar{U}_i} \prec 0$, it signs that the behavior of promoters is relative to the cost.

$\frac{\partial \Delta x}{\partial b} = -\frac{P \sum_{i=1}^{m} f_i \cdot \left(x_i - \sum_{i=1}^{m} f_i \cdot x_i \right)^2}{\bar{U}_i} \succ 0$, when the benefits increasing, the amount of the promoters would be increasing, the situation would be formed to be public knowledge, which can be called 'the culture', which could be accepted by more and more people.

x_{ij} is supposed to be the probability of the promoters in the group i and No. $j (j = 1, 2, \ldots, N)$.

$$U_i = \sum_{j=1}^{N} f_{ij} U_{ij} \tag{18}$$

$$x_i = \sum_{j=1}^{N} f_{ij} x_{ij} \tag{19}$$

$$\Delta x_i = \sum_{j=1}^{N} f_{ij} \Delta x_{ij} \tag{20}$$

$$U_i \Delta x_i = \operatorname{cov}\left(U_{ij}, x_{ij}\right) + E\left(U_{ij} \Delta x_{ij}\right) \tag{21}$$

$$\Delta x = \frac{\operatorname{cov}\left(U_i, x_i\right) + E\left[\operatorname{cov}\left(U_{ij}, x_{ij}\right) + E\left(U_{ij} \Delta x_{ij}\right)\right]}{U} \tag{22}$$

There is no difference in the transferring between the periods, which is $\Delta x_{ij} = 0$, so:

$$\Delta x = \frac{\beta_{U_i x_i} Var\left(x_i\right) + E\left[\beta_{U_{ij} x_{ij}} Var\left(x_{ij}\right)\right]}{U} \tag{23}$$

There are two parts consisted in the frequency of cultural promotion, which is the combined effect in the internal and outternal of the groups. The frequency of cultural promotion is influenced by frequency variance among the groups, partial regression coefficients of frequency and utility among the groups, and the Symbol is affected by partial regression coefficients of frequency and utility among the groups. Frequency of cultural promotion inside of the group is corresponding to the influence among the groups, affected by the relevant internal variables. It is the result of these that decide whether the promotion behaviors are available, which is conducive to the development of communities, the culture would be continued possibly.

The countermeasure of government cultivation behavior. From the model and the parameter description, the government should care about these issues below:

With cultivating the building energy efficiency services market, there are more and more difficulties to guild the no demand users. Because they more or less knew the policies of the market through so many media, who has the expectation of higher reward, or they do not believe the promotion, just as a show. Therefore, the government should strengthen the construction of the credit system, establish positive government image of responsibility, promise keepers. The public are infected by the culture governed by both incentives and punishment means to change their ideas.

As the founder of the culture, the government should encourage awareness to reach better promotion effect, not only improving their income. Therefore, the government should take the initiative to strengthen the mission and responsibility of the users, and further deepen the understanding of the culture, in addition, the difficulties in the promotion process should be found regularly, and seek countermeasures to make the culture establish and promote smoothly.

Furthermore, in the beginning of the implementation of the culture, the government should focus on these issues. The government should focus on the promotion cost, according to the different characteristic to take different policies, to ensure the promoter increasing. Based on this, the benefits of the promoters and lurkers would be increasing, and take this chance to spread the culture. The government should search the promoters in all groups, and attempt to implant the role where is no such persons in some groups, to make sure that all groups should be influenced by the promotions. The government should also make clear the influence of the promoters in the other groups and the scope of the promotions could be received by the lurkers.

CONCLUSION

The government not only cultivating policies to promote the market, but focus on the effect of the policies. The policies of last period are the foundation of the next. Secondly, the government should integrate limited resources for the market, where found the promoters, and their influence could affect most of the public, and then increasing the proportion of using the service.

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Energy Simulation of a Building Envelope for NetZero Energy Home (NZEH) Design

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Abstract

Energy consumption due to residential building operation is a crucial issue in cold-climate regions. In order to alleviate the energy demand from residential building operation, the concept of NetZero energy homes (NZEHs) has emerged as a solution. Appropriate design of the building envelope for NZEHs, (including insulation type and thickness, configuration, and other parameters), is a key to ensuring a high level of energy performance of NZEHs, and energy simulation provides a tool to investigate the energy performance of design options for each component of the NZEH building envelope. HOT2000, which is a widely used energy simulation tool in Canada, is used for energy simulation in this research; in order to achieve the goal of simulation automation, the Batch Version of HOT2000 is utilized. The energy performance of design options is simulated for such main components of NZEH building envelope as main wall, exposed floor, attic, basement wall, and basement floor, and, based on the simulation results, the functions and charts of energy performance are developed for these components. This research contributes to the body of research in this area by analyzing the energy performance of design options for NZEH building envelope.

INTRODUCTION

Energy consumption is a crucial issue which has garnered world-wide attention, particularly in cold-climate regions such as Canada. The NEB (2013) analyzed energy consumption by sector in Canada in 2011, and found that energy use in the residential sector, including for space heating/cooling, hot water heating, lighting, appliances, and other energy-using devices, accounts for 14% of total energy consumption, and that the energy demand is expected to increase at an average annual rate of 0.7% between 2011 and 2035. To reduce the energy usage of residential building operation, the NetZero-energy home (NZEH) has emerged as a solution.

A NZEH is defined as a residential building which produces from renewable sources approximately as much energy as it consumes on an annual base. NZEHs combine highly energy-efficient design with on-site energy-producing technologies to achieve an annual net energy balance (consumption versus production) of zero during occupancy. Efforts in Canada and around the world to promote the development and marketing of NZEHs have been made, including the establishment of the Net-Zero Energy Home Coalition, which is a multi-stakeholder group in North America that supports the long-term vision that all new homes will be built to a net zero energy standard by 2030 (Government of Canada 2005). Meanwhile, the Government of Canada (2005) has announced the NetZero energy healthy housing initiative to advance the objective of achieving net zero energy consumption for new Canadian housing.

To optimize building envelope design for NZEHs, energy simulation at the design stage provides a powerful quantifying tool to estimate energy consumption and to optimize building design scenarios. Currently, representative and widely used building energy simulation programs include: (1) HOT2000, which was developed by Natural Resources Canada and is the official building simulation software of the Government of Canada; (2) Energy Plus, which was developed by the US Department of Energy (DOE); (3) ESP-r, which was initially developed in the United Kingdom, and is an integrated modeling tool for thermal, visual, and acoustic performance of buildings and energy use. HOT2000 has been used for residential building energy analysis and rating in Canada since 1987. The development of HOT2000 was carried out in two main versions, an interactive (Windows) Version written in the Mega-Basic language, and the Batch Version written in FORTRAN. Currently, the Batch Version 10.52 of HOT2000 is compatible with the Interactive Version 10.51 (NRC 2010). With a simulation program as the tool, various efforts have been made to optimize building design. Bucking et al. (2013) have proposed a hybrid evolutionary algorithm to minimize the energy consumption of an NZEH, with Energy Plus as the energy simulation tool. The algorithm proposed in their study uses information gained to improve algorithm convergence using targeted deterministic searches, and the results provide an optimal design scenario for the NZEH case. In another study, to target affordable NZEH within $80,000 incremental cost, ESP-r has been used as the simulation tool for 80,000 simulation runs, with Particle Swarm Algorithm applied to search cost-optimal technology combinations (Carver and Ferguson 2012). Kneifel et al (2015) analyzed the energy performance sensitivity of a NZEH with regard to seven factors of building design, air leakage, occupant behavior, weather, building orientation, and heating and cooling set point temperatures.

In this research, in order to analyze the energy performance of different design options for building envelope, HOT2000 is used as the simulation tool; to gain an overall view of energy performance of various building envelope design options, automated simulation of building envelope of energy performance is carried out.

RESEARCH OBJECTIVE AND METHODOLOGY

Research objective. The central aim of this research is to analyze the energy performance of design options for NZEH building envelope. The specific research objectives include: (1) simulating the energy performance of design options for main components of building envelope, including main wall, exposed floor, attic, basement wall, and basement floor, and (2) analyzing the energy performance for each component. Based on the simulation results, a mathematical function of energy performance is developed for each component and the results are charted graphically.

Research methodology. Energy simulation is utilized as a tool to quantify the energy performance of the building envelope of NZEHs. The main components of building envelope are investigated for NZEHs in this research, and the RSI values of these components are input as the variables. To begin with, a house model is built using the Windows version of HOT2000, and then the model is converted into a V71 & V80 file pair. The energy performance of each component is simulated using the Batch Version of HOT2000, with the substitution of RSI value for iteration (i.e., design option). Based on the simulation results, the energy performance is analyzed for each component. The mechanism and methodology of HOT2000, design code and bylaws, and the independency of components are the criteria of the research methodology. Mathematical functions and charting of the energy performance of the main building envelope components are the key outputs of this research. The research methodology is represented in Figure 1.

CASE EXAMPLE

Initial design information. One single-family NZEH, developed by Landmark Group of Builders in Edmonton, Canada, is used as the case study in this research. The initial building design information is summarized in Table 1.

Energy simulation for each component. The energy performance is simulated for each building envelope component, with RSI value as the variable. Each component is simulated independently, and the Batch Version of HOT2000 is used as the simulation engine. The initial design of the case house is described using a pair of V71 & V80 files; for each option of a component, the RSI value is updated and simulated using HOT2000. The simulation flowchart is given in Figure 2.

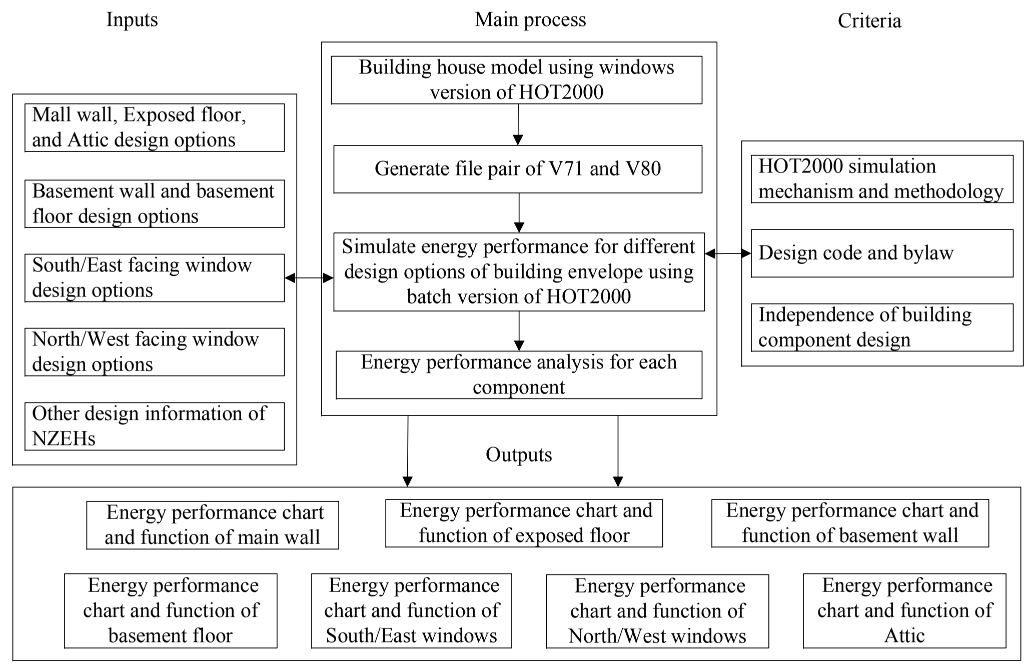

Figure 1.Research methodology.

Table 1.Initial Design Information for Case NZEH.

General Building Information		Building Envelope	
Builder	Landmark homes	Main wall	12.7 cm spray foam with 6.73 cm spray fiber glass
Building type	Single-family home	Attic	8.89 cm spray foam with 41.8 cm blown in
Building orientation	East-facing	Basement wall	8.89 cm Batt + 8.89 cm SPF with drywall
Gross floor area	222 m^2	Basement slab	10.16 cm EPS II under slab with thermal break at footing and wall
Year completed	2013	Window type	South-facing: triple-glazed glass with single low-e argon Others: triple-glazed, two panes with sun stop coating and argon

Table 1.(Continued).

General Building Information		Building Envelope	
Certification	Energy guide 100	Exposed floor	17.78 cm spray foam
Annual heating degree days	5,589	Window U-value	South-facing 0.184, all other directional orientations 0.124
Latitude	53.403°	Air tightness	0.57 ACH50
Other information		MPE systems	
Estimated annual energy use	17,521 kWh	Space heating	ZUBA central air source heat pump with electric resistant heater as backup
Modelled annual heating load	8,761.07 kWh	Ventilation	Venmar EKO 1.5 Ultra-Efficient HRV
Electrical generation	13.7 kW solar PV system	Water heating	AO Smith Voltex Air source heat pump hot water tank (80 Gal) + Drain-water heat recovery system

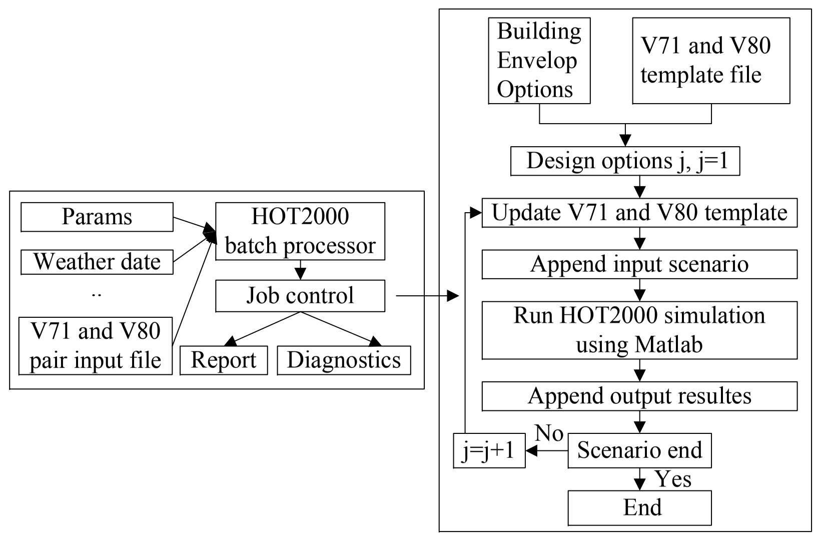

Figure 2.Energy simulation flowchart.

Practical design options of building envelope for NZEHs. A properly designed building envelope can reduce energy consumption. Main wall, exposed floor, attic, basement wall, and basement floor are selected as the main components of the building envelope and are analyzed in detail. For each component, the practical design options with different insulation types used in industry for NZEHs are identified (listed in Table 2), which incorporates the assembly solutions provided by Canadian Wood Council (CWC 2014), which is the national association representing manufacturers of Canadian wood products used in construction. The design options satisfy current industry building codes and take into account the practical experience of the industry partner.

Table 2.Building Envelope Options.

Main Wall		Attic		Basement Wall		Exposed Floor		Basement Slab	
Insulation	RSI	Insulation	RSI	Insulation	RSI	Insulation	RSI	Insulation	RSI
12.7 cm SPF + 6.73 cm Spider	6.25	8.89 cm SPF + 41.8 cm blown in	13.81	8.89 cm Batt + 8.89 cm SPF with drywall	5.51	17.78 cm SPF	7.31	10.16 cm EPS II	2.57
13.97 cm SPF	4.22	34.8 cm Blown-In	8.85	5.08 cm EPS + 14 cm mineral fiber	4.24	22.86 cm SPF	8.76	5.08 cm EPS II	1.29
7.62 cm SPF + 5.08 cm XPS	4.87	41.8 cm Blown-In	10.60	10.16 cm XPS + 14 cm mineral fiber	6.38	25.4 cm Batt	5.97	10.16 cm XTPS IV	3.52
10.16 cm SPF + 8.89 cm Batt	5.11	48.7 cm Blown-In	12.28	14 cm mineral fiber	2.86				
13.97 cm SPF + 10.16 cm EPS	7.04	69.6 cm Blown-In	16.70						

(1) Main Wall. Five practical design options for the main wall, listed in Table 2, are simulated to determine annual energy consumption. The simulation results and the chart with the fitted function are shown in Figure 3 and Table 3, respectively.

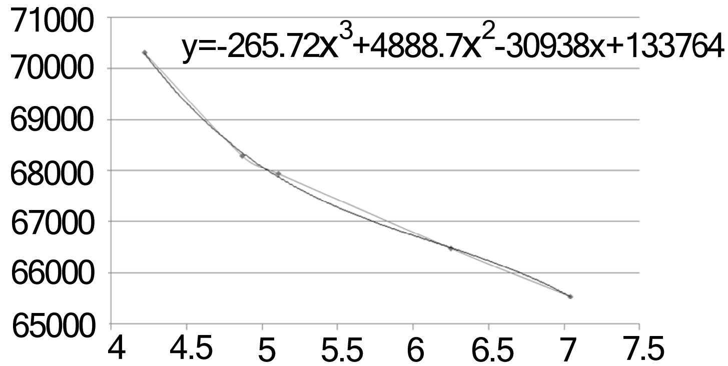

Figure 3.Energy performance of main wall (RSI Value K•m^2/W).

Table 3.Simulation Results for Main Wall.

RSI Value (K•m^2/W)	Estimated Annual Energy Consumption (MJ)
4.22	70,304
4.87	68,282
5.11	67,933
6.25	66,479
7.04	65,540

(2) Exposed Floor. Three practical design options for exposed floor, listed in Table 2, are simulated to determine annual energy consumption. The simulation results and the chart with the fitted function are displayed in Table 4 and Figure 4, respectively.

Table 4.Simulation Results for Exposed Floor.

RSI Value(K•m^2/W)	Estimated Annual Energy Consumption (MJ)
5.97	66,728
7.31	66,506
8.76	66,372

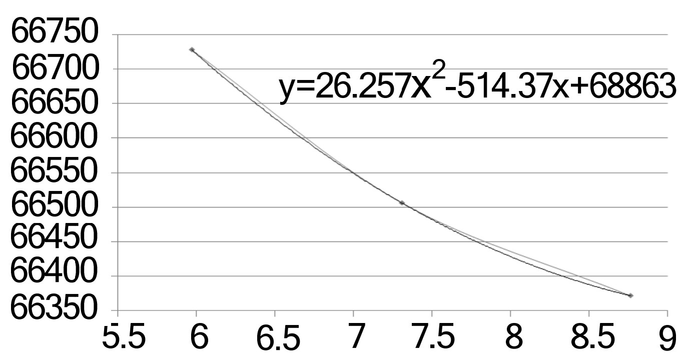

Figure 4.Energy performance of exposed floor (RSI Value K•m^2/W).

(3) Attic. Five practical design options for the attic component, listed in Table 2, are simulated to determine annual energy consumption. The simulation results and the chart with the fitted function are given in Table 5 and Figure 5, respectively.

Table 5.Simulation Results for Attic.

RSI Value(K•m^2/W)	Estimated Annual Energy Consumption (MJ)
8.85	67,368
10.60	66,957
12.28	66,723
13.81	66,505
16.70	66,253

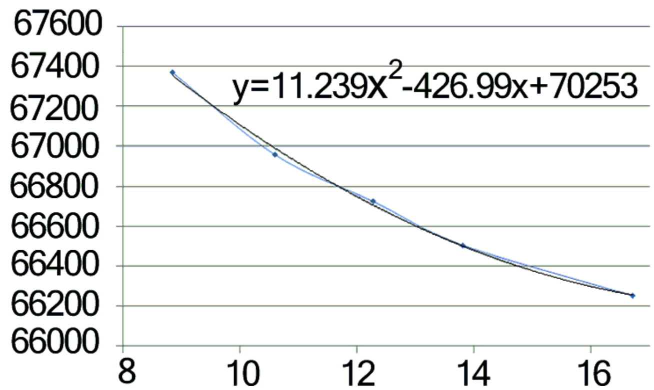

Figure 5.Energy performance of attic (RSI Value K•m^2/W).

(4) Basement Floor. Five practical design options for the basement floor, listed in Table 2, are simulated to determine annual energy consumption. The simulation results and the chart with the fitted function are provided in Table 6 and Figure 6, respectively.

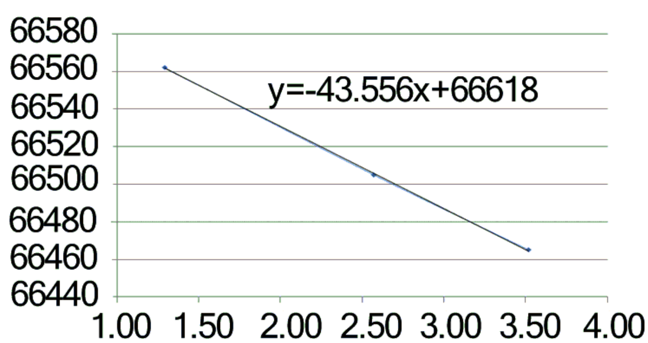

Figure 6.Energy performance of basement floor (RSI Value K•m^2/W).

(5) Basement Wall: Five practical design options for the basement wall, listed in Table 2, are simulated to determine annual energy consumption. The simulation results and the chart with the fitted function are given in Table 7 and

Figure 7, respectively.

Table 6.Simulation Results for Basement Floor.

RSI Value(K•m^2/W)	Estimated Annual Energy Consumption (MJ)
1.29	66,562
2.57	66,505
3.52	66,465

Table 7.Simulation Results for Basement Wall (RSI Value K•m^2/W).

RSI Value(K•m^2/W)	Estimated Annual Energy Consumption (MJ)
2.86	67,984
4.24	67,020
5.51	66,505
6.38	66,254

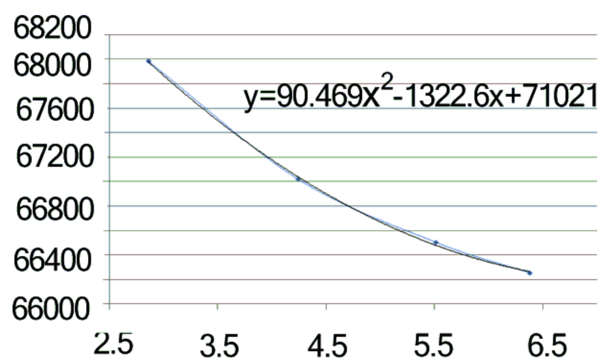

Figure 7.Energy performance of basement wall.

CONCLUSION

Building envelope selection is an important issue for NZEH design with regard to energy performance. This research uses energy simulation to analyze the energy performance of the main components of NZEH building envelope, including main wall, exposed floor, attic, basement wall, and basement floor. HOT2000 is used to simulate the energy consumption for each design option of the building envelope components, and the results are analyzed. The energy performance can be regulated for each component and fitted as a formula using RSI value as the variable. Based on the proposed generic methodology to analyze the energy performance of different design options for each component of building envelope, the research results can be used in building design to improve energy performance of NZEHs.

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Transition to a Sustainability-Oriented Construction Industry in China: A Critical Analysis from the Multi-Level Perspective

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Abstract

Since the Chinese construction industry has huge impacts on China's economy, society and environment, the sustainability of this industry is very important. Scholars have explored the sustainability drivers and barriers of the Chinese construction industry, trying to help it transition to a sustainability-oriented industry. However, few of them succeeded in offering a systematic approach to respond to the complexity of the sustainability transition issue. This paper aims at introducing the multi-level perspective from the socio-technical transition research into the research field of the construction industry, to systematically analyse the sustainability transition issue of the Chinese construction industry. Based on the multi-level perspective, the drivers and barriers are assessed. The results show that various elements in the construction industry, such as the corporations, policy, technology, and culture, coevolve and have multi-dimensional interactions, and various drivers and barriers of sustainability coexist and intertwined. To facilitate the sustainability transition process, systematic instruments are needed.

INTRODUCTION

In 2010, China overtook the US to become the world's largest construction market, and in 2013 the construction industry in China generates a value added of 3.9 trillion RMB, up by 9.5% year-on year. Apart from this economic influence, the construction industry of this large scale also has tremendous impacts on the society and environment. After the manufacture industry, the construction industry is the second largest industrial employer in China, providing more than 40 million jobs. The steel consumption of the Chinese construction industry contributes to more than 20% of the world's total consumption, and the construction waste accounts for 45% of the total garbage in China. The building energy consumption accounts for 27.5% of the national total in China, and if the energy consumption caused by construction material manufacture is included, the energy consumption related to the construction industry constitutes more than 40% of the total consumption in China.

Since the Chinese construction industry has such a huge impact on China's economy, society and environment, the sustainability of the industry is of vital significance. Some scholars have studied the sustainability drivers and barriers of the Chinese construction industry, trying to help it transition to a sustainability-oriented industry. Zhang et al. (2011) analysed the additional cost of three types of green buildings and found that the higher costs has hindered the extensive application of green technologies in China. Shi et al. (2013) concluded that the three most critical barriers prohibiting the popularization of sustainable construction in China are "additional cost", "incremental time" and "limited availability of green suppliers and information". Qi et al. (2010) proved that managerial concerns and government regulatory pressures are the two most important driving forces of green construction in China, while it appears that project stakeholder pressures don't have much significant effect on green construction practices (Qi et al. 2010).

Even though these studies offer valuable references for understanding how to promote the sustainability transition of the Chinese construction industry, few of them succeeded in offering a systematic approach to demonstrate and respond to the complexity of the sustainability transition issue the Chinese construction industry is facing. This paper aims at introducing the multi-level perspective into the construction industry study field to systematically analyse the sustainability transition issue of the Chinese construction industry. The drivers and barriers are assessed, and strategies facilitating the sustainability transition of the Chinese construction industry are put forward.

THE MULTI-LEVEL PERSPECTIVE (MLP)

The multi-level perspective (MLP) views transitions as non-linear processes that results from the interplay of developments at three levels: niches (local innovations), socio-technical regimes (the locus of established practices and rules that stabilize existing systems), and an exogenous socio-technical landscape (Geels 2002; Geels 2005).

In the MLP, niches are the 'protected spaces' of novelties, such as R&D laboratories or subsidised demonstration projects (Geels 2011). In essence, niches are incubation rooms that protect novelties against mainstream market selection (Grin et al. 2010). Niches are crucial since they provide the seeds for potential transitions in the future. In niches, actors can research and develop new technologies, learn about market demand and user behaviour, attract attention and build social networks. The actors in niches hope that their novelties can be eventually used in the regime or even replace it. However, this is not easy, since the existing regime is stabilized by many lock-in mechanisms (Geels 2011).

The established rules and practices of a given system, such as technologies, regulations, user preferences, infrastructures, form the social-technical regimes, which accounts for the stability of the given system (Geels 2004). Changes and innovations on the regime level are mostly slow and incremental due to the existence of many lock-in mechanisms (Markard et al. 2012). Typical lock-in mechanisms include: technical standards or government policies may favour existing technologies; the business network of corporations are difficult to change; engineering practice, consumer preference, ways of doing business are all deeply embedded in existing institutions or infrastructures, etc (Geels 2014; Markard et al. 2012). The concept of socio-technical regimes are developed to demonstrate the stability of an existing socio-technical system caused by various lock-in mechanisms.

According to Driel and Schot (2005), there are 3 types of landscape: (1) factors that do not change (or that change very slowly), such as physical climate, (2) rapid external shocks, such as wars or oil price fluctuations, and (3) long-term changes in a certain direction, such as demographical changes or climate change. These factors can be combined in a single "landscape" category since they form an macro context which actors cannot influence in a short run (Grin et al., 2010).

The core idea of the MLP is that transitions come about through interactions among the processes at the three levels: (1) niche-innovations accumulate internal momentum, through learning processes, performance improvements, and support from powerful groups, (2) changes at the landscape level create pressure on the regime and destabilize it and (3) destabilized regime open windows providing opportunities for niche innovations (Geels and Schot 2007). For a transition to occur, dynamics at different levels should come together and reinforce each other. Although the MLP has been applied in many transition studies of different industry backgrounds, to the best knowledge of the authors, the sustainability transition study in the construction industry context using the MLP is almost non-existent.

MULTI-LEVEL PERSPECTIVE ON SUSTAINABILITY TRANSITION OF THE CHINESE CONSTRUCTION INDUSTRY

Based on the general MLP framework, this paper put forward a MLP framework for analysing the sustainability transition of the Chinese construction industry, as shown in Figure1.

Socio-technical landscape. China has experienced a sharp increase of urbanization rate during the past two decades and the rate soared up to 53.73% from less than 30% in mid-1990s. In March 2014, the Chinese central government released the *China's New-style Urbanization Planning* (2014-2020), which states that: *urbanization is a powerful engine for the healthy and continuous economic development.* Clearly, promoting urbanization is still a policy priority for the Chinese government. Such a huge scale urbanization process has to rely on the construction industry to provide uncounted newly constructed infrastructure and buildings, and if the sustainable and low-carbon development mode of the construction industry is not adopted, tremendous energy and materials will be consumed. Thus, the urbanization plan stipulated that sustainability is one of the top principles of China's future urbanization and sustainability concepts will be comprehensively incorporated in the urbanization process. Sustainable buildings, renewable energy and green traffic systems will be highly promoted by the central government. Thus, China's urbanization process generates a strong driving force for the implementation of sustainability strategies in the construction industry.

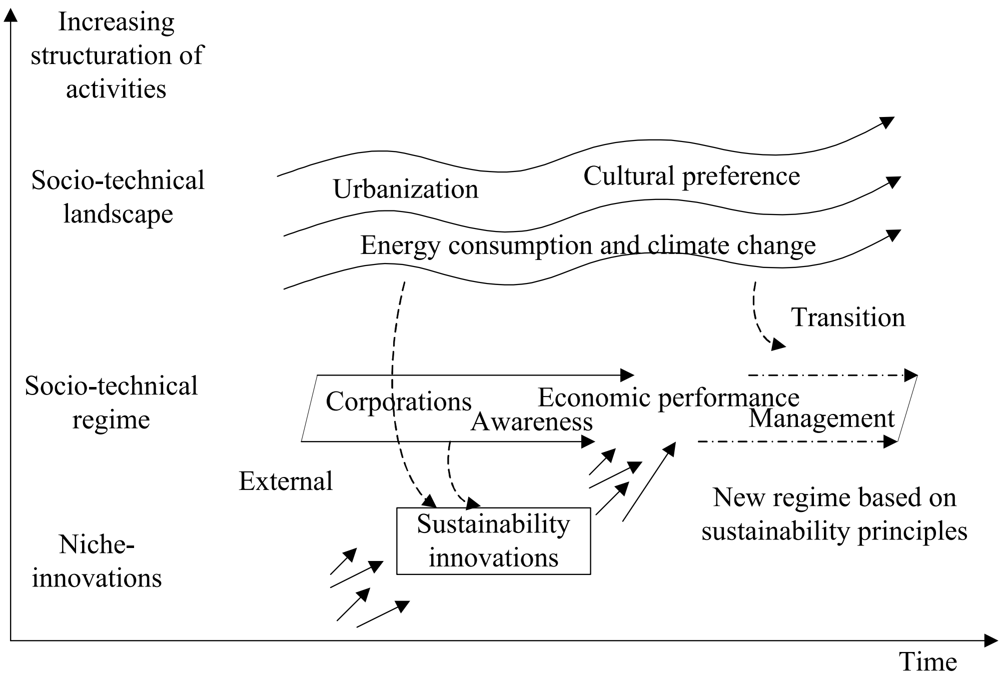

Figure 1.Multi-level perspective on sustainability transition of the Chinese construction industry.

Currently China is the world's largest energy consumer and CO_2 emitter. To deal with rising pressure of emission reduction from home and abroad, the Chinese government has formulated an obligatory target: the CO_2 emission intensity (CO_2 per GDP) in 2020 must decline by 40% to 45% compared to the value in 2005. The Chinese government understands that the construction industry needs to take measures to respond to its high energy consumption and CO_2 emission. The *Twelfth Five-year Plan for the Construction Industry* points out that currently the sustainability performance of the industry is weak, thus promoting energy conservation and emission reduction is one of the major tasks of the industry. The plan also puts forward a quantitative goal: the energy consumption of the industry per value added generated by the industry needs to decrease by 10% in 2015 compared to it in 2010. It is clear that the serious situation of China's energy consumption and CO_2 emission generates huge pressures for the construction industry which needs to transition to a more sustainable industry to contribute to China's overall energy conservation and emission reduction goal.

Urbanization and energy consumption provides strong drivers for promoting sustainability of the construction industry. However, an opposite socio-technical landscape, cultural preference, do exist which reinforces the current operation mode of the industry. Many clients and local governments pursue the concepts of "large, high, new, luxurious and unique" of construction projects and consequently, recent years have seen the continuous emergence of excessive luxurious public buildings. Currently the construction area of public buildings accounts for less than 4% of the total area of urban buildings in China, however the energy consumption of public buildings constitutes 22% of the total building energy consumption. The central government realized this problematic cultural preference and has released a series of regulations trying to rectify this excessive preference of luxury buildings. In 2007, 5 central government departments jointly released a regulation, *Opinions on Strengthening Construction Project Management of Large Public Buildings*, which clearly states that some local governments excessively pursue the uniqueness of architectural appearance, ignoring building function, the consumption of natural resources, the local cultural characteristics, economic feasibility and the harmonious relationships between buildings and the environment. The regulation indicates that a regulatory system for energy conservation of public buildings will be established. In 2012, the government started the revision process of the existing energy standards for public buildings issued in 2005, trying to increase the energy conservation articles in the standard. It seems that the cultural preference of luxuries and uniqueness is so strong that the central government is trying very hard to combat with this preference, which is a huge obstacle of sustainability.

Socio-technical regime. Socio-technical landscape provides both driving forces and obstacles for the promotion of sustainability in the Chinese construction industry. Under the landscape, the socio-technical regime is struggling about whether embracing sustainability, and many drivers and barriers of sustainability coexist.

In terms of the awareness of sustainability, many Chinese construction corporations simply believe sustainability equals to environmental protection or green construction, ignoring the social and economic dimensions of sustainability. In terms of the concept of green construction, ambiguous understanding of green construction still has been discovered to be one of the most critical barriers of promoting it in China. However, even though the concept of sustainability is not popularised in most corporations, the importance of environmental protection, emission reduction and energy conservation is generally recognised. The landscape of energy consumption and climate change in China has force the government to adopt a strict energy conservation policy, reflected by its *12th Five-year Plan for Energy Conservation and Emission Reductions* released in 2012.

Economic implications of promoting sustainability are interpreted differently by corporations. Many Chinese corporations lack the motivation to pursue sustainability since they believe it will not contribute to their competitiveness. However, some Chinese developers have discovered that developing sustainable projects can gain good corporate image which is important intangible asset of corporations, and also the unique sustainable projects satisfy the demands from a certain group of clients who have high expectations on sustainability. A major argument from the Chinese construction corporations undermining adopting sustainability strategies is that pursuing sustainability generates additional cost, which has been identified to be one of the most critical barriers prohibiting sustainability by many scholars. However, there are evidences from Chinese construction corporations that promoting sustainability leads to long-term cost saving mainly due to the reduction of material, energy and maintenance costs. For instance, the adoption of on-site recycling methods reduces material consumption, and thus material cost. The adoption of renewable energy and low-carbon appliances will significantly reduce long-term energy cost. The long-term economic benefits from implementing sustainability strategies still need to be understood and accepted by most construction corporations in China.

Besides from economic performance, sustainability also has many management implications. It has been discovered that incremental time, which affects corporations' schedule management, and limited availability of suppliers, which affects corporations' supply chain management, are two serious barriers of sustainability, suggesting that construction corporations are aware that promoting sustainability may generate management problems. Luckily, some Chinese construction industry associations are trying to identify sustainability leaders and introduce their experiences to the industry. For instance, China International Contractor Association has organized social responsibility assessment for international contractors and released instruction manuals on social responsibility for Chinese international contractors. This association also arranges workshops and seminars on management system to help corporations improve sustainability performance.

Niche-innovations. There are different kinds of innovations, including managerial, technological, institutional and social innovations. Sustainability transitions involve many potential solutions rather than just one, two or sometimes three alternatives as was the case in many historical transitions (Geels 2010; Lachman 2013), so these different kinds of innovations all have a role to play. However, compared to other kinds of innovations such as managerial and social innovations, technological innovation is put much more emphasis by the government. The Chinese government has a strategic plan for the development of sustainability technologies in the construction industry. According to the *12th Five-year Plan for Technology Development of Green Buildings*, issued in 2012 by the Ministry of Science and Technology, three major areas of technologies are identified important and the research of them will be strongly supported by the government. By contrast, there is no guidance of promoting other kinds of innovations. Even though technology development plan has been put forward, there are still huge challenges concerned with the effective application of these technologies. For instance, the lack of competent architects and an integrated interdisciplinary design system is a huge challenge undermining the application of core sustainability technologies.

DISCUSSIONS AND CONCLUSIONS

Based on the above MLP analysis, it can be concluded that on every level both drivers and barriers exist. The main drivers for the sustainability transition of the Chinese construction industry are: 1) the huge transition pressure generated from urbanization, energy consumption and climate change, 2) most corporations' awareness of energy conservation and emission reduction, 3) some corporations' realization of the economic benefits of adopting sustainability strategies, 4) some industry associations' commitment in popularizing management experience of sustainability leaders, and 5) clear technological niche-innovation plan. By contrast, the main barriers for the transition are: 1) the strong stability of China's cultural preference for luxury buildings, 2) most corporations' lack of clear understanding of sustainability, 3) the economic benefits of sustainability have not be realized by many corporations, 4) implementing sustainability strategies may requires many management changes of corporations, and 5) the efficient application of niche-innovations are impeded by some factors, such as the lack of competent architects.

According to the MLP, transitions start to happen when niche-innovations accumulate enough momentum, to break the old regime which has been destabilized by the pressures from the landscape level. In order to promote the industry to efficiently transition to a more sustainable industry, the first strategy is to help sustainability niche-innovations gain enough momentum. Sustainability education needs to be strengthened since the niche-innovations need to be adopted by relevant professionals who master them. Not only architects, but also engineers like civil engineers, and managers such as project managers, should have sustainability awareness. The second strategy is to accelerate the destabilization process of the current regime. The government should create a policy environment which can identify relatively sustainable construction corporations and select them to be the winners in the market, i.e. to make sustainable corporations also competitive. It is recommended that economic incentive policies, such as taxation reduction, and international cooperation should be strengthened by the government to further improve the economic competitiveness of the sustainable construction corporations. China has successfully adopted strong economic incentive policies and strengthened international cooperation to boost the wind power industry, which currently is the largest in the world, and relevant experiences from the energy sector can be used to promote the growth of sustainability-oriented construction corporations. The third strategy is to gradually influence the culture in the landscape level. Currently the environmental pollution in China is severe and the general public is aware of this pollution. Recent years have seen the emergence of environmental parades from the public. It is recommended that the central government should not keep silence about the severity of the environmental problems and by contrast, the central government should take advantage of the general public's deep concern of the environment and leads the cultural shift of the society. Various media, such as the TV shows, the newspaper, and the government official website, should be used as platforms introducing and popularizing the concept of sustainability. Environmental information disclosure and accountability system for construction projects should also be established, thereby transforming public environmental concerns into construction corporations and local governments' environmental protection pressures, which will gradually alter their cultural preference towards sustainability.

This paper adopts the MLP to analyse the sustainability transition of the Chinese construction industry. Driving forces and obstacles from the social-technical landscape, social-technical regime and niche-innovation levels are identified and discussed. The complexity of sustainability transition is revealed and three strategies are proposed to facilitate the transition process of the Chinese construction industry.

Although this paper is focused on China, the conceptual framework of the MLP can be applied to construction research in other regions.

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Developing Green Building in the Manner of Industry Cluster

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Abstract

With global climate change issues and the increasingly serious energy crisis, low carbon idea and green idea are penetrated into many industries. Firstly, the paper is based on the industrial agglomeration theory and industrial gradient transfer theory. Considering the current situation of green building development in China, the paper proposes to develop green building in the way of industry cluster, which is more conducive to improve the green building technology and the rate of green building. Secondly, on the basis of diamond model theory, the paper summarized the factors which affect the competitiveness of green building industry. Also, it analyses our regional green building industry qualitatively. Thirdly, the paper takes the method of empirical research. By comparing results of the cluster analysis and the mean green building amount 72 cities already have, it reaches the conclusion that cluster analysis can be used as a method of green building industry gradient division.

INTRODUCTION

The construction industry is one of the three areas of energy consumption in China. On one hand, the building lighting, heating, air conditioning and electrical equipment consumes a lot of energy. On the other hand, it consumes a lot of cement, steel, non-ferrous metals and glass and other building materials in the building construction process. The construction of green buildings becomes one method of reducing carbon emissions in the construction industry. Green building saves energy, protect environment, and is efficient. It is helpful of reducing carbon emissions, bringing the best economic benefits for the community.

The Chinese government has issued a series of regulations and policies to promote and oversee the development of the green building industry. In 2006, China developed a long-term economic and social development strategy of development planning; “green building” was included in the planning. June 1, 2006, the Ministry of Housing issued a “green building evaluation criteria”. April 27, 2012, the Ministry of Finance and the Ministry of Housing and Urban jointly issued the “Opinions on expediting the development of green building”, documents show wishes to 2020, the proportion of green building new buildings account for more than 30%. May 2012, the Ministry of Housing and Urban-Rural Development announced the “five year building energy special plan” for the next five years to promote energy conservation in buildings of building a comprehensive policy to make statements.

However, compared to the green building industry in developed countries, the number of green building projects in China is less than normal, and lower green building coverage. Green building industry clustering effect can improve this situation, effectively improve the level of green building technology, and improve the government’s laws and regulations and market leading role. With the mature green building mode, reduced demand in the market, such as the scarcity of production factors under the negative effects of the green building industry by gathering diffusion changes resulting effect led to the construction of green buildings nationwide project to improve green building penetration, reducing carbon emissions.

BACKGOUND

Green building. According to Chinese “Green Building Standards” (GB50378), definition of green buildings, “green building refers to the entire life cycle of the building, those building which could maximize the conservation of resources, protect the environment and reduce pollution, provide people with healthy, suitable and efficient use of space, be in harmony with nature”.

In foreign countries, green building started earlier, green building research is more mature. In the United States, mainly due to the impact of green building and urban distribution is the income level of the city, the concentration of government agencies and service level of development (Cidell 2009). Green building owners address concentrated in the city or the Pacific Rim region of California (Kahn and Vaughn 2009). The scale and level of economic development, the number of green building projects and the city’s real estate market has a positive correlation (Fuerst et al. 2011).

Green building industry. Green building industry refers rental transaction until downstream, property management, business services, finance and other stages of the exhibition from upstream planning, financing, design, survey, to building materials manufacturing, equipment manufacturing, construction and manufacturing midstream, to achieve environmental protection, energy saving, industrial system of green development.

Industrial development from industry to industry cluster diffusion iterative process. Industrial cluster refers to a number of different companies (can be the same department or different departments of the enterprise), concentrated economic geographical phenomena in the same geographical space formed, emphasizing space companies get together phenomenon, highlighting the role of the external economy, need to eliminate as companies scale brought uneven geographical concentration effects.

According to industry cluster theory, in the early stages of industrial development, with resource development areas, and supporting the construction of production facilities, subject to the requirements of the economies of scale inherent drive, will inevitably lead to different levels of scale to produce the same product or a similar product companies are concentrated; by under the external driving force of economy of scale, in order to improve productivity, reduce transaction costs and information costs, and enhance the competitiveness of enterprises, the enterprise is bound to be transferred to the relevant product cluster Development. Therefore, it forms industrial agglomeration.

Professor Michael (2002) at Harvard Business School presented Porter diamond theory, also known as the diamond theory for analyzing how a country to achieve competitive advantage in the international arena. Porter argued that if an industry of a country or a region competitive, depending on the six factors. Among them, the factors of production, demand conditions, business strategy, structure and competition in the industry, related industries and pillar are four basic factors, government actions and opportunities are two secondary factors. The four basic elements through the interaction of an industry in a country or a region's competitive advantage play a decisive role, and the opportunity to play a role in government action and indirect effects of competitive industries through four basic elements.

Graham et al. (2004) characteristics of the diamond industry for building the model was revised proposed construction industry hexagon model, model includes industrial properties, elements, human resources, demand, government, corporate strategy and decision-making as well as cultural and opportunities aspect.

Economics, geography, industry, spatial agglomeration forces and dispersion forces exist, the cumulative effects of market proximity and supply neighboring bring circulation will lead to industry concentration, but can lead to excessive industrial clustering factor rising costs and intensified competition in the industry, resulting in crowding , resulting in industrial dispersion.

According to the theory of industrial gradient transfer, with industrial clustering intensifies, leading to increased industry competition within the region, increasing labor costs, lower product demand, followed by industrial agglomeration advantages will be weakened, replaced by diffusion industry. Gradient differences in economic development space, making the migration of economic activity through capital investment, technology dissemination and labor, a steering force from one area.

Combined with the development of the characteristics of green building industry, we can see that the process of the development of green building industry has to adapt to regional industrial clusters and industrial development of decentralized alternate. Industrial agglomeration theory can choose green building as early development, after the green building industry system matures, it can make use of the theory of industrial dispersed nationwide promotion. A total number of urban green building projects and the city's GDP, there is a close relationship between the commercial real estate area and commercial housing price factor.

Advantage of green building. People involved in green building projects, including investors, owners, government agencies, lenders, suppliers, designers, contractors, consultants and so on. Green building can bring more benefits to the project participants.

For the government, its green building can bring in terms of stakeholder. Due to lower overall energy consumption of urban, conventional energy development and investment needs will reduce spending on public finances will be reduced; increase due to low-carbon buildings brought help to improve employment opportunities for local consumption levels, thereby enhancing the region's GDP.

For consultants, green building will generate additional consulting fees, including the additional cost of green building design, the application of green building certification consulting fees required inspection and monitoring costs. According to a study by the US Green Building Council of New York is the cost of green building, LEED-certified project consulting fees increased, green building design costs accounted for 0.14% of the original design fee to apply for LEED certification consultancy fees accounted for the original design 0.08%, accounting for 0.27% fee monitoring acceptance of the original design fee of.

For investors, owners, contractors, the possible economic incentives from the government to obtain additional price or rent, higher occupancy rates, you can save electricity and other energy sources, will help to enhance the corporate image. Some academic studies abroad have proved that green buildings lower vacancy rates and higher rent levels. Eicholtz and others in 2009 to 694 green office buildings have been studied, and compared the similar non-green buildings in the surrounding individual buildings, concluded that the Energy Star green building can get 3.3 % additional rent, sale prices about 19% higher than non-green buildings.

Users of green building operating costs lower than non-green buildings, improve employee productivity, reduce employee population lives, and help to improve the corporate image. Industrial advantages of green buildings can encourage more regional and business development of green building, green building technologies to improve the level, thus promoting the rapid development of green building.

METHODOLOGY

The literature review conducted aided in having a better understanding of green building and green building industry. On the basis of diamond model theory, the paper summarized the factors which affect the competitiveness of green building industry. Also, it analyses our regional green building industry qualitatively. Then, the paper takes the method of empirical research. With the help of SPSS software, it takes advantage of GDP, population, per capital disposable income, commercial real estate area, housing price data of 72 cities who have owned green building, and classifies the 72 cities into six categories according to cluster analysis method. By comparing results of the cluster analysis and the mean green building amount 72 cities already have, it reaches the conclusion that cluster analysis can be used as a method of green building industry gradient division.

QUALITATIVE ANALYSIS

Porter's diamond model based on six elements combined with China's national condition; obtain green building industry more competitive areas.

Production elements. Specific factors of production, including human resources, labor quality, the degree of employee education, business assets, new building materials, equipment, number of units, number of firms and other factors. Porter believes that advanced factors of production in the region has an important role to gain a competitive advantage.

In our regional points in the Yangtze River Delta, Pearl River Delta and the Beijing-Tianjin region labor-intensive, high-tech industrial concentration, corporate capital account for a large proportion of corporate capital nationwide is attracting a large number of labor force migration. According to the theory of comparative advantage, the Yangtze River Delta, Pearl River Delta and the Beijing-Tianjin region is more suitable priority to the development of green building industry gathering.

Demand. Yangtze River Delta, Pearl River Delta and the Beijing- Tianjin-Tangshan area attracts a large number of domestic and foreign high-tech talent, and current news reports, some foreign employees to leave China because of air issues, indicating that people in these areas demand for green ecological lifestyle is large, and thus has a more green buildings discerning customers in these areas will help the region's businesses through advanced levels of productivity and management to enhance their competitiveness, thereby enhancing the competitiveness of industries in the region. The number of existing green building research also shows that the Yangtze River Delta, Pearl River Delta, Beijing- Tianjin- Tangshan area have been signs of green industry cluster.

Related and supporting industries. Upstream and downstream industries green building industry, from design to property management, have impact on the green building industry gathering.

In terms of design, green building design research Institute mainly China Academy of Building Research, Tianjin Branch, Shanghai Branch, Beijing Tsinghua Urban Planning and Design, Architectural Design Institute. The green building design mainly concentrated in Shanghai, Beijing, Tianjin, three cities.

In real estate development, two of the largest investments in green building companies are Vanke and green real estate company headquartered in Shenzhen and Shanghai respectively.

Therefore, this factor to consider, the Yangtze River Delta, Beijing and Tianjin compare priority for the development of green building industry gathering.

Government policy. Shenzhen Municipal Government in July 19, 2013 issued a "Shenzhen Municipal People's Government Order (No. 253), Shenzhen to promote green building approach", clearly put forward for green building according to different stars different rewards, penalties for non-green building. These policies can be in terms of development, Shenzhen green building industry, play a stimulating effect.

Foshan City issued a "Shunde accelerate the promotion of green building advice", provides all or part of the use of financial resources and other construction projects to be included in the scope of the focus of green building, and in the future to achieve the three-star green building standards will receive 80yuan / square m reward.

Haidian District, proposed that "all new buildings must be green buildings have been built did not meet building will be transformed into a green building". Recently, the implementation of low-carbon eco-building program was officially launched in northern Haidian. Yu Dongwei who is the project leader said Haidian

District will be located north of the access threshold; all the buildings in the region will reach the green building standards. The north is also planning to “greenway” system that encourages people to green travel. Here in Beijing will be built into the largest low-carbon eco-zones.

The Yangtze River Delta and the Beijing-Tianjin area are more suitable for priority development of green building industry.

Chance. Coastal cities and foreign trade because of frequent than in the western region have more opportunities. 2013 approved by the Shanghai FTA for green building industry in Shanghai in terms of development, is a good opportunity.

“China (Shanghai) test the overall program of free trade zones” Article XIII of the opening measures of foreign investment in engineering design engineering design of the experimental area of Shanghai to provide services (not including engineering survey) business, cancel qualification when applying for the first time by engineering performance requirements. This provision has helped to attract foreign high-tech companies stationed in the WTO level design area, improving the Shanghai green building design standards.

“China (Shanghai) test the overall program of free trade zones” Article XIV, the construction of wholly foreign-owned enterprises in the experimental area of contract Sino-foreign joint construction projects in Shanghai, from construction projects in the proportion of foreign investment restrictions. This provision will help to attract foreign high-tech level of construction companies have entered the World Trade District, Shanghai, green building construction levels increase.

Other provisions are also conducive to attracting world advanced enterprises settled in Shanghai Free-Trade Zone, providing an opportunity for the development of green building industry.

In summary, the green building industry in the Yangtze River Delta, Pearl River Delta and the Beijing-Tianjin-Tangshan region easier to form industrial agglomeration, as these regional GDP is high, a large demand for a strong economy, real estate development projects are more opportunities.

CLUSTER ANALYSIS

In quantitative research, research scholars, mainly through modeling, using regression, multilevel analysis, principal component analysis, SEM analysis, the factors influencing the green building industry competitiveness comprehensive evaluation to determine each region or country the green building industry competitiveness.

Cluster analysis is a method of statistical research questions, also known as cluster analysis, refers to the collection of grouping physical or abstract objects become objects of a similar analysis process multiple classes. Cluster analysis of “like attracts like” as the guiding ideology, according to data on the nature of the degree of closeness, they are classified. Cluster analysis can be achieved on the various regions of the country is divided gradient green building industry, which provides guidance for the green building industry from the industry gathering to industrial gradient transfer (Zhao and Zhu 2006).

The data used in this text come from the cities Statistical Yearbook, National

Statistical Yearbook,the sixth census data, “China Real Estate Statistics Yearbook 2010”, some not found in the data according to the 2009 Yearbook of each extrapolated.

According to the study, with 2010’s GDP, population, per capita disposable income, commercial real estate area and the price of real estate five factors, 72 cities carries on ward cluster analysis (Xue 2008), which is divided into six categories, the results of Table 1.

Table 1.The Result of Clustering.

City	The number of green building	GDP	Population	Per capita disposable income	Commercial real estate area	The price of real estate	Category
Beijing	15	13778	1961	29073	2679	13799	1
Shanghai	45	16872	2301	31838	2105	12840	1
Shijiazhuang	1	3401	1016	18290	292	3765	2
Qinhuangdao	1	930	299	17118	86	3422	2
Tangshan	3	4469	758	19556	217	3506	2
Langfang	2	1331	436	20268	125	2433	2
Handan	2	2342	917	17562	263	2949	2
Cangzhou	1	2203	713	16116	205	1935	2
Baoding	1	2050	1119	15048	143	2436	2
Zhangjiakou	1	966	435	14649	125	3015	2
Zhengzhou	1	4000	863	18897	643	4294	2
Huaian	1	1345	480	17680	910	2914	2
Lianyungang	1	1151	439	19020	353	3108	2
Rizhao	1	1025	280	17558	32	3062	2
Jinan	3	3910	681	15973	467	4897	2
Hefei	2	2702	570	19051	601	4228	2
Wuhu	1	1109	226	18727	601	2671	2
Yangjiang	1	642	242	14644	126	1532	2
Qingyuan	1	1113	370	15768	193	3400	2
Nanning	2	1800	666	18032	440	4557	2
Beihai	1	398	162	16798	107	1514	2

Table 1.(Continued).

City	The number of green building	GDP	Population	Per capita disposable income	Commercial real estate area	The price of real estate	Category
Nanchang	4	2207	504	18276	365	3775	2
Yinchuan	2	763	199	17073	526	3523	2
Hanzhong	3	510	380	14509	70	2537	2
Baoji	2	976	372	18978	238	3319	2
Changji	1	557	143	13589	93	2255	2
Wulumuqi	1	1311	311	14382	337	3529	2
Dujiangyan	1	144	66	13721	82	4211	2
Kunming	1	2120	636	18876	742	3807	2
Fushun	1	890	214	15303	152	3158	2
Changchun	2	3329	768	17922	581	4142	2
Harbin	1	3666	106	17557	529	4226	2
Eerduosi	1	2643	194	25205	313	3929	3
Taizhou	2	2002	461	21359	874	3930	3
Zhenjiang	1	1956	311	23075	291	4002	3
Jiangdu	1	486	101	19869	79	4180	3
Yangzhou	3	2208	445	21766	843	4381	3
Tonglu	1	198	41	24026	55	8443	3
Jiande	1	190	43	22876	14	4688	3
Dongying	1	2360	203	23796	278	2939	3
Fuzhou	3	3068	711	22723	486	6625	3
Huizhou	1	1730	459	23565	554	4266	3
Jiangmen	1	1550	445	21153	378	6452	3
Sanya	2	231	69	17758	119	5676	3
Xian	3	3241	847	22244	543	3890	3
Dalian	2	5158	699	21293	550	6249	3
Tianjin	26	9108	1293	24293	1902	6886	4

Table 1.(Continued).

City	The number of green building	GDP	Population	Per capita disposable income	Commercial real estate area	The price of real estate	Category
Suzhou	39	9000	1047	29219	1879	2676	4
Nantong	1	3418	728	21825	1380	1999	4
Xuzhou	1	2867	858	16762	1626	4254	4
Wuhan	11	5516	978	20806	945	5329	4
Changsha	7	4547	704	22814	1315	3648	4
Chengdu	11	5551	1404	20835	1741	4925	4
Chongqing	2	7894	2884	18991	2907	3442	4
Shenyang	1	5017	811	20541	1294	4463	4
Nanjing	12	5010	800	28312	1516	7185	5
Hangzhou	17	5945	870	30035	837	10555	5
Ningbo	2	5125	760	30166	666	8992	5
Guangzhou	12	10604	1270	30658	1079	9351	5
Shenzhen	23	9511	1035	32381	402	14615	5
Wuxi	3	5758	637	27750	678	6266	6
Changzhou	5	2976	459	26269	870	6056	6
Kunshan	5	2100	164	30923	427	5735	6
Taicang	1	730	71	30629	135	4759	6
Jiangyin	3	2001	160	30184	168	7660	6
Shaoxing	1	2782	491	30164	430	2304	6
Jiaxing	1	2296	450	27487	394	2100	6
Qingdao	2	5666	871	24998	814	5576	6
Xiamen	4	2054	353	29253	711	7951	6
Zhuhai	1	1203	1516	25382	367	7485	6
Foshan	1	5651	719	27245	241	6251	6
Dongguan	1	4246	822	26350	189	5752	6

Based on the classification results averaged for five indicators for each packet, the text classified into six levels according to the gradient results, the results of Table 2.

Table 2.The Result of Classification.

Level	City
Level 1	Beijing, Shanghai
Level 2	Nanjing, Hangzhou, Ningbo, Guangzhou, Shenzhen
Level 3	Tianjin, Suzhou, Nantong, Xuzhou, Wuhan, Changsha, Chengdu, Chongqing, Shenyang
Level 4	Wuxi, Changzhou, Kunshan, Taicang, Jiangyin, Shaoxing, Jiaxing, Qingdao, Xiamen, Zhuhai, Foshan, Dongguan
Level 5	Eerduosi, Taizhou, Zhenjiang, Jiangdu, Yangzhou, Tonglu, Jiande, Dongying, Fuzhou, Huizhou, Jiangmen, Sanya, Xi'an, Dalian
Level 6	Shijiazhuang, Qinhuangdao, Tangshan, Langfang, Handan, Cangzhou, Baoding, Zhangjiakou, Zhengzhou, Huaian, Lianyungang, sunshine, Jinan, Hefei, Wuhu, Yangjiang, Qingyuan, Nanning, Beihai, Nanchang, Yinchuan, Hanzhong, Baoji, Changji, Urumqi, Dujiangyan, Kunming, Fushun, Changchun, Harbin

The various groups of six gradient averages ended 2011 ranked green building, consistent with the results obtained in Table 2, illustrated by GDP, population, per capita disposable income, commercial real estate area, the five factors affecting the price of real estate cluster analysis can be classified as a method of gradient.

CONCLUSIONS

Based on previous studies, green building industry through qualitative analysis and quantitative analysis, the text reaches three conclusions. Firstly, the Yangtze River Delta, Pearl River Delta, Beijing-Tianjin-Tangshan area more suitable for the formation of the green building industry gathering, according to the data as of 2011, these local green building compared to other regions, with a greater number. Secondly, by cluster analysis Ward analysis, effective green building industry gradient divided region, to provide guidance to gather and gradient transfer of green building industry. Thirdly, the establishment of Shanghai FTA bring new opportunities for the development of green building industry in Shanghai, you can attract more high-level institute, building materials manufacturers settled, will effectively promote the development of green buildings.

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Sustainable Construction Indicators: An Examination of Clients' Requirements in Tender Documents

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Abstract

Tender documents are instrumental for clients to identify the extent to which contractors can undertake some predefined construction activities. By examining tender documents, this study aims to identify the practices of sustainable construction in China. A review of literatures and tender evaluation systems was conducted firstly to derive a set of sustainability performance indicators of construction process. This step was followed by interviewing professionals for validation, and 497 tender documents were collected from 30 major cities of China. The research findings indicate that whilst clients play a vital important role in formulating the rule of sustainable construction, they pay insufficient attention to both environmental and social sustainability performance. This study provides guidance for tenderers to adopt appropriate bidding strategies and shed some lights on the improvement of sustainability performance from the perspective of clients' demand.

INTRODUCTION

Sustainable construction is an effective way for the construction industry to attain sustainability (Zainul 2010). The rationale behind this effective way is that construction activities shall meet the need of human beings in a resource-efficient, environmentally friendly and healthy way (Huang and Hsu 2011). In effect, its main task is not to minimize the impact of construction activities on the environment, but also to increase social and economic benefits (Ahn et al. 2009). This has posed considerable challenges onto traditional construction paradigms which emphasize the importance of economic interests. While academic consensus on sustainable construction has been widening, there still lacks successful practices of sustainable construction (Ashley et al. 2003), and a vast majority of professionals are apt to conduct sustainable construction in their own ways (Zainul 2010).

Previous studies have found that sustainability can be attained through the approach of stakeholder management (Son et al. 2011). With this in mind, the overall performance of sustainable construction can be detected from the perspectives of stakeholders. There are three key stakeholders involved in construction activities - clients, contractors and consultants (Shi et al. 2014), of which clients stay at the center of sustainable development (Bunz et el. 2006). Clients serve as sponsors of projects and have their own requirements or expectation for contractors to implement a sustainable construction process. The implementation of sustainable construction depends on the awareness, requirements and actions that the aforementioned three stakeholders are faced with. Once a client has a sustainability goal, contractors have to make it happen in due ways (Caño et al. 2012). Therefore, clients should be the most influential one in the way towards sustainability (Gan et al. 2015).

A tender document spells out much information about project type, location of project site, client's requirements and expectation, construction conditions and the surrounding (Beck 2011). The client usually consider these types of information to ascertain that all tenderers are able to satisfy the client's requirements (Lambropoulos 2007). Ofori and Chan (1999) found that the contractual agreements between clients and contractors on environmental issues could be a driver of sustainable construction. As such, it is important for clients to improve tender documents by taking into account the sustainability performance of the construction process.

A tender document addresses clients' initial thoughts on sustainable development along the construction process. The targets of time, price, quality, and any other acquirements of a construction project is highly embedded in unique project characteristics that a client has and the channel they can transfer them to potential contractors (Wong et al. 2000). For a long time, construction work contracts are awarded merely through a lowest tender price approach, while other aspects of construction process are overlooked. This traditional approach has some distinctive drawbacks. For instance, the lifecycle construction cost is usually high (Klein 1994), and clients might have considerable risks subject to contractors' profit orientation (Russell et al. 1992). To improve the efficiency of contractor selection, clients have preferred "multi-criteria selection" to "lowest-price wins" in the construction pre-phase (Wong et al. 2000).

In the multi-criteria selection, the indicators of sustainable construction are usually incorporated into tender documents as one of the main evaluation criterion. Therefore, a tender document forms an effective medium to look at the demands and expectation of clients towards sustainability. Sustainable construction has been attracting much attention with respect to technology, economy, biology, environment, and society. However, the relationship between sustainable construction and tender documents, and the link between tender documents and sustainable construction sustains unknown. This paper aims to identify the ways that clients address their concerns over sustainable construction in a tender document. The research findings can provide guidance to contractors to formulate a useful sustainable strategy when running business in China.

METHODOLOGY

Samples. 497 tender documents spanning over the period 2002 - 2012 were collected. The collected tender documents distributed over 30 provinces in China. 199 tender documents adopted a multi-criteria approach, while 166 used the competitive bidding approach. It is noted that the wide time span, wide distribution of geography and different tendering approaches hopefully inhibit bias and prejudice in the study.

The multi-criteria approach has become a popular tendering approach nationwide in China. In this approach, clients are advised to evaluate a contractor's competitiveness by stipulating a couple of competitiveness factors in tender documents. Each indicator might be weighted differently. Contractors' bids are evaluated and rated by a panel of professionals taking into account these weights (Alsugair 1999). Clients or their representatives will score with the method of the centesimal system to determine the winners (Yuan and Yi 2006).

In the current study, tender documents that were based on a comprehensive evaluation method were adopted as they can provide detailed information about biding factors. Through comparing all the sampled tender documents, those indicators with indifferent or similar meanings were grouped. As a result, 43 indicators were derived and were further combined into eight dimensional assessment attributes. The eight dimensional attributes are composed of 11 indicators about bidders' qualification and project management, 12 indicators about technical measures in construction site, 5 economic indicators, 5 social indicators and 10 indicators related to design.

Literature review and interview. Assessment standards from China, Canada and America, were considered in this phase. The Assessment System for Green Building of Beijing Olympic (GBCAS) in China, which aims to achieve the goal "Green Olympic", provides standards on planning, design phase, construction, delivery, and operation management stage in an engineering project. The Sustainable Building Challenge Performance Assessment is an assessment and rating system which was established to meet the requirement for holistic assessments of performance (Larsson et al. 2012). The Leadership in Energy and Environmental Design Green Building Rating System is a green building certification program that can be used to find out those best building strategies and practices (US Green Building Council 2008). These assessment systems commonly give indicators of sustainable construction covering all the life cycle of a construction project.

As discussed above, sustainability indicators integrate environmental, social, and economic factors, and there might have some complicated cause-and-effect relationships between factors (Bradley and Kibert 1998). Bradley et al. listed some potential indicators of sustainability in construction including land, water materials, energy use and toxins, each compassed of 1 to 4 indicators. Xu and Liu (2007) proposed a set of green construction indicators taking into account the importance of economy, environment and integrated management. Their assessment system includes the layout of construction general plan, the technology level of contracts and construction organization design of green construction. Huang and Hsu (2011) created a framework of sustainable construction at the state level with the intention of integrating all the assessment indicators.

In this study, three experts were invited to discuss any potential indicators. The invited experts were knowledgeable about bidding and experienced in the process of comprehensive bidding. They were requested to offer their opinions on sustainable construction factors, which help determine sustainable construction indicators in tender documents to the end.

DATA ANALYSIS

14 sustainable construction indicators were identified as a consequence. Indicators in tender documents were weighted using the centesimal system. The points per indicator given by the clients and its frequency number are shown in Table 1.

Table 1.Indicators and Their Frequency.

	Code	Indicator	Score	Number	Frequency (number/199)
1	D_1	Implementing a construction planning	0.50~20	53	0.27
2	D_2	Follow-up service	0.60~20	50	0.25
3	D_3	Technological scheme	0.75~46	146	0.73
4	D_4	Plan of raw materials	0.50~30	132	0.66
5	D_5	Safety and civilized construction measures	0.50~14	138	0.69
6	D_6	Quality assurance measures	0.60~15	154	0.77
7	D_7	Site location plan	0.50~16	100	0.50
8	D_8	Advanced equipment and technologies	0.50~15	30	0.15
9	D_9	Energy saving measures	0.50~10	25	0.13
10	D_{10}	Core competitiveness of contractor	0.90~23	48	0.24
11	D_{11}	Content of deepening design	3.00~35	13	0.07
12	D_{12}	Material selecting	6.00~20	5	0.03
13	D_{13}	Lowest bidding price	5.00~95	187	0.94
14	D_{14}	Payment plan for workers	0.80~20	3	0.02

The SPSS software was used to examine the points that each indicator can have (the points being *X*), and used the Quantile-Quantile plotsto adjust whether an indicator obey a certain function or not. Besides, the Kolmogorov-Smirnov tests were employed to identify the result of Q-Q plot. If the value of Asymp. Sig. (Z-tailed) is more than 0.05 (p-value > 0.05), the set of observations has no significant deviation from normality (Drezner and Turel 2011).

Q-Q plots show that the scores of 11 indicators have a Logarithmic normal distribution, as their scatters almost distribute in a straight line. The points of X were then converted into LnX in order to test them by One-Sample Kolmogorov-Smirnov Test. The results (see Table 2) of K-S Test verify that the p-values of the 10 indicators are all more than 0.05, they obey logarithmic normal distribution, but two indicators---site location plan (D_7) and price (D_{13})---are not having this regular. As shown in Table 2, the p-value of D_7 is 0.017 which is deviated from normality. Due to the lack of sufficient samples for D_{14}, this indicator has not been analyzed.

Table 2.One-Sample Kolmogorov-Smirnov Test.

	N	Normal Parameters[a,b]		Most Extreme Differences			Kolmogorov-Smirnov Z	Asymp. Sig. (2-tailed)
		Mean	Std. Deviation	Absolute	Positive	Negative		
LnD_1	53	1.0453	0.85235	0.110	0.098	-0.110	0.800	0.544
LnD_2	50	1.0454	0.87689	0.176	0.176	-0.088	1.245	0.090
LnD_3	146	1.7931	0.86277	0.086	0.084	-0.086	1.034	0.235
LnD_4	132	1.1276	0.79754	0.096	0.077	-0.096	1.103	0.175
LnD_5	138	1.1566	0.72251	0.091	0.061	-0.091	1.072	0.201
LnD_6	154	1.1772	0.63671	0.088	0.088	-0.087	1.093	0.183
LnD_7	100	0.7151	0.62202	0.154	0.154	-0.116	1.541	0.017
LnD_8	30	0.6714	0.70839	0.221	0.221	-0.138	1.211	0.106
LnD_9	25	0.8528	0.86869	0.213	0.213	-0.107	1.065	0.207
LnD_{10}	48	1.5637	0.80597	0.114	0.114	-0.098	0.789	0.562
LnD_{11}	13	2.5467	0.61220	0.146	0.078	-0.146	0.526	0.945

Apart from the site location plan (D_7), 10 indicators all obey the Log-normal distribution. These indicators can be described by function formulas. X means the points given by tendering company, and the dependent variable is the probability of the score occurred in the overall sample: $f(x;\mu,\sigma)=\frac{1}{\sqrt{2\pi\sigma^2}}e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}\cdot\frac{1}{x}$. Their parameters and functions are listed in Table 3.

Table 3.Information of Indicators.

Code	Parameters		E_X	D_X	Density Functions
	μ	σ			
D_1	1.0453	0.8523	4.0899	17.8613	$f(x)=\frac{1}{\sqrt{1.4530\pi}}e^{-\frac{(\ln x-1.0453)^2}{1.4530}}\cdot\frac{1}{x}$
D_2	1.0454	0.8769	4.1779	20.2035	$f(x)=\frac{1}{\sqrt{1.5379\pi}}e^{-\frac{(\ln x-1.0454)^2}{1.5379}}\cdot\frac{1}{x}$
D_3	1.7931	0.8628	8.7172	83.9781	$f(x)=\frac{1}{\sqrt{1.4888\pi}}e^{-\frac{(\ln x-1.7931)^2}{1.4888}}\cdot\frac{1}{x}$
D_4	1.1276	0.7975	4.2445	16.0171	$f(x)=\frac{1}{\sqrt{1.2721\pi}}e^{-\frac{(\ln x-1.1276)^2}{1.2721}}\cdot\frac{1}{x}$
D_5	1.1566	0.7225	4.1272	11.6755	$f(x)=\frac{1}{\sqrt{1.0441\pi}}e^{-\frac{(\ln x-1.1566)^2}{1.0441}}\cdot\frac{1}{x}$
D_6	1.1772	0.6367	3.9743	7.8958	$f(x)=\frac{1}{\sqrt{0.8108\pi}}e^{-\frac{(\ln x-1.1772)^2}{0.8108}}\cdot\frac{1}{x}$

Table 3.(Continued).

Code	Parameters		E_X	D_X	Density Functions
	μ	σ			
D_8	0.6714	0.7084	2.5152	4.1229	$f(x)=\frac{1}{\sqrt{1.0036\pi}}e^{-\frac{(\ln x-0.6714)^2}{1.0036}}\cdot\frac{1}{x}$
D_9	0.8528	0.8687	3.4216	13.192	$f(x)=\frac{1}{\sqrt{0.7496\pi}}e^{-\frac{(\ln x-2.5467)^2}{0.7496}}\cdot\frac{1}{x}$
D_{10}	1.5637	0.806	6.6096	39.9631	$f(x)=\frac{1}{\sqrt{1.6119\pi}}e^{-\frac{(\ln x-1.5637)^2}{1.6119}}\cdot\frac{1}{x}$
D_{11}	2.5467	0.6122	15.3952	107.7662	$f(x)=\frac{1}{\sqrt{0.7496\pi}}e^{-\frac{(\ln x-2.5467)^2}{0.7496}}\cdot\frac{1}{x}$

The Lognormal probability density function for the above indicators were formed by using Origin 9.0, and the results are shown in Figure 1.

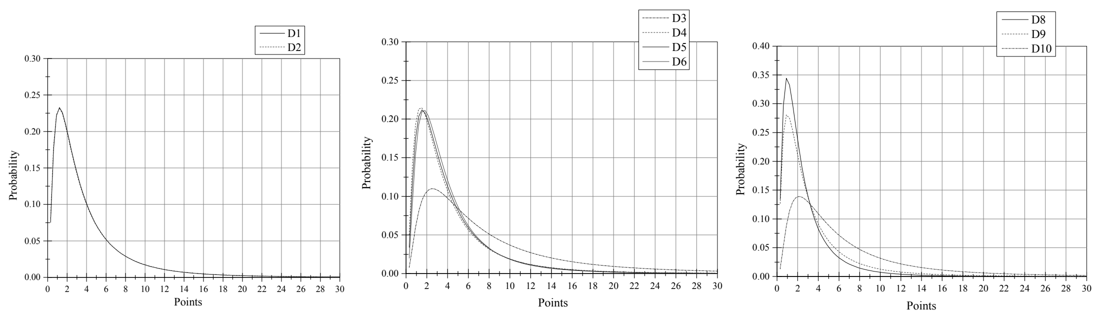

Figure 1.The distribution graph of indicators.

There is only one sustainable construction indicator (D_{13}) selected from commercial bids, however, it is important that almost all theories and experts involved in this study appreciated this indicator as an effective sustainable construction factor. In addition, 187 out of 199 tender documents have their own indicators and each one gives inconsistent score to the factor of bidding price ranging from 5 to 90. According to the distribution for the indicators of bidding price, 27.8 percent tender documents assign 50~60 marks to price, with a mean value 53.9594 and 95% confidence interval (51.4196, 56.4991). The bar chart reflects the distribution of scores as shown in Figure 2.

Furthermore, it is found that only 3 tender documents have the indicator D_{14} with a score being 0.8, 2, and 2. These scores are lower than the mean value of the other sustainable construction indicators. In effect, this indicator can be seen as a social aspect of sustainable construction, and it is concerned with human feelings (Lombardi 2001) and human contributions. Thus, it should have at least two determinants, namely financial plan of constructor as well as plan for social security system and social stability factors.

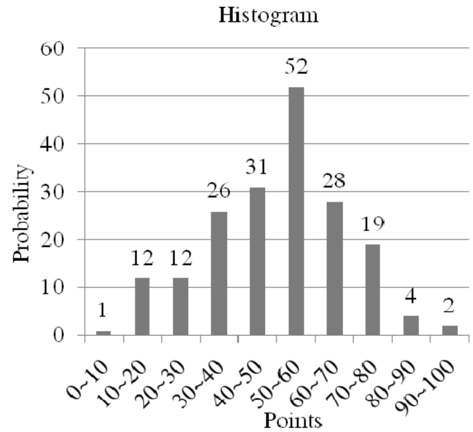

Figure 2.Bar chart of D_{13}.

FINDINGS AND DISCUSSIONS

Generally, technological factors mirror clients' intention to yield better buildings by performing well, requiring better construction technologies and detailed design, and management to ensure the sustainability of construction activities. It is found that 11 sustainable construction indicators are associated with construction organization design. This suggests that technological factor is the main determinant of sustainable construction. The importance of this factor could be attributed to the fact that it not only determines the achievement of project goals, but also reflects the sustainability attributes of a project and the construction process.

D_1 has a similar frequency, mean, and variance to D_2, both having a high mean of score. This means that tenderers should pay parallel attention to the implementation of both construction organization (D_1) and follow-up service (D_2). The frequencies of D_3, D_4, D_5 and D_6 have all over fifty percent, suggesting their importance in the evaluation of contractors' competitiveness. Among them, the expectation of technology measures (D_3) has the highest mean value (8.7172), while its variance (83.9781) is larger than other indicators also.

As illustrated in Figure 1, when the score of D_{10} ranges between 2 and 4, its probability falls between 14% and 15%, almost reaching the peak of the curve. It indicates that clients are tending to give this indicator a lower value in the tender documents. In the same way, D_{11}, D_{12}, and D_{14} occur less frequently in the sampled tender documents. It can be seen that clients pay less attention to those indicators. As well known, energy saving measures and material selecting are concerned with the environmental sustainability of sustainable construction. The smaller values of these factors that clients give suggest that the client has a long way to go towards sustainable construction.

From Table 1, it can also be found that bidding price (D_{13}) has the highest frequency and mean, indicating that the clients attach much importance to the bidding price in determining a contractor. The high value given to this indicator forms a barrier to the implementation of sustainable construction. A survey of building industry conducted by McGraw-Hill Construction reports the perception of higher costs is the most commonly cited barrier to sustainable development

(Robichaud and Anantatmula 2011). The Davis Langdon study (Langdon 2007) found that there are wide variations in costs associated with sustainable projects and conventional projects. In addition, among all the sustainable construction indicators, payment plan for workers (D_{14}) has the lowest mean and smallest occurrence frequency. It reflects the fact to some extent that in China, only government may consider the social sustainability of the construction process.

CONCLUSION

This research helps contractors to identify the scope of sustainable construction that clients in China are apt to outline. It is found that bidding price is still the most significant indicator. Technology related indicators such as technology measures and application of raw material, and quality assurance measures also deserve much more attention when compiling bidding documents. However, despite the step of global environment protection, the indicators associated with environmental sustainability are ranked lowly by clients. To achieve the goals of sustainable construction, it is recommended that clients detail their demands on environmental protection in tender documents to lead contractors to formulate sustainable measures.

The concept of sustainable construction has been widely accepted by participants in the construction industry, but the practices of sustainable construction are not very satisfactory in reality. Clients who serve as original sponsors of projects play an important role in the practice of sustainable construction. They can influence contractors and other project participants to use advantage technology and management to reach sustainability goals. Thus, clients should have a clear idea of sustainable construction, and express their requirements and expectation of sustainable construction in tender documents exactly to appraise a contractor's competitiveness. In order to be successful in bidding, contractors have to formulate a clear sustainability response strategy.

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Survey on the Evaluation Index System of a Green Village in a Cold Region

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Abstract

In the "Twelfth Five-Year" period, under the background of the construction of the new rural, green villages and China's urbanization, for the shortage of rural infrastructure, the insufficient of public service facilities, lack of environmental protection, excessive energy consumption and many other issues, this paper establish an evaluation index system suitable for green village in the cold areas of north China through research on the village green development research status at home and abroad and the evaluation index system of ecology, sustainable development, green building and regional development. Meanwhile, the index system also can be used as the reference of the village construction of other domestic areas with similar climatic conditions.

INTRODUCTION

China is an agricultural country and rural population accounts for a significant proportion. At different stages, many leaders had put forward to the requirement of the construction of the villages and towns, which illustrate the important role of the village. On the other hand, with the development of urbanization, the focus and connotation of the construction of villages and towns has been adjusted. At present stage, the situation of the construction of the village in our country is grim: the low energy utilization rate makes the enormous waste, the village construction lacking planning leads to the idle and waste of the land, the lagging in village construction technology and the poor house heat preservation performance needs more resources in the winter, the lack of sewage treatment and garbage disposal device in the village, etc.. These problems seriously affected the development of villages and the standard of the residents. Therefore, the study on the village construction has important significance.

Domestic research mainly concentrated in the intensive land use, building energy conservation technology, choice of energy and new energy, planning of villages and towns, villages and towns public service facilities, technical suitability, etc. Yang (2011) respectively analyzed the green and durability of the village. Huang

(2006) and Yang et al. (2013) put forward rationalization proposal on town planning. Research on evaluation system of green is mature abroad, but most of them are about the green building. There's little research on green evaluation index system of villages in China, while study on concepts of green villages, such as ecology, sustainable development and low carbon. Li (2011) and Li and Yu (2011) put forward the index system of eco-city through analyzing the present situation of the ecological city construction, and made the research on theory and method of construction of ecological civilization city and expounded the origin and standard of ecological cities. Wang (2012) established the index system of green city by the method of contrast analysis of domestic relevant index system about the green, environmental protection, ecological urban.

Generally speaking, although there is the study on the theory of rural construction development, the theory of green village is very little. There're many studies on evaluation index system of green building and ecological construction, but the green building is only part of the green village and we cannot use them directly. And the objects of study are mostly concentrated in the city, there're very few involved in the countryside. The relevant index system is also unable to apply directly; it's very meaningful to build a set for the evaluation index system of green villages. As the research and application of the evaluation index system of green village is still in its preliminary stage. And in order to further guide and deepen green village construction in the cold region, in this paper, learning from the evaluation index system of ecology, sustainable development, green building and regional development at home and abroad, combining with the characteristics of cold region in China green village, to establish a set of the evaluation index system that is suitable for the green village in cold region of our country.

THE PRINCIPLES OF ESTABLISHING THE INDEX EVALUATION SYSTEM

Green village, involved infrastructure, residential environment, natural resources, ecological environment, social economic activities and many other areas, is a very complex system and there're many factors affect its evaluate result. Index system is established on the basis of certain principles of index set, and it is a complete organic whole rather than a simple combination of some indexes. In the macro level, the green village construction is a complex system and should be based on the characteristics of entirety, dynamics, hierarchy, and diversity, and the relationship between system and element, the relationship between the system and environment to establish the evaluation system. In the micro level, the index system of the green village construction is also a big system, and it has a strong hierarchy, which contains multiple subsystems and each subsystem contains many individual indicators. The select and settings of index of evaluation index system of green village in cold region must seize the main aspects and characteristics of the development process, and highlight the key indicators that reflect the essential character of green village. Accurately give expression to the contents of the pre assessment of indicators with the least number. Refer to the current international and domestic major setting principle of the index system; the establishment of the evaluation index system of green village in cold region should follow the following principles:

The scientific principles. Constructing the evaluation index system of green village in cold region is complicated system engineering. It must be able to fully reflect all aspects of the construction of villages and towns and be in line with the green village construction goal connotation. The index system can reflect the status of the development of the system, the correlation between each subsystem and indicators more objectively and truly. The selection of specific indicators should have scientific basis and the index should be purposeful, definitions, accurate, and cannot be ambiguous, ambiguous.

The compendious principles. When determining the index system of green village in cold region, proceed from the actual conditions of the rural economic and natural conditions and be concise as far as possible. Select the main indicators with the fewer number and characterizing the system nature behavior in accordance with the importance and the contribution rate to the system. Most of the indexes can be gained from government statistical data or public information and its conversion results, and individual index can be obtained from the statistical data of the relevant departments. In ensuring the whole index system is on the basis of scientific and objective, the selection of evaluation index must strive to be simple and practical. And on the premise of guaranteeing the basic same representative, select the index which data acquisition is convenient and the source is reliable.

The hierarchical principles. From the perspective of the methodology, for complex problems it is often difficult for human to solve all the details one-time. So the problem should be decomposed into several layers and then further stratified progressive from global to local. As a complex system, green village in cold region is composed of different levels and different elements. It should be divided into different subsystems based on economic, social, environmental, resources and each subsystem has its respective support index. The structure of the index system is clear for the overall situation of the system and the situation of the subsystems.

The dynamic principle. Everything is changing, so the index system that measures the development level of villages and towns should be dynamic and reflect the development trend of the system. For the same area, different period indicates the different stages of development. At different stages of development, the goal of regional development, the development model, the means that take to achieve goals are not the same, and the focus in the process of constructing evaluation index system is also different. This request index system that reflects the green village in cold region not only can describe the status quo objectively, and the index system itself must have a degree of elasticity that can recognize the different developmental stages of regional development and adapt to the characteristics of different periods. Through monitoring, early warning and evaluation function of the index system, through controlling and improving the rural development's structure and functions to realize the ecological and continued construction of villages and towns.

Operability principles. The evaluation index system of green village in cold region is used for the decision makers to serve policy system and scientific management. The selection of indicators use the statistical data of the existing index as far as possible and the index is measurable and comparable and easy to quantify. Try to choose the representative comprehensive index and the main index and easy to analysis and calculation. And choose the index that can level reflect the actual status of the green village in cold region at the requirements, which make the index system strong maneuverability and easy to facilitate the use and master the evaluation index.

The stabilized principles. Indicators of the index system should ensure the stability and need not be replaced frequently. Use typical indicators and the indicators should not change in a certain period of time. The index system should maintain stability in order to compare in different periods and know the construction of the green village in cold region.

The regional principles. According to the related theory, an area has its own unique geographical features, climatic conditions, economic development level; different area has a very big difference. So the setting of the evaluation index system should reflect the regional principle and give full consideration to the regional circumstances.

THE ESTABLISHMENT OF THE EVALUATION INDEX SYSTEM OF GREEN VILLAGE IN COLD REGION

The establishment of evaluation index system of green village in cold region can guide the construction of green village and has a strong guiding significance. And the reasonable evaluation index system of green village can be used to assess the effect of the construction of villages and towns effectively and promote and supervise the construction of green village, which make it more reasonable for the construction of green village. The climate characteristics of cold region make it different from other regions, such as heating, energy, life style. The establishment of the index system should reflect the climate characteristic and difference of cold region. On the basis of regional characteristics, the ecological environment of cold region and rural economy acceptable level to build the index system for rural and cold region.

The framework of the evaluation index system of green village in cold region. Build green village index evaluation system, the first is to establish system framework. Green is closely linked with the concept of ecological and sustainable, so the establishment of index system of green village can refer to the index system of ecological and sustainable development. There’s a lot of index system of regional development, ecological and sustainable and the general thinking are basically the same.

According to the literature, the index system at the national level, city level and county level development all have established and they are all from economic, social, environmental, and basic management, etc. For example: Qin and Ma (1997) divided the evaluation index system of sustainable development into three levels and five subsystems: economic, social, population, science and technology, resource. Li and Yang (2007) indicated that the evaluation index system of ecological construction can be divided into six subsystems: ecological construction level of economic development, economic growth mode, the ecological environment quality, the quality of life and social progress and the six subsystems is divided into 32 index layers. Wu and Wang (2005) measured the index system of sustainable development of small cities and towns from five aspects: the population, resource support ability, environment quality, economic level and social progress. Zhang (2009) from five aspects to build the index system of new rural construction: the production development, affluent life, rural civilization, village clean and democratic management. Learn from the most common of framework of regional development in our country, this article build the index system with the combination of "4 saving 1 environment protected" of green village, suitability of cold region and the important content of the village and town construction, which is divided into three levels, the first level is cold region green village comprehensive index, the second level is divided into a green economy and industry, green planning and management, resource conservation, green, green infrastructure and ecological environment of road traffic, the third level is the specific indicators of each module.

The primary of the evaluation index. Now commonly used in the primary of indicators are: frequency analysis, theoretical analysis and expert scoring method, etc. The frequency analysis method is to count the indexes in related to the research content of papers, journals and the index system issued by the state. Sort according to the index number of occurrences and select the index depends on the times. Theoretical analysis to establish the index system based on the connotation of the research content, definition and target. And expert method is to establish a comparison matrix with select indicators for experts give each index points to the importance of the evaluation index, and then selected indicators.

Selecting indicators with the method of frequency analysis is more objective and indicators are more comprehensive. The different index system has its particularity, especially for the index system that is no or less reference; this method cannot completely meet the requirements. And theoretical analysis always leads to index is incomprehensive. With the analysis above, these paper select primary indicators based on the frequency analysis combined with theory analysis, which not only comprehensive and reasonable and conform to the connotation of the index system. And combining with the situation of research to modify the cyclones index that conforms to the actual situation.

Although there is no ready-made index system of green village, we can refer to the index system of ecology and sustainable development, relevant indicators of urban construction and green building. Based on the method of the establishment of the system framework mentioned in the text, the first class indicator of the evaluation index system of green village in cold region can be divided into the following several aspects: green village construction ability, resource utilization, the infrastructure construction level, housing construction and public service facilities, greening and rural appearance, environmental protection and environmental health, green industry development, characteristic construction of villages and towns. For initial selection of the index, referring to the relevant national standards and papers totally 81 published papers to determine the audition indicators with the method of frequency statistics and the result is shown in Table 1. 40 indexes are obtained by frequency analysis, but these indicators also cannot be used for a complete evaluation of green village in cold region. In the frequency analysis, most papers are about city. Some indicators of city are not completely in line with the rural economy level, so some indicators need to be modified or eliminated. The index of characteristic construction of villages and construction technology in cold region are also contained in this paper. Through comprehensive frequency statistics and theory analysis, and combined with index framework and add and delete the corresponding indexes, the preliminary basic framework of evaluation index system of green village in cold region is established.

Table 1.Audition Index Statistics.

The third class indicator	Statistical number
Afforestation coverage	42
Per capita public green areas	41
Per capita gdp	39
Annual per capita fiscal revenue	38
Discharge standard-meeting rate of industrial wastewaters	37
So2 of urban area	37
Per capita net income	37
Clean energy penetration rate	36
Tertiary industry per gdp	36
Comprehensive utilization rate of industrial solid wastes	36
Per capita disposable income	35
Treatment rate of domestic sewage	34
The water quality of drinking water source success rate	34
The average area environmental noise	34
Total fixed asset investment as a share of gdp	34
Living garbage collection rate	34
Decontamination rate of refuse	33
The degree of perfection of leisure and entertainment facilities	33
Science and technology, education funding a share of gdp	32
The number of beds per million people	32
Natural population growth rate	32
Fixed line penetration	32
Tap water popularizing rate	30
Per capita living space	29
The per capita arable area	29
The incidence of criminal cases	29
Construction land area per capita	28
Housing area per capita	27
Water consumption per capita daily life	26
Per capita insurance premium	26
Per unit of gdp water consumption	25
Road area per capita	25
Domestic consumption per capita daily life	24
Energy consumptions per gdp	24

Table 1.(Continued).

The third class indicator	Statistical number
Environmental protection investment as a share of gdp	24
Water-saving appliances application rate	21
Average chemical fertilizer application rate	20
Infrastructure complete function sex	18
Planning rationality	10
The government management satisfaction	5

The establishment of evaluation index system. According to the analysis above and refer to the index system of the sustainable development and ecology, and according to the specific requirements of the construction of green village in cold region, the evaluation index system of green village in cold region can be divided into three levels, eight big aspects and 66 specific indicators, as shown in the Table 2.

CONCLUSION

The evaluation index system of green village in cold region above can be used as a general index system. In practice, according to the specific situation of the evaluation of villages and towns, adjust measures to local conditions and adjust the evaluation indexes for the villages and towns. Evaluate the development level of the village through appropriate mathematical model. And through the evaluation results, analysis existing advantage and the shortage in the process of construction of green village in cold region. So as to provide theoretical basis for further adjustment strategy. Of course, there are also some problems in the index system:

(1) the indicators in table 2 can be divided into hard to quantify, difficult to quantify, and easy to quantify several categories. As the indexes of settler's satisfaction and policy technology popularity are hard to quantify, currently they can only get by strong subjective method of questionnaire survey and these subjective factors have different criteria for different people. The indicators of the use efficiency of all kinds of resources are the objective index. But it is difficult to obtain the actual data and lack of the standardized calculation method, it is difficult to quantify. Most of other indicators can be obtained directly from the various statistical data and easy to quantify. These are directly affect the practical application of the index system and are the most difficult to handle in the study of the corresponding model. (2) It should be taken into account that data availability of the index system and create a responsive and timely handling database system, and each index of the unified evaluation criterion is given. There should be an agreed standard for each index to build a dominant platform for the construction of the green village.(3) According to the characteristics of the index system, the mathematical model and the comprehensive evaluation method should be proposed to make the evaluation system more mature.

Green towns and villages in cold region can be seen as a system and it is always in constant development and change. As there're relativity for the understanding of the development characteristics and laws, the index system which based on understanding of green rural development characteristics and laws also has relativity. So, the evaluation index system must be added and modified continually with the development of villages and towns and the specific condition.

Table 2.The Evaluation Index System of Green Village in Cold Region.

The first class indicator	The second class indicator	The third class indicator
Green village construction ability	Planning and construction	The rationality of overall planning
		Rationality of green Village special planning
	Organization management	The health management institutions
		Perfect management system
Green village construction ability	Economic development	The annual per-capita income
		The village collective income
	Policy advocacy and public participation	Awareness of green village construction policy
		Resident satisfaction
	Technology Application	Green construction technology application rate in cold region
		Green construction technology awareness in cold region
Resource utilization	Water resources conservation	Water-saving appliances application rate
		Utilization rate of regenerated water
		Agricultural irrigation water use efficiency
	Safe use of water resources	Drinking water hygiene rate
		Water qualification rate
	Construction materials use	Local material utilization
		Village construction project Material savings rate
		Village construction utilization of 3R materials
	Energy utilization	Utilization of renewable energy
		Use rate of energy-efficient appliances
		Per capita energy consumption
	Construction land intensive degree	Per capita homestead area
		Concentrated residents accounted for the proportion of the total number of residents

Table 2.(Continued).

The first class indicator	The second class indicator	The third class indicator
The infrastructure construction level	Roads and Transportation	Village roads hardening rate
		Road suitability
	Water supply and drainage	The security of water supply in winter
		Tap water penetration
		Production standard sewage discharge rate
		Living sewage treatment
The infrastructure construction level	Water supply and drainage	Communication facilities
		The power supply facilities
	Disaster prevention equipment	Flood control facility
		Natural disaster emergency response system
		Farmland water conservancy facilities drought and waterlogging ability
Housing construction and public service facilities	Housing construction	Per capita residential building area
		Dilapidated house rates
		House vacancy rates
		Building enclosure structure energy-saving ratio
	Public service facilities	Education facilities satisfaction
		Medical facilities satisfaction
		Sports facilities satisfaction
Greening and rural appearance	Landscaping	Forest-cover rate
		Per capita public green areas
	Rural appearance	Rural appearance sanitary
		Rural appearance satisfaction
Environmental protection and environmental health	Air Quality	API is less than or equal to 100 days
		Waste gas treatment rate
	Sound environment quality	The average ambient noise
	Surface water quality	Proportion of jurisdiction water above classIII

Table 2.(Continued).

The first class indicator	The second class indicator	The third class indicator
Environmental protection and environmental health	Garbage disposal	Garbage collection rate
		Decontamination rate of refuse
		Garbage container set
	Environmental Health	The sanitary toilets
		The timeliness of the winter snow clearing
Green industry development	Green industry	The proportion of organic and green agriculture planting area
	Green industry	Green and low energy consumption industry share of GDP
		Green industry planning and implementation
	Green measures	Agricultural fertilizer strength
		The intensity of pesticide
		Agricultural film recovery
		Livestock and poultry farm waste comprehensive utilization
		Straw comprehensive utilization
Characteristic construction of villages and towns	Characteristic landscape construction	The construction of regional culture characteristics
		Construction of the natural environment characteristics
	History and culture protect	Historical and cultural protection and management
		The historical and cultural village protection

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A Survey of Consumers' Perspectives on the 2014 Edition of "Green Building Evaluation Criteria": Take Chongqing for Example

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Abstract

Consumers ultimately pay for green building; therefore, consumers play a decisive role in the process of promoting green building. In order to understand consumers' consumption propensity for green building, in this paper, we design the questionnaire based on the index system of 2014 version green building evaluation criteria released lately by China and investigate consumers' comment on this new "standard" in Chongqing city. By analyzing the survey results, we get index and grading items which consumers believe to be important and further understand which aspects consumers pay more attention to when they buy green buildings. Finally, combined with the results, we put forward some relative suggestions on green building evaluation criteria.

INTRODUCTION

In recent years, our country has introduced a series of related documents to ensure green building's promotion, but the result is unsatisfactory, green building's promotion still face a series of obstacles and barriers. By the end of 2013, just 287 green residential projects are approved, whether construction enterprise or buyers are not interested in green building. Consumers ultimately pay for green building, just rely on the government to guide and promote green building is not enough, Only consumers actively cooperate with, can drive the consumption, leading the green building market, therefore, how to stimulate consumers' purchase enthusiasm is one of the most important topic facing by green building's promotion. Only fully understand what consumers care for, according to the requirements to configure function and design products (Yang and Li 2014), make supply consist with consumers' expectations for green building, can we encourage consumers' buying behavior, increase green building's market demand, thus stimulate property developers to build more green buildings, promote the development of green building.

THE BASIC INFORMATION OF QUESTIONNAIRE

On the basis of the new "standard" (Ministry of Housing and Urban

Construction 2015), cut and shift its index system properly, generate the questionnaire by the resulting index system. The selection of the resulting index system mainly observes the following principles:

Easy to judge and evaluate. Delete grading item which emphasis on technology or design level and will affect consumers' judgment in the new "standard"; Convert the abstract grading item into the one that is easy to understand for consumers.

Closely contact with consumers. Select grading items mainly aimed at ones that consumers often contact in daily life and closely relate to consumers' benefit, only consumers can directly perceive, did they have more say in this matter, the results of the survey are also more worthy for us.

For residential buildings. Residential buildings and consumers are more closely in daily lives, by contrast, consumers involve less in public buildings, therefore, remove grading items which associated with public buildings.

The questionnaire consists of three parts: Part 1 is the import problem, Part 2 is the formal investigation section, in this section, for each index, we all set up a title, to investigate consumers' evaluation for grading items of each index, and then we set up a title for the whole seven indexes, to investigate which index is more important in the consumers' mind, question types are multiple-choice form, data processing method of the questionnaire mainly reference (Ning and Zhang 2012); Part 3 mainly investigate the degree of consumers' willingness to buy green building and the largest incremental cost they are willing to spend.

A total of 300 questionnaires were and 253 recalled. Due to considering that most of the people under the age of 25 age still small, lack of economic strength, consciousness is not high and their experience of buying a house is relatively less, so answers they provide have not much value, in view of this, chose recycling questionnaire through "living in Chongqing area" and "more than 26 years old (including 26)" two conditions, then further eliminate questionnaires that answers are invalid, finally 191 effective questionnaires were reserved. The colleting rate is 84.3%, the rate of effective questionnaire is 63.7% (Zhang 2013).

THE ANALYSIS OF THE SURVEY RESULTS

Consumers' purchase intension is higher, can receive a limited incremental cost. Survey results indicate that: more than 85% people in Chongqing city are willing to buy green building. Compared with ordinary residential, the biggest incremental cost they are willing to pay for green building is concentrated in the 101 yuan/m2 ~ 200 yuan/m2 (76.08%), we can envision: if the cost of the green building is too high, more than the range, it is possible to reduce the enthusiasm of consumers purchase (Zhou 2006). Of course, this is also related to the city's wage level and economic level.

Land saving, indoor environment and operation management index attract more attention. We can find from figure 1 that: consumers regard importance of 7 indexes is as follows (see Figure 1). Land conservation and outdoor environment >

Indoor environment quality > Operation management > Energy conservation and energy utilization > Material conservation and material resources utilization > Water conservation and water resource utilization > Construction management. Answer requirement is choose 3 from 7, therefore, “Land conservation and outdoor environment”, “Indoor environment quality” and “Operation management” is important for consumers.

The available land resources in Chongqing is less, construction land is insufficient, therefore, most buildings are in form of high-rise and super-tall, basically build along the river and the mountain, highly utilize underground space, so “Land conservation and outdoor environment” get the attention of consumers. In addition, “Indoor environment quality” and “Operation management” are indexes which consumers can feel, so consumers also care more.

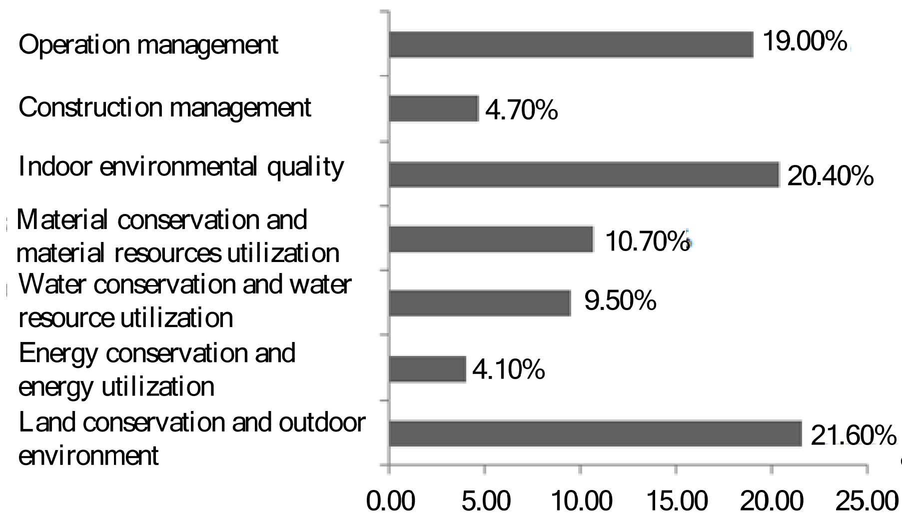

Figure 1.Seven categories of indicators.

Consumers pursuit healthy, comfortable external environment when they buy a house. In the survey of “Land saving and outdoor environment” index, consumers choose “construction and lighting design is reasonable, to avoid producing light pollution” the most, followed by “to take effective measures to prevent noise pollution”, again is “the per capita green area to amount to mark” (see Table 1). Above 3 items are important grading items which consumers regard (Urban Development editorial department 2012).

The result shows that consumers in Chongqing city pay more attention to outdoor activity environment. At present, noise pollution is serious in Chongqing urban area, air conditioning, construction machinery, vehicles and other noise often interfere with normal lives of residents, which has aroused attention of residents. In recent years, Along with the environmental problems become more and more serious, people is more and more sensitive to “pollution”, whether owning a good air environment, wind environment, sound environment, light environment and greening conditions more and more influence consumers to purchase house, choose room.

Table 1.Land Saving and Outdoor Environment.

	Proportion (%)
The per capita living area is appropriate and reasonable development and utilization of underground space	9.60
The per capita green area to amount to mark	20.10
Construction and lighting design is reasonable, to avoid producing light pollution	22.00
Taking effective measures to prevent noise pollution	20.20
Creating appropriate external landscape environment for outdoor activities	10.30
Field inside and outside traffic flow, traffic is very convenient	7.20
Setting up reasonable parking places	1.90
Enjoying the convenience of medical care, education, culture, business and other public services	8.70

Energy saving measures for lighting system attracts more attention. In this survey, "utilize renewable energy sources for water, heating, power supply" and "lighting system of hallways, stairwells, hall, hall, large space, underground parking garage and other places take partition, timing, induction and other energy-saving control measures" are chosen most, accounting for 34.8% and 32.5% respectively, it shows Chongqing's consumers pay more attention to these two items.

In Chongqing, sunshine time is short, the sun radiation is weak, lead to building's request for ventilation, floor spacing, toward is not high, lighting is poor, energy consumption is more in terms of lighting. So, if you can configure complete lighting system energy saving measures will greatly improve the efficiency of energy saving.

Consumers emphases on non-traditional water. In this survey part, consumers choose "reasonably use collection device to convert non-traditional water (including the reclaimed water, rain water, sea water, etc.) to flush toilet, green irrigation, clean road, wash car and so on" the most, followed by "set water saving device and water metering device in every household kitchen and toilet" (see Figure 2). Therefore, consumers think "pay attention to development and utilization of unconventional water resources, and able to household metering, from water source to effective control" is the most effective ways to save water.

Although Chongqing city is rich in water resource, water use efficiency is low, the amount of water available per capita is extremely limited, so frequently in recent years was caught out of the water shortage, develop and utilize unconventional water are inevitable trend for future development.

The green, environmental protection building materials favored by consumers. With the continuous improvement of people's living quality, as well as environmental protection and energy saving awareness, consumers began to pay attention to the environmental protection, health effects of living environment (China's Energy-Saving Residential Network 2009). In this survey part, every person choose 2 items, sorted for grading items based on the selection result of consumers, the two in front of the row respectively "using reusable materials and recycled materials" (34%) and "reasonably use durability, easy maintenance decoration building materials" (32.7%), we can see consumers regard the two items are more important.

Recycled, reused building materials generated by treating and extracting industrial waste, agricultural waste can not only reduce construction cost, saving resources, and manufacturing of building materials product was identified as green, environmental protection, in the true sense has gradually been general recognition of the consumers. With good durability, easy maintenance of decoration building materials can also extend the service life of the building, reduce the cost. Therefore, in building materials market of the future, the green, environmental protection building materials is very promising (see Figure 2).

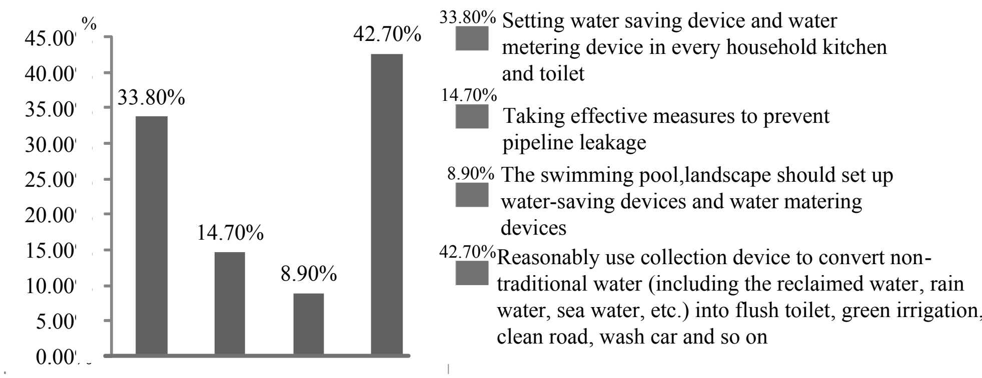

Figure 2.Water saving and water resource utilization.

Consumers have higher requirement for temperature environment, wind environment and light environment. Indoor environmental quality directly determines consumers' satisfaction and comfort, as well as an overall rating of the building. The investigation result shows that: consumers emphasis on "optimizing building space, layout and structural design, improving natural ventilation," "improving indoor natural lighting effects." and "take measures to adjust shade, reducing solar heat in summer." in the numerous indicators affecting indoor environment quality.

Chongqing have less wind but more rain, very hot in summer, so indoor ventilation, lighting, shading effect play a very crucial role on the comfort of indoor. Therefore, we should reasonably plan and design building so as to ensure good wind environment, light environment and temperature environment.

Consumers prefer integrated construction. In the survey of "Construction management", consumers in Chongqing city consider "Realize the integration of civil engineering, decoration construction" (57.6%) to be more important.

Integration of construction can not only make the room layout in one step, but also can save materials and improve the quality of the decoration. Today, consumers are more inclined to buy the fine decoration of existing homes, the standard decoration should meet beautiful, comfortable, fine, environmental, while the overall style should also try harmonization.

Consumers increasingly focus on the soft environment construction. In the survey of "Operations management" index, each person choose four items, the result shows that the top four respectively is "energy saving, water saving, material saving and greening's operation procedures is perfect, and can effectively implement", "periodic check, debug public facilities, and optimize the operation of equipment system according to the monitoring data", "greening is good, plant and transplant trees' survival rate is high" and "property management department can obtain relevant management system's certification" (see Table 2).

Table 2.Operation Management.

	Proportion (%)
Property management department can obtain relevant management system's certification	11.10
Energy saving, water saving, material saving and greening's operation procedures is perfect, and can effectively implement	17.90
Setting up the mechanism of green education propaganda, compile manuals of green facilities to form good green atmosphere	8.20
Periodic check, debug public facilities, and optimize the operation of equipment system according to the monitoring data	13.70
Periodic inspect and clean air conditioning and ventilation system	5.10
Intelligent system's running effect meets the need of building operation and management	9.60
Using information method to conducting property management, construction engineering, facilities equipment, components, energy consumption and other files, and the records is completed	7.70
Adopting pollution-free plant diseases and insect pests prevention and control technology, the standard pesticide, herbicide, the use of chemical fertilizers, pesticides and other chemicals, effectively avoid the damage to the soil and groundwater environment	6.30
Greening is good, plant and transplant trees' survival rate is high	11.50
Implementing garbage classification collection and processing	8.90

By analysis, what consumers care for can be attributed to the soft environment construction. After hardware has meet the basically demand, consumer gradually began to pursue soft environment construction such as property management when they choose or buy a house, especially in recent years, property management is increasingly concerned by consumers. But the level of property management in our country still lags behind at present, lack of specialized personnel and modern management means will seriously affect the normal operation of green building.

RELATED SUGGESTIONS

A set of green building evaluation standard that is perfect, adapt to China's economic and social development is very important for promoting development of green building and guiding design of green building. Combing with above survey results, we put forward the following suggestions for evaluation standard:

Join the economic indicators. Although experts strongly appeal to reduce the cost of green building and make green building civilian, do not play a role in essence. If we join the economic indicators in green building evaluation standard, to limit the cost of each score item. The building must satisfy the requirements of grading items and the corresponding cost requirements at the same time if it wants to get scores. Then prompt designers have to consider cost when designing the product for obtaining evaluation identifies. If green building can meet consumers' demand and its cost can be acceptable by consumers as well, will inevitably encourage consumers' buying behavior.

Evaluation standard should adjust to local conditions. Every city has its own regional characteristics, and the content consumers focus on are various in different cities, therefore, adjust measures to local conditions is the soul of green building evaluation standard. We should set up local standard according to climate, resources, natural environment, economic and cultural levels characteristics in different areas, we should also consider the aspect which local people focus on, then built and evaluated green building can meet the needs of different regional buyers.

Make appropriate adjustments on index weight and grading items combined with needs of consumers. Index weight is determined not only from the technical and expert level, but also with needs of consumers. If consumers are more concerned about the index, the proportion can be appropriately increased. In addition, in each index, the grading item's score can be increased as well if consumers regard it to be important.

CONCLUSION

Green building has become a trend nowadays, how to attract consumers' interest and stimulate consumers' enthusiasm is the key to promote development of green building. Compared with ordinary building, green building has higher incremental cost, therefore, is bound to have an incremental features that consumers expect to. Through this study, we know what consumers focus on when they buy green buildings, to design product and equip function combined with consumers' needs can stimulate consumers' willingness to buy and form market-driven, which has a very important significance to promote green building.

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On the Participation of Rural Collective Economic Organization in Urban Village Reconstructions

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Abstract

In the process of urban-village reconstruction, the collective economic organizations barely participated in the negotiations of economic compensation and resettlement and other scattered stages, which had led to many conflicts unsolved. However, if rural collective economic organization and the developers can set up the company jointly, where both subjects can be involved in all stages of urban-village reconstruction. Then many problems may be solved. Based on former academic researches and practical achievements, with the normative analysis, the author proposes a new thought of the urban-village reconstruction development company, which means the rural economic organization divides the work and collaborates with developers in the process urban-village reconstruction, which can not only adequately reflect the interests of the villagers, resolve many conflicts and lift the efficiency of reconstruction, but make it easier in the resettling and the transformation of the professional roles of the villagers. The author hopes to provide a new thinking direction for other researchers and practitioners.

INTRODUCTION

In recent years, due to the rapid development of urbanization, the urban construction land expanded very quickly. And the countryside around the city, which are not included in the new urban planning, are transformed to be new urban area, while the rest are gradually surrounded and separated by huge amounts of urban architectures (Jiang 2007). This is the formation process of urban-villages, whose basic characteristics are complex staff composition, chaotic surrounding, old buildings and infrastructure. The urban-villages not only hinder the advancement of urbanization, but also bring much inconvenience to the residents of these villages (Berry 1973).

The universality, particularity and complexity of urban-village phenomenon has not only attracted the attention of the government, social organizations, but the researchers in the fields of sociology, anthropology, political science, administration science, geography, urban planning, and so on. From the point of domestic research actuality, early researchers focused on clarifying the concept, characteristics, formation mechanism, effect and other basic researches of the urban-villagers, with few systematic and comprehensive study cases. They argued that "urban-villages" were the name of slum, shelters of poor and educated people with Chinese characteristics, which was "the monster" in the process of urbanization, and should be eliminated urgently (Chen 2009). However, in recent years, most researchers' attitude towards urban-villages starts to change to be more objective and neutral. Urban-villages are only regarded as the localities of informal immigrants, temporary workers and other low-income groups, whose existence also plays some role to the urban development, such as supplying workforces and products for relatively low-end manufacturing and production services (Jiang 2007), and greatly solving the employment and living problems for floating population. Now many researchers pay more attention to the exploration of the reconstruction model of urban-villages, according to different theories, either by combining successful experiences of urban renewal at home and abroad, or putting forward a new perspective of reconstruction pattern.

From the perspective of foreign research actuality, scholars rarely mention the concept of urban-villages. In fact, there is no rural collective economic organization or urban-villages in the developed countries and regions. Accordingly, there would be no study cases abroad on the subject. However, there are a lot experiences about urban renewal achievements, such as slum, urban sprawl and land arrangement, whose research achievements and practical experiences can provide meaningful references to China's urban-village reconstruction (Boomgaard 2011; Edwin 2003; Robert and Sahan 2003). In this sense, the urban-village reconstruction and rural collective economic organizations can be regarded as the unique result of China's special economic system, political environment and cultural background. Moreover, most scholars only proposed the idea of enhancing the participation of rural collective economic organizations in urban-village reconstruction, without concrete way to participate in and role positioning. Therefore, to put forward a set of participation model of rural collective economic organizations in urban-village reconstruction model to provide a new thinking direction is of big practical significance and theoretical value. A feasible pattern is the urban-village reconstruction development company.

NECESSITY AND FEASIBILITY TO URBAN-VILLAGE RECONSTRUCTION DEVELOPMENT COMPANY

Necessity to set up the urban-village reconstruction development company. Traditionally, the main subjects in the process of urban-village reconstruction consist three parts: the city government, the developers and the villagers. In fact, it is balance game, where the three subjects chase their maximum of land increment benefit. The city government and the developers both have their own advantages: the administrative power, advanced technology and abundant capital. Although the amount is huge, the villagers' interest demands are diverse and complex, which lead to the relative disadvantaged position in the game playing. This has triggered many interest conflicts, and calls for new power to coordinate the complex relationships.

Game imbalance of multiple subjects. Urban-village reconstruction was lead completely by the city government, which means the government control the whole process of reconstruction, rely on administrative power and policies to implement the early negotiations, demolition and resettlement, and don't allow developers to participate in. And the villagers' expression channels of their interest are only the petitions, demonstrations and other extreme and inefficient ways. A typical case is the pattern of "uninstall village and house" model of Hangzhou city, Zhejiang Province, from 2001 to 2007. In 2001, the city government founded a multistory apartment construction management center, which was responsible for all the reconstruction of old buildings. Besides, the city government took charge of the whole reconstruction works, including planning, operation, financing, demolition, relocation and even management. When the reconstruction completed, the community management work was taken over by the property management company, which was also founded by the city government (Chen 2009). In this pattern, the government undertook not only all capital investments, like fund and labor force, but suffered huge stress of negotiation, demolition and resettlement, which has been proved to be an inefficient reconstruction model. Therefore, in recent years, some city governments attempted to cooperate with the developers, with the help of their investment and technology advantages to promote the urban-village reconstruction. In this sense, the main subjects of urban-village reconstruction included three parts: the city government, developers and villagers.

As the policy makers, directors and managers of the urban-village reconstruction, the city government is responsible for the policy announcement, bidding work for adequate developer and many other works, which bears too much works. The city government has the advantage of strong administrative power and policy maker role. It occupies the leading position, and pursues the maximization of comprehensive benefit, including economic benefit, ecological benefit and social benefit (Guan 2013). Besides, the city government hopes to acquire much land-transferring fee by transforming the collective land into state-owned land through urban-village reconstruction, as well as improving the messy ecological and social environment, and promoting social stability and harmony.

As the real practitioner, the developer has its unique capital and technology advantages, whose pursuit is the maximization of economic profit. Usually, the profit in urban-village reconstruction consists two parts: one is the support and favorable policies form the city government through hard negotiations. They can acquire tax benefits associated with demolition, or priority of selling or holding estates after reconstruction. The other part is the reduced cost through negotiating with the villagers. Developer wants to reduce the possibilities of contradiction, conflicts, and forced demolition violence.

Villagers are the most susceptible subject of urban-village reconstruction. Also, they are the most vulnerable part, for the quantity is large while the interests are complex. Their interest demands mainly focus on the compensation, medical treatment, employment, education and health care after resettlement (Huang 2013). On one hand, the villagers must negotiate with the city government about relocation and other specific policies, and on the other hand, they also negotiate with developers on specific matters of demolition, to defend their interests. They have bare advantages and no guarantee than the other two subjects.

Thus, as seen in the Figure 1, in the game balance, the city government, by virtue of its strong administrative power, holds the dominant position in the reconstruction, while the developers also occupy an important place, thanks for its capital and technological advantages. By contrast, the villagers, with their dispersed individual interests, are at a relative disadvantaged place. If the three subjects only pursue the maximization of economic benefit, the villagers' interests about settlements and compensation may be ignored, so it will be difficult to meet the needs of the ecological benefit and social benefit of the city government. However, if they pursue the maximization of comprehensive income, it is likely to lead to the developers' economic profit loss, and will also be difficult to arouse the enthusiasm of developers. In such a complex interest circle, it calls for urgently a new force to coordinate and integrate the interests of all subjects, and provide a platform for them, where they can talk over the details of reconstruction equally.

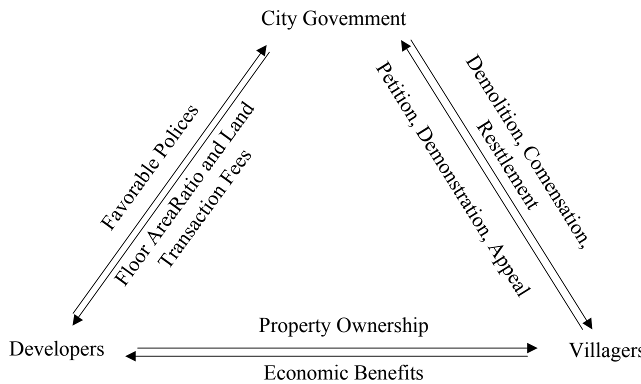

Figure 1.Shetch of the inter-relationship of three subjucts.

Conflicts and contradiction about urban-village reconstruction. Urban-village reconstruction is an important step of urbanization, and often attracts much attention from the beginning of demolition notice issued. To a certain extent, the essence of urban-village reconstruction is the redistribution of land increment benefits between different interest groups. Just as seen in Figure 1, the city government wants to promote the overall urbanization level, and developers want to get the state-owned land use rights and economic profits by selling or holding property after reconstruction. But, for the villagers, their hope is to win the most economic benefits for themselves and generations. From the economic perspective, in front of the huge economic benefits, every subject will spare no effort to maximize their own interests, as a result, conflicts and contradictions will happen.

In fact, the conflicts in urban-village reconstruction mainly focus on two aspects: the coordination of compensation standard and disputes about housing land property rights. In recent years, the amount of conflicts arising from the unequal compensation is not in the minority. "Nail households" and mass incidents appear constantly in newspapers and TV reports. The government is also trying to address these problems, but they don't work out an efficient solution. For the city government should not only be responsible for the villagers' interests, but the other city dwellers (John et al. 1995). In other words, the city government should ensure a relative fair and unified compensation standard for all dwellers. As for the specific house property disputes, the city government couldn't and won't know all the details, and it is also impossible for the government to allocate exclusive human, capital and financial resources to handle the individual disputes, because the city government must distribute the finite resources in many areas, such as the agriculture, the tertiary industry and so on. So, facing the current dilemma in urban-village reconstruction, the city government has no effective approach. And developers, as an important part in the market economy, conduct all business only for economic profit. Where there is money, where they are. What's more, they don't want to sacrifice their own interests to meet the social or ecological requirements of the villagers or the city government (Li 2013). Lacking strong administrative power, and faced with the increasing disputes and conflicts, the developers are also helpless. Since the city government and the developers can't work out a solution, the villagers maybe a breakthrough. However, although the number of the villagers is big, it is difficult to coordinate their interests harmoniously. For example, some villagers want to be compensated by substance, while others are more willing to accept monetary compensation. It is almost impossible to cater for all demands, so they couldn't form joint force. As the most direct and susceptible subject of urban-village reconstruction, villagers can hardly safeguard their own interests, let alone the interests of the other subjects. Therefore, none of the three subjects can alleviate the contradiction and disputes, and it is in an urgent need for a new force to join in, which can take a relatively independent and fair attitude to deal with the interests' conflicts.

Feasibility of urban-village reconstruction development company. The rural collective economic organization can date back to the People's Commune Period in China. In the process of evolution, the rural collective economic organization made great contribution for the rural economic development and social stability (Kong and Wang 2004). So far, it is still a vital force in China's rural economic development. Based on the laws and regulations, as a form of socialist public ownership, the collective economic organization is owned by all the laboring people, and implements double-deck management system, combined of centralization and decentralization, on the basis of the household contract management system. Actually, the essence of it is a kind of economic organization, where all the members occupy and make use of the capital equally, and share its revenue collectively.

The unique idendity of bridge. The rural collective economic organization has its special identity. On one hand, it has louder voice, compared with villagers, which means that it can reflect the villagers' focused appeal or advice about to the urban-village reconstruction to the city government intensively (Wu and Huang 2011). On the other hand, it can also become the representative of the city government and developers to pass on the specific policies to its members, as well as answering their questions. In this sense, it is the "bridge" between villagers and the city government and developers. And its interests focus on safeguarding of collective interests in the process of reconstruction and striving for the property ownership and management rights of the collective assets.

As can be seen from Figure 1, after the city government publishes the bulletin of urban-village reconstruction, due to the different education backgrounds, individual interests and other factors, villagers may have questions or even objections to the policies. Without the participation of the rural collective economic organizations, the villagers can only express their appeal through petition, protest or demonstration and other radical ways, which was proved to be inefficient. But after rural collective economic organization participates and set up the urban-village reconstruction development with developers, it will provide a platform for city government and villagers, where they can consult all the reconstruction details. At the same time, for the rural collective economic organization represents the interests of its members' demands, so it will reflect their appeal to the city government and the developers on behalf of the villagers. Moreover, it can explain the specific content of the city government's policy to the villagers, so as to avoid the misunderstanding caused by asymmetric information, and improve the efficiency of communication (see Figure 2).

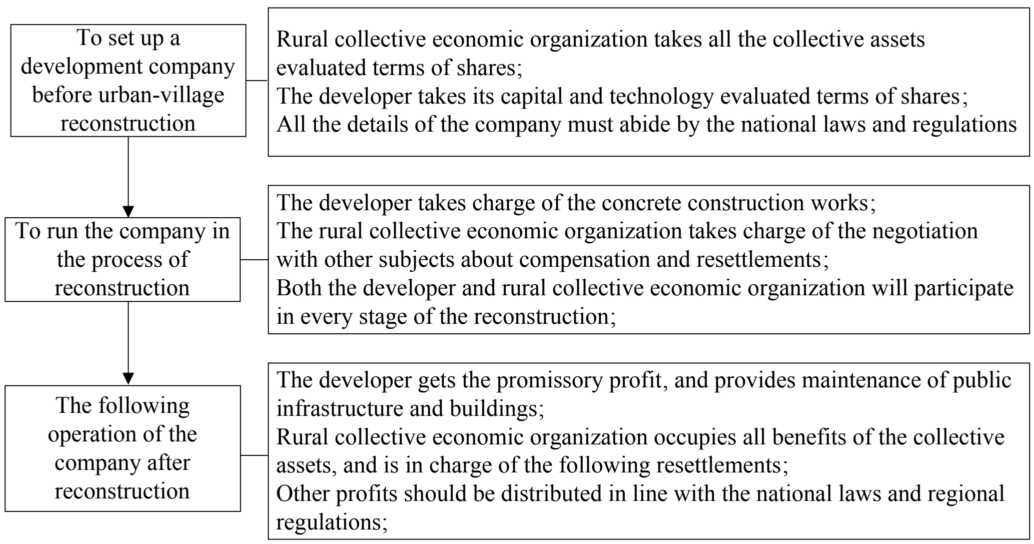

Figure 2.Sketch of the operation of urban-village development company.

The maximum of economic profit is the only pursuit of developers. Some illegal actions, such as forced evictions, may appear and damage the interests of villagers. If the developers and the rural collective economic organizations could set up a special company for urban-village reconstruction, in which they can be responsible for different part of the reconstruction works, and cooperate to promote the process of reconstruction. Thus, everything would be better. The developers can make use of their advanced technology and large amount of capital in the demolition and reconstruction of buildings, while the rural collective economic organizations take charge of the negotiation with villagers and other groups, which can help developer to accelerate the reconstruction progress and reduce the potential barriers.

The function advantages of rural collective economic organization. Although it is difficult to make out the relationship between the rural collective economic organization and the villager committee, in fact the village committee has become the executive of the rural collective economic organization. It not only represents the common interests of all members of the rural collective economic organization, but takes charge of the management of the collective assets, public facilities and welfare insurances of the members (Qing 2007). While, based on the related laws and regulations in China, the two organizations differ in terms of organizational objectives, nature and the organization structure. Details are as follows.

According to The Organic Law of the Villagers Committees of the People's Republic of China, the villagers committee is the primary mass organization of self-government, in which the villagers manage their own affairs, educate themselves and serve their own needs and in which election is conducted, decision adopted, administration maintained and supervision exercised by democratic means. And based on the Constitution of the People's Republic of China and Agriculture Law of the People's Republic of China and other laws and regulations, the rural collective economic organization is the system of collective economy of China's major organization form. The basic economic system of China is the "collective land ownership" and "family contracting, the two-tier management mechanism that combines unification". The rural collective economic organization bears the unification function in rural dual operation mechanism, and it can be roughly divided into three levels: township-level, village-level and the villager group. According to laws and regulations, the rural collective economic organization's main function is to preserve, utilize and increase the value of the collective assets. Thanks for the economic management function, if the reconstruction development company, the rural collective economic organization will be qualified for its works.

Therefore, with the relevant legal provisions above, it is not difficult to come to the conclusion that, as the primary mass organization of self-government, the villager committee's major responsibility is mass autonomy management, similar to the government's administrative management. And the goal of rural collective economic organization is to develop the rural agriculture and manage the collective assets (Wu and Huang 2011). And it is similar to collective enterprises. In this sense, they are totally different organizations. According to the Organic Law of Villagers Committee of the People's Republic of China, the villager committee should acknowledge and respect the independent autonomy of the rural collective economic organization' economic activities, safeguard the double-deck management system, as well as protect the legal property rights of the rural collective economic organizations, villagers, contracting enterprises, partnerships, or other economic subjects. The urban-village reconstruction is not only to reconstruct the existing rural buildings, but to explore a new development model for the urban-villages, where the economic subjects share their advantages for mutual benefit and cooperate for the win-win result. And the If these goals are really realized, the urban-village economy will get huge advancement. In this process, compared with the villager committee, as the manager of the collective assets and representative of interests of the members, rural collective economic organization has more advantages. They can cooperate with the developers, manage the existing collective assets effectively, and greatly lift the villagers' income.

THE PROFILE OF THE URBAN-VILLAGE RECONSTRUCTION DEVELOPMENT CMPANY

To sum up, from the analysis of necessity and feasibility above, rural collective economic organizations should participate in the urban-village reconstruction, and the reconstruction efficiency would be highly lifted. However, currently, the rural collective economic organization barely participates in the preliminary negotiations, economic compensation and relocation and other small stages. Besides, their rights in dealing with the collective property right problems are quite limited, unable to safeguard the interests of its members. Therefore, it is necessary to expand its participation area, as well as deepen its participation degree. A feasible way is that rural collective economic organization and developers set up a urban-village reconstruction company, and both of them can organize, invest and cooperate in all stages of the reconstruction, which means that the rural economic organization takes part in the relocation, land leveling, bidding and reconstruction with the developers together, can not only adequately reflect the interests of the villagers, resolve many conflicts and improve the efficiency of reconstruction to some extent, but also make it easier in the arrangements and the reconstruction of the professional roles of the villagers.

The basic operation procedure of urban-village reconstruction development company. As shown in the Figure 2, at the beginning of the urban-village reconstruction, rural collective economic organization and developers start to negotiate all the details about establishing the development company. The collective economic organization takes all the collective assets (including operational assets and non-operating assets) evaluated in terms of shares, while developer also takes its capital and technology evaluated in terms of shares. The individual shareholding ratio can be consulted by both parties. The other details about the company must on the basis of relevant laws and regulations of the government. Besides, the establishment of the company should also consider the reality of the urban-village, such as the amount of the urban-village, the economic development of the city, and the specific requirements for reconstruction.

After the development company is set up, rural collective economic organization and the developers should then divide the works. With its identity and function advantages, rural collective economic organization can take charge of all the negotiation works, for example, to negotiate with other subjects about compensation, temporary resettlement and other details. What's more, it should also deal with the contradictions and interest disputes. When these works are being done, developers also should participate and have some certain speaking rights. At the concrete construction stage, such as demolition, land leveling, and infrastructure construction of water, electricity and ventilation, shall be the main responsibility of the developer, and the collective economic organization should also be involved in all the procedures, and supervise the developer. This kind of division of work is mainly based on their respective unique advantages.

Under the multilateral forces' participation and efforts, urban-village reconstruction will be basically completed, and the original assets have tremendous value-added benefits. At this point, the rural collective economic organization owns absolute ownership of all collective assets, and developer also gets the promissory economic profits. The rest of the appreciation income should be distributed according to the relevant state policies and company regulations. However, the accomplishment of urban-village reconstruction doesn't mean the company's mission is completed, too. Both the collective economic organization and developer have their own following works. For example, the collective economic organization is mainly responsible for the subsequent resettlement and property management, and developer should also provide urban-village community residents with kinds of services, such as the maintenance of public infrastructure and buildings.

Game balance under the urban-village reconstruction development company. The increasing conflicts in the process of the reconstruction show that the game balance behind urban-village reconstruction is not only the government, developers and villagers, but much more complicated. The interests and value orientation of different interest groups are of huge difference, which makes the urban-village reconstruction become more difficult and complex. Under such a consensus, there are researchers who begin to break the traditional urban-village reconstruction thought, and start to notice other interest subjects, especially the rural collective economic organization. Some researchers have pointed out that, the urban-village reconstruction involves six interest subjects: the city government, villages, developers, villagers, urban residents and the floating population living in urban villages (Han 2007). But in the author's perspective, there are four main interest subjects: the city government, rural collective economic organization, villagers and developers. In most cases, the interests of rural collective economic organization and villagers are consistent, and they both all look forward to get ideal land resettlement compensation for their long-term interests. After the collective economic organization participates in the urban-village reconstruction, the original interest structure will be changed. The division of works is much clearer, and work load of the subjects will be greatly simplified, which can largely improve the efficiency of urban-village reconstruction (see Figure 3).

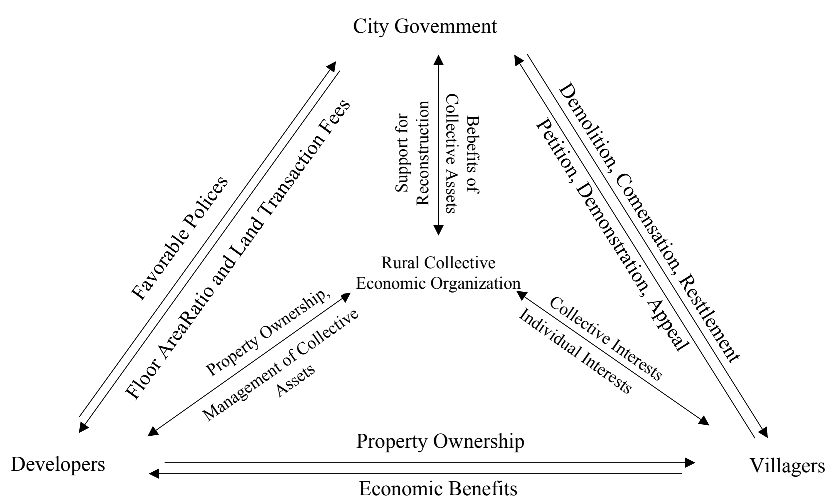

Figure 3.Sketch of the inter-relationship of four subjects.

As seen in Figure 3, rural collective economic organization provides a good negotiation platform for multiple stakeholders. From the view of the city government, it used to be responsible for a lot of work, such as formulating reconstruction policies and regulations, negotiating with developers about the housing capacity rate, land price and other details of specific construction requirements, and dealing villagers' petitions (Jia et al. 2011). After the establishment of the urban-village reconstruction development company, the work load of city government will be greatly simplified. All the city government has to do is to formulate and publish relevant policies and regulations of urban-village reconstruction based on the national policies, regulations and the region economy development. There is no need for the city government to negotiate with developers and villagers directly, and the only work it does is to monitor the whole process of urban- village reconstruction and to safeguard the legitimate interests of the villagers.

From the point of the developer, in the past, the most toughest and challenging work is to negotiate with villagers, city government and other interest subjects about the details of urban-village reconstruction. Considering the reality, lacking of enough understanding of the reconstruction area and effective communication methods, the developer was locked in the about the negotiations for compensation and resettlement frequently. And once the developer and rural collective economic organization set up the company, and the collective economic organization takes over the negotiations with other interest groups, then the developer can put most of manpower and capital into land leveling, infrastructure construction, and other concrete construction works, which will surely improve the efficiency of urban-village reconstruction. In addition, the economic profits, the developer gets, is in accordance with the agreement, which was sighed before the company was set up and was an agreement of both parties. This agreement can prevent the developer from invading of the villagers' personal interests for more profits.

For villagers, the villagers are in a relatively weak position in the urban-village reconstruction. After the collective economic organizations set up the development company with the developer, the interests of villagers will get more guarantees. Villagers are members of the rural collective economic organization. In the process of urban-village reconstruction, especially when the subjects negotiate about the standards for compensation and resettlement, the rural collective economic organization will surely safeguard the interests of its members, and strive for the biggest benefit for its organization members, which can solve the representative problem of villagers. In addition, in the past when villagers face infringement of their legal rights, all they can do is only to rely on appeal, demonstrations and some extreme methods to city government, which may hinder the completion of the urban-village reconstruction. After the joint development company is set up, the villagers can reflect directly to the collective economic organization, and the collective economic organization consult with developer or other subjects. Of course, in case of collective economic organizations and the developer infringe on the interests of villagers together, villagers still can turn directly to the city government for help.

CONCLUSION AND DISCUSSION

Although there are many urban-villages in the process of rapid urbanization in China, and the basic characters of them are similar. But the urban-villages in different areas, different cities, or even different villages in China, have their particularity. For example, the complexity of staff composition is different, the compensation standards may be higher or lower, which depends on the specific reconstruction policies of the city government, and the actual statuses of rural collective economic organization maybe not the same, or even the amount of capital that the developers have maybe also different, which imposes great challenges to a unified pattern of the urban-village reconstruction development company, not alone there is no successful experiences of this model. So the potential significance of this research is to attract the attention of scholars and practitioners of a new pattern for urban-village reconstruction.

In China, as the main organizational economic form, rural collective economic organization has become an important power to promote rural economic development. Although the government stresses the importance of improving further development the rural collective economic organization in the national agricultural documents repeatedly, rural collective economic organization does not have an explicit legal status so far (Li 2013). In fact, many laws and regulations contradict in the terms of rural collective economic organization. And the reality is that the village committee is the executive of the rural collective economic organization. So the urban-village reconstruction development company also needs huge support of the village committee. But from a legal point, the village committee is not and cannot be the executive of rural collective organization. Whether to select a new representative or choose an existing subject depends on future research and practice.

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Strategies for Shenzhen's Public Participation in Urban and Rural Planning in the New Media Era

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Abstract

With continuous development in theories, public participation has become the significant legal and scientific foundation of urban and rural planning decisions. The development and popularization of new media represented by computer network and mobile network have tremendously promoted the endless emergence of public participation. This paper discusses significance of public participation in the planning and management of urban and rural areas and explores its influence on the original system of public participation in urban and rural planning. More specifically, public participation in urban planning in Shenzhen in the new media era and operating conditions are analyzed, existing problems pointed out and strategies are suggested to make the public participation system in the urban and rural planning more perfect.

INTRODUCTION

With the reform of the economic system and the political system and the rapid development of information technology, the role of public participation in urban planning is increasingly significant, which makes urban planning and management more open and democratic. Existent research mainly focuses on principles of public participation. There lacks of research of public participation in urban and rural planning by means of the new media. As the leader of public participation in urban planning in China, Shenzhen's practice has great reference value to other cities. This paper explores the significance of public participation in urban planning, analyzes the change and influence that new media brings to the urban planning and discusses the present situation of Shenzhen's public participation in planning and management. Existing problems are pointed and strategic suggestions are proposed to solve them.

THE VALUE OF PUBLIC PARTICIPATION IN URBAN PLANNING

Public participation is the action by the general public to promote social decisions and activity implementation. It is a kind of coordination measures in social stratification and public demand diversity situation emphasizing the public participation, decision-making and management in urban management process (Shao 2003). With the emergence of the new media, the city planning and management should give more emphasis to public participation. The general public should be taken as active doers in the development of the city, rather than as passive managed object. They should be encouraged to participate in the whole process of city planning, management, decision making and implementation.

Public participation can be defined as ‘a process by which people, especially disadvantaged people, can exercise influence over policy formulation, design alternatives, investment choices, management, and monitoring of development interventions in the communities’ (The World Bank 1992). Arnstein (1969) defines public participation as “the redistribution of power that enables the have-not citizens to be deliberately included in the future” (Arnstein 1975).

The significance of public participation in urban planning is analyzed in the following aspects:

Public participation makes urban management more scientific. The urban management system in most cities in China is still a top-down centralized management system which implements a closed approval mode with only a few planners involving in the whole plan from the establishment to the implementation. A few planners as technical authorities established the city planning, which largely determines the development trend of the city. However, it should be noted that urban planning itself is a science involving multidisciplinary cooperation, and no one can be a comprehensive generalist, therefore urban planning should attract experts in various disciplines, at different levels and from various departments to participate in order to generate new ideas for planning, avoid judgment mistakes and make the planning result more scientific and reasonable.

Public participation guarantees the realization of public interest. The process of urban planning and management usually involves the interests of various social strata and groups. All stakeholders have equal right to fight for their interests, but there are conflicts among the demands. City management, as a public policy, needs to coordinate the interests of all parties and consider the diversification of demands so as to make the right judgment and satisfy the interests of the majority.

However, political and economic differences make it difficult to reach a fair environment to satisfy the interests of different social classes. Therefore, a platform where the public can fairly participate in planning and management enables all levels to fight for their own interests, meet their demands, avoid social contradictions and promote harmonious development of the society (Shao 2003).

Public participation can promote regulation and reduce irregularities. With the improvement of public quality and increased degree of participation, the public has increasing expectations for government’s decision. Public participation can change the past unilateral decision situation and make the government to be more dedicated in organizing and managing the city planning decisions. Meanwhile the public are entitled with greater democratic rights to ask the government to increase transparency of administration, which makes the public power an important social supervision, influence the planning decisions and urban constructions as well as reduce the black-case operations, inequality and corruption.

THE INFLUENCE OF NEW MEDIA ON PUBLIC PARTICIPATION

Concept of the new media. New media, a relative concept, is a new media form developed after the traditional media such as newspaper, radio, television. It includes network media, mobile phones, digital TV and other media. Strictly speaking, the new media should be referred to as the digital new media which meets the need of people's leisure time fragmentation, meets people interactive expression, entertainment and information needs anywhere and anytime (Dan 2004). The third generation media, particularly the Internet, is entering into the stage of individuality expression and communication. With regards to Internet TV and mobile TV, consumers are producers as well.

Public participation in new media. (1) New media promotes diverse opinion expression. There are so-called "threshold" in the traditional media, only contents accord with a certain value standard can enter the transmission channels, thus the information reported by the mass media are selected. In the new media era, although certain degree of control is also exercised, but relative freedom of speech can be released in the new media.

New media with its features of "low threshold" has become the new public opinion expression channel. The public releases information by individuals, which breaks the monopoly of information by the competent department of city planning. The diversified and personalized opinions spread in the new media in great quantities, stopping the policy-makers' wishful thinking to represent the public opinion.

(2) New media promotes interaction and dialogue platform. The prominent influence of the new media on public participation in urban and rural planning is to create a common space that allows public interaction and communication. The rise and popularization of the Internet has provided an ideal platform for public communication. The development of the Internet and particularly the popularity of smart phones which integrates with mobile network, has resulted in a huge increase in China's Internet users, and makes it possible for large-scale social communication based on the network reality. In addition, interaction and communication on the network are not intervened by governments or other stakeholders in advantageous positions. All participants are able to talk and discuss equally since there is no interference from the dominant interests in the real life.

PRESENT SITUATION OF PUBLIC PARTICIPATION IN URBAN PLANNING IN SHENZHEN CITY

Situation of public participation in China's urban planning. With the gradual establishment of market economic system in China, various interest conflicts increase the democratic will of public participation in urban planning. The government has also realized that public participation in urban planning is the important content of modern urban management. According to the three types and eight levels of public participation (see Figure 1) as categorized by Sherry Arnstein (1969), China's current public participation is at an early stage of tokenism participation, i.e. the public is in a position of being passively informed and having to accept. There is still way to go to enter into the substantive participation stage as partnership, delegated power and citizen control. This situation can be attributed to two reasons: (1) China's urban planning has not seen socialization; (2) in China, city governments are consciously or unconsciously affected by developers to pursue political performance. Urban planning is affected by lack of urban management supervision, leaders' opinions and administrative judgment (Che and Chen 2011).

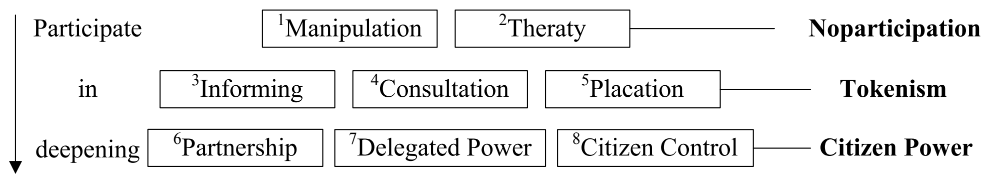

Figure 1.Types and levels of public participation.

Public participation in Shenzhen's urban planning. In recent years, some of China's coastal areas have already begun the practice of public participation in urban planning. Shenzhen as the forefront of the reform and opening up city, has explored a successful way to build the special zone, and has been actively exploring new ways of urban planning. According to the characteristics of early development of market economy, the speedy urban construction, high quality of the citizen and strong public desire to participate, Shenzhen has made some achievements in absorbing public participation in urban planning (Zhou 2000).

Shenzhen has provided the general public with legal rights to participate in urban planning by relevant rules and regulations. Learning from Hong Kong's successful experience, Shenzhen makes the statutory plan as the core of urban planning system, enabling public participation to play an important role. Shenzhen Planning Bureau adopts window type office to strengthen the supervision on Shenzhen's planning management work by the public.

Shenzhen City Master Plan (2010-2020), for example, this round of plan revision will consider public participation in the whole process as an important content, and for the first time in China, professional consultancy has been invited to design, organize and execute for public participation(see Figure 2).

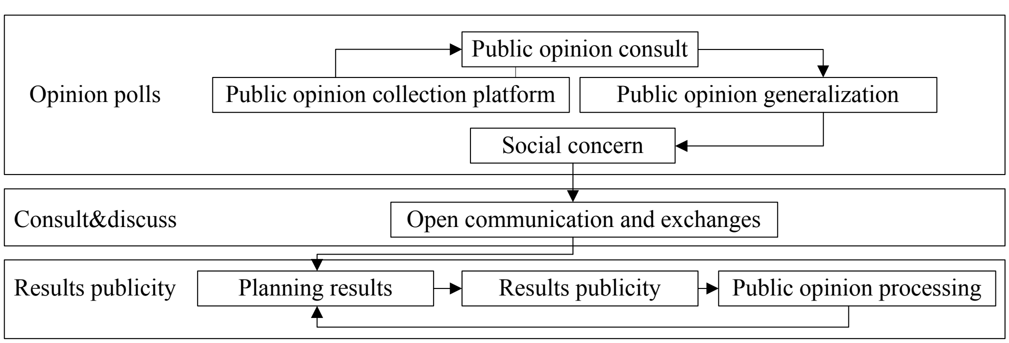

Figure 2.Framework for public participation in Shenzhen City Master Plan.

Residents are attracted to participate in the planning process through various measures to form a public participation mechanism of positive interaction between government departments and the general public and joint decision-making. With the general idea of involving public participation in the whole process, a three-stage procedure of public participation is designed that includes the opinion polls, consultation discussion and results publicity (Zou et al. 2011).

PROBLEMS AND STRATEGY OF SHENZHEN'S PUBLIC PARTICIPATION IN URBAN PLANNING

Existing problems in public participation. New media represented by computer and mobile networks offers people a platform to express diversified opinions. It facilitates public participation at lower costs, makes up for the inadequacy of current legal system of public participation, which can indeed promote democracy. However, there are still problems existing in the process of building up a fair and efficient system of public participation.

(1) Lack of proper regulations guarantee. The existing laws and regulations in urban planning fail to clarify the main body, related legal procedures and specific rights public participation. It only focuses on the authorization of the administrative behavior in the planning and construction department, which limits participation. Handling public opinions not openly makes it impossible for people who complain to defend. Participation is thus closed regardless whether the opinion is accepted or not. The lack of further communication and interaction discourages public participation and affects the perfection of the planning results. The expression and adoption of public opinion in the process of urban and rural planning are still blurred lacking of specific regulations. The actual practice leaves a lot to be desired (Yang 2012).

(2) Indifferent consciousness of public participation. Due to the inertia over the long time, in the public mind, urban planning is the business of the nation and the government. The planning or other departments seldom publish information on planning to the society. Planning seems to be a "secret" and the public is used to drifting away. In addition, the relevant department ignores the cultivation of public participation for a variety of reasons and the media propaganda is not enough either, which have resulted in extreme lack of enthusiasm and consciousness of public participation in urban planning (Yan 2013).

(3) New media brings the imbalance of the speaking rights. Statistics shows that about 3/5 of the population in China have no internet access, which disables them to participate in the urban and rural planning on the network platform. This so-called "digital disparity" makes the weak weaker, and the strong stronger. The needs of the disadvantaged groups, which should be given the greatest attention to are easily left out of public participation in the era of new media.

While the new media brings the convenience of information access and spread, it inevitably brings the polarization of speaking rights. The support for diverse opinion expression and the convenience of dialogue and consultation by the new media platform may leads these procedural participation to too much emphasis on the repetitive negotiation process and neglecting the consultation results. This greatly reduces the efficiency of the urban and rural planning (Yan 2013).

Improvement strategy in public participation. (1) Perfect the legal protection of public participation. In the era of the new media, computer network and mobile network provide the public with infinite open geographical and time wise space for public communication, which makes it possible for mass and continuous public participation in urban and rural planning. In this context, considering both efficiency and fairness, it is suggested that non-procedural participation be included in the procedure in addition to the current procedural participation. It will facilitate the formation of public participation procedure in two stages: periodical opening and continuous opening, which can enrich procedural participation level, and deepen the public participation demands.

(2) Shenzhen takes the lead in the world in new media development in that the ownership rate of mobile phones in Shenzhen is the highest in the world. This is a great advantage for Shenzhen to involve public participation by means of the new media. Set up public participation platform based on the new media for the urban planning information release. The development of information and communication technologies and the popularity of the new media allow public participation in urban and rural planning based on the network apart from the traditional ways such as publicity, panel discussion and feasibility study hearings. In the information era, new media, the infinite opening and two-way interaction in information dissemination provide support to meet the above requirement.

(3) Optimize the public participation program. Adapt to the legal system, in the practice of the urban and rural planning, we should also be in a rich and optimization of public participation in urban planning program design and organization. Traditional participation should also include the social investigation, public forums, hotlines and in the mode of new media. The utilization of the new media, particularly the use of mobile phones makes it easier for public participation in more ways, such as mobile applications, WeChat public account, emails, network forums, opinion polls and so on.

CONCLUSION

Urban planning as a government function involves the interests of all. In a democratic society, all stakeholders have rights and power to express the need. This factor constitutes the political foundation of urban planning. All stakeholders want their needs to be protected and benefit, and in a democratic society, only through the appropriate means to achieve the goal, coordinate the interests of all parties.

The public, as the largest group to coordinate the interests in the urban planning, has gradually received attention from all sectors of the society. Protecting the public rights of participation in the steps of examination, approval and implementation in urban planning is being concerned by the domestic urban planning profession in recent years (Zhou and Lin 2000).

There is still great space in development of public participation in China. Therefore, it is our common goal to strengthen the awareness of planning, to speed up the public participation in the relevant measures, to increase ways of public participation, and expand the scope of participation. China's urban planning needs the public to participate together.

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Measuring Quality of Life from the Perspective of Neighborhood Accessibility

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Abstract

Quality of life (QOL) has been an ongoing subject of discussion in the field of urban planning and development in recent decades. Measuring QOL of residents through fundamental neighborhood metrics provides information on the living conditions of citizens and helps to promote sustainable social development. This study investigates the effect of neighborhood design on the QOL of residents. The metrics used to measure the QOL include availability and accessibility to goods and services. For the this paper, Edmonton, Canada, as an example of a growing city that brings challenges for urban planners in terms of sustainable development, is chosen for the case study. The methodology underlying this contribution relies on a comparative study of four neighborhoods located in four different parts of Edmonton having similar densities. The results of this study provide further insight into land development patterns and can assist decision makers involved in urban development.

INTRODUCTION

QOL is a broad term that incorporates economic well-being, as indicated by such metrics as income, as well as psychological well-being, which encompasses such aspects as positive relationships and personal growth (Sajeva et al. 2012). In recent years, quality of urban life has attracted attention among researchers, urban developers, and municipal planners since the investigation of QOL in urban areas provides information regarding the requirements for improving living and working conditions and promoting sustainable development.

The world's urban population has increased about ten-fold during the 20th century (Satterthwaite 2007), and the growth of a city has a direct effect on the living and working conditions of residents and the quality of urban life. Urban expansion, without appropriate strategies, can result in neighborhood development that meets housing needs but fails to uphold the QOL of individuals. This paper is based on a comparative investigation of QOL in different neighborhoods through the evaluation of objective and subjective variables in the context of a polycentric city, with Edmonton, Canada, as the case study city. The research presented in this paper evaluates QOL with regard accessibility, either by walking or driving, to services such as education, health facilities, transportation, recreation, green space, and other general services. This investigation quantifies QOL within different neighborhoods for the purpose of comparison as well as in order to examine “what if scenarios” at the design stage of future neighborhoods.

BACKGROUND AND IMPACTOF NEIGHBOURHOOD DESIGN

Perry discussed the value of high quality urban design in developing the character of a neighborhood. He also devised a prototypical neighborhood plan where an elementary school and community centre at the main core of the community surrounded by major roads and other community facilities within 5-minute walking distances from the center of the neighborhood. In addition in Perry’s plan, parks and playgrounds are distributed all over the neighborhood and are connected by pedestrian paths in order to provide easy walking access for all residents in the neighborhood (Larice and Macdonald 2012). Perry believed that, enhancing accessibility by walking would make a neighborhood more attractive and contribute to the wellbeing of its residents. He visualized the local community centre as the nucleus of a neighborhood which would increase the face-to-face social interaction among the neighbors (Wang 1965). Steinlater portrayed a concept of several neighborhood units connected together being served by a senior high school and one or two local shopping centers for the larger community (Meenakshi 2011). Later on, numerous organizations adopted the concept of neighborhood and the Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) was established and modify developed this concept further to create rating system for planning and development of neighborhood. The LEED-ND guideline advocates for a walk able and sustainable neighborhood recommending transit stops and public spaces to be located within a ¼ mile, corresponding to a 5-minute walking distance; transit centers, recreational/sports facilities, elementary schools, and junior high schools within a ½ mile walking distance, corresponding to a 10-minute walking distance, and senior high schools within a 1-mile distance, which is equivalent to a 20-minute walking distance (Congress for the New Urbanism et al. 2011; Welch et al. 2011).

Quality of Life (QOL) is closely tied to the neighborhood concept. It refers to the satisfactory feeling or relationship with different features of urban life that helps residents to choose an ideal lifestyle (Rusanen and Hooli 2011). These features can be classified into two types of variables in order to evaluate QOL: (1) objective variables, which use quantitative criteria such as crime rate, income level, etc; and (2) subjective variables, which use qualitative metrics such as accessibility of services, availability of activities, and sense of belonging (McCrea et al. 2005; Sajeva et al. 2012). Objective variables are based on quantitative data, entailing that they can easily be used to compare various aspects of life at different local level such as city and neighborhood (Yuan et al. 1999) and can be measured using secondary data, available through official government statistics. In order to accurately represent the qualitative aspect of an individual's life, one must use subjective variables, collected at the individual level using social surveys. Sense of satisfaction with life is the most widely used metric for evaluating subjective QOL (Sajeva et al. 2012).

In this research, the objective variables are collected from official government sources and Google Maps, and subjective variables are as curtained by surveying urban planners and developers about preferred distances to neighborhood facilities and amenities and importance of closeness of these facilities. Accessibility metrics consist of walking distances and driving distances. According to many studies related to quality of urban life, accessibility in a community improves the conditions for daily walking, public transit use, reduced automobile dependence, and social interaction for pedestrians (ICMA and EPA 2009; Perrotta et al. 2012). Today many prefer to live in a neighborhood with easy access to services, facilities, and workplace, which allows them to spend less time in traffic. In particular, neighborhoods with relatively short walking distances and easy access to all community facilities are associated with a high level of resident satisfaction, which in turn influences QOL.

For this study, four neighborhoods in Edmonton, Canada, with approximately the same population density are chosen: Riverdale, which is located in the central core of the city; Lynnwood, a mature neighborhood outside the central core; Skyrattler, an established neighborhood outside the area of mature neighborhoods; and Ozerna, in the developing area of the city.

RESEARCH OBJECTIVES AND METHODOLOGY

The aim of the research presented in this paper is to determine the effect of urban and neighborhood design from the perspective of accessibility on the QOL of citizens, and to provide information for land developers and municipal planners regarding the important metrics influencing quality of urban life. For this purpose a mathematical framework is developed to evaluate QOL in order to optimize quality of urban life and influence future development by improving living and working conditions of residents and reducing commuting time.

As shown in Figure 1, the research methodology comprises four components: (1) inputs, (2) criteria, (3) processes, and (4) output. The input data are the objective and subjective variables used to quantify QOL in select neighborhoods in the case city, Edmonton, Canada. Expert opinions and neighborhood development criteria (i.e., recommended neighborhood structure and LEED-ND guideline) are the standards used for comparing these variables.

In this study, accessibility to services is explored in terms of walking and driving, where the metrics defining walking accessibility differ from those defining driving accessibility. With regard to walking accessibility, the obtained results (objective variables) are compared with the recommended maximum distances (based on the principles of neighbourhood design described in the literature, the LEED-ND guideline, and expert opinions). For driving accessibility the obtained results (objective variables) are compared with distances recommended by experts (subjective variables).

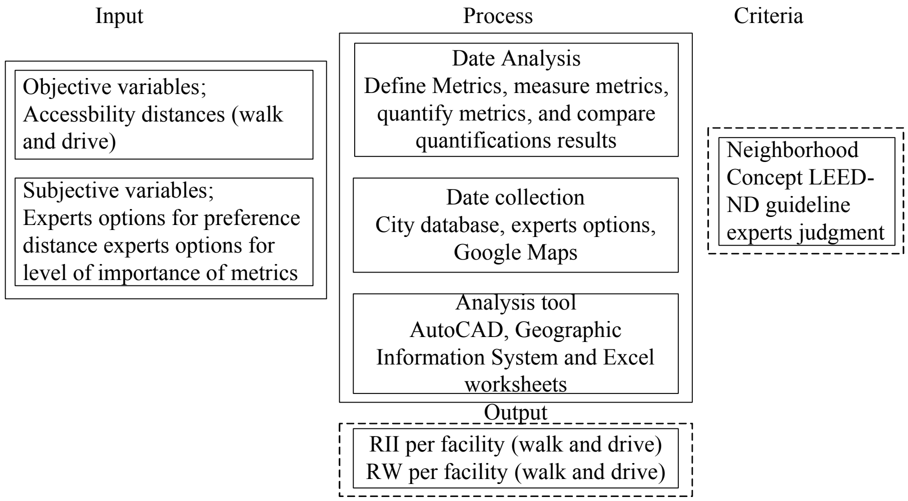

Figure 1.Research methodology.

For the research presented in this paper, walking and driving distances are calculated in two different ways. First walking/driving distance is measured from the centre of neighbourhood to each selected type of facility (in minutes). The centres of the neighbourhoods under study are derived from AutoCAD files received from the City of Edmonton. Google Maps is used for measuring the relative distances (either by walking or driving) between the centre of each neighborhood and the selected facilities. It is important to note that, for each selected type of facility, two available facilities close to the centre of each neighborhood are chosen. In the second approach to calculating walking/driving distances, each neighborhood is divided into areas with similar type of housing (e.g., single-detached home). The calculation of distances from the defined areas of the selected neighborhoods more accurately captures the travel distances of residents, since residents can travel from different areas of the neighborhood to selected facilities rather than just from the centre of the neighborhood. The defined areas of neighborhoods are derived from the AutoCAD drawings provided by the City of Edmonton.

After defining the areas of a given neighborhood, the walking/driving distances from the defined areas to a facility must be calculated. For this purpose, if any area has more than one access route then more than one starting point must be considered in order to accurately measure the walking/driving distances. As a result the average of these distances is considered to be representative of walking/ driving distances for that defined area, shown in Figure 2.

For the research presented in this paper, the distances from defined areas to selected facilities are calculated based on Google Maps. After calculating the population density of each defined area D_A, the average walking distance from a neighborhood to a facility is calculated satisfying Equation (1);

$$WD_{NF}(\min) = \frac{\sum\left(D_A\left(\frac{ppl}{ha}\right) * A\left(ha\right) * WD_{NF}(\min)\right)}{D_{\mathrm{N}}\left(\frac{ppl}{ha}\right) ** A_N\left(ha\right)} \qquad (1)$$

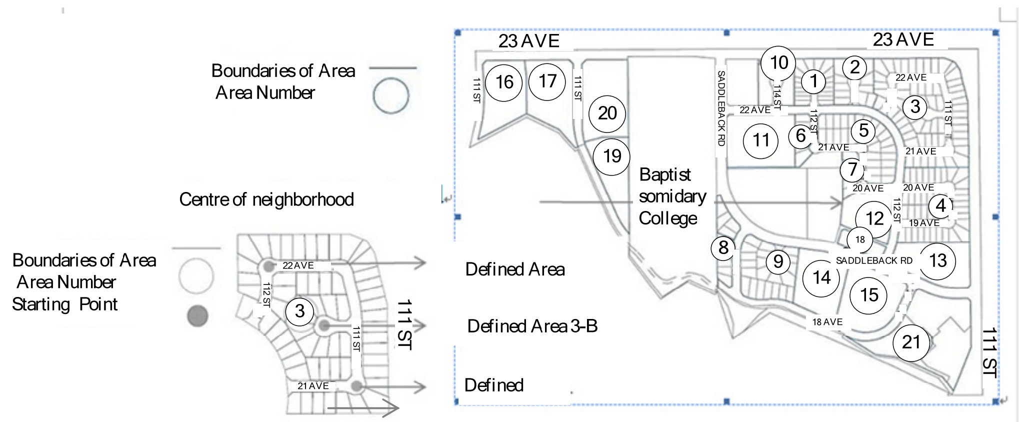

Figure 2.Defined areas and sample of starting points for access routes to facilities in sky rattler neighborhood.

In which WD_{NF} is the walking distance from a neighborhood to facility (min), D_A is the density of each defined area ppl/ha, WD_{NF} is the walking distance from each area in a neighborhood to the facility (min), D_N is the density of the neighborhood ppl/ha, and A_N is the total residential area in a neighborhood (ha). After completing the above calculation for the two nearest facilities to the centre of the neighborhood, the average of these two distances is calculated satisfying Equation (2) as representative of walking distance from neighborhood to each type of facility:

$$NVWD_{NF}(\min) = \frac{WD_{NF1}(\min) + WD_{NF2}(\min)}{2} \tag{2}$$

Where $AVWD_{NF}$ is the average walking distance from neighborhood to a particular type of facility, WD_{NF1} is the walking distance from neighborhood to facility 1, and WD_{NF2} is the walking distance from neighborhood to facility 2.

After measuring the walking/driving distances from the centre of neighborhood to the selected facilities and calculating $AVWD_{NF}$ for both walking/driving, it is necessary to compare the obtained results. For this purpose, a survey is conducted of urban planning experts regarding the importance level of different metrics. Ultimately the indexed results of the survey are used to find determine relative weights of metrics. In this study, relative weight RW_i is calculated satisfying Equation (3):

$$RW_i = \frac{RII_i}{\Sigma_1^n RII} \tag{3}$$

In which RII_i is the relative importance $Index_i$, which represents the importance of closeness of metric *i*, and $\Sigma_1^n RII$ is the Σ_1^n of relative importance index, which is the summation of the Relative Importance Indices for the given evaluation metric. The resulting weights are applied to the obtained results of each neighbourhood (for both the centre and the defined areas), as well as to the recommended maximum distances based on neighbourhood development criteria and expert opinions. Finally, the weighting factors are added together for the purpose of comparison. The outcome is a numerical value that represents the total weighted distances from a given neighbourhood to all facilities for both walking and driving and based on distances both the centre and the defined areas.

CASE STUDY

In the case study the total weighted walking distances ($TWDD$) of four selected neighborhoods both from centre of neighborhood and from defined areas are calculated and then compared with recommended $TWDD_s$. As illustrated in Table 1, the results demonstrate that none of the chosen neighborhoods satisfy the recommended $TWDD_s$. According to these findings, Lynnwood neighborhood, with 19.09 TWWD from centre of neighborhood to facility $TWDD_{CNF}$, and Riverdale neighborhood, with 32.28 TWWD from defined areas of neighborhood to facilities $TWDD_{ANF}$ have the best access to selected facilities and amenities in comparison to other neighborhoods. However, these two neighborhoods still don't meet the recommended $TWDD_s$ to facilities. These findings demonstrate that urban and neighborhood design can have an effect on commuting time and resident travel choices. More focus at the neighborhood design stage on the most critical metric scan reduces walking time and as a result improve QOL in terms of accessibility.

Table 1.Total Weighted Walking Distances to Selected Facilities.

Waking access to facility from selected neighborhoods	Total weighted recommended max. distance	Riverdale	Lynnwood	Skyrattler	Ozerna
$TWDD_{CNF}$	9.24	22.26	19.09	23.41	24.17
$TWDD_{ANF}$	9.24	32.28	145.86	37.30	120.15

In terms of driving, again the Total Weighted Driving Distances ($TWDD$) of chosen neighborhoods both from centre and from defined areas and calculated and then compared with recommended $TWDD_s$. As demonstrated in Table 2, the results show that the TWDDs from centre of neighborhood to selected facilities and amenities $TWDD_{CNF}$ in all neighborhoods under study are below 14.67. This finding indicates that these neighborhoods' have good driving access from centre to facilities. The study also evaluates the $TWDD_s$ from the defined areas $TWDD_{ANF}$ to the facilities. According to the results (see Table 2), only Riverdale neighborhood with $TWDD_{ANF}$ = 6.27 and Skyrattler with $TWDD_{ANF}$ = 7.43 meet the recommended $TWDD$ and have good driving accessibility to facilities. Moreover, a comparison of the results of $TWDD$ from both centre and defined areas of selected neighborhoods shows that the neighborhood with the lowest $TWDD_{CNF}$ is not the neighborhood with the lowest $TWDD_{ANF}$ this may be attributable to the shape of neighborhood and location of facilities. Since the urban design and location of facilities can affect the commuting time in terms of driving, more focus on the most critical metrics in the Lynnwood neighborhood and Ozerna neighborhood can reduce the driving time and improve the QOL in the context of driving.

Table 2.Total Weighted Driving Distances to Selected Facilities.

Driving access to facility from selected neighborhoods	Total weighted recommended max. distance	Riverdale	Lynnwood	Skyrattler	Ozerna
$TWDD_{CNF}$	14.67	5.44	4.95	5.08	6.75
$TWDD_{ANF}$	14.67	6.27	33.41	7.43	32.11

CONCLUSION

This paper has presented a new methodology to quantify the effect of urban and neighborhood design on the QOL of citizens in term of accessibility (either walking or driving). The methodology identifies the important metrics influencing urban QOL and provides information regarding the evaluation of QOL in existing neighborhoods in order to determine redevelopment needs. The research also provides useful insights for urban developers and city/municipal planners seeking to build attractive new neighborhood engendering enhanced quality of life.

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An Empirical Study on the Region-Based Housing Industrialization Grading System in Chinese Rural Areas

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Abstract

Housing industrialization has become a new way to solve current residential building problems in Chinese rural areas; however it's a premise to take different housing industrialization measures according to different local rural conditions within China. This paper aims on analyzing critical rural economic, social and transportation factors related to housing industrialization and establishing an industrial grading indicator system. Based on these indicators, a clustering analysis using MATLAB hierarchical classification algorithm is applied to conduct the empirical study on housing industrialization in rural areas. Then, four clusters and three grading areas are generated according to this clustering analysis, which are prioritized areas, potential areas and support-required areas. Finally, the paper focuses on proposing specific implementation and design patterns for housing industrialization in graded areas, which constitutes a comprehensive decision scheme of housing industrialization in Chinese rural areas as to ensure a better and sustainable China New Countryside Planning implementation.

INTRODUCTION

As a typical developing country, China has approximately sixty percent of the population in rural areas. Meeting the rigid demand of rural housing has become acritical issue in Chinese rural development; however, due to the lack of advanced and feasible construction techniques and effective design concepts among Chinese countryside, it always remains a backward state of housing development in these rural areas. The main problems are manifested in several aspects including waste of land resource and construction materials, poor residential functionalities, obvious disorder in construction and building layout, low quality and short lifecycle of house, dissatisfying national building standards, and lack of sustainability. Generally residence construction in Chinese rural areas is organized in disorder. Hence, it's inevitable to find an innovative method for solving rural housing construction problems. Learning from successful construction experience of developed countries, rural housing industrialization helps to achieve good residential functionality and saves construction materials and improve housing quality.

Housing industrialization is a concept of producing and managing buildings through massive production approach. In particular, some parts of Chinese rural areas began to realize rural building's life cycle commercialization, standardization, industrialization which enables owners to benefit from saving energy, raw materials and land, improving residents' living conditions and environmental quality, gradually forming the modern village housing industry. Therefore, the transformation of Chinese rural housing mode can be achieved by housing industrialization as a guideline and innovation as well as integrating the design, construction, manufacturing, and supplying process. Different residential areas should consider their own local social economic and technological conditions, also their region-related cultural traditions instead of having a universal construction plan, thus it is necessary to conduct the feasibility analysis of determining whether the region is available with industrialization requirements before starting and implementing industrialized construction. Large gap exists among China's rural areas, so it's also critical to distinguish these areas by analyzing villager's housing consumption tendency, the rural residential housing market strength and national investment to its housing industry, in other words, by evaluating economic, social and cultural factors of these rural areas as to define different levels of rural housing industrialization. According to current research on industrialized construction, the main factor of conducting industrialization is to have a mature standardized building components system (Zhou 2012), meanwhile enough input for modular building component manufacturing and people's ability and desire to pay for industrialized house are also essential factors (Ying and Ding 2010), housing demand, construction technology (Yan et al. 2004), transportation capacity, supply chain characteristics (Warszawski 2003) and national policy support (Badir et al. 2002). Construction Method Selection Model (CMSM) is proposed to solve the problem of choosing a specific construction mode for a particular region (Chen et al. 2010). CMSM model has a strategic level for general environmental feasibility analysis and a tactical level for construction method analysis. With two levels of decision-making process, the characteristics of the local housing market, economic development and local construction regulations decision-making, building quality and performance analysis, building component standardization and construction technologies availability are considered in a comprehensive way. Hence for Chinese rural areas, a CMSM model (see Figure 1) will be presented for assessing these housing industrialization related factors as to define the appropriate way of implementing housing industrialization in a particular rural area.

In a word, according to distinctive local conditions, housing industrialization in rural areas should be rationally decided as to adapt to the rural housing market and prolonged building life cycle, also resource coordination and mutual promotion of regional industrial center region should be addressed when considering prerequisites of the decision for developing housing industrialization within each area.

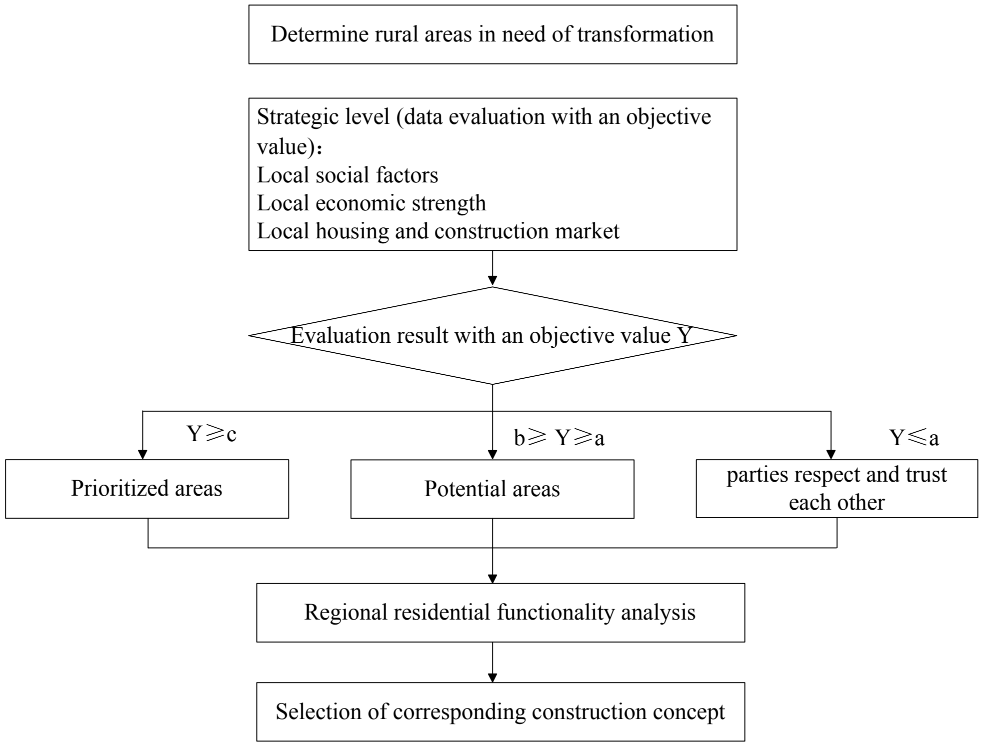

Figure 1.Construction method selection model (CMSM) for rural areas.

SELECTING HOUSING INDUSTRIALIZATION GRADING INDICATORS

Analysis of rural housing industrialization factors. The core concept of rural housing industrialization is residential building design standardization and standardized production and installation of building components. Comparing different regions, rural areas with different levels of development have to adapt to the industrialization path of its own needs. The main factors affecting the industrialization path consist of economic factors, transportation and social factors, as Chinese National Comfortable Housing Project has been successfully implemented in some rural areas indicating this housing industrialization is feasible in areas with good economic conditions and convenient transportation. According to United Nations statistics of residential consumption of more than 70 countries, per capita GNP and the housing industry are positively correlated, and the housing industry enters the rapid development stage when per capita GDP rises to about \$800 (Wells 1984), thus a solid economic condition is a critical prerequisite for industrialization. Light steel residence building is more expensive than the traditional rural house built with bricks and wood, and whether this rural area is affordable to develop industrialized building with sustainable materials or villagers are capable to buy these houses without breaking housing contract is important for deciding adoption of rural housing industrialization. Meanwhile considering most of the villages in China are very underdeveloped, the housing industrialization investment must rely partially on government support and national policy such as National Urbanization Project. Besides, industrialized residential construction requires also the need for effective coordination between building components' production, transportation and assembly. Since most rural population scattered in the mountains or along rivers, the terrain is more complex than urban areas. The factor concerning transportation of standardized building component is more critical, and a set of sound transportation infrastructure and transportation network is beneficial for assisting building components transporting logistics. From social perspective, dissemination capabilities of new ideas is relatively low in China rural areas, rural residents hardly have the perception of the housing industrialization, instead they are over-relying on the construction of brick houses and they do not tend to use new construction materials and new building technology, thereby it is necessary to increase the awareness of energy saving sustainability of rural residents when promoting concept of rural housing industrialization.

Determining rural housing industrialization grading indicators. When selecting evaluation indicators, not only the strong independence between indicators should be considered reflecting the basic characteristics of each factor, but also there should pay attention to each indicator's operability and measurability for the transverse and longitudinal comparisons. Based on economic factor, social factor and transportation convenience along with the statistical targets in Yearbook of China's Rural Residents Statistics, rural housing industrialization grading indicators are selected accordingly (see Table 1).They are 8 second class indicators, and note that five indicators are processed based on the original indicators stated in Yearbook of China's Rural Residents Statistics which are presented as follows:

Housing consumption tendency = yearly living expenses/yearly income

House purchase indemnificatory = yearly living expenses/value of newly bought house in a year

Housing investment driven ratio = newly built house space/housing investment

Labor education level = ratio of resident with a junior college degree in a rural family

Degree of dissemination of non-brick building construction = concrete building floor areas/brick(or wood) building floor areas

Table 1.Rural Housing Industrialization Grading Indicators.

1st class indicator	2nd class indicator
Economical element	Housing consumption tendency of rural residents
	House purchase indemnificatory of rural residents
	Fixed real estate investment of rural residents
	Consumption level of rural residents
	Housing investment driven ratio in rural areas
Transportation	Transportation, warehousing and postal assets investment
Social element	Personal education level of a rural family
	Degree of dissemination of non-brick building construction

BASIC METHODOLOGY OF HIERARCHICAL CLUSTERING METHOD

Hierarchical clustering method. Hierarchical clustering is a method used to determine clusters of similar data points in multi-dimensional spaces. There are a number of methods of determining the distances between clusters, such as single link, average link, complete link of graph method and centroid, median and minimum variance of geometric method (Olson 1995). This paper is implementing hierarchical analysis using Matlab since this software has strong data processing, data analysis and dynamic simulation capabilities, which is efficient for clustering analysis of a mass data. Hierarchical clustering method based on Matlab data analysis includes the following steps:

(1) Data normalization of which the formula is as below:

$$x_{ij}^* = \frac{x_{ij} - x_i}{s_i}, \left(i = 1, 2, \cdots m; j = 1, 2, \cdots n\right) \tag{1}$$

(2) Calculating the distances between the clusters with standardized Euclidean distance. Their standardized Euclidean distance is calculated in the formula as below of which $x_i = \left(x_{1i}, x_{2i}, \cdots x_{mi}\right)^T, x_j = \left(x_{1j}, x_{2j}, \cdots x_{mj}\right)^T$:

$$d\left(x_i, x_j\right) = \frac{1}{s_i}\sqrt{\sum_{k=1}^{m}\left(x_{ki} - x_{kj}\right)^2} \tag{2}$$

(3) Clustering points according to their distances. Based on variance analysis, Matlab is automatically applying the Ward method (deviation square method) so that the individuals within the same classes have minimized squared deviations, and squared deviations between classes are maximized.

CLUSTERING ANALYSIS OF GRADING HOUSING INDUSTRIALIZATION

Hierarchical clustering analysis of rural regions data. The original data is collected from China Rural Statistical Yearbook 2012, containing information of nationwide rural resident's yearly income, living expenses, consumption structure, fixed asset investment, newly built housing space, etc. Since a part of China rural areas situate in extreme climatic regions, such as Tibet with big temperature difference within a day, these areas are not suitable for implementing housing industrialization which does not meet special building standards of heat insulation. Meanwhile considering several rural areas have strict cultural adherence, it is more rational to conserve the minority culture and specific features of traditional villages instead of developing industrialization. Hence, this paper aims to analyze 23 rural areas nationwide except Tibet, Xinjiang, Neimenggu, Guangxi, Yunnan, Ningxia, Qinghai and Gansu Province. According to preliminary analysis of raw data, it is evident that these areas are different from each other by certain characteristics; descriptive statistics including maximum, minimum, average value and standard deviation are shown in Table 2. By executing Matlab code of hierarchical clustering with Linkage function calculating the binary data of hierarchy tree, after the maximum number of iterations is reached, the category polymerization performs to a converging point and the distance between each of the two provinces is illustrated in distribution graph, namely systems Dendrogram (see Figure 2). The number of final clustering category is 4, and the first cluster includes provinces of Shanxi, Heilongjiang, Jiangxi, Hunan, Hubei, Jilin and Sichuan (represented by D, G, M, Q, P, F, U respectively). The second cluster includes provinces of Hebei, Anhui, Shaanxi, Chongqing, Hainan and Henan (represented by C, K, W, T, S, O respectively). The third cluster includes provinces of Liaoning, Guangdong, Shandong, Fujian and Guizhou (represented by E, R, N, L, V respectively). The fourth cluster includes provinces of Beijing, Zhejiang, Tianjin, Jiangsu and Shanghai (represented by A, J, B, I, H respectively). Meanwhile the Cophenet function is used to verify the effectiveness of clustering results of which the value is more approximate to 1.00 indicating better clustering reliability. With an output Cophenet value of 0.9068, it can be concluded that the results are reliable and all the 4 clusters are significantly different from each other.

Table 2.Descriptive Statistics of Rural Areas Grading Indicators.

Rural housing industrialization grading indicators	Maximum value	Minimum value	Average value	Standard deviation
Housing consumption tendency of rural residents	0.22	0.07	0.13	0.03
House purchase indemnificatory of rural residents	1.84	0.38	1.12	0.42
Fixed real estate investment of rural residents	745.00	2.60	246.40	191.51
Consumption level of rural residents	18512.00	4448.00	8325.78	3532.09
Housing investment driven ratio in rural areas	23.23	0.05	1.35	4.81
Transportation, warehousing and postal assets investment	66.20	0.00	20.91	15.85
Personal education level of a rural family	13.50	1.20	3.62	2.67
Degree of dissemination of non-brick building construction	77.00	0.44	7.20	15.68

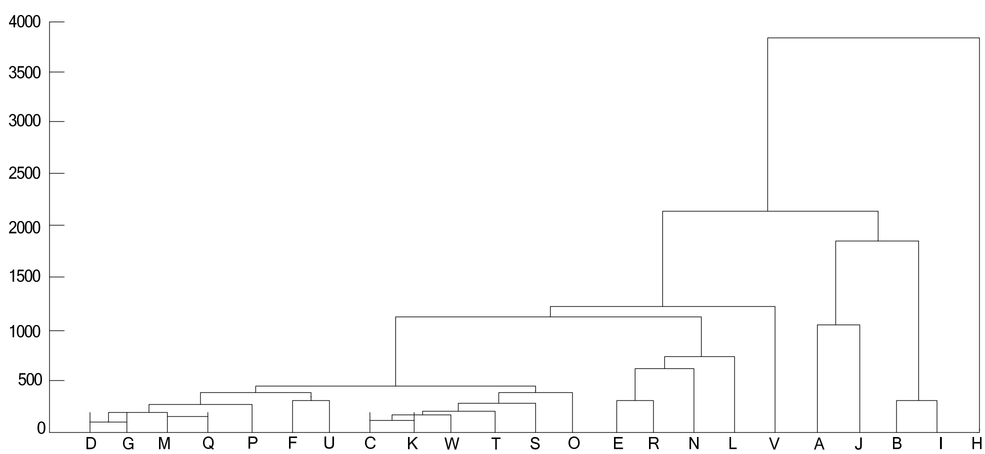

Figure 2.Clustering dendrogram.

REGION-BASED HOUSING INDUSTRIALIZATION GRADING ANALYSIS

Prioritized areas for rural housing industrialization. The prioritized areas represented by the fourth cluster are pioneer areas suitable for housing industry. The rural residents in Shanghai, Zhejiang and other areas with higher income levels and housing consumption tendency will to pay more on housing as to improve the quality of living conditions. This type of region usually has sound financial foundation and high housing credit which is prioritized as a leading role for housing industrialization by National Demonstration Projects. Through urban-rural industrialization integration strategy, the establishment of rural industrialization development group will exert a positive influence in improving the level of industrialization radiation and the integrity of industrialized building component supply chain, hence reducing the cost of building industrialized buildings.

Potential areas for rural housing industrialization. The potential areas represented by the third cluster are mostly concentrated in the east part of China. Although rural residents in these areas comparatively have substantial income, there is less guarantee for performing the housing contract wells, for instance, the values of house purchase indemnificatory inGuangdong, Liaoning, Fujian are all less than the average level of 1.12, while the possible reason for this gap is that the rural residents lack the needs for newly built buildings. Therefore, these areas should focus on improving rural housing functionality, such as making full use of methane and waste water and enhancing the energy efficiency and insulation efficiency of buildings in northeastern region as to improve the overall living standards. At the same time the government should provide adequate investment to rural housing construction and industrial market development, rural areas with high population density may rely on the urban housing industrialization center through setting up material distribution center, the development of these potential areas will be the reserve forces of nationwide rural housing industrialization.

Support-required areas lack of industrialized building prerequisites. The support-required areas are represented by the first and second clusters, whose rural residents have the lowest levels of yearly income and consuming power, for instance, Chongqing rural resident's consumption tendency and house purchase indemnificatory values are minimum. Heilongjiang registered the lowest value in personal education level of a rural family and degree of dissemination of non-brick building construction. The most significant feature of these areas is the poor economic condition and it is not beneficial to promote rural housing industrialization compulsively. However, if the building cost is minimized in these areas, the housing industrialization can be possibly available in the way of absorbing spillover advantages and obtaining indirect support of adjacent developed regions. And government should still encourage rural residents and enterprises in these areas to gradually accumulate the initial capital of housing industrialization, aiming on semi housing industrialization.

PATTERNS FOR REGION-BASED HOUSING INDUSTRIALIZATION

The rural housing industrialization level is significantly different from one region to another, and obviously it is easier to promote industrialized houses in prioritized areas with good economic conditions and comprehensive construction technologies. According to the clustering results, relative rural housing construction modes can be also divided into three patterns (see Figure 3).

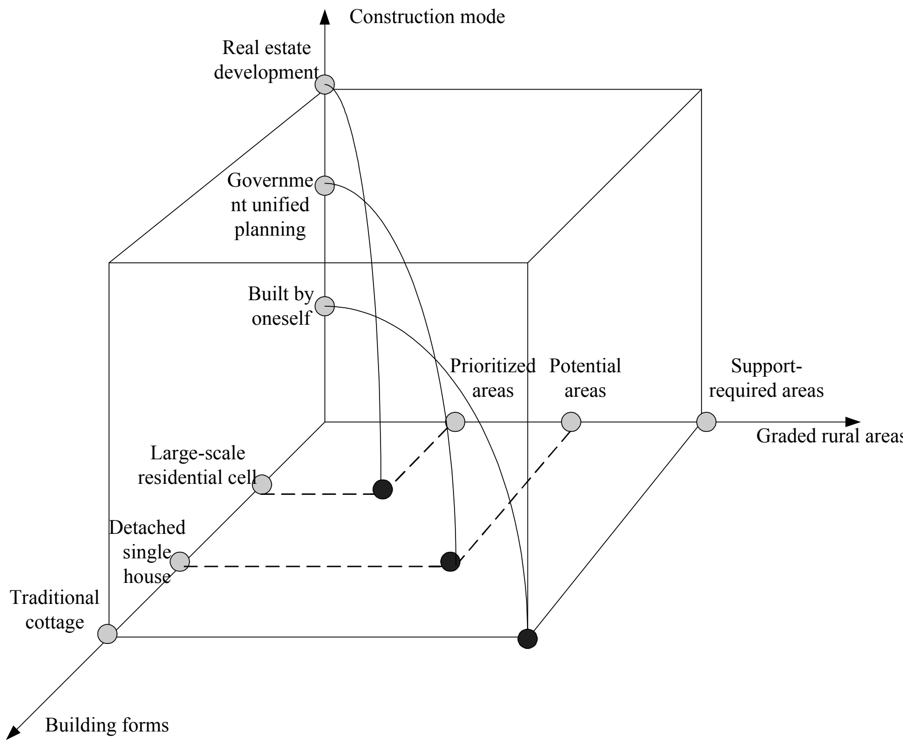

Figure 3.Three patterns for region-based housing industrialization.

The first pattern relates to the prioritized areas. Since they are close to comprehensive industrialized building component distributing system, it is possible to form large-scale industrialized building cells. The second pattern focuses on potential areas usually featured by government unified township planning. These areas are suitable for building detached single house for each rural family which meets rural resident's basic agricultural production and living requirements. The third pattern is in line with the support-required areas of which the houses are lack of the scientific design wasting a lot of construction materials. Villagers tend to build their own cottage with poor security and building performance, hence it is necessary to propagate the core concept of rural housing industrialization among these rural residents and government should strengthen the recognition and usage of standardized design and construction schematics. In supported areas, rural cottages with poor performance should be replaced gradually by detached single house of potential areas, which shows the curve of support-required areas is approaching to the curve of potential areas. Among these three patterns, each curve of a specific housing industrialization grading category is approaching from low level to high level so that the disorder in rural housing construction will be gradually eliminated.

SUGGESTIONS ON RURAL HOUSING INDUSTRIALIZATION KEY IMPLEMENTATIONS

Different housing industrialization implementation measures should be taken according to the three levels of rural along with analyzing the key industrialization procedures and qualifications in these prioritized, potential and support-required areas. First, it is essential to formulate the production specifications for the standardized building components and unified modules system based on the area's building construction features and geographic characteristics. Then the housing functionality needs be improved by professional and technical identification of each specific building performance indicators such as building fire protection, a seismic design, and insulation level. Also the technical specification standards should be proposed for industrialized design of reinforced concrete buildings, especially for those in extreme weather conditions (such as the pretty cold China Northeast region sand southwest regions with earthquake-prone risks). From government perspective, rural housing industrialization needs government policy protection and financial support in resolving the current problem of Chinese rural homestead system and sponsoring housing subsidies. Government should also leveraging small and medium enterprises in rural areas in providing construction materials and building design who will also help foster housing industrialization market, besides, the establishment of a regional distribution center will perform as are source sharing node in suburban areas, reducing the cost of transporting of industrialized building components. Implementing rural house industrialization is a long-term project, which requires the participation of technologists, entrepreneurs, financial sectors and national political sectors. The implementation measure should be constantly revised and adjust the key housing industrialization process to the right path in order to find a more rational way of implementation.

CONCLUSION

Rural housing industrialization is an important path to promoting China New Rural Area Development, which ensures rural residents to have a good life quality. This paper analyzes the key elements of rural housing industrialization concerning the rural economy, social land transportation factors and accordingly establishes eight evaluation indicators. By using hierarchical clustering algorithm in Matlab for data processing, rural areas of 23 provinces nationwide are divided into four clusters with the reliable and effective clustering results. Based on this, the rural housing industrialization grading levels are determined as prioritized areas, potential areas and support-required areas. Each level of rural areas should be provided with different kinds government policy and financial support. Meanwhile the three levels of rural areas should adopt suitable implementation patterns with corresponding building technologies for industrialized building construction, as well as to continue fostering rural housing market and gradually make it clear the path to the housing industrialization development in different regions.

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Local Implementation Problems and Suggestions of China's Real Estate Unified Registration

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Abstract

The institutional integration of the real estate registration and the real estate registration system building is one of the important tasks of the government institutional reform and government functional transformation recently**.** At present, the Ministry of Land and Resources is supervising the implementation nationwide. Under the circumstance, the present study analyzes the current situation and problems of the scattered China's real estate registration. Within the framework of "four unifications", i.e. the unification in real estate registration organizations, registration books, registration basis, and information platform, the present study explores the implementation of the local unified real estate registration from the perspectives of real estate registration duty integration, data integration, business process improvement and information sharing according to the actual situation in different areas. At last, it puts forward concrete suggestions for the implementation of the local unified real estate registration work.

INTRODUCTION

For a long time, the real estate registration of China is in a state of dispersion due to supervision and registration by diverse management institutions and different departments and registration. The legitimate rights and interests of the holder of the real estate are difficult to be guaranteed, and the development of the real estate market is restricted. Therefore, the Property Law of the People's Republic of China promulgated in 2007 states "a unified registration system over realties shall be practiced by the nation", which established the basic structure and provided the overall architecture along with spiritual guidance of China's real estate registration for the establishment of the unified registration system. The 2nd Plenary Session of the 18th CPC Central Committee and the 1st Session of the 12th National People's Congress examined and approved the Scheme of the Institutional Reform and Function Transformation of the State Council ("the Scheme"), which states: the State Commission Office of Public Sectors Reform is responsible for completing "the integration of the duty of housing registration, woodland registration, grassland registration and land registration" before the end of April 2013; the Ministry of Land and Resources, the Ministry of Housing and Urban-Rural Development, the Office of Legislative Affairs, and the State Administration of Taxation are responsible for "planning and implementing the unified real estate registration system" by the end of June 2014. On November 24, 2014, the State Council issued, through the Decree of the State Council signed by Premier Li Keqiang, the provisional regulations on real estate registration, which will take effect March 1, 2015, marking the beginning of China's real estate unified registration implementation.

At present, the national level real estate registration responsibility and organization construction have basically completed; 22 provinces has accomplished the provincial responsibility integration. But the cities and counties haven't started the responsibilities and institutional integration, without any specific implementation. The national plan for 2015 is to form a complete set of system, and to push the implementation smoothly and effectively; for 2016, the national plan is to form a Comprehensive system, which can work more effectively; for 2017, the national plan is to make the real estate information networking sharing available (the provisional regulations on real estate registration 2014). But current situation of registration work nationwide differ in thousands of ways, so the specific implementation process will definitely face many problems. In this paper, we take the frame work of "four unification", i.e. the unification in real estate registration organization, registration books, registration basis and information platform, and try to discuss the implementation of the local unified real estate registration from the perspectives of real estate duty integration, data integration, business process improvement and information sharing according to the actual situation in different areas. The present study would help to put forward concrete suggestions for the implementation of the local unified real estate registration work.

THE PRESENT SITUATION AND PROBLEMS OF CHINA'S REAL ESTATE REGISTRATION IMPLEMENTATION

From the current situation, the unified real estate registration system faces many problems in the process of implementation:

Wide registration scope and varied registration type. In accordance with the "provisional regulations on real estate registration", real estate refers to the land, the sea, as well as the houses, the woods and other attached objects. China's real estate registration ordinance applies in quite a wide range, and the existing real estate registration objects are also varied, including land, houses, forests, grasslands and waters (Yan 2014; Cheng 2014a; Zhu 2014; Wu 2014). Due to the different registration and management authorities, various registration types exists, e.g. land registration, contracted land management right registrations, building property registration, forest rights registration, registration of grassland, and so on.

Superabundant registration departments. Real estate registration involves at least five departments, including the Ministry of Land and Resources, Ministry of

Housing and Urban-Rural Development, Ministry of Agriculture, Ministry of Forestry, and State Oceanic Administration (Cao 2014). Real estate registration is handled by these different departments and registers. For instance, the right to use construction land and the ownership of the collective land is registered by the land and resources authorities; while the management right of the rural contracted land, ownership and the right to use the grassland are registered by agriculture authorities; the ownership of the forest land and the right to use the forest are registered by forestry authorities; and the ownership of the house is registered by housing and the urban-rural construction authorities. Thus, the real estate registration is disseminated to so many different departments that great difficulty lies in the coordination among these authorities.

Affluent registration laws and regulations. The registration of real estate involves so many laws and regulations. Every department of real estate registration has its own laws as the basis, such as the forestry authorities use the "forest law" as a support; the agriculture authorities has the "grassland law" and "rural land contracting law" as the basis; the housing and urban - rural construction authorities has "urban real estate administration law" as the basis; the land and resources authorities rely on "the land administration law", which clearly states: the confirmation of the ownership and the right of use the woodland and grassland, and the confirmation of the breeding rights of water surfaces and tidal flats, should be governed by the relevant provisions of the "forest law", "the grassland law" and" the fishery law". Therefore, it admits the current situation of scattered registration in the law level.

Different registration ways and critical difficulties for unification. The original registration departments have their own practice method so that unification will encounter considerable difficulties (Cheng 2014b). Each department has issued its specific administrative rules, which gradually formed the independent system of "registration organ, registration personnel and registration technical methods". For instance, the Ministry of Land and Resources issued "Land registration method"; the Ministry of Agriculture issued "Measures for the management of rural land contract operation card", "Waters mudflat aquaculture certification registration method"; the State Forestry Administration issued "Trees and forest land ownership registration and management method"; the Department of Housing and Urban-rural Development announced "Housing registration method", etc. Those laws and regulations are used in different registration procedures, contents and certificates, etc. Each department has different regulations originally, so it is difficult for different department to reach consensus.

THE PROPOSAL OF UNIFIED REGISTRATION PATTERN DESIGN

From the operating level, the registration of the specific work is handled by the cities and counties. Registration departments in cities and counties are unified registration departments at the grass-roots level and basic work unit, so the establishment of unified registration departments and working scheme in the cities and counties are important to establish the unified real estate registration system. In accordance with the provisional regulations, local real estate unified registration departments can not necessarily be set up in the departments of land and resources, but must be controlled by one department rather than multiple departments, finally supervised by the Ministry of Land and Resources. But now the integration difficulty is great. Because duty integration is the premise of the specific work to achieve unified registration. Therefore, to design and establish an effective and unified registration model are particularly important, which is the foundation and the guarantee of comprehensively carrying out uniform registration of real property in our country. Below we will discuss the local pattern of unified registration from the perspectives of duty integration, data integration, business process improvement and information sharing.

Duty integration. For duty integration, the unified real estate registration of local institutions should refer to the national top design on duty integration mode, which is to set the unified registration agency at the local departments of land and resources (Zhu and Huang 2014; Wang 2014; Wei 2014). It is suitable for national conditions and status quo of China's administrative management from the work background and it is easy to accept the higher level of instruction in order to realize the management of the flow in terms of vertical management. As the main task of unified real estate registration is registration, whose essence is to protect the right and interest of the public, having no relation with real estate transactions and management. So duty integration has relatively little influence on rights and interests, which greatly lessen the implementation block.

For the establishment of registration departments, it is suggested that the real estate registration department personnel involve the workers from all the relative departments, for the convenience of smoothing the initial work. The local real estate institution is formed according to the new establishment of new institutions and local real estate registration organ, which is incorporated into the local departments of land and resources system.

For the personnel arrangement, it is suggested to choose grass-root level personnel who have been familiar with basic registration business process, including the primary-level worker from the department of forestry, agriculture, marine, etc. in order to carry out the unified registration in the new registration department.

Because the situation in every region of China is very different, there are places with good registration foundation, such as the cities in eastern China, whose technology is strong. Therefore it should focus more on the need of the duty integration. While there are also places with weak foundation, such as the northwestern region, where the registration technology and information platform construction is more important, and thus the process to realize the unified registration will be longer. Therefore, the pattern will be different because of each place is different and the condition basis is different. According to the different situation of different places, it is suggested to build the pattern of cooperation between "administrative department + public institution", and jointly carry out unified real estate registration, which is similar to the national level design of "land registration division + land registration office" in the Ministry of Land and Resources, namely guided by the local land administrative office, examined and approved by specific public institution, and issued certification again by administrative office. This model is also in line with the requirements of streamline administration and institute decentralization. It can also be solely accomplished by administrative department for all of the real estate registration work. In a word, the regions can build different implementation models according to different situations of different places.

Data integration. In terms of data integration, due to the decentralized management history of China's real estate registration, the original information scattered in various departments, especially the large number of real estate, land, forest land and other related information. The unified registration requires to integrate these data to help carry out the unified registration work smoothly in the future. But it is difficult to completely achieve this fusion in a short period of time, and it needs a feasible path to integrate the different types of departments based data, in order to realize the integration of high efficiency.

Furthermore, the integration is not only to carry out the data fusion of different types and the construction of the background database, but also to meet the needs of daily registration and the normal work of the foreground usage (Zhu 2014; Qiao and Hu 2014). Taking Chongqing for example, it adopts the way of integration and application simultaneously: it builds a new database from extracting data from the housing database and the land database, while the old databases are used for daily registration and synchronous backup implementation. Finally, the old database and new database realize the information integration to form a unified real estate registration database.

Data integration and unity is a start, and the ultimate purpose is to meet the requirements of the new work. Only to realize the full data fusion and build a new integrated information data platform, can realize the protection of the real rights of registration.

Business process improvement. Duties and data unification are the precondition of unified registration (Wu 2014; Yan 2014). On the basis, we also need a new process of the unified registration work from application, accepting, auditing to certificating, covering the whole process of design for new registration.

It is suggested to take unified business hall methods in the process of the real estate unified registration implementation in local places, such as the land and resources electronic government affairs hall of Xuzhou city, which unifies the real estate registration process in one unified business hall, by setting different windows for relevant registration matters. In the hall, there is also an advice channel to help answer the questions and distribute the relevant registration process introduction materials, in order to guide the citizens to complete the business procedure more quickly and smoothly. The business hall makes all of the registration procedures in one place, which helps to improve work efficiency.

At the same time, it needs to clear the rights and obligations of each process step for specification, in order to avoid the internal self-contradictory or conflict.

Information sharing. On one hand, the implementation of the real estate registration system is to guarantee the right of the holder of the real estate and interested persons; on the other hand, it is also to facilitate the unification of the real estate management and related social affairs processing of actual needs (Liu 2014; Lu et al. 2014). Therefore, information sharing permission's design is very important. It is suggested to limit access to the information on demand, which can efficiently serve the conservation and management of property rights. For general public, the information can only open to the right holder and interested party for inquiry. For the relevant inner departments of the government, real-time sharing between transaction and registration department is needed; once there's a real estate transaction, the information will timely convey to the registry, so that the obliges can master the latest information of real estate when they are going to registry, which is good for better implementing registration review. At the same time, the registration information will send to the transaction department at once to avoid repetition trading. Mutual foundation of each department information will do well to a better administrative management work. For relevant departments involved in real estate management affairs, such as taxation, finance, public security, etc., the information sharing only opens the needed information to them, to serve on its normal work. So the limited sharing can not only guarantee the right of the holders' privacies, but also satisfy the management needs.

CONCLUSION

Because China's real estate registration regional bases differ in thousands of ways, the unified real estate registration mode will also be different. The real estate registration is closely related to the leadership, technical path, and local government attitude. Through comparing the similar registration region patterns, and discussing from duty integration, data integration, business process improvement and information sharing, etc., this paper can provide some reference for the unified registration work in the future.

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Research on Harbin Rural Land Circulation during New Urbanization

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Abstract

China's rural land issues at this stage mainly perform as circulation problems of the farmers land contract and management rights under the existing land system. The transfer of such land using rights begins with the continuous development of agriculture, and changing cultivated land dispersed crushing situation to adapt the objective needs of the strategic adjustment of agricultural structure and scale operation. In this paper, statistical yearbooks and other reference data are the main source of information, backed by the Marxist theory of property rights and land configuration market capitalization theory. The factors affecting Harbin rural land circulation are analyzed by using quantitative analysis method through the model of multiple linear regressions. Therefore, the paper comes to comparing the impact of various factors on rural land circulation. SPSS16.0 software is used for statistical modeling and quantitative analysis. Based on the successful experience of the land transfer abroad, combining the pragmatic provincial land transfer situation of Harbin, we take proper proposals for the existing problems about transfer of land in Harbin.

INTRODUCTION

Our land is mainly concentrated in rural areas, but the relatively small number of cultivated land per capita. However, agricultural land is a basic composition. There is no the Land, the development of agriculture will be impossible, and more related to the people's livelihood. After the reform and opening up, accelerating urbanization, the steady erosion of our urban land, coupled with the rapid expansion of the population, poses a threat to our food and farmers' basic life, and then the pressure applied to all land. To properly handle the conflicts of population growth and land reduction and solve the contradictions urbanization and avoid waste land has become an urgent problem to be solved.

Meanwhile, due to the high cost of land contractual management, low income and the development of rural secondary and tertiary industries with workforce transfer, land transformation increasingly underestimated especially under the demand for non-agricultural construction projects in rural areas and rural industrial structure adjustment needs. Brandt et al. (2000) pointed out that under the premise of the economic situation facing the differences, the approach and ideas which rural cadres take to handle the land often determines the difference between the person who has the right to use the land, so rural land ownership is great affected by cadres of village-level. They do not agree with the ownership of the land belonging to individuals, in their view, our existing rural land policy will be severely hampered egoism tendency of the local government and farmers. Land in rural areas is irrational rotation, once the land is carried out by regular administrative intervention, it would harm the interests of the people (Zhang 2011).

Harbin City, Heilongjiang: China's largest commodity grain base of the capital city is located in the middle of the Songnen Plain, abundant land resources. Since the second round of the rural land contracting policy implementation, Harbin rural land circulation gradually unfolded spontaneously. Harbin rural land transfer is still in a spontaneous, decentralized, non-standard stage. The farmer awareness is not high, turnover fast enough. In addition, due to the gradual transfer of rural labor to urban areas, there has been fallow land, abandoned phenomenon. At the same time, due to some farming experts, farmers' specialized cooperative economic organizations grasping the scale of agricultural cultivation and management techniques, efficient agriculture, have the desire for transferred the land implementation of scale and intensive farming.

SITUATION HARBIN LAND TRANSFER

In 2008, the land transfer area was 243.9 hectares, accounting for 8.9% of the total arable land. By 2009, the rate of land transfer increased but rate of growth was relatively small. In 2010, the land transfer was 9.5%. The main reason is that people lack a rational understanding of the land transfer. In Harbin, among the total area of the land transfer, the land transfer of 83.1 hectares flowed large grain circulation , representing 34.1%; cooperative economic organizations for the objects of transfer had 10.7 million mu, accounting for 4.4%; enterprises as the transfer target there were 40,000 mu, accounting for 1.7% (Chen 2012a). The forms of land transfer is diversified in Harbin , including subcontract, lease, exchange, shares, transfer .In five kinds of circulation forms ,it mainly was the form of subcontracting. In 2008, the city's land area, mainly in the form of subcontracting, transfer pack Size 233.8 mu, accounting for 91.7% ; the land area of rental was 14.7 hectares, accounting for 6% of the land area; swap area of 30,000 hectares, accounting for 1.2%of the land area; shares and other area of 20,000 acres, the proportion of land area was0.8 percent, the transfer of the land area is relatively small, only 0.5 million mu, accounting for land area was 0.2% (Zeng 2014).

TO ANALYZE INDIVIDUAL AND REGIONAL CHARACTERISTICS TO THE IMPACT OF THE L AND TRANSFER IN HARBIN

Harbin is located at longitude 125°42' ~ 130°10', latitude 44°04'~ 46°40', located in the middle of the Songnen Plain, abundant land resources (Chen 2012b).

In recent years, combining our national conditions, situation in the province and sentiments, it can be found that Harbin's land transfer pulled inadequate and didn't adapted to the requirements of modern agriculture construction, affecting the development of rural economy.

Land transfer is an important means of promoting land reform and land of industrial restructuring. How to promote land transfer? First, we should know what factors affect the land transfer. Second, there are several modes of land transfer. Which direction should the province's land transfer to best? Based on the above issues and the rural land management right is affected by many factors. In order to reveal the complex relationships and accurately determine the amount of variation between them, we can find ways to solve the problems among land transfer. This article will use SPSS16.0 software, with multiple regression models in depth, systematic analysis.

Multiple linear regression theory model. Regression analysis is the analysis of objective things, the number of dependencies. It is an important statistical analysis methods, widely used in all kinds of factors and variables of social phenomena associated with it. Multiple regression analysis is the study of a common statistical method correlation between multiple independent variables and a dependent variable.

Multiple linear regression model refers to a linear regression model with multiple explanatory variables. It is used to explain the Linear relationship between the variables and release several other explanatory variables. The general form is:

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_n X_{in} + \mu_i, i = 1, 2, \ldots, n \quad (1)$$

Where k is the number of explanatory variables, β_i called regression parameters. Traditionally the constant term is seen as dummy variable. In the parameter estimation process, a dummy variable sample observations always take the one. Accordingly, the number of explanatory variables in the mold is $(k+1)$. The form (1) is also known as the overall shape of regression function of the random expression. Visible multiple regression analysis is based on regression analysis of multiple variables to explain the conditions fixed value, the square Cheng X value represents the mean response when each variable Y is fixed. β_j is also called partial regression relation. When his explanatory variables held constant, x_i every change a unit, Y change how many units in average (Brandt et al. 2000).

Selection of indicators and data calculation. According to the analysis above, this article chooses greater five factors impacting on Harbin rural land circulation: food output level, non-farm income, labor force levels, mechanization level, and migrant level (Zhou et al. 2011). This article mainly uses multiple linear regression method, by means of "Harbin Statistical Yearbook 2005-2011", the data for analysis.

Statistical Yearbook from Harbin rural economic development of part of the year (11-1) , it can be found that the data of grain output (10, 000 tons) and arable farmland (10, 000 hectares) of from 2005-2010, at the same time you can get the relevant data of total power of agricultural machinery (Wan kW), secondary industry and tertiary industry and the total rural labor force (people) .The total income of rural residents from statistical Yearbook 9-7 of Harbin, it can be found that the relevant data from the 2005-2010 annual wage income and the net income of farmers per capita (million). From 2-4 national economic and social development of structural conditions, it can get a percentage of farm income levels. Finally, these data are summarized by the Table 1 in the form shown (Tian 2012).

Table 1.Raw Data Summary of Factors Affecting Land Transfer Harbin.

Year	2005	2006	2007	2008	2009	2010
Grain output (10,000 tons)	930.0	987.0	975.0	1053	1131.3	1259
Arable land (million hectares)	178.0	178.0	182.1	182.6	193.1	196.5
Non-farm income level (percentage)	47.4	48.7	46.8	46.2	46.9	46.7
Mechanization level (MW)	453.5	491.7	549.3	583.8	681.7	753.2
Secondary industry (million)	41.5	40.5	43.0	43.0	44.7	46.0
Tertiary Industry (million)	48.8	49.9	51.3	51.9	52.7	55.3
The total rural labor force (million)	240.8	241.2	240.2	240.6	244.1	245.2

Data analysis. The grain output level by the annual grain output divided by the annual arable land. The sum of rural labor transfer to the second industry plus the tertiary industry divided by the total workforce. Each year the level of mechanization is calculated by percentage growth than the previous year of the total power of agricultural machinery (Tian 2012).

First, to estimate the model by the way of OLS. Turnover rate is the dependent variable, it is assumed to be Y; the rest are as explanatory variables, assuming that the level of food output for X_1, non-farm income levels for X_2, migrant level for X_3, mechanization level for X_4, labor transfer level for X_5. Moreover, according to the above analysis, the four factors between rural land management rights transfer should be relevant. Multiple linear regression equation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \mu_j \tag{2}$$

By using the SPSS16.0 software, we can make the OLS regression for data.

Comprehensive evaluation. Thus, the model $R^2 = 0.976, R = 0.952$, coefficient of determination is higher, F-test value 4.319, greater than $F(\alpha = 0.05) = 3.84$, significantly visibility is better (see Table 2 and Table 3). Meanwhile, VIF test value X_5, X_1, X_2, X_3 is greater than 10. The tolerance is less than 0.1, so there is a serious multi-con-linearity (see Table 4).

The results of gradual analysis. Four stepwise regression was conducted by SPSS16.0.The conclusion got this table. Variables tested by the t test. Mechanization level X_4 with serious correlation, then rounding. X_3 couldn't pass t-test (see Table 5). The conclusion that the regression equation is:

$$Y = 7.341X_1 + 1.479X_2 + 1.704X_3 - 45.691 \quad (3)$$

Table 2.Analysis Summary of Land Transfer Factors of Harbin from2005-2010 <Percentage>.

Years	Food output level	Non-farm income	Migrant level	Mechanization level	Labor force levels	Turnover rate
2005	5.224	52.6	0.189	0.075	0.375	7.94
2006	5.544	51.3	0.198	0.084	0.375	6.79
2007	5.354	53.2	0.202	0.117	0.393	5.79
2008	5.769	53.8	0.213	0.063	0.394	8.1
2009	5.859	53.1	0.206	0.168	0.399	8.9
2010	6.408	53.3	0.217	0.105	0.413	9.5

Table 3.Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error	R Square Change	F Change	df_1	df_2	Sig. F Change
1	0.976	0.952	0.948.	0.275	1.000	4.347	5	41	0.000

a. Predictors (constant) X_5, X_4, X_2, X_3, X_1.

b. Depend variable Y_1.

Table 4.Significant Test of Multiple Regression Equation.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	63.679	4	15.920	0.00	0.001
Residual	3.182	42	0.076		
Total	66.861	46			

Table 5.Result of Model Parameter Estimation.

Model	Non-standard Coefficients		Standardized Coefficients		Sig.
	B	Std. Error	Beta	t	
(Constant)	-45.691	3.359		-13.603	0.000
X_1	7.341	.324	2.476	22.627	0.023
X_2	1.479	.096	.940	15.465	0.000
X_3	-165.215	12.214	-1.327	-13.527	0.780
X_5	1.704	9.345	1.013	8.958	0.045

Result analysis. Through the above analysis, it could be found that in the five factors, the impact of food output level of rural on land management right was the greatest. It improves the land transfer. Second, the non-farm income and labor force also showed a positive effect. The other two explanatory variables have serious con-linearity.

Harbin land transfer is mainly in the form of subcontracting, in order to land together. After together, the more grain output is, the more be able to drive the land transfer. The labor force more, people are more willing to migrant workers. It will certainly be a lot of idle land resources.

Under the perfect transfer market system, the transfer of land is the best way to optimize the allocation of land resources. Secondly, a large number of farmers leaving the land not only improves the efficiency of agricultural production, but also increases the income of agriculture. It weakens the security function of land, further stimulating the initiative of farmers to transfer land using rights. Therefore, accelerating the development of non-agricultural rural areas provides more jobs for surplus labor force; it facilitates transfer to the secondary and tertiary industries.

LAND AND TRANSFER PROBLEMS IN HARBIN

Although it can be seen that the future land transfer of Harbin will be bright from the above data, but some issues cannot be underestimated. For land transfer, both the government and farmers lack of good understanding. The Government will consider the land transfer is the trend, to intervene by administrative means forcing farmers to transfer land, resulting in the loss of land resources. The farmers' interests compromised. Farmers lack of proper understanding of the property of the land. This is the root cause of frequently land conflicts in today's society.

In addition, the ownership of land transfer is in the hands of farmers. Whether the transfer should not be the will of the government or the department for the transfer, we should follow the rules of market economy, left unchecked. Because of a clear understanding for the land transfer market and the circulation trends, local governments make the land transfer policies and provide related services lacking relevance and persistence, affecting the pace of development of rural land circulation of Heilongjiang Province.

Finally, there are five kinds of forms of land transfer despite imbalance. The land transfer mode is also scarce. Farmers take a year or 2-5 years of more short-term subcontracting. As the inflow side of agricultural enterprises or individuals, the fear of policy changes and market risks, the majority take a conservative approach of short-term contract. Generally farmers have low education level; migrant workers who are limited will inevitably hinder the transfer of land. In the result, farmers' work is limited, reducing the efficiency of agricultural production, resulting in a waste of labor resources. At the time it also increases the burden of the government, which restricts the development of society.

TO MAKE SPECIFIC COMMENTS BASED ON FOREIGN LAND TRANSFER AND COMBINING WITH THE BASIC SITUATION OF HARBIN PROVINCE

Appreciate of land transfer in Japan. Although we are a significantly different from the development level t of rural land of neighboring Japan, but we all have small-scale operation, a large population and less land, more dispersed development management, and so on (Brandt et al. 2002). No matter where we still do not want to give up some land in rural and farming development of the agriculture. It lies in the core of its rural land use rights and its franchise, the country begin to support for rural land lease and transfer. Throughout the land transfer process, the Japanese government has played a significant role in promoting the land circulation by the ongoing legislative and administrative means. Thus it nurtures a favorable legal environment and policy support for the transfer of rural land circulation. In the meantime it has created favorable atmosphere for agricultural land transfer market. The emergence and rapid development of rural cooperative organizations in Japan also has played a promoting and intermediaries role in the formation of agricultural land market.

The innovation of land transfer in the United States. In the early 20th century, United States' land system is almost finalized mainly in the predominance of family ranch. The land market transaction is also conducive to the expansion of large-scale farm production, promoting the orderly combination of factors of production (Brandt et al. 2000). A large scale farm production also can promote the use of large agricultural machinery and advanced technology and knowledge management agricultural farm. It lies in supporting bank credit and other economic and policy instruments such as government policies to guide, regulate interest bank loans, subsidized prices and a variety of other preferential policies and programs so that the government actively encourage and guide some family farms expansion. Certainly, they provided strong financial support. American land transfer circulation in the back has the sound system support and protection, as well as for the family-based farming ranch. So in the United States the circulation of land transfer process is very easy to reach clarity of land ownership boundaries, then land lease sale on the market has a relatively large degree of freedom and flexibility. The land transfer is able to not only adjust the market well but also in the ownership of land on the farm have better legal protection.

To summary the rural land transfers in French. France issued the "Agricultural Guidance Law" and created the company of a special regulation on rural land and resettlement of farmers. It is mainly responsible for the integration of small pieces of land acquisition, then transferring to a large or medium-sized the farms lord with more appropriate prices. The integration of rural land leads to the old farmers problems. The government granted a lifetime pension paid to protect the interests of agriculture after they leave, so that they do not have to worry about the life. For those young farmers, the government gives priority placement to medium and large farms to help improve the structure of farms. Certainly, the transfer of land does not allow segmentation. The French government has taken a direct way to intervene the merger and acquisition of land transfer.

To sum up. Firstly Harbin should establish a comprehensive land transfer system. The establishment of more authoritative agency is also responsible for the integration of acquisitions of small plots of land, the land price assessment, land quality evaluation and assessment of land for purposes and so on. This will improve the efficiency of land transfer. Secondly, we should make up this loopholes of the land transfer legal to create a strict and stable circulate environment .We can prevent both sides loopholes in the name of land transfer. Once again, the government should actively introduce foreign investment to boost the land transfer. Government should try to provide some financial support, such as bank credit, social investment. With the guarantee of funds, land transfer deadline will be extended. Finally, the government or the body of transfer should provide protection for future farmers. Because the low education level of the most farmers, migrant workers is limited. At the same time, we should encourage the mode of transfer land to the land stock cooperative mode, land contractual management cooperatives, direct the market of agricultural land and homestead wards, agricultural land for social security and other direction. This will raise farmers' enthusiasm but also provide additional income for farmers.

DISCUTION AND CONCLUSION

With the help of SPSS16.0 software and the use of qualitative and quantitative analysis methods, it clarifies the impact of labor force level, grain output level, non-farm income, migrant income and mechanization level on land transfer of Harbin. The more labor transfer, the better food output level, and the more easily we are likely to promote the transfer of land. Secondly, the level of non-farm income also has a very important influence on the land transfer. Wage income and the level of mechanization had serious co-linearity with the other three factors. At the same time, combined with the successful case of the foreign land transfer, for the present issue of Harbin land transfer, this paper proposes relevant proper comments. For example, we should establish the agency of the authority, providing a number of suitable jobs for migrant farmers, finding some ways to actively introduce investment and mode diversification of land transfer. If we want to change the pattern of the city's collectively owned land, in essence, it is the contest among the interests of the central government, local governments and farmers. But the farmer is still in a dilemma. Therefore, to deepen the reform of the existing land system, the most fundamental thing is that we should values the common interests of all three facts.

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Land Use Practice in a Hyper-Dense City: A Lesson from Hong Kong

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Abstract

Sustainable urban development and land use has been a new agenda for over a decade in the world. Particularly in hyper density cities such as Hong Kong, land use conditions are more complicated and different from general large cities and the conflict between growing demand from urban development and limited land supply is more prominent. To facilitate sustainable land use in hyper density cities, this paper looks into land use conditions/characteristics in such cities by examining Hong Kong's land use practice as a real case. Firstly, land demand and supply in Hong Kong are both analyzed. Secondly, the statutory and administrative procedures of land development and allocation are reviewed. Finally, problems in the current land use system are also identified and discussed. The findings can serve as a useful reference for specific further research on sustainable land use in compact/high density cities.

INTRODUCTION

Land use varies among different cities due to different characteristics of terrain conditions, population, legal restrictions, and culture, etc. For example, in a city with high population density, the pattern of land use is always compact, mixed and efficient. In contrast, if a city has low population density or hilly terrain, a reasonable land-use layout (urban form) which can provide convenient living services to the citizens is usually more important than exploring the potential of efficient land use. Land use policies should be made according to local characteristics of land use and development in different countries and even cities. Although the policies may differ in specific standards and regulations, they have a common objective – to adapt the practical land-use conditions and serve for building a sound legal system of land development and management. In metropolises, basically, large population and employment are continuously being attracted there and the land becomes relatively scarce due to increasing demands of urban development. Hong Kong is a quite unique case because of its high population density but very limited space. As a result, land use in Hong Kong is much different from many large cities. In order to better support land use planning in such a high-density city, current land-use conditions and policies in Hong Kong need to be reviewed.

This paper describes the land use condition of Hong Kong from both demand and supply, and reviews the statutory and administrative procedures of land development and allocation in Hong Kong. The analysis on land demand and supply aims to explore the driving forces of land use changes. The summary of statutory procedures for land management helps locate the main aspects which are affecting the land-use allocation in practice. In addition, problems in current land use planning and management such as the difficulties in urban renewal are also analyzed.

LAND DEMAND AND SUPPLY IN HONG KONG

Land demand. As a world city in Asia, Hong Kong is an international financial and service center, serving as a hub for logistics and information services, and a premier tourist destination in the world (Shen et al. 2009). However, contradicting to its important role and huge demands from the world, Hong Kong has very limited land resources (approximately 1100 km^2). It consists of Hong Kong Island, Kowloon Peninsula and New Territories with many small islands, which are all dominated by hilly terrain, including 84% slope areas, unfavorable for urban and agricultural development, and only 16% small plains (Ye 1998). On the other hand, Hong Kong has over 7 million people and average population density reaches 6500 persons/km^2 (over 20000 persons/km^2 in metropolitan areas). How to accommodate the increasing demand of the large population and also a large number of travelers in such limited space is a long-standing question faced by the Hong Kong government.

Before discussing the land use policies in Hong Kong, two questions should be looked into: how much land is basically needed for maintaining the normal development and how much land could be continuously provided by the government.

According to the population projection made by Census and Statistics Department of Hong Kong, see Figure 1 (PD 2007), the population of Hong Kong will keep a steady increase in the next 30 years (0.7% average annual rate). Taking employment into consideration as well, under these assumptions of annual growth rate (population: 0.7%, GDP: 4.0-3.0%, employment: 0.6-1.2%), working population (referring to workers who are also Hong Kong residents) and employment (including the jobs filled by cross-boundary commuting workers) will both keep going up in the future, see Table 1 (PD 2007). As a result, more land will be needed to meet the demand of the population change.

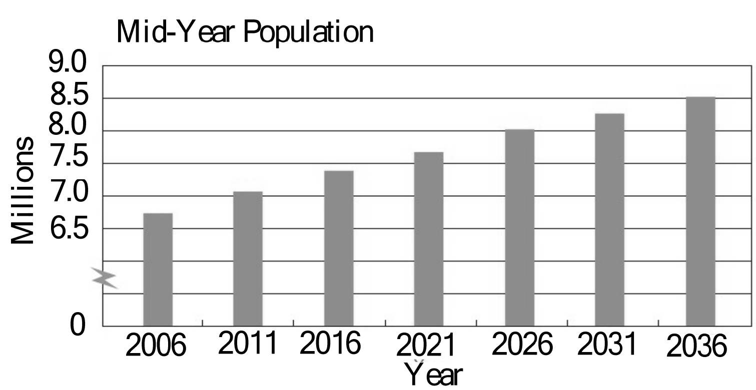

Figure 1.Projected population growth (2006-based).

Table 1.Population and Employment Projection.

	Base Year (2003)	2010	2020	2030
Resident Population	6.8	7.2	7.8	8.4
Working Population	3.2	3.6	3.8	3.9
Employment	3.0	3.5	3.7	4.0

(Unit: million)

To meet the needs of a growing population, one basic land demand is from housing. Housing problem is one of biggest troubles in Hong Kong for many years. Up to 2011, in contrast to mainland China's 31.6 m^2 in urban areas, the average living space (in GFA) per capita was less than 14 m^2 in Hong Kong (Wong 2011). Contradicting to the goal of provision of better living environment, Hong Kong faces a big challenge in providing adequate space for the larger and better housing. Not only should the quality of housing be improved, but also more houses need to be built for the increasing population. In the period between 2003 and 2030, a total housing demand of about 924,000 units (averaging about 34,000 per year) is assumed in the HK2030 Study; see Table 2 (PD 2007).

Table 2.Housing Demand Assumption.

	Base Year (2003)	2010	2020	2030
Housing stock	2394	2642	2948	3319
Accumulative Requirement	-	248	553	924

(Unit: thousand)

In addition, as a financial hub in the world, Hong Kong needs a durative land provision for economic activities serving both the local and global market. Corresponding with the characteristics of modern economic activities, the economic land use can be classified into three broad categories: (i) CBD Grade A Offices, (ii) General Business and (iii) Special Industries. According to an econometric model established to assess future floor space demand in the HK 2030 Study, the total employment-related floor space demand will amount to about 10.5 million m^2 in GFA in 2030. Taking into account the existing surplus stock and the need to accommodate a "natural vacancy" (referring to a level of vacancy that is normally present in the property market), the total requirement will be around 11.0 million m^2 in GFA. The details are displayed in Table 3 (PD 2007).

In addition to the land demand for housing and economic activities, much land is also needed for transportation and infrastructure development. The total land demand is really high due to the important role the metropolis plays. The figures estimated in the above are not easy to fill up because of limited land available.

Land supply. Unlike most of world cities, the built-up (developed) area in Hong Kong is only about 25% (less than 300 km^2) of the whole territory. Geographically, nearly 66% land is woodland/shrub land/grassland/wetland, including 46% country parks and special areas under statutory control. The land distributes in major ten types of land use, for example, residential, commercial, industrial, institution/open space and transportation, see Table 4 (PD 2011). These land uses consist of the whole territory of Hong Kong and the area of each sub class changed slightly from 2006 to 2010.

Table 3.Assumed Floor Space Demand and Requirements.

	Base Year (2003)	2010	2020	2030	Demand 2003-2030	Requirement 2003-2030
CBD Grade A Offices	4.1 (10%)	5.1 (11%)	5.8 (12%)	6.7 (13%)	2.6	2.7
General Business	33.00 (80%)	35.5 (77%)	36.2 (76%)	38.2 (74%)	5.2	5.4
Special Industries	4.0 (10%)	5.5 (12%)	6.0 (13%)	6.7 (13%)	2.7	2.9
Total	41.1 (100%)	46.2 (100%)	47.9 (100%)	51.6 (100%)	10.5	11.0

Table 4.Broad Land Use Distribution in Hong Kong.

Class		Sub-class	Approximate Area (sq.km)				
			2006	2007	2008	2009	2010
Developed Lands	Residential		75	75	75	76	76
		Private Residential	25	25	25	25	25
		Public Residential	16	16	16	16	16
		Rural Settlement	34	34	34	35	35
	Commercial		3	3	4	4	4
		Commercial/Business and Office	3	3	4	4	4
	Industrial		24	24	25	25	26
		Industrial Land	7	7	7	7	7
		Industrial Estates	3	3	3	3	3
		Warehouse and Storage	14	14	15	15	16
	Institution/Open Space		46	47	48	48	49
		Government, Institution and Community Facilities	24	24	24	24	25
		Open Space	22	23	24	24	24
	Transportation		55	57	57	58	56
		Roads	39	41	41	42	40

Table 4.(Continued).

	Class	Sub-class	Approximate Area (sq.km)				
			2006	2007	2008	2009	2010
Developed Lands	Transportation	Railways	3	3	3	3	3
		Airport	13	13	13	13	13
	Other Urban or Built-up Land		55	53	52	52	52
		Cemeteries and crematoriums	7	7	7	8	8
		Utilities	7	7	7	7	7
		Vacant Development Land/Construction in Progress	20	19	17	16	16
		Others	21	20	21	21	21
Sub-total			258	259	261	263	263
Non-built-up lands	Agriculture		68	67	68	68	68
		Agricultural Land	51	51	52	51	51
		Fish Ponds/Gei Wais	17	16	16	17	17
	Woodland/Shrubland/Grassland/Wetland		744	744	742	740	740
		Woodland	245	247	241	234	254
		Shrubland	228	237	238	241	303
		Grassland	266	255	258	260	178
		Mangrove and Swamp	5	5	5	5	5
	Barren Land		9	9	8	8	7
		Badland	5	5	5	5	2
		Quarries	2	2	1	1	1
		Rocky Shore	2	2	2	2	4
	Water Bodies		29	29	29	29	30
		Reservoirs	24	24	24	24	25
		Streams and Nullahs	5	5	5	5	5
Sub-total			850	849	847	845	845
Total			1108	1108	1108	1108	1108

Because of the land scarcity, Hong Kong government has to face challenge in land supply and to search for solutions to provide adequate land to meet the demand. By far, there are two main sources of land supply in the city: government land and private sources (Legislative Council 2004b). Government land is provided by the government through land sales to general developers, and private treaty grants to approved bodies for specified uses. Developers can also procure land from other private land owners in the open market. In addition, private land owners can redevelop their own land according to the town plan and land lease conditions. As displayed in Table 5, from 2005 to 2010, the majority of government land was provided through the means of private treaty grants for specified uses, usually public utilities or non-profit-making purposes. Land exchange and lease modification, to some extent, reflect the frequency of activities of land redevelopment and reutilization, and indicate the vibrancy and stability of the land (real estate) market. Actions of lease modification and land exchange are driven by market forces and private developers can achieve their development plans through seeking lease modifications or land exchanges in the market. Table 6 shows the number changes in the two kinds of approved transactions from 2005 to 2011. The two ways may be chosen by private developers complement the source of land supply by the government.

Table 5.Supply Records of Government Land in Two Means (2005-2011).

Year	Auction/Tender		Private Treaty Grant		Total Land Area (ha.)
	Land area (ha.)	Percentage	Land area (ha.)	Percentage	
2005/2006	3.30	2	138.30	98	141.60
2006/2007	7.79	8	94.67	92	102.46
2007/2008	11.46	6	167.20	94	178.66
2008/2009	2.45	2	151.46	98	153.91
2009/2010	5.97	3	180.13	97	186.10
2010/2011	15.04	9	147.14	91	162.18
2011/2012	35.71	89	4.50	11	40.21

Note: raw statistics from Lands Department

Table 6.The Number of Approved Applications of Land Exchange/Lease Modification (2005-2011).

Year	Land Exchange	Lease Modification	Total No.
2005/2006	25	72	97
2006/2007	15	104	119
2007/2008	13	128	141
2008/2009	15	224	239
2009/2010	12	127	139
2010/2011	20	108	128
2011/2012	12	77	89

Currently, there are six land supply options provided by the government: Rezoning land, Land resumption, Rock cavern development, Redevelopment, Reclamation and Reuse of ex-quarry sites. The existing land supply approaches are selectively adopted to maintain the land provision for increasing land demands every year. In fact, they have both advantages and disadvantages for land development.

For example, Rezoning and Redevelopment are market-driven but unpredictable. Resumption may disturb the local residents and Reclamation may cause some environmental issues. The details about the six options are discussed in Table 7 (CEDD 2011). In the past, reclamation was one of the main solutions to the land shortage problem, and it can produce new flat land along the coast. In recent years, the pace of reclamation has dropped dramatically. One of the main reasons is strong public aspiration of protecting and preserving Victoria Harbour as a special public asset and a natural heritage. The general public protests against the reclamation inside or near the harbor because the excessive reclamation may lead to environmental and landscape deterioration.

Table 7.Six Existing Land Supply Options.

Option	Definition	Key Limitation/Challenge
Rezoning Land	Rezone under-utilized sites and lands that no longer perform their original functions for housing or other uses	A longer process may be required due to the involvement of private owners and developers or different Government departments Timing of development is less predictable because the actual development hinges on market response
Redevelopment	Redevelop the older urban areas or individual buildings through re-planning and re-building to improve the local environment and better utilize the land	Less predictable because private owners and developers take the leading role comparing with other options implemented by the government
Land Resumption	Exercise statutory power to compulsorily take over private lands for public purposes	Local resentment may be caused if residents wish to maintain their rural lifestyle or are not satisfied with the compensation or re-housing arrangement Low flexibility in land use due to only designated purposes for the land acquisition
Reclamation	Create usable land over the foreshore or sea-bed	Much more emphasis is placed on reducing and mitigating the impact on marine ecology
Rock Cavern Development	Place new facilities inside caverns and relocate suitable existing government facilities into rock cavern to release the sites for housing or other uses	May be applicable to many uses only if the public can accept daily activities inside cavern
Reuse of Ex-quarry Sites	Rehabilitate the platforms formed in ex-quarry sites as a source of new land	Limited sources and only be available upon quarry closure

To ensure a sufficient land supply for Hong Kong's development, several government departments collaborate with each other and each of them takes specific responsibilities (see Table 8). In 2011, a study titled 'Enhancing Land Supply Strategy: Reclamation outside Victoria Harbour and Rock Cavern Development' was conducted by a consultant firm (ARUP) who was commissioned by Civil Engineering and Development Department (CEDD), and the first stage of this study - Public Engagement was arranged by multiple hosts: Development Bureau, Planning Department (2004) and CEDD. The government also plans to allocate a large amount of fund (about HKD 300 million) for public engagement exercise to examine the options of reclamation outside the harbour and rock cavern development in the following few years. It can be believed that the two kinds of land supply options will play an important role in new land provision after the feasibility study on them as well as public consultation.

Table 8.Government Departments/Bureaux Involved and Their Roles in Land Supply.

Government Department/Bureau	Major roles/responsibilities
Development Bureau	Facilitate effective land use planning as well as a steady and sufficient supply of land
	Achieve the optimum use of land resources and maintain an effective land administration system
	Manage an efficient system for registration of land
Environment Bureau	Develop policies covering environmental protection
	Facilitate the integration of sustainable development into new government initiatives and programs (e.g. sustainability assessment)
Transport and Housing Bureau	Make policies on matters relating to Hong Kong's internal and external transportation
	Maintain a fair and stable environment to enable sustained and healthy development of the property market by ensuring adequate land supply and the provision of an efficient supporting infrastructure
The Land Registry	Ensure secure, customer friendly land registration and information services
	Advocate reform of Hong Kong's land registration system
Planning Department	Coordinate planning matters
	Prepare OZP, ODP
	Carry out necessary land rezoning
Lands Department	Process land resumption
	Coordinate clearance matters
	Issue possession license

Table 8.(Continued).

Government Department/Bureau	Major roles/responsibilities
Civil Engineering and Development Department	Prepare and handle site formation and infrastructural work contracts including gazettal actions
	Coordinate fill management
	Comment on slope stability and geotechnical matters
	Advise on blasting matters
Buildings Department	Provide services to owners and occupants in both existing and new buildings in the private sector
	Make the built environment of existing buildings safe and healthy
	Approve building plans, audit construction works and site safety, and issue occupation permits upon completion of new buildings
Transport Department	Coordinate major traffic planning matters
	Comment on Traffic Impact Assessment (TIA)
	Advise on road layout and capacity
Environmental Protection Department	Comment on Environmental Impact Assessment (EIA)
	Advise on environmental nuisance control requirements
	Control marine dumping
Highways Department	Advise on road construction materials and maintenance responsibilities
	Comment on road drainage design
	Prepare gazettal actions under the Roads Ordinance
Water Supplies Department	Advise and make provision for water supply
Drainage Services Department	Advise and make provision of drainage connections
	Advise on drainage design and maintenance responsibility
	Comment on Drainage Impact Assessment (DIA)

Note: ODP refers to Outline Development Plans.

In the long run, more land is required to accommodate the population growth and economic development, and to cope with rising public desire for quality living and heritage conservation. Meanwhile, under the circumstance of decline in reclamation, a more flexible and resilient land supply strategy is needed to respond to the changing demand stemming from the complex uncertainties in society and the challenges faced by the land supply options. Land reserve is an effective approach to ensuring timely supply of land. At present, land reserve can be established in three forms: 1) land is formed first for ready use when the needs arise; 2) potential sites are identified with the necessary studies and design work; 3) potential sites meeting the criteria of site selection are reserved. With the presence of land reserve, land can be provided flexibly in correspondence with three establishing forms: 1) land in the land bank can be allocated for temporary use before a permanent land use is determined; 2) construction works can commence immediately when the need is confirmed; 3) further studies to make certain the feasibility of the potential sites and design works can be conducted directly and pertinently after the need is proposed.

MECHANISM OF LAND-USE ALLOCATION

As stated in the Basic Law of the Hong Kong Special Administrative Region of the People's Republic of China (CAB 2006), "The land and natural resources within the Hong Kong Special Administrative Region (the SAR) shall be State property. The government of the SAR shall be responsible for their management, use and development and for their lease or grant to individuals, legal persons or organizations for use or development. The revenues derived therefrom shall be exclusively at the disposal of the government of the Region." (Article 7) In practice, the duties stipulated in Article 7 of the Basic Law, including managing, developing and leasing land in Hong Kong are discharged by the Chief Executive and officials authorized by him, on behalf of the Hong Kong SAR Government.

Over the years, Hong Kong government has attempted to optimize land use and promoted economic development with a vision to enhancing the living environment for the Hong Kong residents. Given the scarcity of land in Hong Kong, land grant is adopted by the government. In order to fully utilize such precious natural resources, land use planning should be determined in line with the development needs of whole society. Under these circumstances, the government will then develop the planned uses in regard to the resource availability and development priorities, or will lease the land to individuals, legal persons or organizations for their use or development.

In addition to maximizing the provision of land, Hong Kong government should regularly review its policy of using land resources and timely provide more available land by improving the efficiency of land-use management. For example, the government has been urged to subsidize commercially operated infrastructural projects through financing arrangements, and supply land through market mechanism and fair competition. Land is also reserved for other developments which are compatible with the public interest, apart from reserving sufficient land for public housing development.

Application list system for land sales (perspective of land management). The government's land allocation policy is based on the principle of fairness and transparency. Here the term of "land sale" is not actually selling the land but the land use right. In Hong Kong, the core of the land system is that land users pay for the right of land use within certain periods on the principle of the separation of land use rights and land ownership. The land can be granted mainly through open bidding (such as land auction and tender) for commercial, residential and other private developments. The land grants system experienced a series of changes over time. Before 1997, land was mainly granted through scheduled land auctions and tenders following the one-year land sale program (LSP). In 1999, an application list system (ALS) was introduced as a supplement to the LSP to enable the market to flexibly determine the amount, timing and type of additional land required (Legislative Council 2004a). Under the ALS, a developer with interest in any land site on the application list can apply for buying this site from the government by offering his/her minimum price first. If the government thinks that the minimum price offered is reasonable and acceptable, the site will be put up for sale by tender or auction as appropriate. The offered price will be taken as the upset price and the site will be sold to the highest bidder ultimately.

Under the annual LSP, the Lands Department of Hong Kong publishes a list of sites available for sale upon application (Application List). The Application List includes information about lot number, location, use, site area and the estimated earliest available date for each of the sites. The application procedure for land sale is described in Figure 2. After the open bidding, the land provided by the Lands Department goes to the highest bidder and the bidder can hold the land use right for a certain lease term (up to 2047 for the lease newly signed after 1997). The price at which the land is sold reflects the prevailing market value of the land concerned. It is government's policy that the land will not be sold at a pathetic price. It means that, if the land site cannot be sold at the upset price or above in the public auction, the government would withdraw the land sale. Actually, there have been two temporary suspensions of land sales with the Application List since 1997; one was nine months from June 1998 to March 1999 and the other from November 2002 to the end of 2003. After the last suspension in 2002-03, the land sales were regularly conducted from 2004 to now (Lands Department 2005).

In addition to open bidding, the government also grants land by means of private treaty to non-government or private organizations under certain circumstances. This way of granting land has been in use for a long time for the purpose of meeting social needs. It is mainly adopted for land assigned to community use or for public utility purposes. Examples include non-profit making community uses such as schools, welfare and charitable organizations, as well as land for essential public utility services like power station and land for certain policy promotion like Science Park. The level of land premium charged on the land grants depends on the uses of the land (Legislative Council 2005). For instance, nominal or concessionary premium is normally charged for non-profit-making community/public uses, and full market premium is usually charged for commercial land uses such as power station (see Figure 2).

Control system for land development (perspective of land planning). The objective of town planning of Hong Kong is to provide a living environment which is comfortable and safe. It meets the needs of social development, achieves sustainable development and benefits the next generation (Legislative Council 2005). In Hong

Kong, Town Planning Ordinance (TPO) stipulates Town Planning Board (TPB) to make statutory plans including Outline Zoning Plans (OZP) and Development Permission Area (DPA) Plans. During the plan-making process, if necessary, specific studies serving the planning are required to finalize the plans. Similar to planning applications, requests for changing land use zoning submitted by the public are also processed by the TPB. This administrative practice is formalized and enhanced in the Amendment Ordinance (PD 2004).

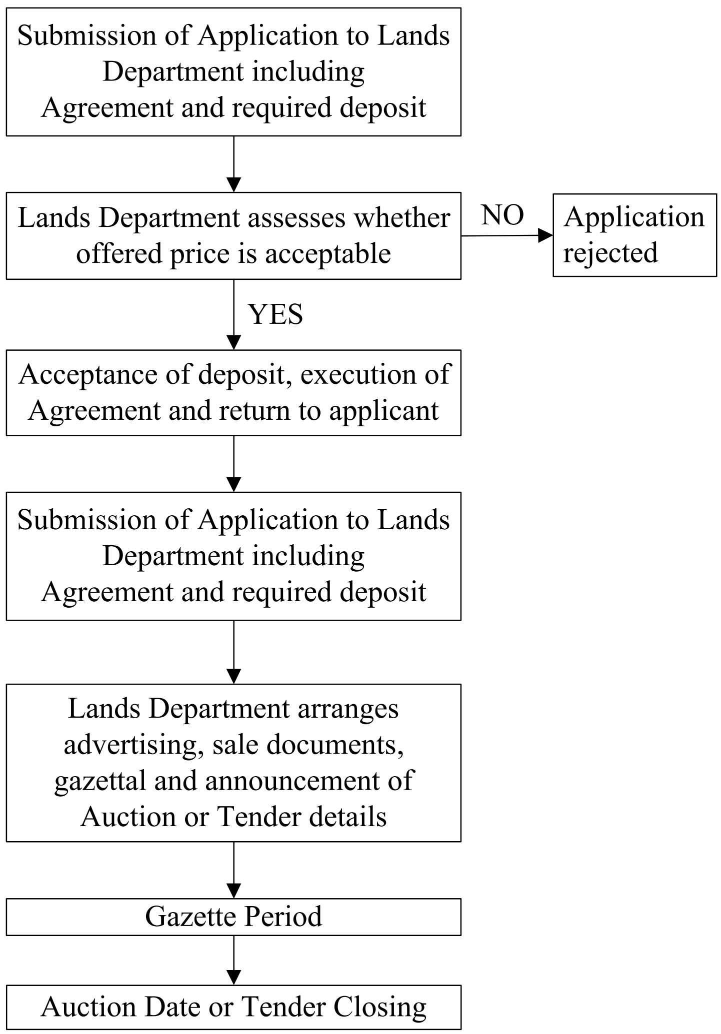

Figure 2.Application procedure for land sale.

According to the nature of uses, land in Hong Kong is classified into 18 broad categories including residential use, commercial use, industrial use, etc. (TPB 2008). These categories enable greater flexibility in the use of land, and facilitate the interchange of the land uses under the same broad use granted by planning permission. On the whole, the 18 land use categories relate to several main aspects of society, such as residence, manufacturing (including industry and agriculture), services sector (including commerce, recreation, education, medical service and other public utilities), and transportation, etc. In Hong Kong, land use planning and control is carried out at two levels: territorial/strategic and district/local (site level). As a result, types of plans are implemented at different levels (see Figure 3). During the territorial planning, the main task is to predict the land demand and supply for all kinds of land uses and plan the land use allocation correspondingly. In contrast, analyses on the quantity (area) of land demand and supply do not make sense for site-level planning. Site selection for specific land uses is the major work in this level.

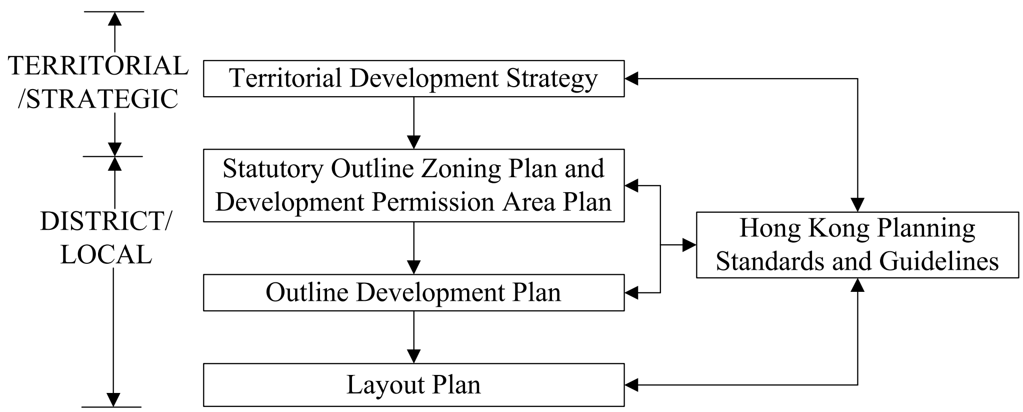

Figure 3.Plans involved in the two-level planning process.

When a piece of land is selected for development, it must comply with the OZP in which the site is located. Figure 4 shows the application process of land development. As depicted in the diagram, sites with different land uses have different development processes. TPB sets the development requirements and controls the development processes. The varied procedures enable a more flexible environment for developers. If the plans made by developers are classified into usually permitted use, they can be proceeded to get other approvals such as land lease modification and building plan submission instead of waiting for the approvals from TPB. It makes the development process more efficient by reducing the cost and time.

Continuous public engagement. Public participation and support is the key to success in any planning process/system (Legislative Council 2005). In Hong Kong, major strategic and development plans drafted by the government are required to be reviewed by the public from time to time to collect the views from the citizens and merge the public needs into the plan revision. It is an effective way to cope with the changing environment and the desire of the public for the development in different regions or areas. Kai Tak Planning Review is a good example. Kai Tak airport was closed in 1998 and left a large piece of land to be redeveloped in the metropolitan area of Hong Kong. The redevelopment of Kai Tak is a big issue for the government and surrounding residents. Since the planning for Kai Tak started over ten years ago, many rounds of public consultation have been conducted to gather the views from the public. Public consultations in the form of forums and community workshops aim to ensure that the development proposal to be carried out will not only take into account the local characteristics of the area/zone to be developed but also meet the public aspiration. Like Kai Tak redevelopment project, planning reviews for other projects are similar and successful in collaborating with different stakeholders for the better future of the community. In the future, this planning policy will continue to actively engage the public in every planning process to ensure that the current planning system/mode not only satisfies the physical demand of land in quantity, but also reflects the common desires of the public with regard to the certain development projects and also the future landscape of Hong Kong (see Figure 4).

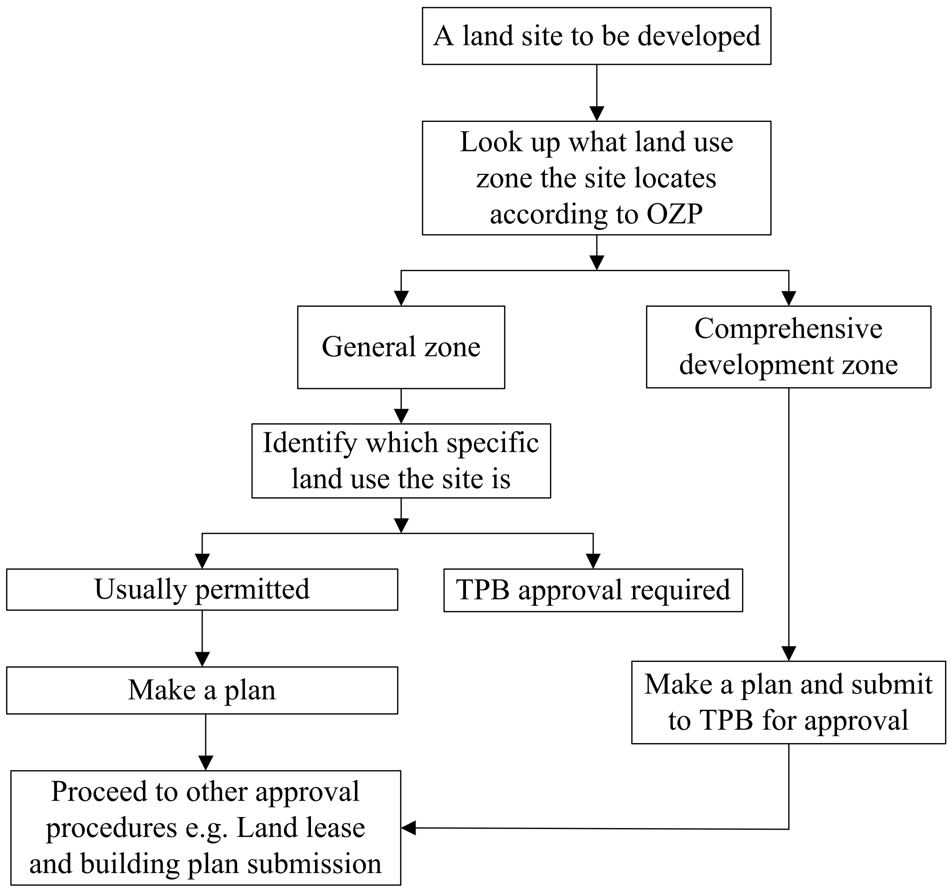

Figure 4.Application process of land development for specific uses.

PROBLEMS IN CURRENT LAND USE SYSTEM

To ensure economic growth in the long term, a flexible land provision mechanism should be developed and adopted by the government. Although six land supply options have been identified and land reserve is being established for adequate and flexible land provision, some problems still exist in the current land use system.

Inherent shortage of land. The fact that Hong Kong has a small territory but a large population cannot be changed, so that the government must efficiently utilize the land available to accommodate the increasing demand from population growth and economic development. In view of this inherent constraint, the government should not only create new space through reclamation or rock cavern development, but also explore land potential and improve the efficiency of land use by rezoning and redeveloping the under-utilized sites and old areas. Only increasing the land in quantity/amount is not enough to catch up with the pace of land demand, and an efficient land use/reuse mechanism managing the land resource in quality is required. Land reuse in urban renewal is an effective way to maximize land use efficiency and improve the built environment (Wang et al. 2013).

Regarding the housing issue, the objective of Hong Kong government is to ensure timely provision of adequate land and infrastructure for the development of housing and community facilities. However, the supply of affordable housing is still lagging behind the public needs. According to an annual report published by Housing Authority (2011), the waiting list for public housing application is becoming longer during the past ten years (increasing from 108,000 live applicants in 2000/01 to 152,000 in 2010/11), and the average waiting time for the applicants to be allocated with public housing in 2010/11 was about 2 years. Comparing with other cities in mainland China, average living space per person for public housing is much smaller. It had only 2.1 sq.m increase from 2001 (10.7 sq.m) to 2011 (12.8 sq.m).

Difficulties in urban renewal. The redevelopment works are not easy to accomplish because of some difficulties in urban renewal, such as resumption of land, coordination between governmental departments, and public protest and problems of social equity. For example, urban redevelopment in Hong Kong is mainly restricted to the multiple ownership of the land and buildings within potential redevelopment sites, and most of the sites on which sporadic high-rise old buildings (commonly called “pencil development”) stand are small (Adams and Hastings 2001). This constraint leads to lengthy negotiations for land resumption of a number of small lots assembling into a larger site for redevelopment. During the implementation of urban renewal projects, many stakeholders are involved in the planning process, such as governments, developers and local residents. They have their own aspirations in the renewal projects and interact with each other for frequent negotiations (Wang et al. 2013). It is really a difficult task to reach a consensus among the different parties. Under these circumstances, an urban renewal project often takes a long time to complete starting from the feasibility study of the proposal, and the timing of redevelopment is always unpredictable. In addition, the impact on surrounding residents is also an unavoidable issue. People who live in the renewal area are affected, and sometimes are disturbed more or less. Anyway, urban renewal plays a key role in improving living environment in urban developed areas and reshaping the image/landscape of cities. The government needs a way to shorten the time of redevelopment and improve the communication among the different stakeholders for reducing the impacts on local residents.

Procedure and regulation amendments. Although Hong Kong has a set of existing statutory procedures and codes in managing land planning and development, some of them may be out of date and some can be simplified. In many cases, large projects need a long time, usually over 10 years to be completed partially due to the outdated regulations in an increasingly complicated land administration system. Particularly, it often takes a long time for the feasibility analysis in urban renewal projects. Therefore, simplifying and shortening some procedures are necessary for the government to improve the efficiency of management and further benefit the investment environment for Hong Kong. The point for the regulation updates is to facilitate a balance which can both meet adequate public participation and time saving during the projects. Last but not least, as discussed in the previous paragraphs, the coordination of different governmental departments which are involved in land planning and development with different responsibilities is also a key issue in terms of the efficiency improvement for town planning and land development.

CONCLUSION

Over the years, Hong Kong government has attempted to ensure an adequate supply of land together with the necessary supporting infrastructure to meet market demands in a timely manner. It is a big challenge for the government to continually supply sufficient land to meet the changing market demands and the needs of the prevailing market conditions.

This paper comprehensively introduces land use practice in Hong Kong. The picture of Hong Kong's land utilization is shown from both land demand and supply: the demand from different land uses and the land supply measures are described respectively. In addition, the mechanism of current land-use allocation is analyzed from two perspectives: land management and land use planning. Finally, major problems in the current land use, in particular, urban renewal projects are identified.

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Study on the Potential Evaluation of Intensive Urban Land Utilization: A Case Study of Harbin City

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Abstract

With the rapid growth of economy and urbanization of China, the demand of construction land has been increasing. Meanwhile, the urban construction land use is widespread inefficient. On the one hand, this phenomenon influenced the step of modernization to a great extent; on the other hand it caused a great waste of land resources. It is necessary to improve the urban land utilization and a method of intensive utilization of land is highly required. This study opened with an observation about the present condition of land use of Harbin, proceeded to discuss the basic characteristic and main limitation of land use in Harbin. It focuses on the selection of indicators and the establishment of the model to analyze the inner potential of land use in Harbin. And corresponding measures is suggested. Evaluation methods applied in this paper, such as the evaluation of the land use intensity and other evaluation index will provide innovative theory and reference of urban land intensive utilization potential evaluation for other developing cities.

INTRODUCTION

Rapid socioeconomic development and urbanization are leading to significant changes in land use of China in recent decades. On the one hand, the rapid expansion has been boosting the progress of modernization of China, but as a negative result of this, large areas of high quality agricultural land have suffered encroachment through urbanized land, which is likely to have an impact on the future food security of China and even to have cumulative effects on climate change. As China has a quite large population and limited amount of land resources in rapid economic development period, intensive utilization of urban land is highly needed. As China sets set to continue its drastic course of socioeconomic transition, a thorough study of intensive utilization of urban land is necessary, in order to be able to grasp the current extent of intensive utilization of urban land in China and to offer policy makers useful information as to the best directions for future sustainable development. This study combined with intensive use of land in the new era background and based on the basic theory of intensive land use, comprehensively analyzed the current situation of Harbin city and evaluated the level of intensive use of urban land. Then put forward the suggestion and measures to promote the intensive use of land. I believe the product of this research may provide references to the study of potential of intensive urban land use of other cities.

ANALYSIS OF THE CURRENT SITUATION OF LAND USE OF HARBIN CITY

Harbin city is located in the northeast China with 53100 km^2 of land area and it's the biggest center city in northeast China. Harbin city has 8 districts including Nangang district, Daoli district, Xiangfang district and 10 counties (cities) including Wuchang city, Bayan County, etc. Harbin city has a population of more than 12 million and over 5 million in the main city area by the year of 2013.

Process of Harbin land use extension. From the total amount of urban construction land growth, the area of city construction land increased year by year in the past 35 years, from 391.28 km^2 in 1976 to 707.55 km^2 in 2010, increased by 1.8 times (Feng and Liu 2013). Therefore, in the past 35 years, the urban land expansion of Harbin is very clear, as shown in Table 1 and Figure 1.

Table 1.The Area of Harbin Urban Land Use from 1976 to 2013.

Year	1976	1989	1995	2000	2006	2010
Construction area (km^2)	391.28	473.70	556.04	606.23	655.64	707.55
Average annual growth rate(km^2/year)	--	5.89	11.76	8.36	7.06	10.38

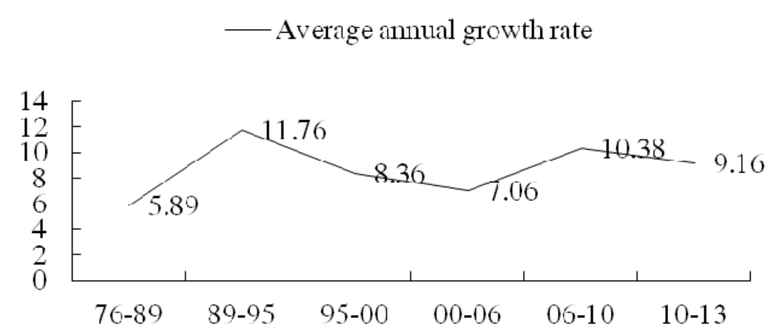

Figure 1.Average annual growth rate of Harbin urban land use area.

As the table and figure above show, from the annual average increase rate of urban construction land area, the growth trend of Harbin urban land expansion waved a long time. From 1976 to 1989, the annual average increase rate of area increased slowly maintained at about 5.89%; from 1989 to 1995 urban land area went up sharply to a peak of 11.76% for the first time; From 1995 to 2006, the progress was steady then a great leap forward and went steady after then.

Analysis of structure of Harbin city land use. Structure of urban land use refers to the proportion of multiple functions of land use in city and the influence of each other. The structure of urban land use results from rational allocation of land resources and is also a reflection of industry layout in space. To a large extent the structure of urban land use influences the efficiency of the city and the performance of main functions the, determining the image of the city. By the structure of land use in Harbin we can see that the trend of Harbin urban construction land has increased year by year. The residential land has increased every year, which means real estate investment has maintained a good momentum of development.

THE PROBLEM OF LAND USE IN HARBIN

Irrational structure of urban land use. The irrational phenomenon of land use in Harbin lies in these aspects: small proportion of the land for green space and square road while relatively large proportion of industrial land. In 2011, the land for green space and square road in Harbin were 10.3% and 8.4% respectively, while the figure of industrial land was 23.2%. And in the urban planning standards of the world, green space should be accounted for more than 15% of the built up area, and industrial land should be less than 15% of the built up area (see Table 2).

Table 2.Compare of Urban Land Use Structure between Harbin and National Standards in 2011.

Types of land use	Ratio to construction land (%)	National standards (%)	Land use per capita (m^2)
Residential land	30.1	20-32	23.36
Industrial land	23.1	15-25	17.99
Green space land	9.4	8-15	7.32
Square road land	9.9	8-15	7.78

As we can see from Table 2, comparing with relevant national standards, the urban land structure of Harbin was on the average level in the proportion of residential land and industrial land. The proportion of green space and road square land was a slightly higher than the bottom line of the national standard. So in the future development of Harbin, the configuration of land use need tilt to road square land and green space and in this way can the second and third industry get to develop and the living environment could improve.

Unbalanced utilization level of city land. In the process of Harbin urban expansion appeared a lot of new districts and development zones, such as Songbei district. These areas usually tend to waste phenomenon and low rate of land utilization. A lot of land has been left to “dry” after expropriated or leasehold due to financial difficulties or other reasons. And the old town is densely populated with high building density. In the aspect of per capita land area, the lowest part is a quarter of the highest part. Such as Daoli district, the area of construction land is only 38.6 km^2 while population has reached 731500, and the population density is 18951 people/km^2. Most of the buildings are low-rise with low plot ratio, crowded and barely space available. The construction land area of Songbei district is 26.9 km^2 and a population of 211,000 (Haller 2014). The population density is 7843 people/km^2 (only two fifths of Daoli District). The imbalance of land use is still increasing with the expansion of the city.

Large demand of construction land and growing contradiction between land supply and demand. This part aims to analyze the growing demand of construction land and the more and more serious contradiction between land supply and demand. The following Table 3 shows relationship between scale of construction land and population growth:

Table 3.Relationship between Scale of Construction Land and Population Growth.

Year	Construction land area(km^2)	Population of main-city(100,00)
2005	318.06	398.96
2006	331.21	472.72
2007	336.00	475.48
2008	340.00	475.10
2009	345.00	474.68
2010	345.30	471.70
2011	346.71	471.50
2012	347.33	471.36
2013	349.21	473.60

As shown in Table 3 above, with the acceleration of urbanization and industrialization, the population of urban area has been increasing and the demand of construction land went up, leading to obvious contradiction with agricultural land. Harbin is of great importance in the revitalization of northeast old industrial base, and is also the developed area economic trade of Northeast Asia. With the progress of science and technology and the development of modern industry, the industry of Harbin gets to rapidly develop. The increasing population and the gradual adjustment of industrial structure at the same time make the sharp increase of construction land, leading to serious imbalance of land supply and demand.

Insufficient space of urban human settlements. With the expansion of urbanization and the continuous improvement of people's living standard, the city's function has been changing and the demand for public space has been growing day by day. The lack of urban function and the new demand of development led to the relative lack of the city public space, mainly manifested in the urban public green space area, parking lot and restricted public leisure fitness place.

MACROSCOPIC EVALUATION OF INTENSIVE LAND USE IN HARBIN

Index system and data of evaluation. Referring to previous research results, considering the level, importance, and the reliability of the economic, social and ecological data, this part took in 20 indicators (including four aspects: intensity of land input, intensity of land use, economy of land and ecological environment of land use) to build a comprehensive evaluation index system, which is shown in Table 5. In this paper, the original data sources are from the following reports: "Statistical Bulletin National Economic and Social Development in Harbin 1992-2011", "The Statistical Yearbook of Harbin 1992-2011", "The Statistical Yearbook of Heilongjiang Province 1992-2011", the data used in the evaluation methods was calculated and classified by the original data (National Bureau of Statistic s of China 2011). This paper did not list everything because of limited space. Then it applied multi-objective comprehensive evaluation method to calculate the value of the urban land intensive utilization: $Di(Wc)=\sum_{j=1}^{n} b_{ij}w_{cj}, i=1,2,\ldots,n$.

Analysis of the result of Harbin land use intensive degree. According to the principle of urban land intensive utilization evaluation and the established index system, using the optimal combination method to determine index weight. Then it adopted the multi-objective comprehensive evaluation method to analyze the situation of Harbin intensive land use from 1991 to 2010. The weights of evaluation index values are shown in Table 4.

The indicators above can be used to evaluate the level of Harbin urban land intensive utilization from the following four aspects: levels from land input, benefits of land outputs, degree of land use, ecological benefits of land use (Huang et al. 2009). Level of land intensive utilization can be expressed as: $Di(Wc)=\sum_{j=1}^{20} b_{ij}w_{cj}, i=1,2,\ldots,n$.

In this equation, b_{ij} stands for standard values of different indexes and w_{cj} stands for corresponding weight of different value. Plug Wc into the equation, and calculate Harbin urban land intensive use level. The result can be described in a line graph so that we can preserve the past and foresee the future. And the trend from 1991 to 2013 is shown in Figure 2.

It can be seen from Figure 2, there is a downturn in the urban land intensive degree apart from individual year, as a whole urban land intensive utilization level of Harbin is on the rise. Harbin urban land intensive utilization level increased from 0.1857 in 1991 to 0.7252 in 2010 before a relatively stable growth (Wang et al. 2012). It suggests that Harbin urban land intensive use level has been improving year by year. By analyzing relevant data, basically it can be assumed there was two main reasons accounting for the decline of intensive degree in the three years: the first one is that the area of Harbin city all changed and the area of downtown increased. And the increasing parts have great influence to the whole intensive degree of the urban land; the second one is that in the three years, a lot of new districts appeared in the process of urban expansion of Harbin such as the Songbei district, Hulan district and some development zones, etc. It is the rapid expansion period of construction land area. For example, the area of construction land of Harbin in 1996 is 191.00 km^2, increased by 34.00 km^2 compared with the 157.00 km^2 of 1995. From 1991 to 1995,

Table 4.The Evaluation Criterion Weight of Intensive Land Use of Harbin.

Target layer	Rule layer	Index layer	Index weight
The level of land intensive usage	Land investment level	Fiscal spending per acre (hundred million RMB)	0.1274
		Fixed assets investment per acre (hundred million RMB)	0.0997
		Number of second and third industry practitioners per acre	0.0621
		Penetration of tap water	0.0084
		Penetration of gas	0.0425
		Number of hospital beds per ten thousand people own	0.0188
		Number of bus per ten thousand people own	0.0271
	Land output benefit	GDP per acre	0.0641
		GDP of the secondary and tertiary industry per acre	0.1144
		Retail sales of social consumer goods per acre (yuan/m^2)	0.0618
		Urban population density (people/km^2)	0.0365
	Land use degree	Area of housing per capita (km^2)	0.0433
		Area of construction land per capita (m^2/people)	0.0275
		Building volume rate	0.0778
		Density of building	0.0710
	Ecological benefits of land use	Greening coverage of Built up area (%)	0.0105
		Area of public greening coverage per capita (m^2/people)	0.0275
		Control rate of city wastewater discharge	0.0263
		Comprehensive utilization of urban solid waste	0.0255

the addition of urban construction land area is only 7.80 km^2, and by contrast 1996 is the rapid period of urban construction land expansion; city construction land area in 2004 is 293.00 km^2, also a rapid growth year. These new districts and development zones are often taken over without using. Unused land proportion has been going up and the overall intensity, on the other hand, has been decreasing.

CONCLUSIONS

This article takes Harbin city land intensive utilization as the research object to evaluate the level of urban land intensive use

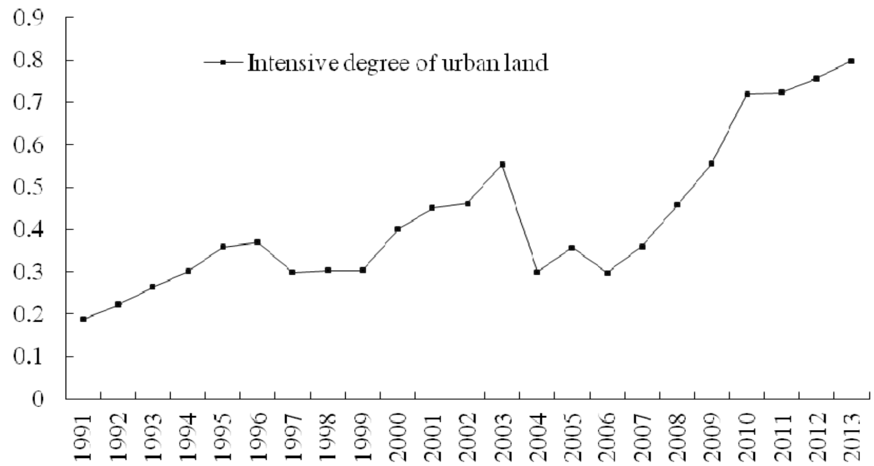

Figure 2.Urban land intensive level in Harbin in 1991-2013.

level in Harbin. Then put forward the several policy Suggestions as follows. Firstly, apply economic levers to strengthen the management of land market and promote the intensive utilization of urban land resources (Weng 2012). Secondly, optimize the urban land spatial layout and pay more attention to reasonable development and utilization of urban underground space resources. The development and utilization of underground space in Harbin has made big progress, but the legal system is far from perfect and it should really meet the need of economic development and people's life. Thirdly, establish the urban land access mechanism and respectively set land use standards of construction for different purposes for various industries. Fundamentally change the former old way of determining the urban land supply simply by investment scale. To those projects which have a smaller scale of development and construction and low level of land plot ratio, building density, unit investment and yields, the policy makers should make some restrictions.

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Analysis and Design of the Land Resource Dynamic Monitoring System Based on 3S Technology

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ABSTRACT

This paper studies and designs the land resource dynamic monitoring system, which makes the work more efficient, accurate and rapid response. Firstly, the current surveying and mapping technology, computer technology, network technology and communication technology are studied to design a land resource investigation subsystem, in which the data acquisition, processing, updating and achievement management are integrated. Secondly, based on the research of the rule drive model, a more flexible and efficient method of business flow construction is designed. Finally, the system structure, database, function module, key technology and etc. of the system are studied here. Though the system proposed in this paper, the intelligent land resource dynamic monitoring is realized. Meanwhile, it provides an important technical support and a brand new idea for land resource management.

INTRODUCTION

An accurate land use data is an important basis for scientific decision-making and development planning of the government. In recent years, while seeing rapid economic development, Shanghai also suffers from increasingly severe shortage of land. In the meantime, there have been significant dynamic changes in both rural and urban land use. What's worse, the data collected in the past on land use is now outdated whereas surveying and updating would entail huge workload and high expenses. Meanwhile, with current technology, it is rather difficult to furnish the government in time with accurate data critical for decision-making. Apparently, the Land Resource Dynamic Monitoring System is urgently needed to acquire a comprehensive, quick and accurate grasp of the status quo of land use as well as changes in it.

In recent years, with the rapid development of science and technology, great strides have been made in data collection, accuracy and efficiency while techniques for the storage, processing, analysis and application of massive data continue to be improved, which facilitate the construction of Land Resources Dynamic Monitoring System.

The rapid development of GIS technology together with the wide dissemination of database technology provides more various platforms and techniques for data storage, analysis and display. A myriad of software systems and solutions based on big data and cloud technology keeps springing up, which makes data organization, management, update and interaction more convenient and the applications of results and services more diverse (Giannaka et al. 2014; Hsieh et al. 2009; Li and Wu 2006).

Aviation and aerospace remote sensing technology have mushroomed and expanded into applications in civilian fields with its high-resolution, hyper-spectrum characteristics. Particularly, the low-altitude UAV remote sensing technology is focal point of current research (Rodgers and Méndez 2012). It is flexible to use and easy to deploy. Additionally, the data collected in this way is fairly precise. Due to these and other properties, it has become a crucial instrument for surveying and monitoring dynamically the use of land resources.

The widespread application of CORS technology has greatly enhanced the efficiency of field measurement and made it possible to collect precise information on three-dimensional coordinates of the target point in real time.

Laser scanner (LiDAR) can quickly obtain high-density point cloud data of the measuring object, comprising three-dimensional coordinates, color and gray-scale information (Yin et al. 2008; Zhou et al. 2013; Zhang and Cui 2011).

The rapid development of network communication technology has reversed the situation in the past where reliable, high-speed wireless data communication methods were unavailable. With 3G and 4G mobile communications technology, land surveyors can quickly send back results and in this way the goal of monitoring land use dynamically can truly be achieved.

Against this background, Shanghai Municipal Planning and Land Resources Administration established a "discovery-screening-survey-disposal" mechanism for dynamic monitoring of current land use. On the basis of the integration of 3S technology, computer and network communication technology, a dynamic monitoring system of land resources was designed in line with the situations in Shanghai.

OVERALL DESIGN

Objective of system design. Shanghai carried out land management information monitoring at an early time. By 2006, the city had already established a city-wide land use database and it has been progressively updating land use data. However, owing to technical limitations, approaches to update data have been rather monotonous and the data is mostly outdated. The database still cannot meet the requirements of dynamic monitoring of land resources. Therefore, the last round only represents an initial stage in informatization as it just introduced information technology tools on the basis of the original business model and did not innovate fundamentally the original businesses model and working mechanism.

With changes in management thinking, progress in science and technology, Shanghai Land Management Administration has set the goal of establishing a land resources dynamic monitoring system in line with the social and economic development of Shanghai. To ensure the expandability of business system processes and the inclusiveness of data, it has been proposed that the objective of system design should be to achieve "hardware diversity" and "unified platform". "Hardware diversity" is to provide a unified platform for a variety of data acquisition devices on the basis of common information systems and unified data standards while "unified platform" stresses data processing and the shift of management, which further evolves into physical storage and physical computing on the cloud.

System design. In line with the overall goal of “hardware diversity” and “unified platform”, a distributed operational system as shown in Figure 1 is proposed on the basis of the integrated application cloud technology and 3S technology. The system conducts physical storage and physical computing of data on the server side, and provides end users with cloud service of the application layer. In the terminal, the field data and information are synchronized, stored and processed by the application service driven by business rules that on the cloud.

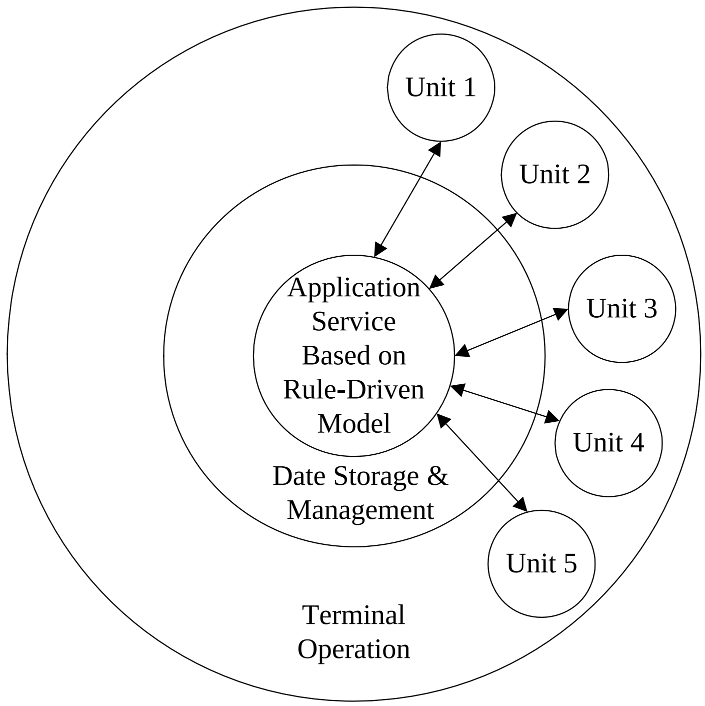

Figure 1.The schematic diagram of the goal-based business process.

System structure. As mentioned above, in this study the Land Resources Dynamic Monitoring System centers on the server and the business system provides various services including data storage and processing. As shown in Figure 2, the business operation terminal and the field data collection terminal are connected to the server through high-speed mobile communications network. Business executives, in accordance with the project control flow requirements, complete their work in all units through the terminals and after the work of a unit is completed, the terminal will automatically synchronize with the server.

The integrated field data collection terminal proposed in this paper is signified in the red box. The integrated system is made up of industrial tablet and GPS antenna / total station theodolite (TST) connected wirelessly through Bluetooth. Meanwhile, the system gains access to the centralized control service platform through 3G or GPRS network modules. Industrial tablet carries out positioning and measurement through operating GPS / TST. In the meantime, it operates the business system by using its own camera to take photographs or videos and by using the network access centralized control servers.

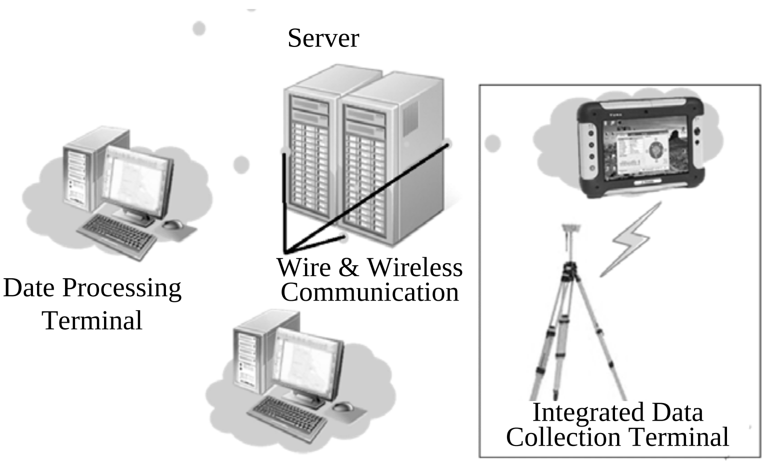

Figure 2.The structure of land resource dynamic monitoring system.

DESIGN OF LAND RESOURCE DYNAMIC MONITORING SYSTEM

Rule-driven system design. Referring to different types of existing business systems design, this paper adopts rule-driven model in system design. In contrast to existing information systems, when a business changes or is changed (for example, the introduction of new technologies leads to changes in the process) , this system will only need to maintain its rule base, create subunits on this basis, and then reconstruct business units as needed to update businesses.

Through identification and abstraction of entity objects, events objects and process objects, the business model for application system is reconstructed which includes:

(1) Rule Extraction. Break down business processes step by step, until atomic processes are formed. Extract business rules from atomic processes to form atomic rules. The whole set of atomic rules in the business system is known as the rule base, which is the core of the business system.

(2) Rules refinement. Further analysis of the atomic rules reveals that some similar rules can be further combined into a reusable atomic rule through parameter control. This step constitutes a further refinement of the rules and shows an improvement in the understanding of businesses.

(3) The construction of an atomic unit. Every atomic unit constructing is based on atomic rules. The input for every atomic unit is the conditions defined by its rules and the output is the processing result by the rules as shown in Figure 3. Atomic units have a self-checking mechanism which makes the project quality control in the atomic unit. And in this structure, the output may be the end result or it may also be an input of other units.

(4) The structure of business units. Every business unit is composed of the atomic units. And the business unit is the functional unit of specific business functions, similar to the node of common system. The business unit of atomic units has been able to achieve a single business function and the quality control and the role control. The changes and adjustments of business unit can be implemented by reassembled atomic units, and it is simpler and efficient compared to the common system.

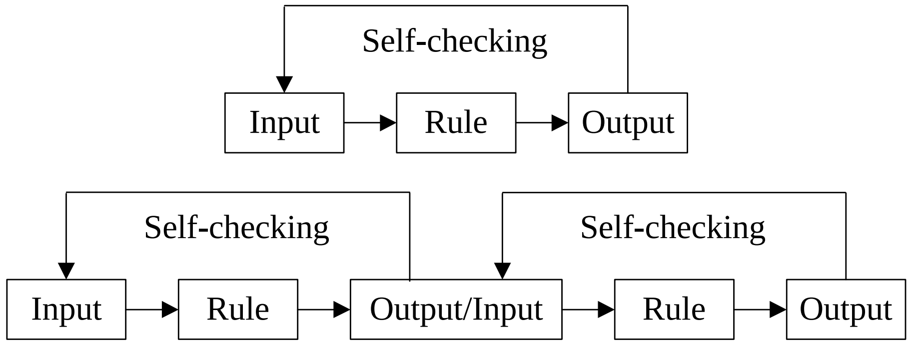

Figure 3.The structure of atomic units.

Rule-driven control flow of business system. Control flow is an abstract representation of the order of all possible events in the process of business execution. The atomic units mentioned in this paper constitute business units and the rules that finally form business processes are an actualization of the rule-driven model in the business system control flow.

To ensure dynamic, fast-response and timely monitoring of land resources, this paper proposes a control flow where a project is seen as a unit and which supports dynamic editing and extending. This control flow has the following characteristics:

(1) The control flow is built on the project level, rather than on the traditional business level. According to the specific project, the control flow can change at any time, to make it more suitable with the actual condition.

(2) The control flow is designed and edited as needed by system operators with designated rights or roles, rather than fixated after the system is developed. In this way, the System seems easier to maintain, and more flexible.

Staff roles in rule-driven business systems. Business systems built under the guidance of this design philosophy are both extendable and dynamic. Staff roles in such systems can be divided into three categories:

(1) Business supervisors, whose task is to work out the overall design. First, they will break down the whole business to obtain atomic rules. Then, they refine atomic rules to build atomic units. Finally, they construct the business system control flow, namely about reorganizing atomic units into business units to form a complete business;

(2) System development and maintenance personnel, whose task is to develop and implement. They implement business executives' design of a business in the establishment and operation of the system and meet business requirements dynamically and systematically;

(3) Business executive staff, whose task is to execute the business. They formulate rules of business units in compliance with the prescriptions of business control flow and the operation rights.

Example of control flow. According to the rule-driven model, a control flow in line with the actual situations in the dynamic monitoring of land resources in Shanghai was designed as Figure 4:

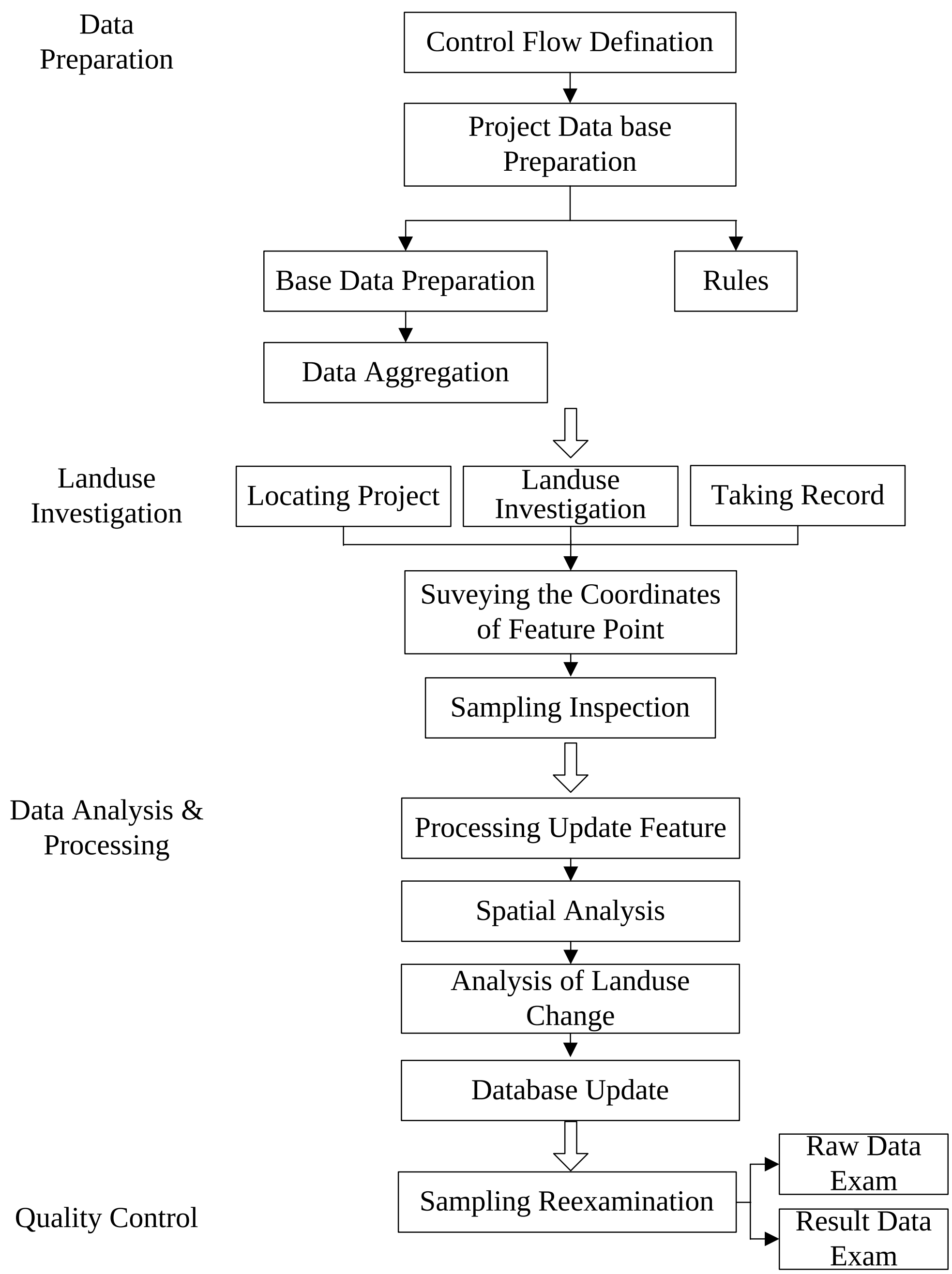

Figure 4.The land use survey control flow.

CONCLUSION

The Land Resource Dynamic Monitoring System designed in this paper combines 3S technology with computer and mobile communications technology and through the effective integration of software and hardware, it improves the expandability of its business processes and adopts an inclusive approach in data management.

Besides, it takes into account the characteristics of land use in Shanghai as well as the need for fine management of land. Aiming at precision, fast response and timeliness, the Land Resource Dynamic Monitoring System further integrates and optimizes land surveying techniques and processes, which will have very positive practical significances for improving the efficiency of land surveying and strengthening the organization and management of land data.

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Research on Problems and Countermeasures of Post-Disaster Reconstruction in China

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Abstract

An increasingly number of disasters has occurred in our country, which is caused by several multiple elements: the significant duration growth of population, the severe environment damage, etc. Faced with such a phenomenon, to select a scientific and effective reconstruction planning is taking into account as a way to revitalize our nation following major natural disasters. The paper is constituted by three parts based on the analysis of domestic and foreign study. The first part presents us several experiences of reconstruction in Japan. The second part mainly summarizes and analyzes current situation of district reconstruction in China and points out several problems in Wenchuan and Ya'an city. The third part contains a series of improvement approaches in reconstruction planning. The paper applies new methods as well as new technology applications on reconstruction planning, such as: comparative analysis; a combination of empirical and standard analysis; urban post-disaster design; planning assessment; shelter design. post-disasters reconstruction improvement derives from the empirical analysis on preceding research, which is considered not only to make a significant contribution to urban recover but the efficient approach to impulse the national innovation.

INTRODUCTION

The situation of China's earthquake-prone is extremely serious, which made reconstruction planning face tremendous pressure. Wenchuan earthquake on May 2008 made a strong destruction in people's lives, property, economic and social development of Sichuan, Shanxi, Gansu (Chen and Li 2011). Likewise, Ya'an "4.20" earthquake has caused huge loss in Sichuan, so the task of reconstruction is very heavy. However, because of the relative lack of laws, regulations and policies in the early study, obvious problem of inadequate policies and regulations exposed in major disasters reconstruction, which also led to the result that reconstruction planning and research work are still in the exploratory stage (Chen 2014). The reconstruction planning experiences in domestic and international were analyzed and summarized before we discuss the problems in the reconstruction process in our country. The purpose of this study is to propose reconstruction planning system suited to our country by drawing on foreign experiences.

FOREIGN POST-DISASTER AREA RECONSTRUCTION EXPERIENCES

Post-earthquake reconstruction in Japan. Take reconstruction in Japan for the analysis of foreign post-disaster reconstruction experience (Yu 2014). Due to the terrain in Japan, there is the highest proportion of natural disasters in the world, especially the occurrence of earthquake. For instance, the magnitude 9.0 earthquake occurred in northeastern sea area on March 11, 2011 and tsunami triggered. Due to the earthquake, tsunami caused 15,756 deaths, 4460 people missing, 5927 injured, resulting the heavy losses in northeast industrial area as well as great economic losses. At the same time, many companies were influenced on production. But Japan has adopted a series of reconstruction measures, such as: the establishment of sound legal and organization for disaster prevention; strengthening the study in disaster reconstruction, especially normative reconstruction; reconstruction balanced, focusing on the future; promoting enterprises conduct of self-help and rescue actively and orderly; the establishment of a sound financial system; phased implementation of the corresponding sub-field reconstruction work; emphasizing to summarize and exchange experiences, and so on. Gradually, enterprises in Japan stepped out the shadow of earthquake. The economy regained adjustment and embarked on growth track.

Post-earthquake reconstruction in Haiti. The magnitude 7.0 earthquake occurred in Haiti on January 12, 2010, which caused 222,500 deaths, 196,000 injured (Yu 2014), beside, there is a heavy loss in its capital PORT-AU-PRINCE and other areas. However, a series of problems appeared when post-disaster reconstruction started, for example, several hundreds of non-government organizations had mixed reactions and internal disagreements when facing with rescue operation, this leaded to the lack of uniform and well-organized command in Haiti post-disaster reconstruction, moreover, it not only extremely interfered the endeavor and plans of government, but also influenced the rate of progress in Haiti rebuilding. Specific performance listed in the following respects: due of the paralysis of government, there is no emergency measure to take; a big drain on the public purse caused the government had to wait for rescue; because of the incomplete relief structure, it is difficult to know where to begin.

We can conclude some experience and lesson from the foreign reconstruction above before we set about the reestablishment in China. Such as: the detail and accurate policy formulation, all-around and harmonious management organizations; the efficient and timely use of reconstruction resources; to encourage the positive participation of NGO in rebuilding.

CURRENT POSITION OF POST-DISASTER IN CHINA

"5.12" Wenchuan earthquake occurred seven years ago, during the first two years from October 2008 to September 2010, the national plan of 29,700 reconstruction projects has started 99.3%, 85.2% completion (see Table 1); 736.59 billion yuan has been spent, accounting for 85.6% of total investment (Li and Chen 2012) (see Table 2).

Table 1.Wenchuan Post-disaster Reconstruction Projects in September 2010.

	Completion	Total	Percentage
Projects	25305	29700	85.2%

Table 2.Wenchuan Post-disaster Reconstruction Investment in September 2010.

	Completion	Total	Percentage
Investment (Unit: billion yuan)	736.59	861.3	85.6%

Among the rebuilding projects, rural residences in Sichuan have been completed in May 2010, completing the task of basic reconstruction in two years successfully (Gao 2012) (see Figure 1). As of July 2014, with a total investment of 1 trillion yuan, each Institute and other senior engineers have carried out final acceptance of 58 major geological disaster control projects by the status quo. The completion of the inspection work means that the earthquake recovery and reconstruction task in Wenchuan have been completed. In this period, it is extremely vital to assess the current situation of recovery and reconstruction in Wenchuan earthquake.

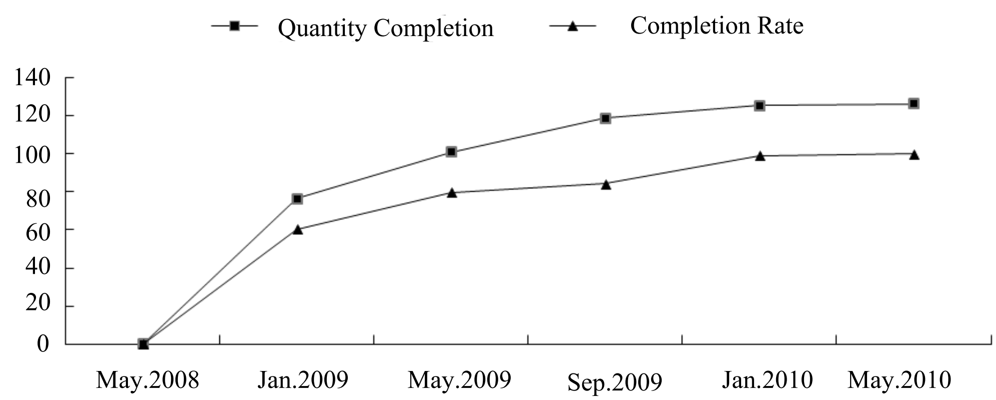

Figure 1.Reconstruction process of rural residences in Sichuan.

In addition, Ya'an earthquake occurred on April 20, 2013, three months later, the State Council issued Lushan earthquake recovery and reconstruction master plan as well as 11 special planning. Ya'an City explored new mechanism actively to rebuild and create models to promote redevelopment. As of October 2014, redevelopment completed 897 projects among a total of 2148 (see Table 3) accounting for 41.8%, total investment 36.23 billion yuan, accounting for 51.5% of the estimated total investment (see Table 4). Overall, compared with Wenchuan, Yushu, repair facilities, medical treatment and other aspects have made great progress. Compared to Japan, however, it is necessary to improve in many aspects.

Table 3.Ya'an Post-disaster Reconstruction Projects in 2014.

	Completion	Total	Percentage
Projects	897	2148	41.8%

Table 4.Ya'an Post-disaster Reconstruction Investment in 2014.

	Completion	Total	Percentage
Investment (Unit: billion yuan)	36.23	70.35	51.5%

THE PROBLEMS IN RECONSTRUCTION

The implementation of policy. We develop a rebuilding target according to housing, employment, and basic living security, public infrastructure, economic and ecological in the overall plan. Content included strong principle, but its relevance and overarching of objective were slightly weak, which also caused the conflict in the specific implementation. The contradictions and conflict between target and process reflected relatively weak policy content in rebuilding as well as the lack of core support (Peng 2012). This is a primary reason why the reconstruction work is still in a static blueprint.

The mechanism integration in rebuilding. Due to the better legal system planning in United States, US can clearly be divided into three levels; they are, respectively, federal, state and local. This bottom-up system can deepen its institutional coordination and integration further. In contrast, there are often some problems in reconstruction mechanism in China, such as: more than one lead unit, department dispersion and so on. Because of ambiguous responsibilities division during all levels of government and the lack of coordination between overall and special planning, the reconstruction system remains disorder. Moreover, throughout the reconstruction process, the central government is often responsible for the most important role in this top-down, so the body can easily produce interests' conflict between different stakeholders. This phenomena will not only hinder the government at all levels to fully play its role in coordination and support, but also undermine the initiative policy implementation of local government to rebuild, which makes reconstruction work remain difficult.

The level of resource mobilization. Regulated market economy and sound laws and regulations have laid a good foundation for reconstruction activities. The tacit coordination between all levels of government and non-governmental organizations makes disaster resources fully utilized. Eventually, resource mobilization works in a more flexible way. But the way in our country shows oneness and closeness. On the one hand, due to the relative lack of preliminary studies in reconstruction planning policy, there is no effective mechanism of market economy adjustment when disaster comes, which will hinder the speed of reconstruction. On the other hand, due to the excessive pressure on central government and the limited financial capacity of provincial and local governments, the financial resources cannot be allocated in optimum way, besides, the lack of system and stability will undoubtedly increase the difficulty that affected people benefit directly.

CORRESPONDING RECOMMENDATIONS

Optimization of policy implementation system. First, it is vital to strengthen the coordination and cooperation among government departments to ensure the efficiency of policy implementation. At the same time, each department in the reconstruction needs to realize their respective responsibilities explicitly. Secondly, personnel quality and behavior directly determine the effect of post-disaster reconstruction, so it is necessary to improve executor qualities in implementation process, which includes political quality and professional quality. Besides, we need to notice the follow-up assessment of implementation timely and promptly correct all deviations in implementation process. Finally, non-governmental organizations have strong organizational skills so they can approach vulnerable groups and encourage them to participate in decision-making as well as resource allocation (Chen and Mao 2014). While taking full advantage of NGO in reconstruction, remember to strengthen oversight and management, making legitimacy of its reconstruction activities guaranteed.

Construction of policy guaranteed mechanism. Policy support can provide a good opportunity for the successful plan implementation. We need to combine public policy with rebuilding planning scientifically to penetrate into all levels of urban planning effectively, which will not only play a role of coordination, verification and decision-making, but also promote and supervise the implementation. And then, we can increase the degree of mechanism integration in reconstruction planning. In addition, target planning gets more attention than planning process according to the existing planning mechanisms, resulting the guidance and control of urban construction and development have not been fully realized. Therefore, we must make sure clarity and practicability of policy objectives in the planning process and emphasize on the control and management during the implementation process.

Promote resource integration. In the context of market economy system, a flexible and diversified resource mobilization mechanism should be established in China. A top-down flow of resources is more dispersed and inefficient when it reaches disaster area. Besides, the reconstruction involves multiple departments, resources between various departments also need to be integrated, however, the lack of a effective integration mechanism will affect the efficiency of reconstruction resources indirectly. When the resources get to the grassroots, the executors should integrate them effectively and start reconstruction work as soon as possible, and then local governments should establish its authority to own the appeal and credibility, which will be necessary in resources integration, overall planning, and supervision and management aspects. During the process of resources integration, to expand grassroots democracy and increase the participation of victims will make good use of reconstruction resources, which will provide a steady power in grassroots disaster area reconstruction. Only when the resources get effectively allocated, can affected people receive truly benefit.

CONCLUSIONS

Reconstruction is a relatively long-term process; its top-down development often starts with foresight planning (Chen and Li 2011). In recent years, we should pay continuous attention to academic study and introduce reasonable and effective means of implementation in these aspects as follow: optimization of policy implementation system, construction of policy guarantee mechanism, improvement of resources integration, the active public participation in reconstruction process and other aspects. What's more, to track the whole story of the reconstruction process and make the reconstruction theory framework as thorough as possible, which will, eventually, provide a valuable reference material for similar reconstruction in future.

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Urbanization Quality Evaluation under the Perspective of New-Type Urbanization in China: A Case of Chongqing

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Abstract

China is now in the stage of the fast urbanization, whereas the quality of urbanization is still in a low level. Thus, it is necessary to develop an urbanization quality evaluation system to guide and rule urbanization scientifically. This paper develops a comprehensive evaluation system for measuring urbanization quality under the perspective of new-type urbanization in China. Then, taking Chongqing as a case, measuring the relative level of urbanization quality of each region in Chongqing is evaluated. It can be concluded that the urbanization quality in different regions are in wide gaps and measures proposed to resolve the issue.

INTRODUCTION

Chinese society has experienced a remarkable change since the reform and opening-up in 1980's.Urbanization level has increased from 17.9% at the beginning and opening-up to 53.7% in 2013. At the same period, urban population has increased from 172 million to 730 million. This speed is unprecedented in history. However, in recent years, with the rapid development of urbanization, some problems in this process show up gradually such as unscientific and short sight , low urban public service level, incomplete social security system, weak comprehensive bearing capacity, high pressure of ecological environment and so on.

Nowadays, the economy in China is in a critical period of transformation. Especially after 2014, many economic indexes have showed downward tendency, and economic development is facing increased uncertain factors. In order to keep economic growth and promotion, many local governments lay more emphases on the function of driving economy forward urbanization construction. In their point of view, the development of urbanization is significant to the society. Thus, governments put forward a series of attractive goals of development. However, we should not only be excited to these pictures but also consider them with rational attitudes. It is not wise to promote economic development simply by increasing the rate of urbanization.

After national new-type urbanization construction requirements being presented, it has become increasingly urgent to establish complete urbanization theory system and conduct researches on quality problems from the perspectives of new-type of urbanization. The new-type urbanization construction requires us to pay attention to the environment, resource and history protection. The establishment of comprehensive evaluation index system of urbanization quality has direct and huge effect on the rate and quality of urbanization in China. However, it is hard to set up a unified comprehensive evaluation index system due to enormous difference in economy, geography and history in different districts. Consequently, it is essential to select specific indexes and build evaluation index system according to different environment in each district, which provides theoretical foundation for development of new urbanization by reflecting the quality of urbanization more objectively. Chongqing is selected as the research object in this paper because it's one of the four municipalities directly under the Central Government in China. Chongqing has been remaining a rapid growth both in economy and urbanization development in the last few years. Meanwhile, there are great challenges in the way of urbanization because of its special mountainous terrain. Therefore, the research on the index system of urbanization quality would effectively provide basic support for selecting the direction and path of urbanization development in Chongqing, as well as other mountainous cities in China.

This paper firstly explains the importance of the new-type urbanization, secondly analyses the necessity of urbanization quality under the new condition of Chinese economy, and then the paper establish the evaluation index system of urbanization quality to evaluate the urbanization quality of Chongqing. Finally the paper puts forward the proposal to the development of new-type urbanization.

LITERATURE REVIEW

Generally, urbanization level in a country or district is measured by the indicators of economics, society, ecology and resources. But for international statistics data, per capita GDP, GNP (gross national product), labor productivity, and proportion of three industries are usually used to estimate the quality of urbanization (Wang and Chen 2009).

Nowadays, some scholars in China have conducted active research on quality evaluation of urbanization. The indicators they chose cover demographic change, infrastructure transformation, social development, health care, employment, living environment, urban-rural development, and other fields.

Besides, along with various problems in the process of urbanization, local governments in China attach great importance to the work of estimating and controlling the quality of urbanization, and also try to establish a suitable comprehensive index evaluation system of urbanization quality actively. For instance, construction department in Guangdong province released urbanization development in Guangdong province assessment report (CDGP 2007) every two years, which focused on urban agglomeration level, urban factor' mobility, service quality of urban life, quality of urban environment, capability of urban and rural coordinated development, and urban civilization development level. The ten most representative indicators were selected from the six respects above to make up a comprehensive index system to assess the quality of urbanization of 21 prefecture-level cities in Guangdong province. Taking Hunan province as another example, planning commission in Hunan province issued evaluation index system of urbanization in Hunan province (URPCHP 2006). It established an evaluation system of urbanization quality from five aspects about urbanization improvement, economic development, living convenience, good environment and social stability, including 5 first class indicators and 31 secondary indicators.

Based on the above analysis, it can be seen that academic institutes, government departments and related research institutions have built up a set of evaluation index systems toward to quality of urbanization. The evaluation index system was proposed by central ministries or local governments meeting the need of economic and social development in China. And these indicators highlighting the connotation of government regulations have a certain operability, measurability and can be regulated and provide help for public service. However, the evaluation indicators are set from the position of cities, not having a complete consideration about the background of nation and provinces.

In terms of academic study, scholars choose lots of indicators to study evaluation index system of urbanization quality. These indicators have strong relation with region but lacking of universality. Some are too idealistic to practice in reality and it leads to bad comparability. What is more, some indicators even deviate from government policy terribly, causing difficulty for index system to be generalized.

RESEARCH METHODOLOGY

Northam, an American geographer, is the first one who put forward the indicator to measure urbanization. He used the proportion of urban population in total population as the standard. Because of its simplified index and easily obtaining data, it became the internationally applied indicator at a period of time. But it is difficult to apply in China under the national situation, and especially difficult in Chongqing due to its geography, political environment and urban landscape. The principle of representativeness, systematic and comprehensiveness for index should be taken into account carefully in the process of selection. And also, it is essential to get the data of index via scientific methods, in order to measure urbanization level effectively.

This paper chooses a series of evaluation indexes from different aspects of urbanization respectively to build the index system combined with the characteristic of Chongqing. And based on the index system, using factor analysis method, this paper measures the quality of urbanization from a relative degree. All the data are from statistical yearbook 2013 in Chongqing and are highly authentic and credible, reflecting the current quality of Chongqing urbanization objectively.

EVALUATION INDEX SYSTEM

The new-type of urbanization includes 4 aspects. The first one is the urbanization with sustainable economic growth, mainly reflected in the optimization and upgrading of industrial structure. Under the guidance of the new-type urbanization theory, industrial chain should become advanced and hierarchical gradually. At the same time, the large-scale and intensive development of modern service industry and agriculture shall be realized. The second one is green urbanization, whose key target is to protect the environment, save the energy, get rid of the excessive dependence on conventional energy and materials and strengthen enterprises' awareness of saving energy .The third one is the urbanization with enhancing people's livelihood, which means to guarantee that the residents feel equal and happy in the process of urbanization. This aim is mainly reflected on improving the relevant supporting for migrant workers' citizenization, realizing the integration of urban and rural service, breaking through traditional household registration system and land system, improving the income of both urban and rural residents, and finally narrowing the gap of income of urban and rural residents. The last one is intensive urbanization, basically including the improvement of the urban space structure, the intensivism of urban and rural land use and effective utilization of urban and rural infrastructure (Shu 2008).

These 4 aspects have covered all perspectives of the quality of the new–type urbanization, providing the basis for establishing the index system of the new-type urbanization quality to rely on.

Based on the analysis procedure mentioned above, this paper brings forward the evaluation index system targeting at the urbanization quality in Chongqing, which is aimed to evaluate the present urbanization quality of Chongqing in more accurate way， so as to provide theoretical evidence for finding out more scientific ways to realize new-type urbanization. Concretely, this paper divides the index system into overall level, systematic level and index level.

(1) Overall level. directly reflecting the development of new urbanization quality.

(2) Systematic level. efficient economic development forms the basis of urbanization, and urban infrastructure and social security system are the key to enhancing people's living standard. But under the requirement of the new-type urbanization, excessive resource expenditure and environment damage have become the important factor restricting the urbanization process. Therefore, in order to reveal the level of urbanization with the index system in a full-scale way, this paper classifies the systematic level into 4 dimensions, economy, society, space and environment, and people's living.

Specific indexes can be checked in Table 1, which represent the overall situation of urbanization quality in Chongqing.

Table 1.Measure Index System of the New Type of Urbanization.

Type of Indexes	Specific Indexes	Code of Indexes
Economic development	GDP per Person	X1
	Non – agricultural Industry Percentage	X2
	The whole Social Fixed Assets Investment	X3

Table 1.(Continued).

Type of Indexes	Specific Indexes	Code of Indexes
Social advancement	Urban Registered Unemployment Rate	X4
	Hospital Bed Number per 1000 in the Jurisdiction	X5
	Book Number of Public Library per 100 in the Jurisdiction	X6
Space and environment	Energy consumption per unit of GDP	X7
	Satisfaction Rate about Environment protecting in	X8
	the Jurisdiction Completed floor space of houses	X9
People's living	Proportion of Urban Population	X10
	Proportion of Non-agricultural Population	X11
	Urban per-capita Disposable Income	X12
	Fiscal Budgetary Expenditures	X13

THE RELATIVE MEASUREMENT

The principle of factor analysis and the establishment of the model. Factor analysis method is a kind of statistical method which uses some typical factors to illustrate the connection between indexes and elements, and reflect the most information of original materials with relatively fewer elements (Wang and Huang 2005). This paper uses the factor analysis method to measure the relative lever of urbanization quality in Chongqing.

The source of data. Accurate data collection and analysis provide the foundation to objectively evaluate the level of the new type of urbanization in Chongqing. The data of this paper are gathered from Chongqing statistical yearbook in 2013. These data fully reflect the development status of the new-type urbanization in Chongqing.

The process and results of factor analysis. This paper makes use of a composite index system concluding 13 indexes. After normalization, this paper analyzes factors with the software SPSS, and here follows the results:

(1) The examine for the reasonableness of factor analysis method. The value of KMO is 0.785, the testing statistic is more than 0.6 and the value of p tested with Bartlett method is below the significant level, 0.05. It indicates the index variables in this paper can be factor analyzed.

(2) The identifying and analysis of common factor. 11of the indexes are over 80%, which means most information of original variables can be represented by the selected factors.

The eigenvalues of factor analysis and variance contribution in Table 2 show the characteristic values and contribution rate of selected indications. Accumulated variance of six common factors reaching 88.087%, reflects most of the information of selected indicators.

Table 2.Explained Total Variance.

Components	The Initial eigenvalues (%)			Extraction the sum of squares loaded (%)		
	total	variance	cumulative	total	variance	cumulative
1	6.942	53.401	53.401	6.942	53.401	53.401
2	1.514	11.643	65.044	1.514	11.643	65.044
3	1.040	8.002	73.045	1.040	8.002	73.045
4	0.797	6.133	79.178	0.797	6.133	79.178
5	0.634	4.880	84.058	0.634	4.880	84.058
6	0.524	4.030	88.087	0.524	4.030	88.087
7	0.499	3.837	91.924			
8	0.377	2.902	94.826			
9	0.245	1.883	96.710			
10	0.216	1.664	98.373			
11	0.127	0.977	99.350			
12	0.052	0.401	99.751			
13	0.032	0.249	100.000			

And then get the rotated factor loading matrix after biggest orthogonal rotation of factor variance. Select high indicator values and divide into 6 categories according to the load, and rename the factors. According to the result, rename the 6 main factors in Table 3 as following.

Table 3.Meaning of Factors.

Main factor	Number of factor	Name of factor
Main factor1	F1	Factor of living
Main factor2	F2	Factor of social construction
Main factor3	F3	Factor of resource and environment
Main factor4	F4	Factor of employment
Main factor5	F5	Factor of health care
Main factor6	F6	Factor of cultural development

There can be expression of each main component via extracting score coefficient from score coefficient matrix. And this paper ranks the results in Table 4.

Table 4.Comprehensive Score of Urbanization Quality.

District	Score	Rank	District	Score	Rank
Yuzhong	1.89	1	Nanchuan	-0.14	20
Shapingba	1.09	2	Fuling	-0.18	21
Jiangbei	0.99	3	Dazu	-0.23	22
Jiulongpo	0.94	4	Chengkou	-0.26	23
Dadukou	0.79	5	Wulong	-0.27	24
Nanan	0.65	6	Tongnan	-0.32	25
Yubei	0.48	7	Shizhu	-0.34	26

Table 4.(Continued).

District	Score	Rank	District	Score	Rank
Beibei	0.410	8	Dianjiang	-0.370	27
Banan	0.270	9	Liangping	-0.380	28
Wanzhou	0.240	10	Kaixian	-0.390	29
Jiangjin	0.120	11	Zhongxian	-0.440	30
Changshou	0.060	12	Xiushan	-0.450	31
Bishan	0.013	13	Fengdu	-0.470	32
Yongchuan	0.010	14	Yunyang	-0.490	33
Rongchang	-0.040	15	Fengjie	-0.530	34
Qijiang	-0.060	16	Youyang	-0.540	35
Tongliang	-0.090	17	Wuxi	-0.560	36
Hechuan	-0.110	18	Wushan	-0.582	37
Qianjiang	-0.110	19	Pengshui	-0.585	38

From Table 4, it can be seen that Yuzhong district scoring at 1.89, is in the first place regarding to urbanization quality, while the lowest score is -0.585, still the Miao-Tujia autonomous country of Pengshui. The result indicates the index system established in this paper is feasible. Though the data is only relative value after process of standardization, the result of analysis still have realistic significance. At the same time, it also can be seen that the urbanization quality of Chongqing need to be improved from the result.

On the basis of the research above, in the interest of guiding a scientific and reasonable new urbanization development path of Chongqing, and promoting the urbanization quality completely, this paper puts forward the following suggestions. (1) Stepping up efforts to implement the harmonious development strategy of urban and rural areas. (2) Strengthening the optimization and upgrading of industries. (3) Promoting the resource and environment security. (4) Actively taking *5 Functional Areas* Regional Development Strategy into actions. (5) Breaking the dependence on the conventional urbanization development path.

CONCLUSION

Some constructive conclusions are presented from the analysis results above.

(1) Based on the theory of new urbanization construction, combining with the conditions of Chongqing, this paper establishes a relatively complete and feasible comprehensive evaluation index system of urbanization quality. On the basis of 4 core indexes, economic development, social progress, space and environment and living as well as 13 sub-indexes, from the perspective of relative level, this paper evaluates and analyses present urbanization quality of Chongqing deep and quantitatively.

(2) The results of analysis and evaluation show wide gap in urbanization level between different districts in Chongqing, tallying with the actual conditions of Chongqing. This matter of fact indicates that the evaluation index system established is reasonable and feasible, and the evaluation methods are effective, besides, this paper

give relatively reasonable evaluation and analysis about the urbanization quality, meanwhile a reference for a full-scale urbanization quality measurement in the future.

(3) What is supposed to be pointed out is that owing to the difficulty of space development data collection, evaluation indexes established in this paper only select one dimension of those indexes referring to space development. Therefore, both the completeness of indexes and the universality of application need optimizing continuously. In order to perfect the research concerning urbanization quality evaluation, establishment of evaluation index system and model need to be explored in depth.

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Analysis of the Potential for Intensive Use of Urban Land in Harbin City

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Abstract

With the rapid development of economy and quick urbanization, urban land will continue to expand at a rapid rate. on the one hand, it leads to a result that the layout of city industrial land, commercial land and residential land are in chaos; On the other hand, a large number of plough in suburb area loosed, In order to alleviate the city expansion speed and reduce the loss of agricultural land, this paper analyzed the present situation of land use in Harbin city, and by establishing the model and index system of intensive land use potential evaluation, calculating the index weight by AHP method. According to the related standards and the relevant research results, build a quantitative grading system of land the potential of Harbin City, obtained the intensive use comprehensive macro potential level of Harbin's city land, and carried on the analysis of potential

INTRODUCTION

City land intensive use potential, refers to difference between the best and the current of land intensive use, under the specific the technical and economic conditions and planning requirements intensive degree and it can reflect the state of potential of current land use. The lower the degree of intensive land use is and the less reasonable land use structure is, the bigger the land use potential is (Song 2007).

The evaluation on intensive use potential of city land is to establish the of evaluating index system, according to the connotation of city land intensive use and combine the requirement of implementation of city planning and the development of the city, evaluating the using efficiency and using potential of current city land to get the potential situation of land intensive use.

This study combined with the background of land's intensive use in the new era, according to the basic theory of intensive use of land, aiming at the existing problems in land utilization, focus on the analysis of present state of land use in Harbin City, giving the comprehensive evaluation on the level of intensive use of urban land, analyzing intensive use potential of urban land.

ANALYSIS ON PRESENT SITUATION OF LAND USE IN HARBIN CITY

Present situation of land use. Harbin has a high city level and a large percentage of non-agricultural construction land. The proportion of urban and rural residents and land for industry and mining as well as transportation and other non-agricultural land is relatively high, forming the trend that taking Harbin's urban area as the center and show decreasing trend towards outward (Zhang 2013). Urban construction land is mainly composed by city construction land, and at the end of 2011, Harbin's city area is 7086 Km^2, and 367.14 square kilometers is built area. Look at Table 1 for area and proportion of each kind of land.

Table 1.The Land Use Structure in Harbin City at the End of 2011.

Land use types	Area (km^2)	The proportion accounted for the built-up area (%)
Residential land	110.14	30.1
Industrial land	84.81	23.1
Public facilities land	57.28	15.6
Storage land	8.44	2.3
Road and square land	36.71	9.9
External traffic land	15.42	4.2
Green land	34.51	9.4
Other land	19.83	5.4
Total area	367.14	

The analysis of land use structure. From the follow data we can see some existing problems of Harbin city urban land use.

(1) The structure of city land use in Harbin city is not reasonable. Specific performance: the ratio of green space and road and square land area is low, the per capita land area is close to or lower than the lower limit of national standard (as shown in Table 2).

(2) The proportion of the industrial land is closed to the upper limit of the national standard, which brings more environmental problems.

Table 2.Harbin City's Land Use Structural Comparison with National Standards.

Land use types	The proportion accounted for the built-up area (%)	National standards (%)	Per capita land (m^2/person)	National standards (m^2/person)
Residential land	30.1	20-32	23.36	18-28
Industrial land	23.1	15-25	17.99	10-25
Green land	9.4	8-15	7.32	≥9
Road and square land	9.9	8-15	77.78	7-15

THE MACRO EVALUATION ON HARBIN CITY'S LAND INTENSIVE USE

Macroscopic evaluation is to make an overall evaluation on the level of land saving and intensive utilization in the region of built-up area, reflecting quantitatively the close degree on the situation of land saving and intensive utilization and reasonable land intensive use in Harbin city (Wang 2006).

The establishment of the evaluation index system and determination of potential weights of the city land intensive use. Take system of macro level evaluation index which has been used by studied city as a reference, combined with the basic characteristics of China's city land utilization, establishing the system of land intensive use evaluation index in Harbin city, and uses AHP to calculate the weight value, finally using multi-factor comprehensive scoring method to calculate the comprehensive score.

The establishment of the evaluation index system. According to the actual situation of Harbin City, starting from the connotation of city land intensive use potential, selecting indicators according to the principle of index selecting, in general, the evaluation index of land intensive use potential should mainly include: the index that reflects the rationality of land use structure and layout , the index reflects the land investment intensity, the index that reflects the land use intensity, the index that reflects the land use efficiency (Cha 2002). The final target system construction is shown in Table 3.

Table 3.The Index System of Harbin's Land Intensive Use Evaluation.

Target Layer	Factor layer	Index layer	The meaning of index
A_1 Potential evaluation of land intensive use in Harbin city	B_1 Layout and structural condition of city land	C_1 Industrial land use rate	The area of industrial land/the total area of construction (%)
		C_2 Public green space ratio	The area of public green space /the total area of construction (%)
		C_3 Residential land use ratio	Residential land/the total area of construction (%)
		C_4 The proportion of road and square land	The area of road and square land /the total area of construction (%)
	B_2 City land investment intensity	C_5 Fixed assets input of equal area	Investment in fixed assets/urban area (yuan/m^2)
		C_6 Road area of equal person	The area of road and square land/ urban total population (m^2/person)
		C_7 The proportion of infrastructure investment accounted for GDP	Investment in public facilities/ annual GDP (%)
A_2 Potential evaluation of land intensive use in Harbin city	B_3 City land use intensity	C_8 City construction land per capita area	Area of construction land/urban total population (m^2/person)
		C_9 City integrated volume rate	City structure area/city built-up area (%)
		C_{10} Idle rate of land	The area of idle land/Area of city construction land (%)

Table 3.(Continued).

Target Layer	Factor layer	Index layer	The meaning of index
A_2 Potential evaluation of land intensive use in Harbin city	B_4 City land use efficiency	C_{11} Population and city land use growth elasticity co-efficient	The growth rate of city population /the growth rate of city construction land
		C_{12} GDP of unit area	Annual GDP/construction land of urban built-up area (10^4 yuan/hm^2)
		C_{13} GDP and construction land growth elasticity coefficient	The growth rate of city's GDP/the growth rate of city construction land
		C_{14} Average total retail sales of social consumer goods	Total social retail sales/ urban built-up area(10^4 yuan/Km^2)

The determination of index weight. In this paper, according to the index system has been constructed, using the AHP method, through reading massive literature, having invited professionals and according to the relation between various levels to construct different judgment matrix. By comparing the all indexes of intensive land use in Harbin City, getting final judgment matrix from top to bottom. Because the judgment matrix is numerical matrix that through making subjective judgments by experts according to their own understanding, views of the experts will be not consistent, which inevitably contributes to the problem that there will be one-sidedness and subjectivity, so this judgment may not be accurate, by conducting consistency test, we can ultimately determine the weights of each index, see random consistency index table and the table of index from Table 4 to Table 10.

Table 4.Random Consistency Index RI.

The number of the order (n)	1	2	3	4	5	6	7	8	9	10	11	12	13
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.52	1.54	1.56

Table 5.Judgment Matrix of Layer (B) for Layer (A) and Weight Value.

A	B_1	B_2	B_3	B_4	Weight value
B_1	1	3	3	3	0.21132
B_2	1/3	1	1	1	0.21132
B_3	1/3	1	1	1	0.21132
B_4	1/3	1	1	1	0.21132

Table 6.Judgment Matrix of Index Layer (C) for Evaluating Factor (B_l) and Weight Value.

B_1	C_1	C_2	C_3	C_4	Weight value
C_1	1	2	5	3	0.4723
C_2	1/2	1	4	2	0.2854
C_3	1/5	1/4	1	1/3	0.0727
C_4	1/3	1/2	3	1	0.1697

Table 7. Judgment Matrix of Index Layer (C) for Evaluating Factor (B_2) and Weight Value.

B_2	C_5	C_6	C_7	Weight value
C_5	1	1	3	0.429
C_6	1	1	3	0.429
C_7	1/3	1/3	1	0.142

Table 8.Judgment Matrix of Index Layer (C) for Evaluating Factor (B_3) and Weight Value.

B_3	C_8	C_9	C_{10}	Weight value
C_8	1	1/5	1/3	0.1042
C_9	5	1	3	0.6372
C_{10}	3	1/3	1	0.2583

Table 9.Judgment Matrix of Index Layer (C) for Evaluating Factor (B_4) and Weight Value.

B_4	C_{11}	C_{12}	C_{13}	C_{14}	Weight value
C_{11}	1	3	3	3	0.36603
C_{12}	1/3	1	1	1	0.21132
C_{13}	1/3	1	1	1	0.21132
C_{14}	1/3	1	1	1	0.21132

Table 10.The Results of Total Taxis of Hierarchy.

Layer	B_1	B_2	B_3	B_4	The total order weight value that layer C for layer A
	0.3660	0.2113	0.2113	0.2113	
C_5	0.0000	0.4290	0.0000	0.0000	0.090656280
C_6	0.0000	0.4290	0.0000	0.0000	0.090656280
C_7	0.0000	0.1420	0.0000	0.0000	0.030007440
C_8	0.0000	0.0000	0.1042	0.0000	0.022019544
C_9	0.0000	0.0000	0.6372	0.0000	0.134653104
C_{10}	0.0000	0.0000	0.2583	0.0000	0.054583956
C_{11}	0.0000	0.0000	0.0000	0.3660	0.077349460
C_{12}	0.0000	0.0000	0.0000	0.2113	0.044656142
C_{13}	0.0000	0.0000	0.0000	0.2113	0.044656142
C_{14}	0.0000	0.0000	0.0000	0.2113	0.044656142

Calculation of comprehensive score. Calculating comprehensive score according to the following formula:

$$F=\sum_{i=1}^{n}\left(F_i\times w_i\right) \quad (1)$$

Type: F refers to comprehensive score the intensive utilization index; F_i refers to the i index score; w_i refers to index weight value; n refers to the number of indicators.

Through calculating, the entire judgment matrix passes the consistency test and has satisfactory consistent.

Consistency checks formula:

$$\mathrm{CR}=\sum_{j=1}^{m}a_j\times CI_j/\sum_{j=1}^{m}a_j\times RI_j \quad (2)$$

The results of calculation: $CI=0.069863603$, $RI=0.764740471$, $CR=0.091355964<0.10$. It shows that the level of total order evaluation factor layer C on the total target of A through the consistency test.

The determination of standard value and the corresponding scores of the index. The standard values determined generally by using the method of literature, expert consultation method, experts ask method and the average value determining method (Ruan 2011), this paper determine the index of the standard value according to the characteristics of each index, by reading a lot of literature, and combining with the existing data with the corresponding method, see the result in Table 11.

(1) Fixed assets input of equal area C_5: By using the literature material method, combined with regional actual situation, this paper takes the fixed asset investment of Harbin city downtown in 2011 as a reasonable value of index; the value is 200 yuan/m^2.

(2) The proportion infrastructure investment accounted for GDP C_7: The United Nations recommended the proportion infrastructure investment accounted for GDP developing countries should be between 3% and 5%, we take 4.5% as the standard value.

(3) City construction land per capita area C_8: According to actual development of city of our country, the experts believe that taking the index as 80to120 m^2/person is more reasonable, taking General Land Use Planning of Harbin City (2006-2020) as the reference; this paper determines the reasonable value of the index for 100m^2/ people.

(4) City integrated volume rate C_9: In 2006, China's Ministry of land cadastre Secretary Fan Zhiquan in the forum "urban construction land reorganization and the use of" proposed our country city comprehensive volume rate should be increased to about 0.8. We take 0.8 as the index of reasonable value.

(5) The land idle rate of C_{10}: Taking the fact that idle land is a serious waste of resources into account, this paper determines the rational value of land idle rate for 0.

(6) Population and city land use growth elasticity co-efficient C_{11}: International generally agrees on the 1.12 for reasonable values of the index. Thus this paper determines the reasonable value of this index is 1.12.

(7) GDP of unit area C_{12}: Take standard 1138.255 (10^4/Km^2) as the value of standard by using average value method.

(8) GDP and construction land increase elasticity C_{13}: Take the upper limit of 1 in accordance with the overall planning of Harbin city is as the value of standard.

(9) Average total retail sales of social consumer goods C_{14}: Take the Heilongjiang province's total retail sales of social consumer goods as reference, this paper selects the highest ranked of 0.4 (10^8 yuan/Km^2) as the standard value.

Table 11.The Index Scores.

Index Layer	Standardize value(D)	Actual value (E)	Scores (S)
C_1 Industrial land use rate	20%	23.10%	86.58
C_2 Public green space ratio	15%	9.40%	72.82
C_3 Residential land use ratio	26%	30.10%	86.38
C_4 The proportion of road and square land	15%	8.41%	69.48
C_5 Fixed assets input of equal area	377.16 (yuan/m^2)	225 (yuan/m^2)	88.89
C_6 Road area of equal person	15 (m^2/person)	7.78 (m^2/person)	67.51
C_7 The proportion infrastructure investment accounted for GDP	4.5%	2%	64.29
C_8 City construction land per capita area	100 (m^2/person)	77.87 (m^2/person)	81.88
C_9 City integrated volume rate	0.8	0.67	86.02
C_{10} Idle rate of land	0	0.13	0.00
C_{11} Population and city land use growth elasticity co-efficient	1.12	0.17	54.11
C_{12} GDP of unit area	1138.2559 (10^4/hm^2)	853.63 (10^4/hm^2)	80.00
C_{13} GDP and construction land growth elasticity coefficient	1.0	1.171	85.40
C_{14} Average total retail sales of social consumer goods	0.4 (Billion/Km^2)	0.2 (Billion/Km^2)	66.67

NOTE: $S = D/\left(D+\left|E-D\right|\right)\times 100$

The evaluation results. City land intensive utilization degree is generally divided into 3 types: excessive use, moderate and intensive use as well as inefficient use and extensive use, the concrete division of various types are shown in Table 12:

Table 12.The Partition Table of City Land Intensive Use Degree.

Scores	0-50	50-60	60-80	80-90	≥90
The degree of utilization	Inefficient and extensive use	Elementary intensive use	Medium intensive use	The higher intensive use	Excessive use

The comprehensive score of index calculated by the above formula (1) is 73.23, which indicates that Harbin city land saving and intensive use level is in the medium level of intensive utilization degree and we can make a further mining on Harbin city intensive land use potential.

POTENTIAL ANALYSIS

Structure and layout of city land. The proportion that industrial land accounts for urban construction land area is 23.1% in Harbin city, which closes to the highest standards of the country, showing that Harbin's industrial land almost no development potential. The growth speed of industrial land in Harbin city was significantly faster in recent years, which affected the urban function and urban land income value to a certain extent and hindered the coordinated development of the urban economy but also caused serious environmental pollution. Harbin city green space and road square land area ratio is low, the roads are narrow and traffic jam phenomenon is serious, which effected benefit of urban land use, and is not conducive to supporting the construction of infrastructure, making city difficult to play a gathering effect.

The analysis from city land investment intensity. Analyze the level of investment of land use in Harbin city, we can draw a conclusion: There was a big difference between the investment level of Harbin infrastructure and the fixed and the national average level, investment is not enough. We can get more benefits and better effect by directly putting additional land investment.

The analysis from land use degree. Analysis index data of Harbin city, we can be see that the comprehensive volume rate is less than the highest level. It is difficult to increase the comprehensive volume rate, but there is a great land scale potential by increasing the volume rate; On the other hand, construction land per capita in Harbin city was 77.87m^2, which is far below the per capita construction planning for city in the third level (90.10~105m^2), lower than the national standard value. Population distribution in Harbin city is not balanced, the old city area has a high density, while population density is relatively low in new built-up area. So how to play the city features of Harbin city better and improve the land use degree, has become a new topic for the development of Harbin city; Finally, the land idle rate is still greater than zero, therefore, it can also bring a certain potential area of land by using idle land and the additional supply of land.

The analysis from the land use efficiency. The highest level of output of GDP of unit construction land area is 1495.44 (10^4 yuan/hm^2), while that of the Harbin is 853.63 (10^4 yuan/hm^2) which is lower than the national level. The fact that land use efficiency is not high also reflects Harbin city land use potentiality is enormous. The value of population and construction land increase elasticity is less than 1 shows that the increasing speed of urban land is more slightly quicker than the speed of population, and the city land intensive use potential is low; On the contrary, a value greater than 1, it shows that he increasing speed of urban land is more slightly slower than the speed of population and the city land intensive use potential is in high level (Xue 2010). This value of Harbin city t is 0.17, which is far below the international standard value of 1.12, suggesting that the speed of Harbin city expansion is greater than that of population growth and not takes advantage of agglomeration benefit of city land using, and there is a need to take effective measures to limit excessive expansion of city scale.

CONCLUSION

In this paper, the structure of land use in Harbin City in 2011 were analyzed , conducting a evaluation of potential of land intensive use from four aspects :the structure and layout of city land, the city land investment intensity, city land use intensity and city land utilization benefit and getting the following conclusions: Harbin city land saving and intensive use level is in the medium level of intensive utilization degree and we can make a further mining on Harbin city intensive land use potential.

But in addition to quantifiable indicators, there is a close relationship between Harbin city land intensive use degree and index that cannot be quantified such as government policy, institutional factors and management factors, and the city land intensive use potential evaluation is a dynamic process, with development of the structure of social and economic and the improvement of industry, index system should be modified according to different stages of development of city, so as to draw a more accurate evaluation results and make more precise analysis.

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Industrial Structure Evolution and Urbanization Development in China

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Abstract

Urbanization is an inexorable trend of the human social modernization. The evolution of industrial structure and urbanization development is a complementary phenomenon. Based on the real case of industrial structure evolution in China, the process of urbanization and industrialization in China, as well as their coupling relationship, is analyzed and evaluated in this paper. Empirical analysis shows a stable relationship between the industrial development and urbanization. But no significantly causal relationship is found between them. By further analyzing Shandong province, the urbanization process is found to be slower than the industrialization process, while the gap is gradually reduced. The urbanization and industrialization process is not balanced among regions and intra-regional differences are significant. The deviation degree of urbanization and industrialization is high in the West and low in the East, which shows a ladder-like distribution.

INTRODUCTION

Urbanization as an outcome of economic modernization, significantly promoted the vigorous development of the construction and real estate industry. Since cities and towns are distributed where those nonagricultural industries are centralized, urbanization is greatly interrelated with industrialization and de-agriculturalization. Industrialization and urbanization are seen as interdependent processes of modern economic development (Atack et al. 2004). However, the exact nature of their causal relationship is still open to considerable debate (Kim 2005). Chenery and Syrquin (1975) studied the industrialization and urbanization in 90 countries and regions. They reached conclusion that there was quantitative relation among the level of per capita income, industrialization and urbanization. The higher was the level of industrialization, the higher was the level of urbanization and per capita income. From then on, lots of fruitful studies about urbanization and industrialization have been made. Henderson (2005) calculated correlation coefficient between the world urbanization rate and GDP per capita (logarithmic) is 0.85. Renaud (1981) analyzed 111 countries and discovered that when the GDP per capita reached $5000, the urbanization level would rise to more than 75%.

However, China's GDP per capita in 2013 was $6629 with urbanization rate of 53.73%, which is different from previous studies. According to the World Bank, China has entered the ranks of upper middle income countries 2014. But China's rate of urban population in 2012 & 2013 were below the upper middle income country average (see Table 1). Is China's urbanization and de-agriculturalization significantly unlike the experience of other countries? This paper evaluates the evolution of industrial structure and the process of urbanization development in China, and analyzes their coupling relationship in the case of Shandong province.

Table 1.The Comparison of Urban Population (% of Total) in 2012&2013.

Country Name	2012	2013
China	52.6	53.7
Brazil	84.9	85.2
India	31.7	32.0
Germany	74.1	74.9
France	86.3	79.1
United Kingdom	79.8	82.1
Japan	91.7	92.5
United States	82.6	81.3
Medium Income Countries	49.5	50.0
Upper Middle Income Countries	60.7	61.8
High Income Countries	80.2	80.0

Source: The World Bank. The data for China is according to Chinese National Bureau of Statistics

EMPIRICAL ANALYSES OF URBANIZATION DEVELOPMENT AND INDUSTRY EVOLUTION

Based on the developments of urbanization and industry, this paper aimed to perform an empirical analysis of the interaction between urbanization development and industry evolution by using co-integration test and Granger test. The contributions of non-agricultural industry to the growth of GDP and urbanization which were released by Chinese National Bureau of Statistics from 1996 to 2013 (see Table 2) are used in this paper.

Table 2.Urbanization Levels and Industry Contribution to GDP of 1996-2003.

Year	Urbanization Level (X)	Contribution to GDP (%)		
		Secondary Industry (Y2)	Tertiary Industry (Y3)	Non-Agricultural Industry (Y2Y3)
1996	30.48	62.90	27.50	90.40
1997	31.91	59.70	33.50	93.20
1998	33.35	60.90	31.50	92.40
1999	34.78	57.80	36.20	94.00
2000	36.22	60.80	34.80	95.60

Table 2.(Continued).

Year	Urbanization Level (X)	Contribution to GDP (%)		
		Secondary Industry (Y2)	Tertiary Industry (Y3)	Non-Agricultural Industry (Y2Y3)
2001	37.66	46.70	48.20	94.90
2002	39.09	49.80	45.70	95.50
2003	40.53	58.50	38.10	96.60
2004	41.76	52.20	39.90	92.10
2005	42.99	51.10	43.30	94.40
2006	44.34	50.00	45.20	95.20
2007	45.89	50.70	46.30	97.00
2008	46.99	49.30	45.00	94.30
2009	48.34	51.90	43.60	95.50
2010	49.95	56.80	39.30	96.10
2011	51.27	51.60	43.80	95.40
2012	52.57	48.70	45.60	94.30
2013	53.73	48.30	46.80	95.10

Unit root test. As making co-integration tests on data should be on the premise that the time series data must be stable, ADF test are firstly carried out on time series X and LNY2Y3 by using Eviews6.0 and the following results are obtained (see Table 3). The ADF value of the DDX and DDLNY2Y3 is less than the critical value at the 1%/5%/10% level, so the original hypothesis is rejected and time series is stable. This shows that both X and LNY2Y3 are second-order integration series which meets the same order and unit root condition for co-integration test.

Table 3.ADF Test Results of the Time Series.

Serial Variable	Test Type (C T K)	ADF Statistical Value	Critical Value at the 1%/5%/10% Level	Conclusion
DDX	C 0 3	-5.016941	-4.004425/-3.098896/ -2.690439	Stable
DDLNY2Y3	C 0 3	-4.785818	-4.057910/-3.119910/ -2.701103	Stable

Co-integration test. Engle-Granger test approach (or EG two-step method) is used as Co-integration test approach in this paper. By using LS method, the estimated equation of LNY2Y3 and X is obtained as LNY2Y3 = 4.49373255768 + 0.00130671091279 * X. Through the residuals of Reviews, residual series and ADF test results of the residual $\varepsilon 1$ are shown in Table 4.

The above results show that the ADF statistics of residual sequence is smaller than the critical value at the 1%/5%/10% level, so the original hypothesis can be rejected and $\varepsilon 1$ is believed as a stable series. Thereby, X and LNY2Y3 are believed to be co-integrated and there exists long-run equilibrium relationship between them.

Table 4.ADF Test Results of ε1.

Serial Variable	Test Type (C T K)	ADF Statistical Value	Critical Value at the 1%/5%/10% Level	Conclusion
ε1	C 0 3	-4.125057	-3.886751/-3.052169/ -2.666593	Stable

Granger causality test. In order to study the causality between urbanization and industry, this paper adopts Granger causality test. The basic process to test whether X is the reason to cause Y changing is as follows: (1) Taking "X is not a reason for Y changing" as the original hypothesis; (2) Making regressions on the lagged values of Y to Y and Y to X, and establishing regression model without restriction:

$$y_t = \sum_{t=1}^{m} a_i y_{t-i} + \sum_{t=1}^{m} b_i x_{t-i} + u_t \tag{1}$$

(3) Making regressions on the lagged values, regression model with restriction:

$$y_t = \sum_{t=1}^{m} a_i y_{t-i} + + u_t \tag{2}$$

(4) Calculating F statistics with the residual sum of squares of regression model and testing whether the regression coefficients *b* are not significantly equal to zero. If it is, then refuse the original hypothesis, there exists causality between X and Y. Similarly, whether Y is the reason for X can be tested.

The results are shown in Table 5, which indicate that at the 5% confidence level, chance of making mistakes by refusing the hypothesis of "LNY2Y3 is not the Granger reason for X" is greater than 59%, and that of making mistakes by refusing the hypothesis of "X does not Granger Cause LNY2Y3" is greater than 72%, so whether LNY2Y3 is the Granger reason for X or whether X is the Granger reason for LNY2Y3 cannot be determined at the 5% confidence level.

Table 5.Granger Causality Test between LNY2Y3 and X.

Original Hypothesis:	Lag	Obs	F Statistical Value	Prob.
LNY2Y3 does not Granger Cause X	4	14	0.09294	0.9805
X does not Granger Cause LNY2Y3			0.32593	0.8500
LNY2Y3 does not Granger Cause X	3	15	0.22418	0.8770
X does not Granger Cause LNY2Y3			0.45381	0.7218
LNY2Y3 does not Granger Cause X	2	16	0.54682	0.5937
X does not Granger Cause LNY2Y3			0.33699	0.7210

COORDINATIONS OF URBANIZATION DEVELOPMENT AND INDUSTRY EVOLUTION

Drawn from the above analysis, there was a correlation between the conversion of de-agriculturalization and urbanization in China. But there are no causality between urbanization and de-agriculturalization. Does this mean the development of the two is consistent? In order to examine this problem, their coordinated evolution is studied in this paper. In view of Chinese huge regional differences, the case of Shandong Province is researched in order to avoid deviations in the national level.

Comparison of industrial structure and urbanization level to Chenery's level. The GDP per capita of Shandong province in 2010 was \$6034, which was \$1206 when converted into dollars in 1970 (Zhu et al. 2012). Shandong province has entered the middle to late industrialization periods. Shandong Province had the industrial structure of 9.2:54.2:35.6 and had the urbanization level of 49.7% in 2010. Comparison of industrial structure and urbanization level with Chenery's founding showed that the level of urbanization in Shandong province was lower by 10%. The second industry output value (54.2%) was higher than the output value of all level while the output value of the tertiary industry (35.6%) was lower than that of this group (51.4%) (Chenery et al. 1987).

The employment structure was 35.5:32.6:31.9. The employment proportion of agriculture was higher than that of corresponding group while the employment proportion tertiary industry was lower than that of corresponding group (see Table 6). The comparison shows that the agriculture has low productivity and there are a large number of surplus rural labors. In all, urbanization of Shandong province lags behind the development industrialization and the urbanization level is lower than the average value by 10%.

Table 6.Chenery's Industrial Structures and Urbanization Level.

Per capita GDP (US dollars in 1970)	Production value structure %			Employment Structure %			Urban-ization level %
	Primary industry	Secondary Industry	Tertiary Industry	Primary industry	Secondary Industry	Tertiary Industry	
700	21.1	29.4	49.5	39.5	25.8	34.7	52.7
1120	15.5	33.1	51.4	29.9	30.3	39.8	60.1
1400	13.8	34.7	51.5	25.2	32.5	42.3	63.4
>1400	13.2	37.9	48.9	15.9	36.8	47.3	65.8

International standard value method. Based on a correlation between industrialization and urbanization, to judge whether the industrialization and urbanization of a certain countries or regions is coordination, the general methods are using IU and NU. IU refers to ratio of the rate of industrialization (I, i.e. industrial labor force accounted for the total proportion of the workforce) and the rate of urbanization (U), NU refers to ratio of the rate of non-agricultural labor force (N, i.e. the non-agricultural labor accounts for the total proportion of the workforce) and the rate of urbanization (U) (Gugler 1988).

Researches show that when the urbanization, industrialization and non agriculture development are coordinated, IU is getting more and more close to 0.5, and NU is getting more and more close to 1.2. If IU is significantly less than 0.5, and if NU significantly less than 1.2, labor not only engaged in industry and other non-agricultural industry but also engaged in agricultural production concentrated almost exclusively in urban areas. This means the development of urbanization advance the development of industrialization and non-agriculturalization. On the contrary, the development of urbanization lags behind industrialization and non-agriculturalization.

Based on our calculation, the urbanization rate and the labor force non-agricultural rate increases faster than the labor rate of industrialization in Shandong province from 1978 to 2010. In 2010, IU and NU reduced to 0.81 and 1.61 respectively. The level closes more and more to the standard value. But it is still greater than the standard value. The results show that the level of urbanization in Shandong province is still lagging behind the level of industrialization. But the urbanization development is gradually reducing the gap with the industrial development (see Table 7).

Table 7. Urbanization Rate vs. I_U、N_U in Shandong Province (1978-2010).

Year	I	N	U	I_U	N_U	Year	I	N	U	I_U	N_U
1991	0.23	0.36	0.19	1.18	1.86	2001	0.24	0.48	0.28	0.86	1.71
1992	0.23	0.37	0.20	1.14	1.82	2002	0.25	0.50	0.29	0.86	1.72
1993	0.24	0.39	0.22	1.11	1.76	2003	0.26	0.53	0.31	0.84	1.71
1994	0.25	0.42	0.24	1.05	1.75	2004	0.28	0.56	0.32	0.86	1.73
1995	0.25	0.46	0.25	1.01	1.83	2005	0.30	0.60	0.34	0.90	1.76
1996	0.25	0.47	0.26	0.95	1.80	2006	0.31	0.61	0.35	0.90	1.76
1997	0.25	0.46	0.26	0.95	1.77	2007	0.33	0.63	0.37	0.89	1.71
1998	0.24	0.46	0.26	0.91	1.78	2008	0.32	0.63	0.38	0.84	1.67
1999	0.23	0.47	0.26	0.90	1.80	2009	0.32	0.63	0.37	0.85	1.69
2000	0.24	0.47	0.27	0.88	1.75	2010	0.33	0.64	0.40	0.81	1.61

Regional Difference. Shandong Province includes 17 cities. Are there differences among the regions in urbanization development and industry evolution? The IU and NU of 17 cities are calculated. The level of urbanization in eastern coastal area was significantly higher than that in the western region of the city.

According to the deviation of urbanization and industrialization, 17 cities are classified to four types: The first type is Ji'nan city and Qingdao City. The second type has 5 cities with deviation between -1 to -5. The third type includes 7 cities whose deviations of urbanization lag value between -5 to -10. The fourth type of 3 cities' process of urbanization seriously lags behind industrialization (see Figure 1).

The spatial disparity of urbanization development shows the process of urbanization in western region lags behind the industrialization process in Shandong.

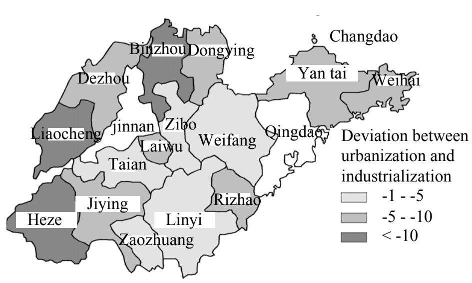

Figure 1.Relationship between urbanization and industrialization in Shandong province.

CONCLUSIONS

China has experienced rapid expansion of urban population and rapid growth of economy. Empirical analysis shows the existence of stable relationship between the industrial development and urbanization. But there is no causal relationship significantly. By further analyzing Shandong Province as a case, the process of urbanization is found to be slower than the process of industrialization. In the more economically underdeveloped regions, the gaps are wider.

This phenomenon deals with the characteristics of Chinese urbanization. That is the industrialization launched by the government. The establishment and development of cities and towns are arranged by the government, forming the network of cities and towns which is the duplicity of both political center and economical center. At some stages, the political indicators are prior to the economic indicators. The disadvantage is that it is liable for the governments to impose too much administrative intervention and economical interference. The capability of urbanization to absorb nonagricultural labor force is quite low. The tertiary industry is relatively undeveloped.

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Review on Studies of Urban Spatial Behavior and Urban Planning from the Perspective of Big Data

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Abstract

The rapid development of information technology has brought the era of "big data", which changes the research on urban spatial organization and structure. On the basis of the studies on traditional urban space research method, this paper analyzed the big data processing technology and summarized the studies on urban functional area and social space using big data concept all over the world, including the aspects of urban traffic, function zoning, behavior characteristics, social relations, urban planning and some major events. All these studies should be have provide new insights in understanding the inter-relationship between the human and geographical environment which is establishing a new urban spatial research system based on big data applications at present. It is helpful for the interdisciplinary studies on city development and also better for guiding the urban planning for innovation on smart city construction.

INTRODUCTION

Big Data was firstly considered as the large number of data sets that were used to updated the network search index and do batch processing or analysis at the same time, but it is not only a concept of number at present. It has four characteristics including huge, complicated, loose value, and high processing speed, and then can be divided into several areas concerning big data technology, data engineering, big data science and big data applications. .According to "the 31 times China Internet network development state statistic report" issued by China Internet network information center(CNNIC), Internet users in China has arrived at 564 million in 2012, while the annual growth rate comes at 3.8%, and the Mobile Internet users is 420 million, while the annual growth rate is 18.1%. Since the net work has become the platform of the urban economic and social development, it affects residents activities, business, science and technology research and development, and government management, which make the possibility to get the network data (social networks, theme Standing, search engine, etc.) reflecting the urban spatial organization and resident behavior characteristics. At the same time, the mobile information device (GPS, smart phones, IC Card, etc.) technology which based on the positioning function is gradually mature, providing more accurate location information of the residents and accelerating the period of "big data".

DATA ACQUISITION AND TECHNOLOGY INNOVATION

Data acquisition and processing is the key to the urban special research, which determines the scope and depth of research. With the rapid development of constantly updated information technology, the traditional method of data acquisition and analysis exposed a lot of defects or problems gradually, while big data and its processing technology is becoming more and more attractive for the scholars.

Along with the development of Internet, 3S technology (GPS, GIS, RS), and smart phones, data acquisition and processing in the field of humanities and social science research has shown a new trend, mainly including: data mining using the software, data collection and analysis using GPS, LBS and smart card equipment, combined with GIS, or web logs, visual development using the network to get the map data. These techniques can be used as a big data resource for urban space research, and will be conducive to expand the scope of research, and increase the depth of the research results and accuracy.

Web data mining technology. Web data mining is an important content of computer science research, including content mining, structure mining and use mining. Content mining derive the web page text and media to study the state of user activity and characteristics. Structure mining analyzed the link structure to evaluate the web resource. Use mining provided personalized products and services by mining web access log records. At present, network data mining is usually mainly implemented through the design of “web crawler” (retrieval and access to the data of a computer program) software, and different sites or data acquisition target needs different crawlers design. For example, the authority web mining program or visits mining program in a search engine (Ling 2003), data mining programs concerning user address, text, images, and relationship in the social network, (Sun 2011; Hollenstein and Purves 2013), network top events in the mining program and web data mining process like taobao topics (Feng 2012), etc. This shows, the existing network data mining technology is relatively mature, and the data mining types has already covers almost the explicit and implicit characteristics of all information in web pages. With the deepen influence on urban life, the network data become a more and more important carrier of the characterization of residents’ social activities, and its application research has raised in the fields of sociology, geography, management science, drew the attention of scholars (Shi et al. 2010).

Map integration and visual development. Data spatial analysis and visualization has been the key technology in map research for a long time, while the function development of network map brings this technology a new breakthrough. Hudson et al. (2009) developed a software that could integration in the Google maps engine (Maptube), and then making a thematic map by superimposing other maps on the Google map. It is consist of three parts including Google maps producer, pictures producer, and superimposed producer. Field and O’ Brien (2010) also produced thematic map or display on the base of Google map and combined with GIS and Twitter (one of the world’s most popular social networking site currently), so as to realize the simulation of social space structure. Predictably, the residents’ activities and the change of urban spatial structure can be clearly expressed by a large number of information using the network map and thematic information integration technology, and thus more inherent law of urban phenomenon or mechanism can be revealed.

Behaviour data collection and analysis. Since residents is the main activity part of urban space, the change of behavior and activity may affect urban spatial organization and structure. With the continuous development of geographic information and computer science, residents' behavior data collection and analysis relied more on information processing software or device with improved accuracy. Kreitz (2001) developed a network GIS software (CHASE - GIS) to collect spatial data, which was consist of network map, activity data input, mobile computing path, and data analysis and display parts. Ma et al. (2007) integrated the mobile information device (GPS) with network map, using the function of LBS and family activities logging to obtain the space-time activity data of the residents. Papinski et al. (2009) provide a new network routing survey system on the base of GPS, GIS and loggings the residents information. using the advantages of both technologies above, GPS records the route choice, and GIS is used to record plan route information, while web loggings can display the path selection results. At the same time, the "activity - travel" detection algorithm that used to process the GPS data, reduces the technical defects or residents attribute factors that may affect the accuracy of the data. Overall, residents' behavior data collection and analysis has become the focus of data processing technology, and has experienced a period that using a single method combining GIS software, and then towards a time that obtaining and analyzing data on variety of information equipments.

STUDY ON URBAN RESIDENTIAL BEHAVIOR

Studies on urban character and people behavior. Urban characteristics and activities research is the foundation of urban social spatial research, for the traditional research, it is mainly based on small sample survey data, combined with descriptive statistical analysis, and finally get the qualitative description and generalizations. With the development of social network and the increase of the users, a large number of urban residents travel and rich activity data can be extracted from the website, which has greatly improved the accuracy and scientific of the research. Wakamiya et al. (2011), using Twitter geographic collection system for more than one thousand Twitter data with a geographic label, including the user ID, published time, location, and text content, and then using the kernel function clustering analysis to build the Japanese social and geographical boundaries, and simulated the urban characteristics of the groups based on social network combining the geographical regularity of Voronoi diagram and daily activities crowd. Croitoru et al. (2012) has built a geographical analysis platform (G - SAW) system to study the characteristics of cities and activities, including social media data acquisition and collection, time and space and social analysis, expert decision-making system, user feedback. The current urban characteristics and activity research mainly did through the large sample size residents network activity to reflect the change of the city and local characteristics.

Studies on social relation. Residents are the main body of social relations, while the relation between urban spatial structure and social networking is increasingly close together under the influence of information technology. And as a result, it also attract the attention of the city geography scholars. Java et al. (2007) using a statistical method to analyze data, combed with the econometric model and group osmosis to depict the user different potential intentions when tweeting posts, which revealed the phenomenon of similar intent of connected users. Lee et al. (2010) using social network analysis, obtained a large amount of network data from the Google search engine, and analyzed 109 U.S. senators in social relations and their dynamic change. The result is more accurate than that comes from the traditional social behavior questionnaire data. Crandall et al. (2012) has reconstructed the residents activity information database using social networking websites such as online photo data, including extraction of photographs concern emotion and geographic information, network structure and simulation of the photographer based on the photos, etc. Traditional research base on interview which get a small amount of sample has shifted to a wide range of complex social network research, which can better analyze urban social spatial structure with lower cost of research and reach high precision.

Studies on urban traffic. Since road line selection and construction in traditional transportation research is mainly based on population size and functional partition, which concentrate more consideration on the urban space coordinate and ignore the actual demand of traffic conditions of resident individuals, it seems poor flexibility, and always come with the traffic distribution, traffic congestion, and some other issues. With the development of information technology, it's possible that study urban residents travel mode by the use of information equipment starting from the residents' individual or group, and this may make the reasonable arrangement of resources become a new trend of traffic planning gradually (Qin et al. 2013).

Becker et al. (2011) obtained the anonymous call detail records (CDRs) of 20000 residents in the two months in the United States Maurice from the telecommunication operators, including zip, voice and text messages, which was used to reveal the trend urban population flow and change by statistics and mapping analysis. Mark and Nick (2011) has used the 9223 users Twitter data in the Leeds city of 4 months to establish the intelligent model and explore the relationship between the living, education, work, entertainment and shopping and their basic activities, which was then visualized by 3d GIS technology. Sagl and Hawelka (2012) combined the mobile network traffic data (directional switching vector and the overall network traffic data) and social networking sites (Flickr) data, using spatial analysis to explore the hot spots under different seasons and travel activity and changing characteristics. Liu et al. (2012 a) has simulated the residents daily travel distance and direction in Shanghai using the data from the 15000 consecutive 1 week taxi trajectory, and established the Monte Carlo Simulation concerning the fusion of land use difference and distance attenuation effect. Liu et al. (2009) derived the GPS data of taxis (5000), the bus or the subway IC card data (5 million) in Shenzhen, and used the method of clustering and statistical analysis to get the quantitative description of urban residents travel commuter, relations between different places travel, travel and land use, and designed a monitoring and real-time visualization platform combined with web pages and GIS. The urban traffic research of the big data period is the typical "flow space" research, which is develop mainly around the large sample size of urban residents travel, and it finally may lead to a more reasonable transportation planning and land use adjustment (Liu et al. 2012b).

STUDY ON URBAN SPACE AND PLANNING

Functional zoning. Urban functional zoning is the focus of the urban geography and urban planning research, while city geography concentrates on the formation mechanism of urban spatial structure and its impacts on urban development, and urban devotes to functional organization and space layout arrangement according to urban scale and development strategy demand. Both starting point is the function of the macro level based on the population, land use, industrial scale and so other factors, and less studies did from the perspective of residents' perception when make classification.

Hollenstein and Purves (2013) determined the central border in London and Chicago metropolitan area by 8 million Flikr (social networks) location and image information for a period of one month. take the British cities for example and puts forward three methods for dividing areas of the city, including using tourist map, bus or website description information for synthesis of central district of the city boundaries; using Flikr social network with the geographic location of the image information to differentiate central district of the city, combined with a text description content; using the Panorama website (panoramic photo sites) to determine the scope of the central area of the city, combining with the experience of residents network log investigation. All these were based on topographic map database for urban space, with the residents contains emotion and experience of cultural elements at the same time.

The traditional classification principles has been changed by the use of emotional data in research concerning city dividing. The results of these study seems meet the demand of the humanities (Cranshaw et al 2012), and reflects the planning idea of "compact hybrid layout". But the researches concerning classification of other functional areas by the network data are relatively lack at present. And how to coordinate the relationship between the function area will become the challenge of such researches.

Spatial interaction. In fact, mobile behavior between different geographical areas can be seen as a kind of spatial interaction process. Spatial interaction can not only reflect the intensity of regional social and economic relationship, and can also reflect the spatial structure of the city.

The law of universal gravitation has been introduced in the study of human movement between cities for the first time in 1942 by Zipf (1946). The gravity model and its variants has become the main method in the study of human movement behavior between geographical regions. But for the gravity model, it needs too much parameters, and the physical meaning of the model is not clear enough, it has been questioned by many scholars (Gao et al. 2013; Calabrese et al. 2010; Sadilek et al. 2012). In recent years, researchers have put forward some new models. The sort-distance model is put forward by Noulas, which can more accurately capture the human movement between the two cities compared with the gravity model (Liang et al. 2012). Simini et al. (2012) built a radiation model according to the human space mobile behavior characteristics, which improved the prediction precision of the regional population mobility, and this model does not require any parameters. Lenormand et al. (2012) has put forward a model of single parameter, and proved its accuracy was better than that of the radiation model. Although new models are better than the gravity model in some respects, some studies gravity model method, which using direct population to approximate the "quality" of the geographical area (Liu et al. 2014). it studied commute in the city using mobile data, and pointed out that when using the number of residence population approximate geographical area "quality", the gravity model fitting effect is better.

In addition to build the spatial interaction model to explain and predict human individual/group movement between geographical areas, a growing number of studies has analyzed the behavior of human individual/group mobile geographic area from the perspective of network in recent years (Gao et al. 2013; Kang et al. 2013a). Moving between the groups in multiple geographic areas can be used to construct a network structure by geographic area for the node, mobile intensity between geographical area for the weights. In addition to the analysis of network node and edge weight, aggregation coefficient, average path length and other properties, community detection methods are commonly used to identify the community structure of the mobile interaction strength, and the regional spatial structure can be analyzed, the rationality of administrative divisions can be assessed, etc. Some studies have found that community boundaries can be divided using the method of community detection, which results show consistency with the existing administrative division. This meant that the movement of the human behavior has been limited by inherent administrative divisions to some extent (Gao et al. 2013).

Urban hierarchy. Differ from the traditional data study concerning the network domain name (Zook 2001), the network user number (Wang & Ning 2004), professional web page structure (Wang et al 2003), and so on, the urban hierarchy is mainly based on large data research started from the behavior data of residents, which is to build a regional urban network system. The research data usually comes from the social networks and mobile communication equipment which record the residents' behavior of time and space, and the research method always use the related content analysis of the traditional network.

Social networks not only reflect the virtual relationship between residents and contact, it also reflect the urban physical activities in cyber space. Then the city's ability to control information resources could be measured through the data mining on social network data, which shows the level in the regional environmental characteristics. Twitter data is more often used by foreign scholars, the domestic scholars explore have just started on sina weibo. Naaman et al. (2012) using Twitter firewall cracking programs to extract large orders of magnitude of geographic coordinates and text data, and combined with time series model to analyze the different characteristics and distribution of urban Twitter post keywords. The result found that only a few cities can offer more information by keyword search, through which to get the level of network activity and link between cities. Zhen et al. (2012) selecting cities on the base of their strong economic strength and high information level, used the sina weibo website statistics to get the friends weibo activity location and relational data from 1020 weibo users in China's top cities in a single day, and draw lessons from the world city network research methods to analyze the Internet in China's urban social space network system. Therefore, reflecting the behavior relationship between urban residents through social network data, and determining the relationship between cities and their hierarchies can be used for the study of the regional spatial structure and urban system planning. At the same time, it also has to pay attention to the issue of the false social data.

Mobile communication data between residents can also represent the relationship between cities. In general, the larger of the urban economic strength and scale, the stronger it correspond with the outside world.

Krings et al. (2009) studied the communication links and hierarchy between cities using the city's social network based on the user mobile phone bills address corresponding to the zip code, which were derived from the 25 million users communication information during six months provided by the Belgian telecom operators. Kang et al. (2013b) has built two local area network using the 1.9 billion mobile phone records data of Heilongjiang province within a month, and explored the strength of links among the cities by the gravity model.

CONCLUSIONS AND DISCUSSIONS

In big data era, facing the change environment of the human activities, the urban space, information technology transformation, the urban special behavior research which using network information equipment to get research data has to pay attention to the exploration of new methods to cope with the increasingly complex urban problems, except the traditional research methods.

In particular, it requires the integration of discipline to promote and strengthen the research methods of residents' behavior study, which may provide the basis of urban planning.

Integration of multidisciplinary research method. Information technology has provided a diverse and complex data to the researches of multiple disciplines, which also enlarged the research scope for interdisciplinary gradually. Their research methods tend to start from the application and analysis of "big data" despite their different focus. Therefore, the integration between discipline will become the main trend of future development. In particular, on the basis of the development of computer science, mathematics, geography information system need further integration in the existing network for residents' behavior data collection and analysis including data mining network map and visualization technology, which may promote the continuous update of data acquisition and application of information technology. On the other hand, since the impact of information technology has played more important role on individual behavior and urban space, the city's business organization, tourist and cultural groups, government agencies and other activities will face great changes which would require city geography scholars pay attention to draw lessons from sociology, economic geography, culture, geography and tourism geography and other disciplines to study the theory and methods of human activities and regional spatial organization during this rapid change.

Residents' behaviour and urban space research methods. At present, studies on the residents space-time behavior concerning the big data by domestic and foreign scholars is still weak, which need constant exploration on new data sources and methods.

On one hand, most of the research was based on the use of the high cost of information equipment (such as GPS, mobile phone, etc.) to obtain the data, while data mining methods for smaller cost, larger sample size are relatively lack. For the residents travel characteristics, sina weibo friends attention or Posting data, check data of street network and social activities and BBS data could be considered. On the other hand, urban space research on the base of big data should pay more attention on urban land use, urban spatial structure and urban space, and urban theme website is another orientation in the future should be considered. For example, public comments on the net, review data concerning the service quality, spatial distribution of city services, and SouFang housing information can be used to evaluate the quality of urban living environment and space distribution characteristics. Also, ZhiLian job information in the net can be used to study urban employment spatial structure, and Baidu index can be used to measure the degree of connection of all urban functional areas.

Information technology has created the city's enterprise network, industry network, Internet, social network and information network, which are the embodiment of the residents' behavior and activities, and root of city space organization changes. Therefore, urban geography scholars need to pay attention to data mining and applications on all kinds of network behavior, which would enrich the city space behavior research method system on theoretical height. It is would have expected widely used in city planning, social management, residents service and other fields.

Guidance method of urban planning and management innovation. For urban residents, information technology is changing people's life, which lead to space liquidity and produce complex changes. These need more "wisdom" of city space organization, technical system and urban management system. For the urban geographers, research on influence of information technology on geographic space information technology and urban development, through which guide the innovation of urban planning and management. Specifically, the city space behavior research based on big data can be promoted from four aspects:

(1) combined with the existing area planning methods, using the urban residents' behavior research to innovate urban detailed planning, community planning and residents' behavior planning method;

(2) combined with the existing urban function zoning and land use planning and transport planning method, using methods of city characteristics and space analysis to carries on the urban planning, urban detailed planning or urban special planning innovation;

(3) combined with the method of existing urban population and land scale prediction and regional function judgment, using urban hierarchy research methods to make urban system planning idea and method innovation;

(4) combined with the city space behavior research system, build the intelligent management information system based on the development of new technology and comprehensive utilization of various existing technologies.

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Tianjin City's Low-Carbon Energy-Saving Building Usage Analysis

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Abstract

Our planet's resources are limited, how to conserve natural resources is an urgent problem. The construction industry is energy-consuming, it relates to water, timber, minerals, and many other resource consumptions. Related statistics show that nearly half of the resources that people get from nature are used in the construction industry and the construction of ancillary facilities (Gottfried and Malik 2009). Meanwhile, the construction industry is also highly polluting industry and the broken of natural resources is shocking, so energy conservation is an important object.

In modern society, many countries are seeking to develop a low-carbon economy and circular economy, striving to get the maximum benefits. The researches of the low-carbon-saving building can develop a low-carbon economy and circular economy, but also benefit future generations.

Tianjin is the first city to study the carbon-saving buildings and constructions of energy-saving city, its constructions of low-carbon energy-efficient buildings always walk in the forefront of our country. For example, the financial district named Jiabao and community service centers named Beitang are Tianjin's low-carbon energy-efficient building landmark projects. This article briefly describes the main low-carbon energy-efficient buildings in Tianjin status and the concepts and construction techniques of carbon-saving building constructions.

INTRODUCTION

Carbon-saving building is to reduce pollutant emissions through the rational use of energy and natural resources and the preferred materials. It's dedicated to the conservation of resources and to use land resources and energy efficiently, focusing on promoting the use of renewable resources, timely using life sewage, minimal use of resources, and recovering and recycling various materials to some extent (Derek 2012).

Carbon-saving buildings most vigorously develop new conservation-oriented architecture, promote the use of low-carbon renewable resources and energy and strengthen reuse and other building components.

Housing constructions consume a lot of natural resources, mainly to non-renewable resources, having a serious negative impact on the environment. According to relevant statistics, the half of the natural resources that human get are used in constructions and related infrastructures. Therefore, the study of carbon-saving construction has a far-reaching impact on maintaining ecological balance, protecting the environment and achieving sustainable development.

Although China has vast land and is rich in natural resources, but waste is widespread and the relevant technology is still lagging behind compared with developed countries. The implementation of low-carbon-saving building research is imminent.

In accord with the relevant laws and regulations of national building energy efficiency, we study building materials of low carbon energy-saving building, design, use of energy and resources through the use of advanced technology and collect the reference of foreign experience in order to realize the sustainable development.

THE USAGE OF LOW CARBON ENERGY-SAVING BUILDING ABROAD

As one of the most developed countries in the world, The United States' development level of the constructions has been in the world. Besides, in the aspect of low carbon energy-saving buildings, it also has been at the forefront of the world, having issued a series of building energy efficiency standards. In order to efficiently promote energy conservation, The U.S. government actively encourage building energy saving from the aspects of economy.

Japan has a large population with relatively little land and is not rich in natural resources. As a result, Japan has been very attention to efficiency of resource utilization. A series of economic incentives make it become one of countries with the highest energy efficiency in the world.

The British government is committed to promoting green energy-saving buildings' developments and achieving building zero carbon emissions. Bedzed is environmentally friendly eco-district and currently the largest in the United Kingdom. It is based on environmentally friendly and practical, focusing on a number of energy saving technologies.

THE ANALYSIS OF LOW CARBON ENERGY-SAVING BUILDING IN TIANJIN

Tianjin is the first city to study and teach the constructions of low-carbon-saving buildings, various studies have been at the forefront of the country.

Tianjin financial district named YuJiabao has built green ecological buildings, including the best management systems of storm water, the air conditioning systems, curtain wall systems, the use of renewable energy and roof plantings.

Tianjin has made "twelfth five-year" energy saving target responsibility evaluation scheme. In the "twelfth five-year", Tianjin is committed to building ecological city.

The target of Building energy conservation is to increase the proportion of energy-saving building in the city's urban homes by eighteen percent, to reduce the heating coal consumption by twelve percent and make eighteen percent drop in public building energy consumption per unit floor area.

THE MEASURES OF PERFECTING LOW-CARBON ECONOMICAL CONSTRUCTION

The energy-saving design of retaining structure. Retaining structure components include roof, metope, ground, heat insulation, sealing materials, doors, windows and sun visor. They directly affect the building energy consumptions, indoor and outdoor environments and the comfort of living. Generally increasing the cost of retaining structure accounts for the proportion of total investment but the effect of saving is remarkable. First of all, the palisade structure of the thermal performance is the primary goals for improvement. Then we can use the software DOE-2.0 to optimize retaining structures in combination with the local climate and construction characteristics. Finally, we evaluate the technical and economic feasibility of retaining structure to optimize design. The international community generally uses OTTV as an evaluation method, it is convenient and practical.

The design points of exterior energy-saving. In general, the outside wall components 60% of building palisade structure. In building heat consumptions, forty percent of it transmits through walls. Therefore, impermeability and wall thermal insulation performance for building energy conservation plays a pivotal role [(2)]. What were used in the past were the solid clay brick, only considering the bearing without taking into account thermal insulation, and greatly wasting land resources. It has been banned now. Now more praise highly is composite walls, mainly including inner thermal insulation composite wall, sandwich thermal insulation composite wall and external thermal insulation composite wall.

The design points of doors and windows energy saving. Doors and Windows are an important part of building palisade structure, having ventilation, lighting, sound insulation, wind rain, and many other important functions. According to relevant dates, the amount of heat is lost through doors and windows of buildings in China, so energy saving technology of the doors and Windows in the study of building energy saving effect is very important.

Now, in our country, what are most used are wood doors and windows, aluminum alloy doors and windows, plastic windows and model steel windows. Energy saving of doors and windows is to study how to optimize its performance (Li 2011):

(1) The glasses of energy -saving doors and Windows. Glasses occupy the main area of doors and Windows, the optimization of glass heat preservation and heat insulation performance means the improvements of the performances of doors. We can choose energy-saving glasses according to the different location, the design characteristics of the structures, local geography and climate features.

(2) Energy saving technologies of sunshade. In summer, the sun transports a large number of indoor heat through the window, while sunshade measures can effectively reduce the illuminate of sunshine so as to achieve the goal of energy saving.

The design points of roof building energy-saving. Roof as building palisade structure; its energy saving also plays an irreplaceable role in building energy efficiency. In addition, energy-saving roof has a good waterproof performance and has superior heat insulation performance (Hu and Li 2012). The unusual ways of roof insulation have the following kinds: external thermal insulation roofing, inversion type roof, roof ventilation, water storage roof and roof planting.

THE RATIONAL USE OF NATURAL RESOURCES

Natural resources are rich on earth; we humans have obtained from the nature of itself what we need. The reasonable use of resources in the architectural design is an important part of our low carbon energy saving building research. The solar energy, geothermal resources and water resources are mainly introduced in low carbon economy type used in construction.

Solar energy in the application of low carbon energy-saving buildings. The sun is far away from the earth which we live, but it companies us all the time. Solar energy resources are known as the inexhaustible resources. Now, the utilization system of the solar energy heat includes hot water systems, photovoltaic power generation and solar heating.

Solar water heating systems. Solar water heating system is applied more widely. Solar water heating systems include collector, circulatory system, heat storage system, control system, racks and other reasonable together. Solar photovoltaic power generation technology is developing rapidly in recent years. Solar energy into electricity has two ways: one is through the photoelectric power device, simply said that "sun power". The other is to convert solar energy to heat energy, namely "sun power", as shown in Figure 1 (Cao and Hu 2011).

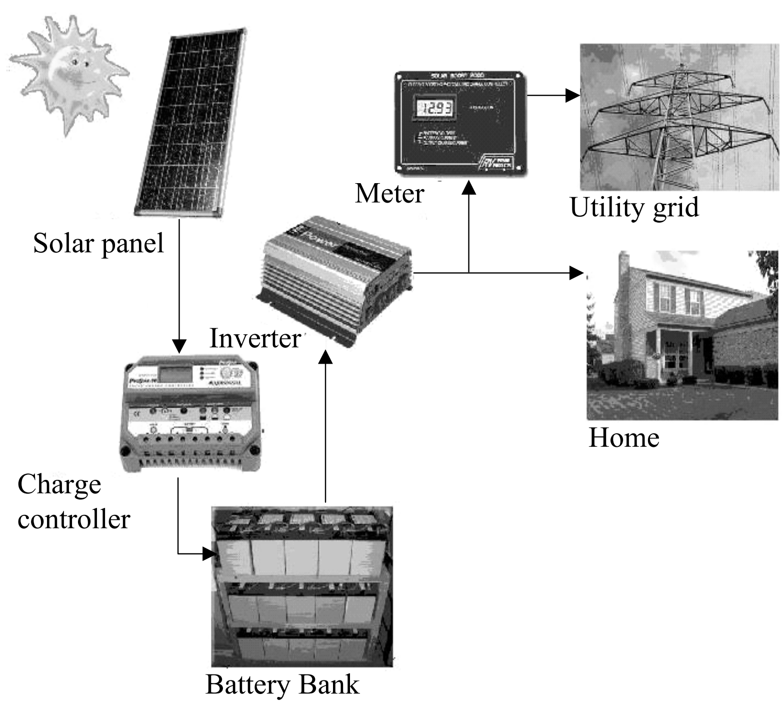

Figure 1.Solar photovoltaic power generation.

The principle of solar photovoltaic power generation is semiconductor photoelectric effects. The system is divided into communication system, dc system and ac/dc hybrid system.

At present, in the construction of residential area, install solar street light is more common and practical.

The application of geothermal energy in low carbon energy-saving buildings. Geothermal energy refers to the heat of the underground soil and groundwater. It is distributed widely and is rich, which is a kind of energy to be developed. It can be divided into low temperature geothermal, medium temperature and high temperature of the heat of the geothermal according to the temperature. All countries in the world pay great attention to the use of geothermal. In our country, Tianjin is China's earliest city to use geothermal; its size is bigger (see Figure 2).

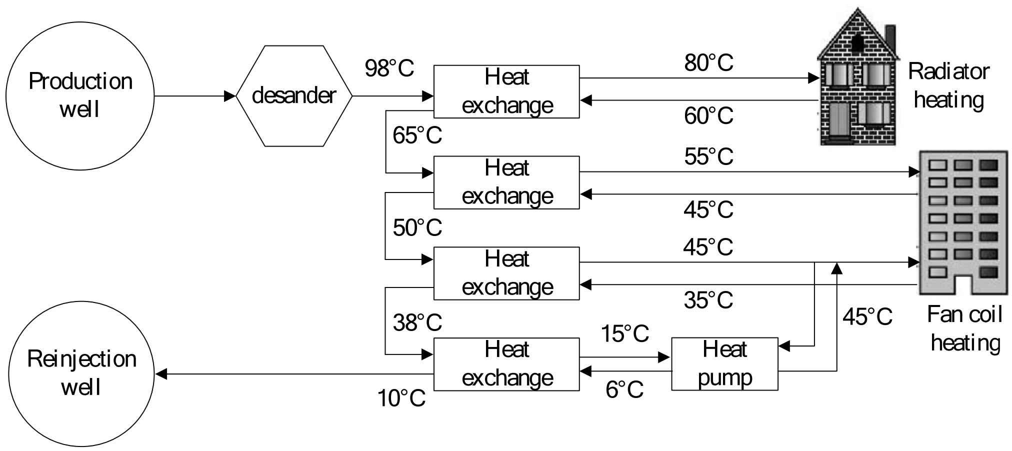

Figure 2.The application of geothermal energy.

Geothermal energy can be used directly or used indirectly. Geothermal heating directly refers to the geothermal water through the heating of the heat users directly to the user terminal heating, and then discharge. Geothermal heating indirect geothermal water is through the heat exchange station to transfer heat to the heating pipe network circulating water.

The water-saving measures in the application of low carbon energy-saving building. Water-saving measures contain a lot of surfaces. Water-saving equipment refers to satisfy the same function with water, but water consumption is normal product less water apparatus, including energy-saving tap, energy-efficient washing equipment, energy-efficient showers and energy-saving toilets (Shi 2012). Water recycling is an important part of the construction of water-saving. Rainwater utilization is also a kind of important energy saving technology.

CONCLUSION

Now our country actively promotes low carbon economy in the form of low energy consumption, low emissions and low pollution. Construction industry is the large energy consumption; low-carbon economical construction and the system of low carbon emissions can effectively reduce carbon emissions and have great significance on developments of low carbon economy.

On a global scale, low carbon energy-saving buildings have two major development directions: one is the full use of every technology. It reduces energy consumption and pollution and realizes the sustainable development; the other is to explore the indoor environment and to create livable environment.

Our country always attaches importance to environmental protection and gives policy and financial supports to the development of low carbon energy-saving building, it is booming in our country. For mankind in the 21st century, low carbon economy type construction improves the earth's environment and is conducive to the sustainable development, which build a good living environment and certainly will suffer the highly praise of mankind. Low carbon energy-saving buildings will continue to benefit mankind.

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Research on the Establishment of a Rural Construction Standard System Based on Petri Net

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Abstract

At the background of the new socialist countryside, there is an urgent need of the rural construction standard system to guide and restrict the development of villages and town. For now, the rural construction system is under the state of construction, there are so many problems such as the original standards lag in the rural construction, the lack of implementation of new technology platform, the development of the China's energy-saving construction and the ecological protection and so on. These all have an urgent need for the rural construction standard system. This paper is based on the Petri net, divide the rural construction standard system into three dimensions to describe and analyze the construction of rural construction standard system. Finally, the establishment process scheme of the rural construction standard system is given.

INTRODUCTION

The engineering construction standard system is that all the engineering construction standards in a construction field combine with the internal connection which makes the standards interdependence, mutual restriction, mutual supplement and mutual cohesion (Zhang 2011). Nowadays, the engineering construction standard system has made a great effect on the urban construction in China (Su and Dong 2009). But the engineering construction standard system is not fit for the rural construction. With the development of the economics, the government has paid more attention to develop the villages; there is an urgent need for the construction of the rural construction standard system to instruct the rural's construction (Wang 2010). The rural construction standard system means all the relative standards form an organic whole that cover the whole rural construction activities of the various aspects in accordance to a certain relation in order to guide the rural construction activities to abstains the best benefit (Su et al. 2012). This paper focuses on the research on rural construction standard system to help the rural construction.

THE CONSTRUCTION OF THE RURAL CONSTRUCTION STANDARD SYSTEM'S PETRI NET MODEL

The rural construction standard system is a complex open system (Sun and Zhang 2012). There is a complex contact among the subsystems, the layers of the subsystems and even the main participating departments and so on (Qi and Cao 2012).The Petri net is a method used to describes the sequence, concurrency and conflict relationship among the complex system process connection (Jiang 1997). The establishment of the rural construction standard system is a complex process that involves many steps and the establishment process will dynamically change with the elapse of time. Based on the complex characteristics of the rural construction standard system, this paper constructs a Petri net for the establishment of the rural construction standard system. Through the Pet net model (Murata 1989), we can vividly describe and judge the complex form and the existing problems of the establishment of the rural construction standard system.

The assumptions of the model. (1) Definition 1: The quadruples $N=\{S,T;F,M\}$ that satisfies the following conditions is a Petri net.

$$S\bigcup T\neq\varnothing \tag{1}$$

$$S\bigcap T=\varnothing \tag{2}$$

$$F\subseteq(S\times T)\bigcup(T\times S) \tag{3}$$

S and T are two disjoint elements in the Petri net N. Among the Petri net, S and T respectively mean Place and Transition which are usually expressed with circle and block. Besides, M is a token set in the Place which is used to reflect the state of the system.

(2) Definition 2: Set $N=\{S,T;F,M\}$ is a Petri net for the establishment of the rural construction standard system, for $x\in S\bigcup T$, remember:

$$^{\bullet}x=\{y|y\in S\bigcup T\wedge(y,x)\in F\} \tag{4}$$

$$x^{\bullet}=\{y|y\in S\bigcup T\wedge(x,y)\in F\} \tag{5}$$

So we call $^{\bullet}x$ and $x^{\bullet}$ are the extension of x. The $^{\bullet}x$ is the input set or the pre set while the $x^{\bullet}$ is the output sector the post set (Zeng and Wu 2004). Apparently, the extension of a Place is a subset of the Transition set T and the extension of a transition is a subset of the Place set P. For $\forall x\in S\bigcup T$, $^{\bullet}x$ and $x^{\bullet}$ are both not null set.

In the establishment of the rural construction standard system, we set the Place the technical knowledge of the standard system, the Transition the establishment process of the standard system. The Place turns the relative technology into the technical standards through the connection of the Transition that is to say the standard establishment bodies use their special technology knowledge that they obtain to establish the rural construction standard system step by step.

(3) Definition 3: Set the Petri net $N=\{S,T;F,M\}$.If the net has the transition rule below:

(i) For transition $t\in T$, if

$$\forall s \in S : s \in {}^{\bullet}t \rightarrow M(s) \geq 1 \tag{6}$$

then we say transition t has enabled for the identification M, remember $M[t>$.

(ii) If $M[t>$, then under the identification M, the transition T can happen from identification M and get a new identification M_1, remember $M[t>M_1$, for $\forall s \in S$ there is:

$$M_1(s) = \begin{cases} M(s)-1, if s \in {}^{\bullet}t - t^{\bullet} \\ M(s)+1, if s \in t^{\bullet} - {}^{\bullet}t \end{cases} \tag{7}$$

Considering the establishment of the rural construction standard system as a Petri net, it has an initial value that M_0, in order todescrible the system's initial situation. Definition 3 means, at the initial situation, the system has some enabled transition. When a transition happen, we can get a new identification M_1. Under the identification M_1, there can be some other transitions (Ou-Yang and Winarjo 2011). According to this mode of operation, with the constantly updated of the transition and the identification, the multi dimension of the rural standard system's establishment path can gradually form.

The correlation analysis between the technical knowledge and the establishment steps of the standard. The process of the establishment of the rural construction standards system need to figure out the relationship among the technical knowledge that the standard itself involves and subject establishment activities (Xu et al. 2012; Zhao and Jian 2006). As the establishment of a standard is based on the research work, the special standard knowledge place forms through accumulation of knowledge and the technical standard system of functional group formation in the presence of a field standard required. The relationships between the technical knowledge of rural construction standards can be divided into three categories: independence relationship, dependence relationship and coupling relationship as seen in Figure 1.

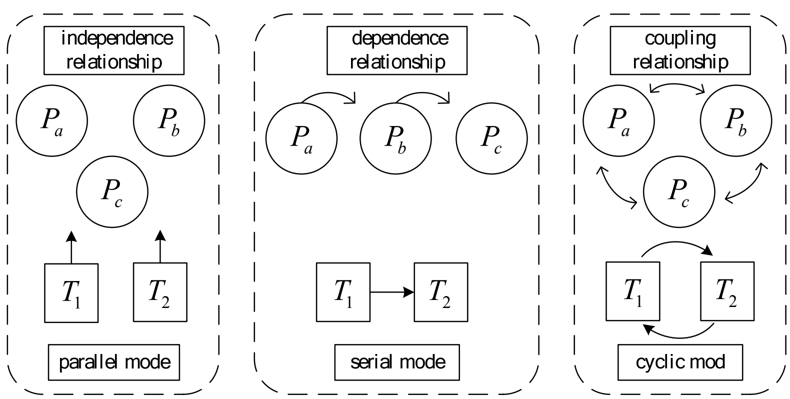

Figure 1.Relation graph of technology knowledge and activity.

The independence relationship means that the technical knowledge required for the standard terms with special attributes significantly as it may not need the link with the Transition. The dependence relationship means one technical knowledge item needs for other knowledge as a prerequisite. The coupling relationship means that the relationship between the technical knowledge base on each other and rely on each other.

From the establishment of the rural construction standard system, the relative establishment process according to the technology knowledge can been divided into: parallel mode, scribal mode and cyclic mode as seen in Figure 1.The parallel mode means the behavior of the main body need to conduct after the pre necessary behavior .The scribal mode means the related behavior of the different participations can be done at the same time as the technical knowledge they require are not related. The cyclic mode is focused on the standard technical knowledge coupling; the different participations need coordination of reciprocating to complete the standard.

THE PETRI NET OF THE ESTABLISHMENT OF THE RURAL CONSTRUCTION STANDARD SYSTEM

The dimension of the standard establishment. According to the relatively published rural construction standards and the current situation of the establishment situation, we set the rural construction standard system into three dimensions in order to construct the rural construction standard system's Petri net which we can see in Figure 2.

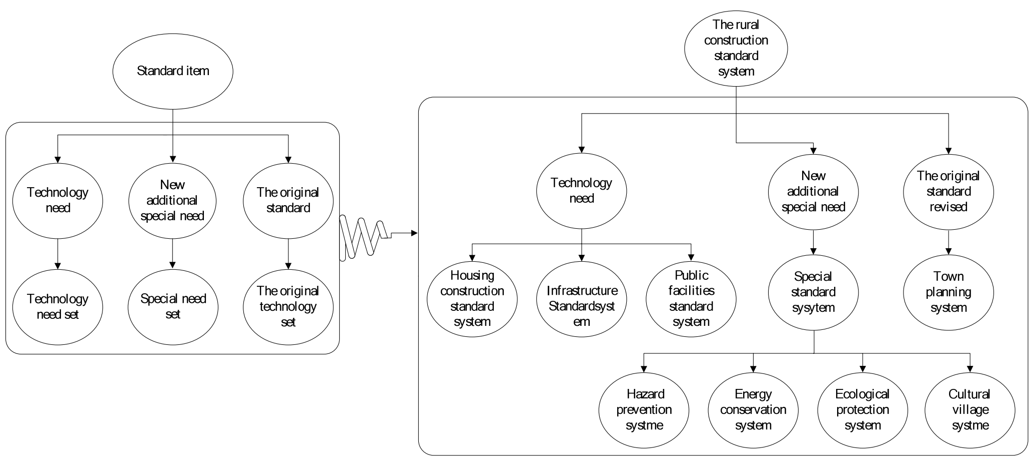

Figure 2.Three dimensional flow process of country construction standard.

First, the technology dimension. The rural construction standard system is an integrated complex system which is centered on the rural construction and development and related on housing construction, electrical engineering, municipal drainage, roads and bridges and other areas of technical knowledge. The engineering construction standard has made a great effect on the city's construction while the engineering construction standard is not fit for the rural construction which makes the key technology hardly to function well. Based on the technology, the standard's special departments investigate the rural actual situation with professional and technical knowledge and consider the special standards' the applicability and coordination at various aspects, it can guarantee the scientific construction of the rural construction standard system and makes an application platform for the technology used in the rural construction.

Second, the dimension for the revision of original system. Although our country has not built a system for the rural construction system, but the town planning standards (GB50188-2007), the urban and rural construction part in the engineering construction standard and so on, have been existed and functioned .Searching the original standards and revising based on the current situation of the construction of town planning can guarantee the good continuity, transitional and adaptability of the development of rural construction standard system. Besides, it can also guarantee to avoid the duplication of the contradiction that appears in standard system construction process.

Finally, the dimension of the new special requirement. At the trends of the socialism new rural reconstruction and the urbanization, it has an unguent need for rural construction standard system to guide the development of villages and towns. At now, the new issues of Chinese rural ecological environment protection, energy saving buildings and historical and cultural village and local landscape protection and other are emerging. The establishment of the rural construction standard system plays an important role to ensure the safety of the rural residents, improve the quality of life of the village, the protection of ecological environment in towns and villages. The building conservation, ecological villages and historical and cultural village and other point of view are also objectively promoting the preparation of needs new special standard for the rural construction.

The synergy Petri network of the rural construction standard system establishment. During the process of the establishment of the rural construction standard system, the Petri net model can not only describe flow process of the technical knowledge, but also can construct the multi dimension standard establishment process through the different layers of Petri net. Figure 3 gives the multiple dimensions of the establishment of rural construction standard compilation of collaborative Petri net flow chart (Pan and Jiang 2000).

From Figure 3 below, we can see that the whole process of the establishment of the rural construction standard system contains some parallel and serial segments. That means the formation of a standard is not an isolated and single dimension process as it needs to consider both the need for technical ability to fully explore the standard also fully consider the comprehensive property. The evaluation of comprehensive attribute in Figure 3 consists of whether the range of the rural construction standard that relates to is comprehensive, the security is guaranteed and at the same time the advanced technology considers the economy and the applicability of the standard's using process and also the degree of adaptation for the current management level. In the Petri model, the Transition T_{10} need a large number of tokens to been triggered, so it can been be regarded as the key segment of the whole process .Through it the chief department can improve the efficiency of the whole establishment of collaborative process by strengthening the focus on change management and optimization of change before the token generation's efficiency and process.

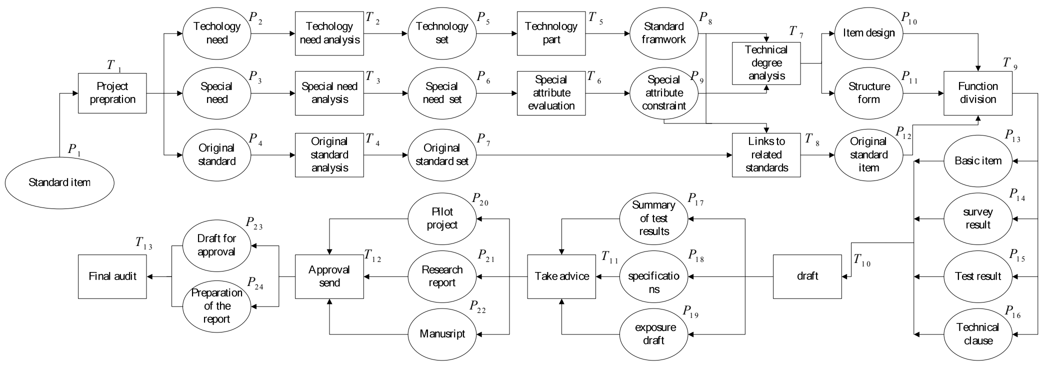

Figure 3.Flow process of synergy formation based on Petri net.

MULTI DIMENSION COOPERATIVE PERFORMANCE OPTIMIZATION MODEL

One of the main purposes of using Petri net on modeling of the system of rural construction standard system is to use the model to analysis of the process of system operation as the Petri net model is both an intuitive graphical representation and can give the formal description. If the Petri net model accurately describes the operation process of rural construction standardization system, then the properties possessed by the system will be reflected in the Petri net model. The collaborative optimization process of the rural construction standard system establishment is adjusted to reflect the model rural construction problems and ultimately promotes the subjects' collaboration feasibility and effectiveness.

As the definition 3 says an identification of a Petri net can been represented as a non negative integer vector like m, the structure of the Petri net can also use a matrix to represent. According to this, we import linear algebra method into the analysis of Petri net.

Definition 4: The structure of the Petri net N can been constructed as a matrix $A=[a_{ij}]_{n\times m}$ with row m and column n, the matrix A is a correlation matrix of N:

where: $a_{ij}=a_{ij}^{+}-a_{ij}^{-}, i\in\{1,2,\ldots,n\}; j\in\{1,2,\ldots,m\}$

$$a_{ij}^{+}=\begin{cases}1,(t_i,s_j)\in F, \\ 0, \quad \text{or},\end{cases} \text{i}\in\{1,2,...,n\},\ j\in\{1,2,...m\} \tag{8}$$

$$a_{ij}^{-}=\begin{cases}1,(s_j,t_i)\in F, \\ 0, \quad \text{or},\end{cases} \text{i}\in\{1,2,...,n\},\ j\in\{1,2,...m\} \tag{9}$$

Definition 5: Set $N=(S,T;F,M_0)$ a pet net, $S_1\subseteq S$. If ${}^{\bullet}S_1\subseteq S^{\bullet}$, then call S_1 is a Deadlock of N.

Theorem 1: Set $N=(S,T;F,M_0)$ is a pet net, A is a correlation matrix of

N. The necessary and sufficient condition for $S_1 = \{s_{i1}, s_{i2}, \ldots, s_{ik}\}$ is a deadlock of N. Each non all zero row contains at least one "-1" elements in the A generation of sub column S_1 to a column in the array (Wu 2006).

Through testing the reach ability of rural construction standards' three dimension programming model, calculating the correlation matrix of the model, we find that the transpose matrix generated sub association matrix columns. The generation of sub columnar $P^{'}\{p_1, p_2, p_5, p_8\}$ and the transpose matrix of $P^{''}\{p_1, p_3, p_6, p_9\}$ in the matrix A is:

$$(P')^T = \begin{bmatrix} -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & -1 & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{10}$$

$$(P'')^T = \begin{bmatrix} -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & -1 & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{11}$$

Every nonzero column in the two transpose matrixes has "-1" element. According to the deadlock rule of the Petri net, we get that in this model there is deadlock at P_8 and P_9.The occurrence of the deadlock means that the transition is waiting for the result of the pre segment and as it cannot been triggered thus affects the whole collaborative process .In order to solve the deadlock problem to optimize the model, we need to divide the P_8 and P_9 into two Places that used to trigger behind two changes. The optimized flow process is in Figure 4.

The adjusted establishment process divides the results of the standard framework design and the comprehensive properties of standard into two Places which are respectively used for technical analysis of the standard degree and the link toothier standard. The practical significance means during the establishment of the rural construction standard system, the stage results that different subjects complete need to be communicated to every relevant subject to the next stage in order to assure the continuous of the system's behavior. Through the improvement process, the chief department can ensure the rural construction standards' quality and the completion efficiency.

CONCLUSION

This paper used the Petri net as a tool to analysis the establishment process of the rural construction standard system. Through the Petri net model of the rural construction standard system, this paper found out that the problems of the establishment process of the rural construction standard system are P8 and P9.According to the problems the government can make targeted decisions. The rural construction standard system is a complex system which contains professional and technical knowledge of the various professional sectors during the establishment of the standards. That makes the establishment process of the rural construction standard system exists of nonlinear coupling mechanism. Besides, the original relative rural standards increase the repetition and overlapping of the standard preparation when establishes the new rural standards. Using the Petri net to analysis the establishment process of the rural construction standard system can intuitively show the establishment process of the rural construction standard system and find and solve the process of possible problems.

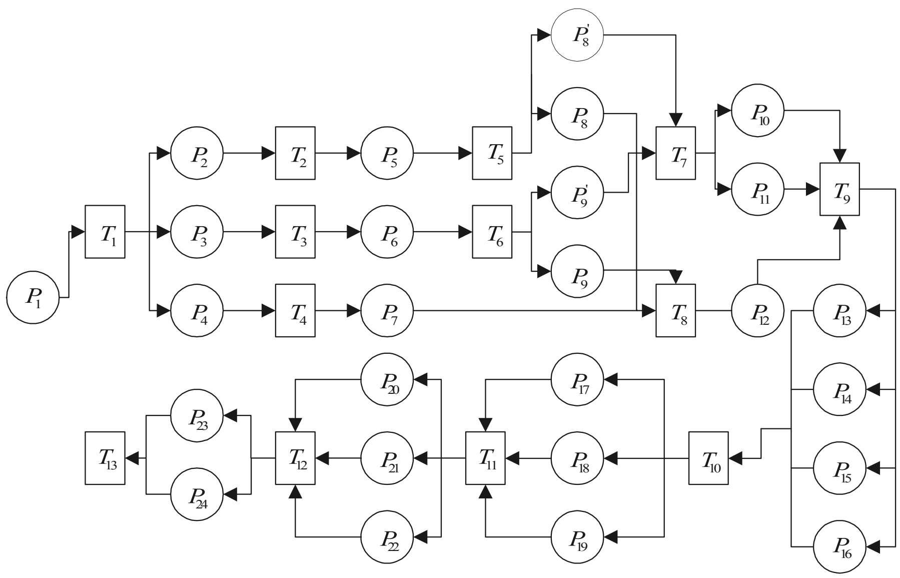

Figure 4.Optimized flow process of synergy formation based on Petri net.

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Comprehensive Evaluation of an Urban Village's Reconstruction Ability under the View of Sustainable Urban Development: Case Study of Guangzhou

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Abstract

In the future, urban village will be a sort of irreplaceable resource for sustainable urban development in China. With great amount of resources invested into urban village reconstruction, selecting some villages with advantages to be reconstructed is urgently necessary. After comprehensively analyzing the influencing factors of reconstruction, this paper builds a comprehensive evaluation system of urban village reconstruction ability, with 14 indexes from three aspects: the basic situation of urban villages, asset size of villages and social demands. By the mean-squared deviation method, this paper calculates the index weight and the comprehensive level of the reconstruction ability of several Guangzhou urban villages. Then by the cluster analysis with SPSS software, the villages are compartmentalized into 8 grades. This paper also gives some further countermeasures on the issue to cater to the need of sustainable urban development.

INTRODUCTION

Urban development in China greatly depends on the supply of urban construction land, and as a result of its rough and extensive way, the shortage supply of land resources becomes one of the significant factors in restraining urban sustainable development in China (Song and Wang 2013). Especially, since the reform and opening-up policy implemented in 1978, by constantly devouring the rural land around cities, the urban built-up area scale in China mainland has expanded rapidly, as well as city buildings and urban roads gradually surrounding villages by a half and then the whole. Consequently, urban village, the particular phenomenon in the urbanization process, has come into being. Although urban village has some problems, this paper believes, the surplus land of urban village is also a demanding and essential resource for urban development. So how to take advantage of the resource, and organically integrate the urban village reconstruction with the urban sustainable development should be considered, so that the reconstruction can benefit city development in China.

LITERATURE REVIEW

The urban village issue is hard to be eliminated because of the occupancy of Rural Land (Tian 2008), and the factors such as drawback of Urban and Rural Dual System (Liu et al. 2009), Rural Industrialization (Wang 2004), Rental Housing Economy (Hao et al. 2013), Informal Sector (Lang 2007), Farmers Income Structure (Chen et al. 2009), Rural Cultural (Wei and Lai 2006), etc.

Although some paths of urban village reconstruction had been put forward, such as the Low-Rent Community for the people with low incomes (Xu et al. 2012), Low-Quality Community for the people with medium and low incomes (Yang and Wang 2011), Commercial Residential Building for the people with high and medium incomes (Zacharias et al. 2013), and Mixed Housing Patterns for people with different income levels (Pang et al. 2013), the reconstruction pace is rather slow.

However, putting the urban village as a resource into the urban sustainable development system will effectively solve the problem of the shortage supply of land resources (Song and Wang 2013). So, this paper studies on the assessment and decision making of urban village reconstruction ability to reduce the process risks so as to promote the urban sustainable development and raise the city level positively and effectively.

METHODOLOGY

Study area. In order to evaluate the reconstruction ability of the urban villages, this paper sets the urban villages (the 1st level of CAF, the Chinese Administration Frame) as the basic unite of the comprehensive evaluation research, simultaneously using the economic and social situation of cities (the 2nd level of CAF), counties (the 3rd level of CAF) and community streets (the 4th level of CAF) as the external environment of the evaluation. This paper selects Guangzhou as its study area, which has the advantages of large sample capacity and good external reconstruction environment.

Data collection. Relevant calculations and original data directly adopted in this paper are mainly from as below.

(1) "Proposals of Accelerating the Reconstruction of the Work of "Three Old Transformation." (Guangzhou Municipal Government 2009);

(2) "Guangzhou Statistical Yearbook 2013." (Guangzhou Statistics Bureau 2014);

(3) "The Twelfth Five-Year Plan of Guangzhou." (Guangzhou Municipal Government 2011);

(4) "Reports on the Real Estate Market Operation in Guangzhou." (Guangzhou Land Resources and Housing Administration 2013-2014);

(5) "Guangzhou Red Shield Website, http://www.gzaic.gov.cn/." (Guangzhou Industry and Commercial Administration April, 2014);

(6) The Bus Traffic Information from Baidu Maps (http://map.baidu.com/ April 2014).

Index system for evaluating the reconstruction ability of the urban villages. As the current researches which lacking the evaluation system of urban village reconstruction ability, and there is no similar evaluation index system as a reference, this paper needs to refine the evaluation index system from the basic influencing factors of urban village reconstruction. With reference to the 4M1E method in the quality management of engineering project, this paper analyzes the influencing factors of the realization of urban village reconstruction's goals from five aspects: the stakeholder groups of reconstruction (Man), technic and methods of reconstruction (Machine), resources invested in the reconstruction (Material), policy and regulation environment (Method), and other external situations (Environment), and constructs a Framework as Figure 1.

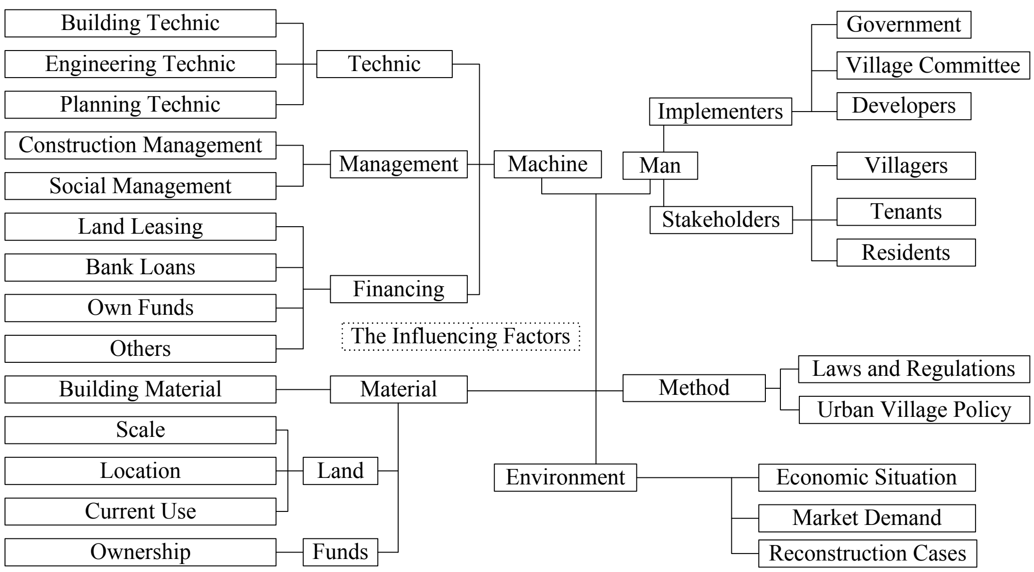

Figure 1.Structure analysis of influencing factors for urban village reconstruction.

The influencing factors in Figure1 are demonstrated for a single urban village reconstruction. In order to simplify the evaluation index system and strengthen its maneuverability, factors including technic, management, financing, building material, laws and regulations, urban village policy, economic situation, market demand and reconstruction cases, are the same in one city or county, not incorporated in the evaluation. Instead, four aspects with great differences including land scale and location, funds capability, villagers and renters and surrounding residents should be closely associated with the evaluation indexes selection. Considering the access limitation to statistics and comprehensive, scientific and operable principles, this paper builds the evaluation index system as Table 1, which reflects the reconstruction ability from three aspects: urban village Basic Situation, Asset Size (it contains capital, resource and property) and Social Demand.

Evaluation method. This paper selects the Mean-Squared Deviation Method, which is more practical in multi-index comprehensive evaluation system for each index weight.

Table 1.The Evaluation Index System of the Urban Village Reconstruction Ability.

1st Level Index	2nd Level Index	Attribute	Date Process
B_1 Basic Situation	C_1 Village Location	Cost	C_1 bus stops to commercial district
	C_2 Stakeholder Scale	Cost	C_2 villagers and stockholders
	C_3 Reconstruction Area	Efficient	C_3 village area
B_2 Asset Size	C_4 Own Funds	Efficient	C_4 registered capital of village
	C_5 Farmland	Cost	
	C_6 Water Area	Cost	
	C_7 Construction Land	Efficient	
	C_8 Other Unexploited Land	Efficient	
	C_9 Property Assets	Cost	
	C_{10} Physical Assets	Efficient	
B_3 Social Demand	C_{11} Real Estate Market Condition	Efficient	C_{11} avg. price of new commercial residential buildings
	C_{12} Resident Purchasing Power	Efficient	C_{12} avg. salary of workers
	C_{13} Potential Customer Scale	Efficient	C_{13} resident population of county
	C_{14} Propensity of Urban Invest & Construction	Efficient	C_{14} referred to 12^{th} Five-Year Plan

The principle of Mean-square deviation method: the weight of each index depends on the discrete degree of the sample's attribute values. If the index with a big discrete degree of the samples attributes values, the index weight will be big too, vice versa. The indexes usually are divided into two types, such as, efficiency index and cost index. The efficiency index with the more attribute value is better, in the contrast, the cost index with the less is better. The main steps adopted are as follows:

Step 1. Do data standardizing processing, $X_{ij} = \left(F_{ij} - F_{j\min}\right) \div \left(F_{j\max} - F_{j\min}\right)$ is for efficient index, $X_{ij} = \left(F_{j\max} - F_{ij}\right) \div \left(F_{j\max} - F_{j\min}\right)$ for cost index.

Step 2. Use $\sigma\left(W_j\right) = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(X_{ij} - \bar{X}_j\right)^2}$ to calculate the Mean Square Error of X_{ij}.

Step 3. Use $G_j = \sigma\left(W_j\right) \div \sum_{j=1}^{m}\sigma\left(W_j\right)$ to calculate the Weight Coefficient G_j of each index in its subsystem.

Step 4. Use $Y_{ij} = G_j \times X_{ij}$ to calculate the Index Score Y_{ij} from Weight Coefficient and Attribute Value.

Step 5. Use $D_i = \sum_{j=1}^{m} Y_{ij}$ to calculate the Score of 2nd Level Index D_i.

Step 6. Put second level index and first level index system into a new system and repeat Step 2, 3, 4, to get the final value of the first level index system. Then plus the value of three first level subsystems, it can get the Comprehensive level of urban village reconstruction ability.

In the equations, F_{ij} is the initial value of index j of urban village i $F_{j\max}$ and $F_{j\min}$ separately refer to the maximum and the minimum of index j X_{ij} refers to the value of index j after range standardization in urban village i n and m separately refer to the amount of urban villages involved and index quantity in each second level subsystem.

RESULTS

Reconstruction ability of urban village. This paper collects some original data of 141 Guangzhou urban villages and gets 90 valid samples after deleting 51 samples (as some original data of villages lack some index attribute value), and related information and data process is in Table 2.

Table 2.Situation of the Sample.

District	Total Collected	Valid Samples	Effective Rate (%)	Remarks
Tianhe District	23	23	100.00	
Panyu District	4	4	100.00	Only 4 villages in the HEMC are added
Liwan Distric	20	18	90.00	2 villages lack the data of index C_2
Haizhu District	20	17	85.00	3 villages lack the data of index C_2
Yuexiu District	5	4	80.00	Xikeng lack index C_2, Siyou is added.
Luogang District	13	10	76.92	3 villages lack the data of index C_2
Huangpu District	14	9	64.29	5 villages lack the data of index C_2
Baiyun District	42	5	11.90	37 villages lack the data of index C_2
Sum	141	90	63.83	

With methods mentioned above, each index weight in the index system is obtained in Table 3 and Table 4. As B_3 stands for the Social Demand index with 0.5426 is the weightiest index, and B_1 stands for the Basic Situation index with 0.3021 is weightier than the Asset Size index with 0.1553. Figure 2 shows index $C_{14}>C_{12}>C_{13}>C_2>C_1>C_3>C_{11}$, and B_1 & B_3 stand for more than 80% of reconstruction ability.

Table 3.Index Weight by the Mean-Squared Deviation Method (1).

C	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}
G_j	0.0985	0.1051	0.0985	0.028	0.0217	0.0181	0.0184	0.0221	0.0273	0.0197	0.0916	0.1562	0.133	0.1618

Table 4.Index Weight by the Mean-Squared Deviation Method (2).

B	B_1	B_2	B_3
G_m	0.3021	0.1553	0.5426

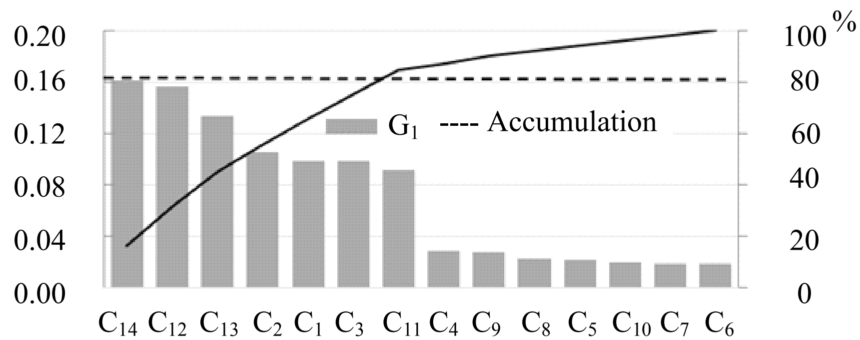

Figure 2.Pareto chart of index weight.

With methods mentioned above, the reconstruction ability of 90 urban villages and its order are obtained in Table 5 and the Top 10 villages are Lide, Linhe, Xian, Shadong, Yinhe, Changpeng, Tangdong, Qianjin, Shidong and Jiangxia. Because of the paper length limitation, Table 5 only demonstrates the top four villages of each district, and 36 in total. It shows that urban villages in Tianhe District have the highest comprehensive level while ones in Huangpu District have the lowest.

Guangzhou has confirmed 52 urban villages requiring comprehensively reconstruction which have good location condition and reconstruction ability and 16 of them are ticketed (marked with √) in Table 5. The degree of fitting comes to 57.14% (there are not urban villages can be comprehensively reconstructed in Panyu District), indicating the comprehensive evaluation model can reflect the situation of urban village under the view of reconstruction ability level. And this paper argues that the main factor influencing is some samples having blank indicators, so they are not counted into the final results.

Table 5.Reconstruction Ability of Urban Villages (Part of Guangzhou).

First Level Index		Basic Situation		Asset Size		Social Demand		Reconstruction Ability	
District	Urban village	Index	Ranking	Index	Ranking	Index	Ranking	Comprehensive Levels	Ranking
Tianhe District	Lidei√	0.4836	60	0.6122	2	0.7451	1	0.6454	1
	Linhe√	0.6424	15	0.4805	12	0.6893	4	0.6427	2
	Xian√	0.5123	51	0.6102	3	0.7157	3	0.6379	3
	Shading	0.6832	10	0.5750	6	0.6086	16	0.6259	4
Panyu District	Beigang	0.6162	21	0.4549	20	0.4992	38	0.5277	32
	Beiting	0.6014	23	0.4632	13	0.4992	39	0.5245	34
	Nanting	0.6026	22	0.4583	16	0.4992	40	0.5241	35
	Suishi	0.5852	28	0.4505	24	0.4992	41	0.5176	39
Liwan District	Shan	0.6433	14	0.4376	40	0.1892	56	0.3650	53
	Xijiao√	0.6237	18	0.3146	89	0.1857	58	0.3380	59
	Hesha√	0.5429	40	0.3947	76	0.2011	55	0.3344	60
	Baihedong	0.5538	36	0.4621	14	0.1538	65	0.3225	63
Haizhu District	Pazhou√	0.6506	13	0.4368	42	0.5630	29	0.5698	16
	Lianxing	0.6899	9	0.4266	62	0.5270	32	0.5606	21
	Hongwei√	0.7125	5	0.4159	67	0.5077	35	0.5553	23
	Shiji	0.5206	46	0.4283	59	0.5630	30	0.5293	29
Yuexiu District	Yangji√	0.8789	1	0.4438	30	0.4215	50	0.5631	20
	Dengfeng√	0.5729	30	0.5744	7	0.3120	53	0.4316	50
	Siyou	0.4627	65	0.4515	23	0.3745	51	0.4131	52
	Yaotai√	0.3386	83	0.4311	54	0.3123	52	0.3387	57

Table 5.(Continued).

First Level Index		Basic Situation		Asset Size		Social Demand		Reconstruction Ability	
Luogang District	Changing	0.7455	2	0.4318	49	0.1022	85	0.3477	54
	Qianggang√	0.7238	3	0.4318	45	0.1054	81	0.3429	56
	Yushu√	0.7081	6	0.4318	46	0.1054	82	0.3382	58
	Huangma	0.6928	8	0.4318	50	0.1022	86	0.3318	61
Huangpu District	Wenchong√	0.7069	7	0.4128	69	0.1220	75	0.3439	55
	Miaotou	0.5323	44	0.5852	5	0.1120	78	0.3125	67
	Jitang	0.5728	31	0.4003	73	0.1227	73	0.3018	70
	Maogang√	0.5034	54	0.4606	15	0.1160	77	0.2866	75
Baiyun District	Jiangxia√	0.5513	37	0.4418	32	0.6512	9	0.5885	10
	Xiaogang√	0.4012	75	0.4533	21	0.7268	2	0.5859	11
	Tonged	0.4895	59	0.4556	19	0.6606	5	0.5771	14
	Cuolong	0.5423	42	0.4296	57	0.6190	14	0.5664	18

Cluster analysis result. K-means Cluster Method and SPSS22.0 software are used to analyze samples of 90 urban villages. Considering the Cluster Analysis usually take 3-6 classes is appropriate, this paper did a Two-Stage Cluster Analysis as below.

Firstly, The 90 urban villages are classified into eight grades, according to the Basic Situation index (high and low), the Asset Size index (high and low) and the Social Demand index (high and low) of the samples. The result of the K-means Cluster analysis is in Table 5.

Secondly, The 90 urban villages are classified into four grades as in Table 6 and Table 7.

After analyzing the change of each village's cluster label in the Two-Stage Cluster Analysis, it shows that four-grade cluster label 1 includes eight-grade cluster label 1 (all), label 2 (all) and label 3 (five), four-grade cluster label 2 includes eight-grade cluster label 8 (all), and label 3 (almost), four-grade cluster label 3 includes eight-grade cluster label 5 (all), label 6 (almost), four-grade cluster label 4 includes eight-grade cluster label 7 (all), label 4 (all), label 6 (few) and label 2 (one). So four-grades can stand for the differences of the 90 samples. Considering some individual villages with larger difference, the 90 samples are divided into five categories (as Table 6 shows) is suitable.

Take Haizhu District as an example, the 17 samples of urban village in Haizhu district is divided into two categories (1) Category 4 has 4 villages including Shixi, Longtan, Tuhua, Xiaozhou, with low Basic Situation index, high index of Asset Size index and high Social Demand Index 2) Category 5 has 13 villages including Lianxing, Fenghe, Ruibao, Hongwei, Lijiao, Chisha, Beishan, Guanzhou, Luntou, Pazhou, Huangpu and Shiji, with high Basic Situation index, Asset Size index and Social Demand index. It shows the reconstruction ability of urban villages in Haizhu District is relative stronger.

Table 6.Two-Stage Cluster Analysis.

First stage		Panyu	Tianhe	Haizhu	Baiyun	Liwan	Luogang	Yuexiu	Huangpu	Sum
Eight grades, Cluster Labels	1	0	0	0	0	3	8	0	2	13
	2	0	0	0	0	4	0	2	2	8
	3	0	0	0	0	9	2	0	5	16
	4	0	1	0	0	0	0	0	0	1
	5	0	0	0	0	0	0	1	0	1
	6	4	13	13	2	0	0	0	0	32
	7	0	9	4	3	0	0	0	0	16
	8	0	0	0	0	2	0	1	0	3
Sum		4	23	17	5	18	10	4	9	90
Second stage		Panyu	Tianhe	Haizhu	Baiyun	Liwan	Luogang	Yuexiu	Huangpu	Sum
Four grades, Cluster Labels	1	0	0	0	0	9	9	1	6	25
	2	0	0	0	0	9	1	1	3	14
	3	4	9	9	0	0	0	1	0	23
	4	0	14	8	5	0	0	1	0	28
Sum		4	23	17	5	18	10	4	9	90

Table 7.Classification of Urban Village.

Category	Basic Situation Index	Asset Size Index	Social Demand Index	Cluster Labels	Amount (in different district)
2	low [0.4314]	low [0.3783]	low [0.1446]	3	16 (9 in Liwan,5 in Huangpu,2 in Luogang)
	low [0.2731]	high[0.4514]	low [0.2197]	8	3 (2 in Liwan,1 in Yuexiu)
3	high [0.6451]	low [0.4178]	low [0.1236]	1	13 (8 in Luogang,3 in Liwang,2 in Huangpu)
3	high [0.5241]	high [0.4828]	low [0.1971]	2	8 (4 in Liwan, 2 in Yuexiu, 2 in Huangpu)
1	low [0.4617]	low [0.2407]	high [0.6086]	4	1 (1 in Tianhe)

Table 7.(Continued).

Category	Basic Situation Index	Asset Size Index	Social Demand Index	Cluster Labels	Amount (in different district)
4	low [0.3995]	high [0.4686]	high [0.6176]	7	16 (9 in Tianhe,4 in Haizhu, 3 in Baiyun)
5	high [0.8789]	low [0.4438]	high [0.4215]	5	1 (1 in Tianhe)
	high [0.5912]	high [0.4543]	high [0.5643]	6	32 (13 in Tianhe, 13 in Haizhu, 2 in Baiyun, 4 in Pangyu)

DISCUSSION AND CONCLUSIONS

According to the results of cluster analysis, the 90 urban villages are divided into 5 categories (as Table 6 shows). Each category is defined and described as below. This paper also gives some reconstruction suggestions for each category as below too.

Category 1, villages with remote location and more farmland resources. They can be exploited and constructed as agriculture and gardening production bases, and then tourism resources of ecological agriculture can cultivated, focusing on renting projects with high additive values like farmland experiencing, gardening rent and selling, etc.

Category 2, Villages with disadvantageous location, more stakeholders and low price of real estate market. The urban village situation is not serious, so current architectural structure and function should be possibly remained. More mild measures should be taken, like expanding the village roads, rectifying and reforming the fire fighting access, dredging the river, and making the villages become landscapes in the city. But if the villages with severe problems, they should be reconstructed entirely to eradicate their problems.

Category 3, Villages with moderate location conditions, abundant land resources and large reconstruction areas. These villages should be exploited in large scale, form a new rally center for residents; take on part of the population and commercial service in CBD. For those with better social public resources, the reconstruction can be conducted to get profits from prices of advanced buildings. Instead, village reconstruction with bad public resources should be combined with measures beneficial to residents to gain quantity advantages.

Category 4, Villages with location advantages, large stakeholder scale and strong reconstruction demand from society and market. Villages with cultural heritages and tourism resources should avoid significant structure or function changes. They should better to plan and exploit tourism, and preserve ancient buildings. Others are recommended to conduct comprehensive reconstruction, renew the spatial pattern of villages, improve and strengthen service functions and effectiveness.

Category 5, Villages with location advantages, moderate stakeholder scale and strong reconstruction demand from society and market. Their construction should improve and innovate on the current usages of the village and then offer superior social public service.

In summary, data adopted in this paper objectively reflects the Basic Situation of urban villages, Asset Size and Social Demand.

Research methods are feasible and the evaluation results of urban village reconstruction ability also approach both the truth and anticipation. However, the index system built simply takes the objective and current situation of urban village into consideration, so the following studies can add the index of the reconstructive willing of village collectives and villagers, the index of urban village issues, and collect more data by questionnaire.

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Research on Evaluations of City Space Performance

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Abstract

The article chose spatial performance as the aspect of performance problem of the city. By discriminating the theoretical foundation of city performance connotation, the article attempted to construct a theoretical framework and index system of city space performance evaluation. The evaluation system is decomposed into economic, social structure, resources and environment, space and system innovation performance. The article evaluated the space performance of 35 main cities in China from 2003 to 2013, and focused on the impact of the trend, factors and dynamical mechanism in the process of the development of the Northeast four major center cities.

INTRODUCTION

Since 2003, China's city construction has made great achievements, but the spatial development quality of big cities is uneven. On the one hand, the scale of construction land is rapidly expanding, from 2000 to 2012 12 years, China's 35 key cities' built-up area average growth rate reached 8.2% (Ruan et al. 2011). The total amount of the city average economic growth was nearly 7 times, GDP average annual growth rate got to 18%; this is the strong authentication of development of our city and enhancement of the economic strength. On the other hand, the formation of the big cities in this process has many problems, such as land of single function, long commuting distance, high prices of the central area, inadequate infrastructure, traffic congestion and other problems which restricting effect of city space operation efficiency. And the understanding of space performance is the key to solve a series of problems in the organization of city space, with the city space elements of production, exchange, circulation, interaction as the main feature, the element in the space level organization is of high efficiency to judge the rationality of city space.

Since the city is a complex giant system, single factor cannot effectively measure space efficiency; therefore this article took an in-depth analysis of the connotation and extension of city space performance. With the help of interdisciplinary research in related field, this article established the evaluation index system of city space performance from a comprehensive perspective, and selected 2003, 2005, 2007, 2010, 2012 as five time nodes for overall evaluation of China's 35 key city space performance, by analyzing changes in different years and combining with the result of dynamic characteristics of comprehensive evaluation of northeast four major center cities' space development performance, the article provides a new perspective for further study on city space inefficient problems.

PERFORMANCE OF SPACE STRUCTURE

Performance of space structure is a comprehensive result or effect refers to the city space. In order to optimize city space form and structure, and meet development needs and maximize the satisfaction of city functions, effectively improve the rational allocation of space resources of the city, the elements in the city operation must have a balanced development.

Basic research on quantitative evaluation of space performance. In the related research abroad, comprehensive discussion of city space development focused on evaluation index system of sustainable development. According to the characteristics of each country and region, many studies evaluated and analyzed the scale from different methods. The UN Commission on Sustainable Development (UNCSD) chose economic, social, environmental, institutional dimensions, constructing "driving force-state-response" (DFSR) model. Through the empirical analysis of 22 countries and regions, they finally determinate 58 core indicators, and verified the applicability of indicators, evaluation and role in decision-making (Cervero 2001).

In the domestic study, there are many representative literature researches. Wu (2011) constructed city space index system of performance evolution, including three dimensions, resources allocation, governance structure and institutional environment. Peng and Zhao (2010) put forward the index system of spatial structure measurement. 24 indicators were divided into system structure, size, morphology and structure, the density of social economic structure and innovation of the structure. In addition, some relevant research was mainly focused on the research of city competitiveness, such as the new city. Wang and Niu (2013) raised the level of analysis index system, analysis sort city level and balance urban and rural development, urban and rural power system from development of quality system, urban and rural development in three aspects of justice system.

Research on evaluation system of space performance summarized to social, economy, environment and space aspects, covering the relevant field of city economic activities, resources and environment, spatial structure, infrastructure construction and social life level, but each specific aspect of index selection focused on different points. The evaluation system of this article draw on relevant research results, and combined with the objective specific characteristics on spatial performance, adding some typical index, making the space performance of the explanation more reasonable and comprehensive, and building a strong operational evaluation system.

Establishment of the evaluation system of city space performance. Overall design of the space performance framework of this thesis is divided into four subsystems, which contains the economic and social structure, resources and environment and the space.

(1) Economic performance system. Economic performance improvement is the fundamental purpose of space performance, economic performance chose capital agglomeration degree, land use, economic input-output ability as the core, including GDP, per capita GDP, per capita disposable income of urban residents, rural per capita net income, per unit area of investment in fixed assets and other specific index.

(2) Social structure performance system. Focus on life security, employment and development opportunities and infrastructure and service level, including infrastructure service level, level of social life, public service level three factors.

(3) Resource and environmental performance system. As an important aspect to measure the city environment, sustainable growth and spatial attraction, resources environment mainly covers two aspects, one is the sustainable development of ecological environment, such as the number of parks, and the other is the usage of resources and environment in the process of economic development. Therefore the system selects three specific indexes of Road area per capita, park green area per capita average growth rate of construction land, etc.

(4) Space shape performance system. City spatial morphology is composed of city physical environment, it is the spatial carrier of social economic activities, mainly analyzed from the city level, residential density, employment density, density of economic and other aspects, spatial morphology affects and restricts the city social and economic performance.

As the city itself is a complicated system, taking into account the feasibility of research and data availability, according to the different characteristics of each level of analysis, this research constructs the corresponding index system in Table 1, each dimension corresponds to the main factors to describe their characteristics, can be obtained through the index to carry on the concrete analysis and evaluation, eventually formed a comprehensive performance evaluation index system of city.

Table 1.Indicators for Evaluating Urban Compactness in China.

Object Level	Space level	Index level
Comprehensive index of performance evaluation of city space	Economic indicators	GDP, GDP per capita, per capita disposable income of urban residents, rural per capita net income, per unit area of investment in fixed assets
	Social structure	Scientific research and technical service personnel, the number of public management and social organization employees
	Resources and environment	Road area per person, per capita park green area, the average growth rate of construction land
	Space form	The level of city, residential density, employment density, economic density

THE METHOD OF EVALUATION AND ANALYSIS, PROCESS AND RESULTS

The method of evaluation. Because there are many influence indicators on performance of city space, and indicators are closely related, if the article using direct application of the evaluation method based on subjective evaluation, the result would emphasize on the index attribute, causing the objectives and results deviation. According to the analysis of the main characteristics of spatial performance evaluation and using the applicability, the article chose factor analysis method. Analysis of the load is not the only factor for one hand, the factor rotation provides a convenient, factor analysis can observe the internal structure of a factor data, through checking the suitability variable settings, the method finally can sort comprehensive evaluation, and analysis of different periods can effectively reflect the development of the characteristics of the sample city.

The evaluation object and data sources. Data samples selected 35 main cities, including the provincial capital city and other big cities in China. On the one hand, the city has certain geographic range independence in the spatial sense; on the other hand, each city is an independent economic body in the economic sense and as the center city of each area, so that the evaluation has certain significance. The study chose 2003, 2005, 2007, 2010 and 2012 as study period. Data were selected from the corresponding year Chinese City Statistical Yearbook, China City Construction Statistical Yearbook and China regional economic statistical yearbook.

The overall evaluation of city spatial performance on multidimensional comprehensive perspective. (1) Test correlation between variables. The data for factor analysis must be relevant; otherwise it is not suitable for factor analysis. Kaiser-Meyer-Olkin Measure of Sampling Adequacy in Table 2 is 0.752, closer to 1, so it is suitable for factor analysis.

Table 2.KMO and Bartlett's Test.

Inspection item		Value
Kaiser-Meyer-Olkin measure of sampling adequacy		.752
Bartlett's test of sphericity	Approx. Chi-Square	2509.626
	df	91
	Sig.	.000

(2) Extract factors. The heart of the factor analysis is through a linear combination of the original variables and each principal component to solve and realize the variable dimension reduction. In this paper, we will extract common factor according to the principle of cumulative contribution rate of >80%. According to Table 3, we can extract 4 common factors from the first group of items, The first common factor explains the original 14 variables for 32.511% of the total variance, cumulative variance contribution rate is 32.511%; the second common factor explains 19.017% of the original 14 variables, the cumulative variance contribution rate is 52.313%; the rest of the data has the similar meanings. 4 factors extracted explained 81.471% of the total variance of the original variables. On the whole, the loss of information of original variables is little, the effect of factor analysis is ideal.

Table 3.Total Variance Explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.707	40.761	40.760	5.707	40.761	40.761	4.552	32.511	32.511
2	2.662	19.017	59.778	2.662	19.017	59.778	2.772	19.802	52.313
3	1.884	13.457	73.235	1.884	13.457	73.235	2.356	16.832	69.145
4	1.153	8.236	81.471	1.153	8.236	81.471	1.726	12.327	81.471
5	.847	6.049	87.520						
6	.503	3.590	91.110						
7	.370	2.640	93.749						
8	.293	2.094	95.844						
9	.201	1.438	97.282						
10	.142	1.015	98.297						
11	.112	.798	99.095						
12	.056	.397	99.492						
13	.038	.271	99.763						
14	.033	.237	100.000						

(3) The factor rotation. Through the coordinate change, it is easier to explain the practical significance of the factor solution. After the rotation we get the Table 4.

Table 4.Rotated Component Matrix.

Index	Component			
	1	2	3	4
Urbanization level	.156	.077	.023	.804
GDP	.565	.740	.069	.108
GDP per person	.882	.124	.120	.293
Economic density(Yuan / ha)	.903	.324	-.041	-.023

Table 4.(Continued).

Index	Component			
	1	2	3	4
Total investment in fixed assets per unit area (10000 yuan / square km)	.822	-.061	-.201	-.134
Road area per capita (square meters)	.376	-.135	.748	.317
Average per capita disposable income	.887	.217	.178	.183
Average per capita net income of rural residents	.884	.259	.190	.180
Per capita public green areas	.013	.029	.890	.149
Employment density (million persons / sq km)	.341	.372	-.082	-.554
Residential density	-.252	-.107	-.292	-.684
Construction land average growth rate (%)	-.110	.097	.883	-.026
Number of scientific research, technical service personnel	.078	.941	-.021	.000
Public management and social organization of employment	.175	.958	.061	.006

(4) The calculation of factors comprehensive scores. In the process of data processing, the factor score matrix can be obtained, and factor score can be saved as a variable, then select the variance contribution of every standardized factor as weight, enter each factor into the formula $F = aF_1 + bF_2 + cF_3 + dF_4$ to get the comprehensive evaluation scores of space performance of every listed city in Table 5.

In the above formula, a, b, c, d were multiplied by the original Numerical and index factor scores in the matrix.

Table 5.35 Main Cities Space Performance Scores and Rankings.

City name	2003		2005		2007		2010		2012	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Beijing	0.9509	3	1.2995	3	1.4340	3	1.7594	3	1.9904	2
Chengdu	0.6186	23	0.8788	21	0.9902	19	1.2469	14	1.3996	13
Dalian	0.7595	13	0.9884	12	1.1125	11	1.3651	10	1.5511	8
Fuzhou	0.6955	18	0.8997	18	1.0179	18	1.1928	18	1.2584	17
Guangzhou	0.9319	4	1.1720	5	1.3357	4	1.4675	6	1.6844	5

Table 5.(Continued).

City name	2003		2005		2007		2010		2012	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Guiyang	0.5684	28	0.7236	32	0.7795	33	0.9245	32	0.9690	29
Harbin	0.6145	24	0.7574	28	0.8081	28	1.0023	25	1.1071	24
Haikou	0.5082	33	0.7175	33	0.8029	29	0.9493	31	1.0630	25
Hangzhou	0.7583	14	0.9281	16	1.1738	8	1.3970	8	1.5558	7
Hefei	0.7279	16	0.8868	20	1.0398	17	1.1756	19	1.2082	19
Hohhot	0.5647	29	0.8007	25	0.8775	25	1.0567	23	1.1406	23
Jinan	0.7257	17	1.1271	7	1.0721	14	1.2838	12	1.3570	14
Kunming	0.6042	25	0.7237	31	0.7837	32	0.9527	30	0.8761	34
Lanzhou	0.5362	31	0.8046	24	0.8297	27	0.8311	34	0.9581	30
Nanchang	0.6881	19	0.9634	13	1.0776	13	1.1698	20	1.1549	22
Nanjing	0.8334	7	1.0615	9	1.1646	9	1.3330	11	1.4544	11
Nanning	0.5218	32	0.6462	34	0.7600	34	0.9668	29	0.9217	33
Ningbo	0.9078	5	1.1736	4	1.1547	10	1.3683	9	1.5289	9
Qingdao	0.8574	6	1.1352	6	1.2549	5	1.4735	5	1.5234	10
Xiamen	0.8204	2	1.0678	8	1.2270	6	1.4105	7	1.5834	6
Shanghai	1.1571	2	1.3446	2	1.5319	2	1.8690	2	1.9242	3
Shenzhen	1.7841	1	1.8487	1	1.9304	1	2.1593	1	2.0849	1
Shenyang	0.7717	10	0.9462	15	1.0834	12	1.2544	13	1.3357	15
Shijiazhuang	0.6444	20	0.8979	19	0.9454	20	1.1343	21	0.9995	28
Taiyuan	0.5362	30	0.7724	26	0.8337	26	0.9918	26	1.0422	26
Tianjin	0.7622	12	1.0527	10	1.1969	7	1.5115	4	1.7160	4
Urumqi	0.5899	27	0.7691	27	0.7999	30	0.8507	33	0.9557	31
Wuhan	0.7827	9	1.0479	11	1.0526	15	1.2432	15	1.4293	12
Xian	0.6345	21	0.8640	22	0.9406	21	1.2074	17	1.2490	18
Xining	0.3375	35	0.6031	35	0.6469	35	0.8250	35	0.4219	35
Yinchuan	0.6012	26	0.7498	29	0.8936	23	0.9783	27	0.9516	32

Table 5.(Continued).

City name	2003		2005		2007		2010		2012	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Changchun	0.7496	15	0.9130	17	0.9346	22	1.0993	22	1.1715	20
Changsha	0.7671	11	0.9487	14	1.0460	16	1.2425	16	1.3251	16
Zhengzhou	0.6286	22	0.8207	23	0.8803	24	0.9743	28	1.0175	27
Chongqing	0.4929	34	0.7333	30	0.7915	31	1.0137	24	1.1700	21

City spatial performance influence factors analysis of four key cities in Northeast China. According to the Northeast four center cities development characteristics analysis of 2005 to 2012 years in Table 6, we can get the following conclusions: the development trend of Dalian City is good overall performance, which has a steadily rising trend, Dalian ranked by original 12th to 8th place, the comprehensive performance in the first place of the four Cities in Northeast china. Shenyang city's development is lack of power; space performance showed the first decline after rising trend, to the end of 2012, the comprehensive ranking is 15th, which has a downward trend obvious. Harbin and Changchun City have been in the back of the ranking for ten years.

Table 6.Northeast Four Major Center Cities Space Performance Scores and Rankings Change.

City name	2005		2007		2010		2012	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Dalian	0.99	12	1.11	11	1.37	10	1.55	8
Harbin	0.76	28	0.81	28	1.00	25	1.11	24
Shenyang	0.95	15	1.08	12	1.25	13	1.34	15
Changchun	0.91	17	0.93	22	1.10	22	1.17	20

CONCLUSIONS AND RECOMMENDATIONS

Since 2003, cities of China have entranced a rapid development stage, the 35 research objects all have gone through a process of construction land, population, and economic gross explosive growth. From spatial perspective of multi dimension during this period of the city development, conclusions can be summarized as follows.

Related to the stage of Chinese urbanization. With the reform of China's system mechanism in depth, liquidity of China's population and the regulation of the land gradually relaxed, a large number of rural population transferred to the urban areas, urban land management authority has been gradually relaxed, so that the past 10 years has become a period of rapid growth of China's urban population, economy and space, and the main features of this growth is the epitaxial growth

How to control the spatial performance of a city in this paper is an exploring problem. It is not to say that higher city performance index suggesting optimal quality development, to a certain extent, big cities' land scale, population scale, jobs opportunities, number of enterprises and production value gross index illustrate the city's economic development strength, but the cost of energy, land resources, the development process of environmental governance has paid the price. Spatial performance is to explore a high efficiency and sustainable development model. Through the study of different dimensions of certain level, the article tried to find the problem indexes, and then in the city development process, we can focused on adjusting and optimizing. The effective coordination of space, the overall objectives of the organization, and the rule of reasonable demand are the keys to decide the success or failure of the space performance.

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Delayed Payment Problems in Public Construction Projects: Subcontractors' Perspectives

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Abstract

The problem of the contractors and sub-contractors cash flow is mainly due to delayed payment and nonpayment which can severely affect the implementation and performance of any project. The objectives of this study are to identify the causes of delayed payment and nonpayment issues in construction projects in Gaza Strip from subcontractors' perspective; to study the reaction of subcontractors towards payment problems; and to study the subcontractors' opinion on effective remedies to delayed payments. A questionnaire survey was adopted to elicit the perception of subcontractors concerning payment problems. The findings of this study indicated that most subcontractors encountered delayed payment and nonpayment from the main contractors. Delayed variation orders payment was found as the most frequently problem faced by subcontractors which has led to disputes. The results revealed that most disputes were resolved through negotiation. The average time that was taken to resolve the disputes was less than 3 months. The findings showed that the inclusion of the arbitration clause in the contract is the most important effective remedy to solve the payment and dispute issues in construction projects in Gaza Strip. The findings from this study would be valuable for all construction professionals.

INTRODUCTION

Subcontracting and outsourcing has been the subject of a growing number of studies in recent years (Tan 2004). Hoban and Francis stated that a subcontractor is specialist hired by the main contractor to perform specific tasks on a project as part of the overall contract (cited in Mbachu 2008). The main contractor's overheads commitment in the form of supervision, office staff, accommodation, can be reduced significantly, when working with reliable subcontractors (Mbachu 2008). Dainty et al. and Karim et al. emphasized that selecting appropriate subcontractors and managing subcontractor relationships are pivotal to project performance (cited in Hartmann and Caerteling 2010). Devries (2011) stated that one of the greatest risks on a construction project involves the payment process. Particularly in these economic hard times, a contractor and its subcontractors and suppliers expect to be paid on a timely basis once the work has been performed.

Well-timed run of money is required for the achievement of a construction project, commencing the owner in the direction of the contractor downwards to the subcontractors, suppliers and vendors (Supardi et al. 2011). May and Siddiqi added that in the subcontract, contractors frequently try to transfer the risk of the owner's non-payment to subcontractors. This is done by including contingent payment provisions, for instance pay-when-paid or pay-if-paid clauses (cited in Supardi et al. 2011). The objective of this study is to identify the causes of delayed payment and nonpayment issues in the construction projects in Gaza Strip from subcontractors' perspective.

LITERATURE REVIEW

The majority of works (85%) in construction projects (such as shuttering, building, plastering, painting, carpentry, and ironmongery works) are implemented by subcontractors through the main contractors (Hartmann and Caerteling 2010). The ability of the main contractor and consultants to deliver the project within time, quality and cost targets depends largely on the performance of the subcontractors (Mbachu 2008). Mbachu (2008) explained that the main contractor passes on the risks and responsibilities of redeployment, hiring and firing of subcontracting workers on to the subcontractors; cash flow problems and the challenge of financing the project are all eased by the use of subcontractors. Without adequate cash flow, contractors and subcontractors find themselves in the invidious situation of having to finance construction projects on their own (Pillai 2010). Skaik (2011) stated that contractors and subcontractors in the construction industry run on cash. The business viability of contractors and subcontractors depends more upon cash flow than profit margins. The existence of a stable and healthy labor market is also dependent on the cash flow emanating from the employers (Cheng et al. 2008).

Yin (2007) said that the practice of efficient and timely payment in construction projects is a major factor leading to a project's success. Cheng et al. (2008) argued that the security of payment is fundamental to developing a healthy, professional and competitive construction industry. Singh confirmed that there are three principle methods of paying the subcontractor in consideration for the work executed: '*payment upon certification*', '*direct payment*' and '*contingent payment*'. Even though the main contractor is disbursing the required payment to the subcontractor in the first and third methods, the second method is only an employer and sub-contractor deal. Loulakis and Santiago explained that '*contingent payment*' is one of the additional contentious types of clauses in today's construction contracts which commonly main contractors apply to assign the risk of an owner's non-payment to subcontractors (cited in Supardi et al. 2011). A ***"pay when paid"*** clause contemplates that payment will be made by the contractor "when" payment is received by the owner, whereas the *"pay if paid"* clause requires payment only "*if*" the owner pays the contractor. In other words, the first clause is about timing of payment, while the second clause is about whether payment is even required when the owner does not pay. The enforceability of these types of clauses may be limited by a particular state or jurisdiction (Devries 2011). Abidin presented that 8 areas/nature of construction disputes had been recognized which are payment, delay, termination, variation, damages, performance bond, default, and defect" (cited in Supardi et al. 2011).

Al-Hazmi said that the contractor, or subcontractor(s), will plan their work schedule and payment to vendors and laborers according to expected cash flow of the contract progress payments. The owner may delay payment to the contractor; the contractor will therefore be forced to delay the payment to the subcontractors and thus upset his plan. In this case, a conflict will be developed between the two parties (Al-Hammad 2007). Mbachu (2011) stated that payment problems may occur because of several reasons such as: delay in issuing approvals/certification or confirming verbal instructions in writing; reluctance to certify variation work arising out of consultants' errors; and unreasonably withholding approval for completed work. According to Lay (2010) out of the 15 common causes of payment problems paying variation orders later was the most frequently problems faced by the contractor, while payment based on pay-when-paid was at fifth position. An attempt to avoid problems with payments, general contractor can make his subcontracts explicitly clear by stating that the subcontractor assumes the risk of non-payment by the owner due to insolvency or other inability to pay (Devries 2011). Subcontractor should closely review the contract's terms and negotiate equitable provisions addressing final payment to try to head off disputes early that may cause the all-important final check to be late (Logsdon 2007; Devries 2011).

METHODOLOGY

A questionnaire survey was adopted to elicit the perception of subcontractors concerning delayed payment problems. The respondents are senior professionals within their organizations, mainly projects managers, projects coordinator and site engineers. A non-probability sampling technique was used. This method of sampling is preferred when it is difficult to get response from sample population selected at random. Thirty five questionnaires were distributed to senior professionals in the public construction sector, and 30 questionnaires were received yielding 85.7% response rate. Most of the respondents had experience more than 15 years.

The questionnaire was designed based on previous related studies (Lay 2010; Supardi et al. 2011; Supardi and Adnan 2011; Kheng 2005; Cheng et al. 2008; Chen et al. 2011). A pilot study was conducted with 5 experts who have a large experience in the construction industry. According to the results of the pilot study, some questions were omitted from the questionnaire and others were added to the questionnaire as suggested by the respondents.

In this research, ordinal scale was used; it is a ranking or a rating data that normally use integer in ascending or descending order. The numbers assigned to the agreement or degree of influence (1, 2, 3, 4, and 5) does not indicate that the interval between scales is equal, nor do they indicate absolute quantities. They are merely numerical labels (Naoum 2007). The respondents were asked to indicate their response on a five point Likert scale (using 1 for not important, 2 for of little importance, 3 for somewhat important, 4 for important and 5 for very important) on a number of factors that are related to payment problems; causes, reaction and remedies. The data collected were analyzed using the Relative Importance Index (RII) technique. The R_{II} for reach explored factor was quantified by the following formula (Enshassi et al. 2007):

$$\text{Relative importance Index Formula}=\frac{\sum w}{AN}=\frac{5n_5+4n_4+3n_3+2n_2+1n_1}{5N}$$

Where W is the weighting given to each factor by the respondent, ranging from 1 to 5, (n_1= number of respondents for not important, n_2= number of respondents for little importance, n_3 = number of respondents for somewhat important, n_4= number of respondents for important, n_5= number of respondents for very important). “A” is the highest weight (i.e. 5 in the study) and “N” is the total number of samples. The relative importance index ranges from 0 to 1.

RESULTS

Number of contracts that encountered payment problems. The results revealed that 9 (30%) from the respondents did not face payment problems in contracts for the past 3 years, 15 (50%) from the respondents encountered payment problems for the past 3 years in “*1 to 2 contracts”*, 5 (17%) from the sample encountered payment problems for the past 3 years in “*3 to 4 contracts*” and 1 (3%) from the respondents encountered payment problems for the past 3 years in “*5 to 8 contracts*”. This result stressed the current payment problems in the construction industry in the Gaza Strip. This result is in line with Lay (2010) who found that there was only 15% of the respondents had no payment problems from their main contractors. In addition, 85% was encountered delayed payment and nonpayment from the main contractors.

Number of contracts that encountered dispute. The results revealed that 10 (33%) of the respondents did not have any dispute with the main contractors because of payments for the past 3 years, while 20 (67%) of the respondents were having dispute at least in “*1 to 2 contracts*” because of payments for the past 3 years. The result reflected that construction industry is prone to disputes and has unbalance contract conditions. This result is in line with Lay (2010) who found that there were only 12% of the respondents not having any dispute because of payments with the main contractor, whilst 88% of the respondents had disputes. The majority (60%) of the respondents were having dispute at least in 1 to 2 contracts. This result also is in line with Abidin who stated that payment disputes had (51%) of overall rate of eight areas/nature of construction disputes (cited in Supardi et al. 2011).

Method of dispute resolution. The results indicated that there are 6 (20%) of the respondents with the reply of “nil” simply because they did not have any dispute with the main contractor for the past 3 years. The majority 18 (60%) from the sample stated that their companies used “*negotiation”* as dispute resolution for the past 3 years. It was also found that 2 (7%) from the sample stated that their companies used “*conciliation”* as dispute resolution for the past 3 years. While (13%) of the respondents, used “*arbitration”* proceeding to resolve their dispute for the past 3 years. The popularity of “*negotiation”* by market players was found the highest response. Despite the divergent opinions about dispute resolution, negotiation is non-adversarial and it maintains both party relationships. Resolution through negotiation is the most common, efficient and effective method in Gaza strip construction industry. Parties are keen to resolve the dispute in an amicable environment in order to accomplish the project on time, within budget and with high quality and look forward the business continuity. There is no record from the survey about mediation and litigation cases. This result is in line with Lay (2010) who found that the majority of 83% of the disputes was resolved through negotiation while there were 2 cases (4%) of dispute referred to the arbitration proceeding to resolve their dispute.

Time was taken to resolve dispute. The results indicated that 24 (80%) from the sample said that the average time that was taken to resolve the disputes was less than 3 months and 6 (20%) from the sample said that the average time that was taken to resolve the disputes was 3 to 6 months. It is important that dispute should be resolved in the shortest time possible, where the work efficiency will be affected if the dispute resolution is protracted. This result is not consistent with the result of Lay (2010) who found that 65% of dispute cases required a minimum of 6 months to 5 years to resolve it and 4% of dispute cased required more than 5 years.

Factors that lead to payment dispute. As shown in Table 1 "*Paying variation orders late"* is the most important reason that leads to a dispute; it was ranked in the first position with ($R_{II} = 0.760$). "*Delaying the payment by the payer"* ($R_{II} = 0.633$) was ranked in the second position which caused payments dispute of interim or final payments. The findings indicated that "*Payment based on pay-when-paid"* was at the third position with ($R_{II} = 0.620$). "*Payer refuses to pay"* was ranked in 10th position as the least important causes of payment disputes with ($R_{II} = 0.453$). Out of the 10 common causes of payment problems, *"Paying variation orders later"* was found the most frequently problems faced by the subcontractor. Quite often, contractors would not get paid or will get paid later after variation work had done. Due to that, contractor is suffering a bad cash flow and it is not uncommon that the contractor only gets half of what he supposes to get. That's why the contractor faces problems in paying for the subcontractor. Second serious problem is when the payer delays the payment. This default is an act of breach of contract as the payer did not pay the payment.

Table 1.R_{II} and Ranks of Factors that Lead to Payment Dispute.

Factors that lead to a dispute of payment	R_{II}	Ranking
Paying variation orders late.	0.760	1
Payer delays the payment.	0.633	2
Payment based on "pay-when-paid"	0.620	3
Part payment on the certified amount but not whole.	0.607	4
Payer inability to pay because he has bad financial status.	0.607	5
Defect works have found.	0.573	6
Delay by the supervising engineer in issuing of "taking-over certificate" for a part of works.	0.547	7
Delay by the supervising engineer in issuing of "performance certificate" after "remedying defects".	0.527	8
Delay in issuing payment certificate.	0.507	9
Payer refuses to pay.	0.453	10

Reaction of subcontractors towards payment problems. According to Table 2 "*calling for a meeting to address cash flow problem"* is the most common reaction by the subcontractor toward payment problems issues with ($R_{II} = 0.787$). "*Writing a reminder letter about the delayed payment"* with $R_{II} = 0.780$ was ranked as the second most common reaction by the subcontractor. If there is a payment default by the payer, subcontractor normally chooses to "call for a meeting to address cash flow problem" rather than any other unsound reaction. Termination the contract will be not a smart move if the subcontractor terminates the contract immediately without thinking of the consequences. This result is in line with Lay (2010) who found that subcontractors didn't prefer to resort to termination as a reaction to problems in payments. Lay (2010) pointed that subcontractors preferred to slow down the progress until payment is received, where it was the most common reaction by them towards problems in payments.

Table 2.R_{II} and Ranks for Reaction towards Payment Problems.

Reaction towards payment problems	R_{II}	Ranking
Call for a meeting to address cash flow problem.	0.787	1
Write a reminder letter about the delayed payment.	0.780	2
Request part payment/ installment on the certified amount.	0.680	3
Interpret the contract document on payment issue and seek legal advice.	0.573	4
Do nothing and continue to submit the next claim.	0.547	5
Slow down the progress until payment is received.	0.500	6
Suspend the work until payment is received.	0.500	7
Resort to the judiciary, but continue the required works.	0.427	8
Resort to the judiciary and stop the work.	0.387	9
Terminate the contract.	0.373	10
Others.	0.307	11

Subcontractor's opinion on effective remedies to delayed payment and nonpayment. The results revealed that "*the inclusion of the arbitration clause in the contract as a way to solve any dispute before thinking to go to court*" is the most important effective remedy to solve the payment and dispute issues in construction projects in Gaza Strip (Table 3).

Table 3.R_{II} and Ranks for Remedies to Delayed Payment and Nonpayment.

Participants' opinion on remedies to delayed payment	R_{II}	Ranking
The inclusion of the arbitration clause in the contract as a way to solve any dispute before thinking to go to court.	0.800	1
Provide some of the procedures are followed in the case of requesting the payments which have been delayed.	0.760	2
Provide a legal remedy to non- payment.	0.740	3
Provide the payment security bond in the contract provisions.	0.727	4
Built up better trust on each other	0.727	5

Table 3.(Continued).

Participants' opinion on remedies to delayed payment	R_{II}	Ranking
Provide a default mechanism that establishes a payment process	0.720	6
Statutorily the implied terms should be applied	0.713	7
Deregistration of the license from the "PCU" for the general contractor whose refusal to pay for a number of subcontractors frequently in various projects.	0.687	8
Outlawing the practical of "Pay-when paid".	0.613	9
For the subcontractor: make a direct request of the payment from the principal/client rather than from main contractor.	0.593	10
Allow the subcontractor to suspend the work until payment is received.	0.533	11
Charging interest on late payment amount.	0.513	12
Allow the subcontractor to slow down the work until payment is received.	0.473	13

It was ranked in the first position with ($R_{II} = 0.800$). The second highest opinion with ($R_{II} = 0.760$) is "*providing some of the procedures are followed in the case of requesting the payments which have been delayed*". The lowest response on the opinions about effective remedies with ($R_{II} = 0.473$) is to "*allow the subcontractor to slow down the work until payment*". It is the least effective remedy to solve the payment and dispute issues in construction projects in Gaza Strip. This result does not match with Lay (2010) who found that the top opinion response was to allow the subcontractor to slow down the work progress until payment is received.

CONCLUSION

From the analysis results, it can be concluded that construction industry in Gaza Strip has payment problems and dispute dilemma. The current contract environment has no security to subcontractors' payment. The choice of alternative resolution for the dispute has not been widely practice. Many of them either suffer in silent or some even went into bankruptcy. As a result of the analysis, the conditions of the contracts need to be improved by focusing on payments system, mechanism and procedures that could be followed in such a dispute with maintaining good circumstances of the cash flow of the subcontractor. Subcontractor has to know his contract by reading the contract, review the contract's terms and understand the nuances as far as payment is concerned. Since he might be bound via higher contracts up the chain, so he needs to get all the contracts and take the advice of an attorney about every item. Subcontractor should negotiate equitable provisions for addressing final payment to try to head off disputes early that may cause the all-important final check to be late. Negotiating about terms could prohibit the condition payment or *"pay-when-paid"* payment terms and any other ambiguous contingent condition. Subcontractor can save his right in receiving the payment from the contractor on time by setting out a provision in the contract to force the contractor to pay an interest over every day in delaying the payment. The inclusion of the arbitration clause in the contract as a way to solve any dispute before thinking to go to court is very important where it is not only providing a security to the payment but also provides a fast, time-bound, economical, binding and contemporaneous dispute resolution to the parties in dispute.

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A Research Framework for Evaluating the Maturity of Relationship Management in Chinese Mega-Construction and Infrastructure Megaprojects: A Relational Contracting Perspective

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Abstract

The number of mega construction and infrastructure (MCI) projects has increased exponentially in China over the past two decades as a result of the outstanding economic achievement and rapid urbanization development. However, projects of that size are commonly beset with performance paradox. Relationship management has been increasingly recognized as a key for improving the outcomes of construction projects by developing and implementing various related tools, such as relational contracting, partnering schemes, and strategic alliance. Given that good relationships amongst project parties is crucial to project success as Guanxi plays an essential role in Chinese societies and businesses, this study aims to develop a systematic and pragmatic framework for evaluating relationship management practice in Chinese MCI projects in terms of its maturity. This study will be conducted as part of a key program funded by the National Natural Science Foundation of China. Mixed methodology, including interviews, survey, and case studies, will be employed to identify the critical factors for and their relative importance in good relationship management to formulate a unified and pragmatic evaluation framework. Furthermore, the developed framework will be used to evaluate the status of relationship management in MCI projects based on case studies of selected projects. Findings of this study will be beneficial to promote relationship-based collaboration and improve the outcomes of MCI projects.

INTRODUCTION

The number of mega construction and infrastructure (MCI) projects with an individual cost of RMB 5 billion (nearly USD 800 million) or above has increased exponentially in China over the past two decades as a result of rapid urbanization. However, these projects are usually beset with performance paradox (Flyvbjerg et al. 2003), such as cost overruns, delivery delay, quality defects, safety and environmental incidents, as well as insufficient outcomes.

Lack of good relationships and inter-firm collaboration amongst key project parties is a key cause to failures of construction projects (Cook and Hancher 1990; Eriksson and Laan 2007). This may be either because of insufficient economic incentives provided by clients (Rahman and Kumaraswamy 2004; Eriksson and Laan 2007) or because of the lack of top management support from both contracting parties (Chan et al. 2008). Thus, relationship management plays an essential role in developing mutual trust and building collaboration amongst project parties for achieving prescribed objectives and benefits. In the past two decades, various managerial strategies for strengthening trust-based relationships amongst key project parties such as partnering schemes, strategic alliance, design and build, and joint ventures have been developed and tested widely in construction practices (Chan et al. 2010). Particularly, relational contracting, the latest relationship management tool, has received growing advocacies from researchers and practitioners for its crucial role in building, sustaining and strengthening the relationships between two contracting parties through the design and implementation of a relation-oriented contract (Macneil 1978; Baker et al. 2002). Compared with other existing strategies, relational contracting provide a proactive and formalized approach that can better facilitate the operation of the partnering mechanism in construction projects. Particularly, the New Engineering Contract (NEC) 3, a standardized relational contract published by the U.K. Institution of Civil Engineers (ICE) in 2005 (Gerard 2005), has greatly promote developments of relational contracting practices in the UK, South Africa and other 19 countries (Patterson 2007). Despite the emerging trends of relationship management research worldwide and the rapid growth of MCI projects in China, limited studies are available on relationship management in Chinese construction projects. With the recognition that some critical factors for good relationship management in MCI projects, such as contract incentives and top management support (Tang et al. 2008; Hu et al. 2012), have been well operated in some Chinese MCI projects, which have revealed a potential for application of relationship management strategies to Chinese MCI projects, this study aims to develop a project relationship management (PRM) framework to evaluate the status quo of relationship management in Chinese MCI projects and examine the applicability of relational contracting for future application. The following are specific objectives to be addressed in this study: Identify the PRM evaluation criteria for MCI projects; evaluate the applicability, usefulness and operation mechanisms of PRM evaluation criteria in Chinese MCI projects; Developing and validating a PRM evaluation model for MCI projects in China.

RELATIONSHIP MANAGEMENT IN CONSTRUCTION

Relationship management stems from relationship-based management philosophy embedded in relational contracting. Relational contracting refers to the design and implementation of a formalized agreement established by contracting parties for future relationships (Baker et al. 2002). This approach addresses a commitment to deepening collaboration for predefined targets (Bird 2005). In the construction industry, this method is regarded a pragmatic means of improving collaborative relationships amongst two main project parties, thus contributing to the success of construction projects. With the rapid development of relationship management practice in construction projects worldwide (Chan et al. 2010), relational contracting has been increasingly promoted as an innovative approach that reflects the latest relationship management experience and widely practiced in the UK, South Africa, Australia, New Zealand and other countries mainly through the newly released NEC contracts (Wright and Fergus 2009; Ling et al. 2014b). With the rapid developments of relational contracting in many major developed countries, Guanxi, a Chinese concept close to relationship management, has also received increasing attention from scholarship in some Asian countries and regions, particularly those with Chinese origins. These studies usually benchmark western relational contracting theory and practice. Zou et al. (2014) stated that relationship management can be regarded "a structured approach of understanding, defining, and supporting a broad spectrum of inter-business activities regarding providing and consuming knowledge and services via networks", and thus there is a need for developing a set of comprehensive strategies and processes to strengthen relationships amongst key project parties. Based on a survey in Singapore-based contractors, Kumaraswamy et al. (2005) further identified some critical factors for building integrated teams through relationship management strategies. Wong et al. (2008) also proposed a framework for developing trust-based relationship in construction contracting, and examined three kinds of trust's effects on construction contracting in Hong Kong.

Guanxi plays an essential role in Chinese businesses (Wong 2007), there is no exception in the construction sector either (Kang et al. 2007). Based on an empirical survey in 12 Chinese large construction firms, Cheah et al. (2007) identified Guanxi as a determinant of resource-based capabilities for Chinese firms in increasing revenue and profitability. Previous relationship management research in construction focuses on trust-based relationships amongst key project parties. Jin and Ling (2005) proposed 16 tools to strengthen inter-firm relationships in Chinese construction projects. In their later study, Jin and Ling (2006) further examined the execution factors and operation risks of utilization of these tools on key project performance in China. Ling et al. (2014b) compared the relationship quality in Sydney and Beijing, and revealed that the quality of relationship among key parties in public projects can achieve an excellent level or above, and relationship quality have better performance in Sydney than in Beijing as a result of the wide promotion of relational contracts. Similar findings are obtained from a comparatives study between Hong Kong and Beijing (Ling et al. 2014a). However, existing studies seldom address the degree of relationship management practice in Chinese MCI projects. Therefore, there is a need to develop a systematic and pragmatic PRM framework and evaluate relationship management practice in Chinese MCI projects. The development of PRM model will also benchmark the capability maturity model (CMM) by the Software Engineering Institute, Carnegie Mellon University; the CMM is a widely accepted model used to evaluate the maturity of project management capability of a software developer, and this concept has been extend to various aspects of relationship management in construction, such as partnerships, supply chain and working relationships (Meng et al. 2011).

RESEARCH PLAN AND METHODOLOGY

Objective 1: Identifying the evaluation criteria of Project-based Relationship Management (PRM) for construction projects. An in-depth literature review will be conducted to examine PRM developments in various types of academic publications, such as books, conference proceedings, and peer-reviewed journals. Best PRM practices in construction projects, such as those derived from relational contracting in developed countries/regions such as the U.S., the U.K. Australia, New Zealand, Singapore, and Hong Kong (Patterson 2007; Wright and Fergusson 2009; Chan et al. 2010), will be collected and documented. A critical analysis of PRM developments in academic publications will be conducted, and the PRM best practices in developed countries and regions will be summarized. A list of PRM evaluation criteria will be formulated based on the literature review; the applicability of these criteria will then be verified by comparing the successful PRM cases collected.

The questionnaire is the main research instrument to be adopted in this task. The questionnaire is a research instrument commonly used in surveys to measure people's attitudes towards certain subjects (Hoxley 2008). Given that little research on the subject of PRM in Chinese MCI projects, a survey is deemed appropriate to gather insights into related megaproject practices. A questionnaire survey instrument will be developed in terms of the refined list of PRM evaluation criteria. The questionnaire survey aims to identify the principal PRM evaluation criteria by comparing the ratings on relative importance of these evaluation criteria obtained from experienced practitioners involved in MCI projects. The target participants will be practitioners involved in Chinese MCI projects, mainly including clients, consultants, and contractors. Three main economically advanced regions in the country such as the Bo Hai Coastal, Yangtze River Delta and Pearl River Delta regions are the demographic target of the survey because the economic and social developments of these regions are similar to nearby developed countries and regions such as Australia, Singapore and Hong Kong, where relational transactions have been widely practiced. Considering that the information solicited through the questionnaire survey requires sound knowledge and hands-on experience about PRM in Chinese MCI projects, a purposive approach will be adopted to quantify the selection of survey participants through predefined criteria (Bryman 1996).

Objective 2: Examining the applicability, usefulness and operation mechanisms of PRM evaluation criteria in Chinese MCI projects. Both interviews and questionnaire survey will be employed as main tools to collect opinion-based data on relationship management and its evaluation criteria from key project parties involved in Chinese MCI projects. Interviews with selected experts are used to examine practitioners' perception on the motives behind, difficulties and benefits for adopting the PRM maturity model in Chinese megaproject projects. The interviews can also the refine PRM evaluation criteria identified. The questionnaire survey will further be conducted to extract the relative importance of the refined PRM evaluation criteria. In the survey, the respondents will be asked to provide ratings on the level of importance of each evaluation criteria based on a 7-point Likert scale. Through the survey, opinion-based data from participants will be obtained. In analyzing the survey data, the Statistical Package for Social Sciences (SPSS) will be used as a main tool. Main analyses proposed in this study will include factor analysis (FA), discriminant analysis, and fuzzy synthetic evaluation (FSE).

FA is a statistical technique commonly used to aggregate multiple variables into a few underlying factors, and to examine the underlying patterns for those variables (Norusis 1992). This study will adopt this analysis to extract the underlying factors from the PRM individual evaluation criteria identified and to reveal key issues in improving PRM of Chinese megaprojects.

Discriminant analysis is a technique to test whether a significant agreement exists in the group means of a number of independent variables among two or more (Hair et al. 2013). In this study, the technique is used to compare the ratings of PRM evaluation criteria obtained from different groups of respondents (e.g. clients, contractors, consultants). This procedure is particularly appropriate for variables whose group memberships are categorical.

FSE is employed in this study to develop the PRM maturity model for a specific megaproject. This method is used to addresses multi-attribute and multi-level problems in the construction management field, such as Lu et al. (1999) and Xu et al. (2010). Evaluating the maturity of PRM depends on the identified evaluation criteria and their underlying factors (categories) and they are often multi-layered and fuzzy in nature, which involve subjective judgment of experts, adopting the FSE technique is appropriate to develop such a PRM maturity evaluation system for Chinese megaprojects.

Objective 3: Developing and validating a PRM maturity model for Chinese megaprojects. Based on the findings derived from research works for objectives 1 and 2, a systematic and pragmatic PRM maturity evaluation tool for Chinese megaprojects will be proposed. The model will also benchmark against international best PRM practices identified in the work of Objective 1. Various PRM evaluation criteria will be systematically classified into several categories, analyzed and compared to each other. By evaluating their pros and cons and the associated project requirements, recommendations for improving PRM mechanism will then be provided.

Validation is the final and indispensable step in each research cycle to test whether the quality of a developed model has achieved an acceptable requirement. In this study, validation of the proposed maturity evaluation model will include focus group and action research through case studies. First, focus group discussions will be organized and designated to validate the research findings and developed tool with related parties to examine the relevance of the findings in the Chinese context. Compared with traditionally one-to-one interviews, focus group meetings are regarded as a convenient, efficient and useful means of collecting a great amount of information from a group of participants. Second, several real MCI projects that are regarded as successful examples for relationship management in China will be selected; and their relational practices will be further evaluated using the developed model. Summarization of relationship management practices in these cases may provide an overall picture of the status quo of relationship management in Chinese megaprojects. The focus of action research is on research in action, rather than research about action, and thus this method is deemed appropriate in this study to validate the newly developed model.

CONCLUSION

Although relationship management have been practiced in western developed countries and some Asian developed countries/regions for more than two decades as a growing number of construction projects, particularly megaprojects, are reported to adopt various relationship management strategies, such as relational contracts, to strengthen relationship management in practice, the concept is very new in Chinese MIC projects. With the recognition of the dominant role of Guanxi in Chinese societies and businesses, identifying the evaluation criteria and promoting best PRM practices in the current surge of MCI projects in China has become increasingly important. Therefore, this paper provides a more systematic and in-depth research framework to examine the nature, components and their correlation of relationship management in the Chinese context so that some proper relationship management strategies will be proposed and practiced in future MCI projects for better performance.

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Ontology-Based Representation Model to Support Cause and Effect Analysis

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Abstract

Quality management is one of the most essential topics in the construction industry. Cause and effect (CE) analysis is one of the tools and techniques for quality management, and is widely used in construction quality management practices for identifying all possible causes associated with a particular problem. CE analysis requires participation and brainstorming of domain experts and experienced practitioners; however, such a brainstorming session is usually time-consuming and cumbersome, making the CE analysis process inefficient. Therefore, an ontology-based representation model is proposed in this paper that can be applied to organize experts and practitioners' CE analysis knowledge as an ontology to benefit the reutilization of the knowledge. A case study is performed to demonstrate how the model works and can benefit the brainstorming session of a CE analysis process as well as the limitations of the model. Further studies on incorporating an automated reasoning mechanism into the model, including its implementation and advantages, are briefly discussed as well in this paper.

INTRODUCTION

Quality management is one of the most essential topics in the construction industry; it aims to ensure that the product generated or service provided by a construction process satisfies owners and customers' requirements. To achieve construction quality, traditional quality management tools and techniques, such as the seven basic quality tools emphasized by Kaoru Ishikawa (Rumane 2011), are widely adopted in construction practices and verified effective to manage quality problems in construction projects. In addition, various information technology (IT)-facilitated tools have been developed for facilitating quality management tasks for construction projects (Leung et al. 2008; Li et al. 2011).

One of the traditional, widely used quality management tools and techniques is cause and effect (CE) analysis. CE analysis is an analytical technique for identifying all possible causes associated with a particular problem, and an analysis result is typically represented in a CE diagram (also known as Ishikawa diagram or fishbone diagram) that organizes and graphically displays multiple causes with a particular problem (Rumane 2011). A CE analysis process typically comprises four steps: (1) identify and define the problem to be analyzed; (2) identify the primary categories contributing to the problem; (3) identify specific causes for each primary category; and (4) analyze the result to determine the causes which have the greatest impact on the problem and should be focused on first (Ben-Daya 2009; Silverstein et al. 2009). Performing this process requires participation and brainstorming of domain experts and experienced practitioners. During a brainstorming session, they target a problem and use their knowledge to determine the causes leading to the problem. However, such a brainstorming session is usually time-consuming because the participants have to retrieve their knowledge of dealing with problems through recall of previous experience or search for relevant documentation. If the knowledge retrieval is unsuccessful, the CE analysis process becomes ineffective and inefficient.

Therefore, an ontology-based representation model is proposed in this paper that aims to organize experts and practitioners' CE analysis knowledge as an ontology for facilitating the retrieval of the knowledge. Gruber (1993) defined an ontology as "an explicit and formal specification of a conceptualization." In other words, an ontology is a normative model, which represents concepts of a knowledge domain and the relationship between the concepts. Ontological modeling, therefore, can be viewed as a systematic approach for modeling concepts and relationships into ontologies (Wang and Boukamp 2011). The proposed representation model relies on an ontological modeling technique that is based on Web Ontology Language (OWL) for developing ontologies in this study because OWL has stronger reasoning capabilities than other ontology languages and is the most popular one in academic studies recently. The OWL-based ontological modeling technique is used in this study to represent CE analysis knowledge as classes and relationships between classes in an ontology; thus, CE analysis knowledge can be formalized in the ontology from which required knowledge can be easily identified and reused.

This paper is organized as follows. An overview of CE analysis knowledge is first reviewed and the CE analysis semantics that form the basis of the proposed representation model are introduced. Then, the representation model is discussed regarding how to deploy the model to represent CE analysis knowledge as a CE ontology. The paper then presents a case study to demonstrate the application of the model as well as how the model benefits the brainstorming session of a CE analysis process. Lastly, the paper summarizes the findings of this study, the limitations of the model and future research directions.

OVERVIEW OF CE ANALYSIS KNOWLEDGE

CE analysis knowledge basically consists of a targeted problem and its associated causes classified in different primary categories, as the CE analysis result example shown in Figure 1. Three major semantics are observed from the composition of CE analysis knowledge:

A construction problem has multiple cause categories because it usually results from many causes of different types. Figure 1, for instance, illustrate five categories (i.e., manpower, machine, material, method, and environment) to organize the causes for insufficient compressive strength of concrete.

Each cause category classifies the causes which belong to the category and result in the targeted problem. In addition, these causes are represented in hierarchical levels; that is, a generalized cause can be broken down into more specialized causes. For example, for the machine category, one can identify a generalized cause “Malfunctioning truck” and then determine two specialized sub-causes “Malfunctioning mixing transport truck” and “Malfunctioning pump truck” for the generalized cause.

Multiple construction problems also can be represented in hierarchical levels. For those construction problems which belong to different CE analyses and have common features, a generalized problem can be determined for grouping them as specialized problems.

These semantics are critical because they guide how CE analysis knowledge should be represented as an ontology. The first semantic indicates that association relationships exist between a targeted problem and its related primary categories, whereas the last two semantics indicate a requirement of classifications for representing CE analysis knowledge. Furthermore, causes with equivalent meanings exist and are used by practitioners in a CE analysis. For example, two causes, “Unclear division of labor” and “Unclear demarcation of responsibility,” represent that workers’ duties cannot be clearly distinguished; thus, they are semantically equivalent causes and can be used interchangeably. This fact concerns the communication and utilization of CE analysis knowledge and should be reflected in the proposed representation model.

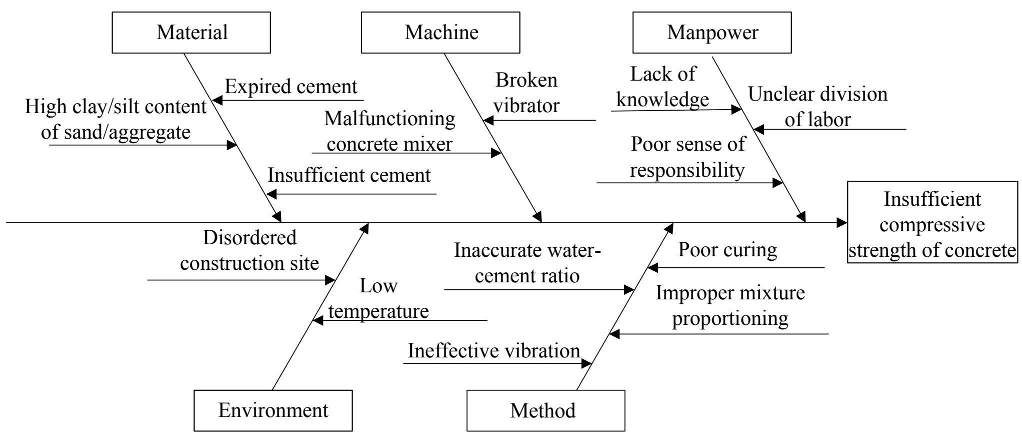


Figure 1.CE analysis result example represented in a CE diagram.

THE PROPOSED REPRESENTATION MODEL

The purpose of the representation model is to provide a structure for organizing experts and practitioners’ CE analysis knowledge as a CE ontology. That is, historical CE analysis information can be properly classified and stored through the representation model. To achieve this purpose, the representation model comprises three steps that are discussed in detail as follows.

The first step is to define classifications that formally represent CE analysis knowledge in class hierarchies for considering the CE hierarchical semantics as discussed in the previous section. Two first level major classes, i.e., “Construction problem” and “Cause,” are defined in this study, which store and organize construction problems and causes information of CE analysis knowledge respectively. Five second level major subclasses are defined for the class "Cause" (i.e., "Manpower cause," "Machine cause," "Material cause," "Method cause," and "Environment cause"), indicating that causes can be classified into these five sub-cause categories. This study suggests using the five categories because they are the most commonly seen categories discussed in different literatures and adopted in practices (Mauch 2010; Rumane 2011; Silverstein et al. 2009) and also fundamental and comprehensive enough for classifying causes of problems. In addition, additional classes subordinate to these major classes then can be defined in the representation model. For instance, a class "Expired material" is defined as a subclass for the class "Material cause" for representing classes that are causes relating to materials whose storage life has ended. The defined classifications, including the major classes and their subclasses, are shown in the rectangles with non-italic names in Figure 2. Notably, these proposed subclasses are changeable; different subclasses can be flexibly defined according to what CE analysis knowledge is available and to be modeled.

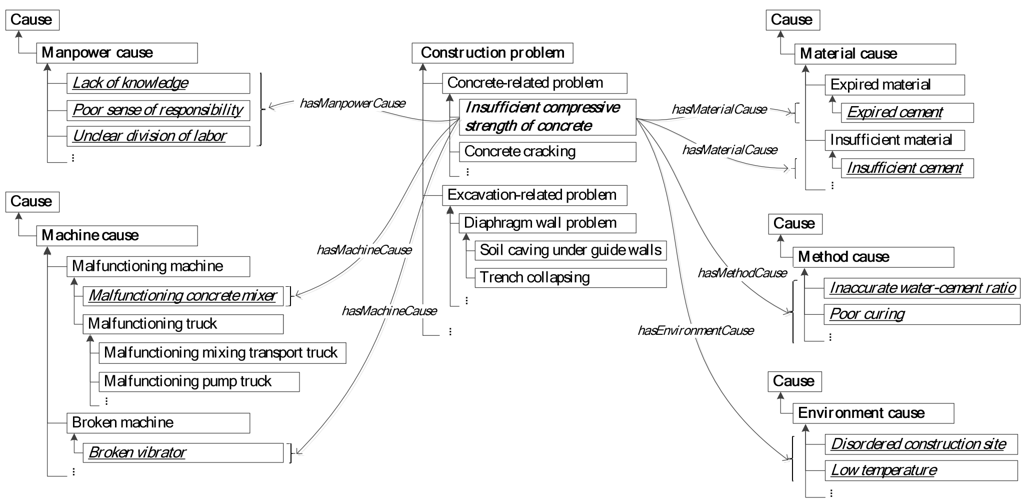


Figure 2.Overview of the proposed representation model.

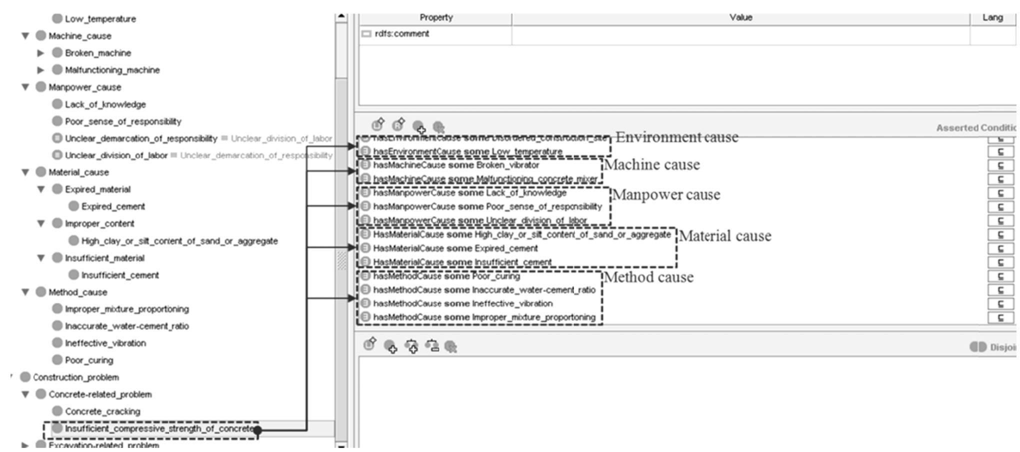
The second step is to classify CE analysis knowledge, such as those shown in Figure1, as subclasses into the classifications. For example, the causes "Lack of knowledge," "Poor sense of responsibility" and "Unclear division of labor" are classified as subclasses of the "Manpower cause" class, whereas the construction problem "Insufficient compressive strength of concrete" is classified as a subclass of the "Concrete-related problem." The modeled CE analysis knowledge is shown in the rectangles with italic and underscored names in Figure 2. In addition, users also can define equivalent classes in this step to indicate the problems or causes with identical meanings.

The third step is to define association relationships and use them to connect problems and causes. Five association relationships are defined in this study: has Manpower Cause, has Machine Cause, has Material Cause, has Method Cause, and has Environment Cause, which represent the relations between the "Construction problem" class (i.e., the domain class) and the five second level major classes (i.e., the range classes) respectively. For instance, the construction problem “Insufficient compressive strength of concrete” connects to the material cause class “Expired cement” through has Machine Cause, indicating that expired cement is one of the causes resulting in insufficient concrete compressive strength. The connections between the problem class and its cause classes for Figure 1 using the five association relationships are shown as the titled arrows in Figure 2.

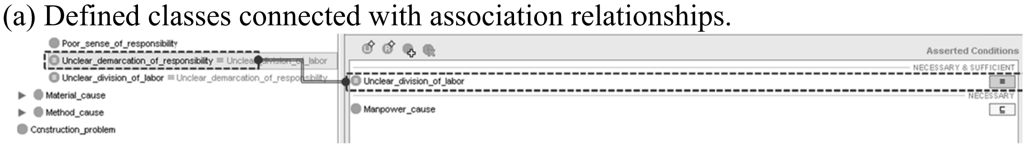
CASE STUDY

This study uses the proposed representation model to formally represent the CE analysis knowledge example (shown in Figure 1) as an ontology. Protégé, an ontology editor developed by Stanford University (Protégé 2015), is adopted to implement the three steps of the representation model.

Figure 3 shows screenshots of Protégé user interface with modeled CE analysis knowledge. Figure 3(a) illustrates all the classes defined for the example and construction problem and causes classes are properly connected. For example, the problem class “Insufficient compressive strength of concrete” (the dash-line enclosed rectangle on the left) connects to the five types of cause classes with the defined association relationships respectively (the five dash-line enclosed rectangle on the right). Additionally, Figure 3(b) demonstrate that two manpower cause classes (i.e., “Unclear division of labor” and “Unclear demarcation of responsibility”) are defined as equivalent classes.



(a) Defined classes connected with association relationships.



(b) Defined equivalent classes.

Figure 3.CE analysis ontology example.

The developed CE ontology helps the brainstorming session of a CE analysis of a construction problem in two ways. First, participants select a construction problem which they focus on from the CE ontology (for instance, insufficient compressive strength of concrete). Then the ontology shows all the causes which are connected and related to construction problem; from the cause list, participants can choose those causes which are applicable to the current analysis context and filter out those inapplicable causes. In other words, the ontology provides a list of potential causes of a construction problem according to past experience of experts. Such a cause list serves as a good reference for a new CE analysis, and a brainstorming process thus can be facilitated. For example, if participants are certain that no expired material were used in concrete, then the cause "Expired cement" can be excluded and not considered as a cause of the insufficient concrete compressive strength problem that is currently being analyzed. Second, if participants determine one applicable cause and afterward find another cause which is equivalent to the applicable one, then both should be considered as causes of a targeted problem. This action ensures the semantic completeness of a CE analysis and no relevant causes are overlooked during an analysis.

The proposed representation model serves as an assistant role in a CE analysis process, as shown in Figure 4. First, domain experts or practitioners' knowledge as well as historical CE analysis information are collected. Then, they are stored and organized in a CE ontology that helps generate a list of potential causes as well as a reference for a CE analysis (represented in a CE diagram).

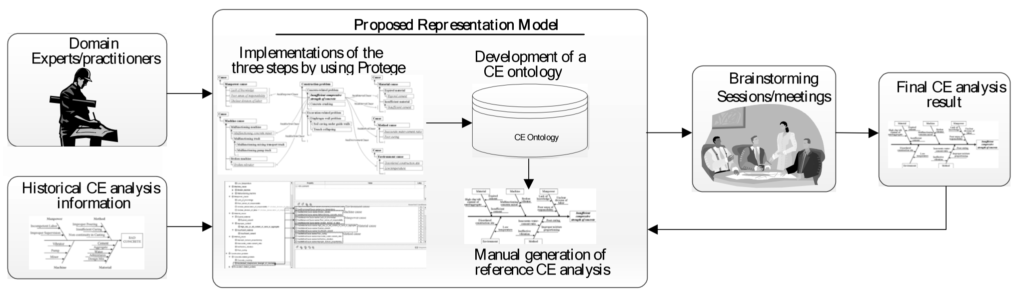


Figure 4.Scheme of using the representation model in a CE analysis process.

In a brainstorming session/meeting, the list of potential causes is discussed and participants determine what causes are applicable and what are not applicable to the current targeted problem. Lastly, the reference CE diagram is updated and a CE analysis result and diagram is finalized. The final CE analysis result can be feedback to the CE ontology if new causes of a problem are identified. The flexibility of modifying existing CE ontology allows the representation model to be easily used to represent CE analysis knowledge of various domains.

CONCLUSIONS

This study proposes an ontology-based representation model for developing an ontology for CE analysis knowledge. This ontology-based model can store CE analysis experiences and knowledge of domain experts from previous cases. It can also store historical CE analysis information. Additionally, this study utilizes the characteristics of an ontology, such as defining association relationships between classes and defining equivalent classes, to establish the representation model. The study result shows that required CE knowledge can be easily identified through the representation model and steps demonstrated in this study to develop a CE ontology.

The proposed representation model and the steps of developing a CE analysis ontology is part of an ongoing research, which aims to automatically implement a CE analysis and generate a CE analysis result/diagram. This study still has limitations to be improved in the ongoing research. The herein proposed representation model currently only allow users to identify required causes manually and does not support automated identification of and reasoning about CE analysis knowledge. However, such a limitation makes a CE analysis process less efficient. In the ongoing research, an automated reasoning mechanism should be developed using ontology reasoning languages or programming language. Once combined with the representation model. the reasoning mechanism shall be able to further facilitate CE analysis process and therefore shorten the time for estimating construction project costs.

ACKNOWLEDGEMENTS

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Understanding Construction Projects' Schedule Overruns in South Africa

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Abstract

Construction schedule overruns are not uncommon on construction projects world over and the South African construction industry has not escaped the challenges of failing to deliver projects on time. In order to find mitigation measures of schedule overruns, the first step is to identify the causes of these overruns. Therefore, this paper assesses the causes of construction projects schedule overruns in the South African construction industry, a case of the Gauteng Province. The data used in this paper were derived from both primary and secondary sources. The secondary data was collected via a detailed review of related literature. The primary data was collected through a structured questionnaire which was distributed to construction professionals, who include: Architects, quantity surveyors, civil engineers, construction mangers and project managers. Data received from the questionnaires was analyzed using descriptive statistics procedures. Findings from the study revealed that slowness in decision making process, reworks due to errors during construction, delay in approving major changes in the scope of work, delay in material delivery, shortage of skilled equipment operators, low productivity level of workers, delay in obtaining permits from municipalities and workers risky behavior on sites were the major causes of construction projects schedule overruns in Gauteng, South Africa. The study contributes to the body of knowledge on the subject of the causes of construction project schedule overruns in Gauteng, South Africa.

INTRODUCTION

Construction schedule overruns are not uncommon on construction projects world over and the South African construction industry has not escaped the challenges of failing to deliver projects on time. Alkhathami (2004) defines schedule overruns as extra time required to finish a given construction project beyond its original planned duration, whether compensated for or not. Mohamad

(2010) says schedule overruns are an act or event that extends the time to complete or perform an act under the contract. Also, Assaf and Al-Hejji (2006), defined schedule overrun as the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project. However, despite the proven importance to deliver construction projects on time, it is not uncommon to see construction projects failing to achieve their objectives (Memon et al. 2012). Hence this paper aims to identify the causes of construction projects schedule overruns.

CONSTRUCTION SCHEDULE OVERRUNS - CAUSES

Causes of schedule overruns are factors or events that occur before and during the construction process that will affect the time of completing a project. Ali et al. (2012) states that there are four factors that causes schedule overruns and categorized them into the following categories: contractor- related factors, consultant-related factors, client-related factors and external factors. Motaleb and Kishk (2010) five factors that can cause schedule overrun and these include change orders, slow decision making by clients, lack of capability of client representative, construction financial difficulties and late delivery of materials. Furthermore, Sambasivan and Soon (2007), describe the following as the main causes of construction project schedule overruns: contractor's improper planning, contractor's poor site management, inadequate contractor experience, client's finance and payments for completed work, problems with subcontractors, material shortages, labour supply, equipment availability and failure, lack of communication between parties, mistakes during the construction stage.

Hoverer; the current study adopted the categories studied by Theodore (2009) as they were more comprehensive categories of causes of construction projects schedule overruns.

Owner-related causes of construction project schedule overruns. The study by Wei (2010) shows that late revising and approving of design documents by the client is the major cause of schedule overrun associated with the client. However, Mohamad (2010) study illustrates that change in orders by owner during construction is a major cause of schedule overruns in project delivery time, which is also in agreement with the study by Motaleb and Kishk (2010). In the work by Haseeb et al. (2011) and Assaf and Al-Hejji (2006) delay in progress payments by owner was identified as the major cause of schedule overruns in project delivery associated with the client. This is also shown in the study by Sambasivan and Soon (2007). Further, Denini (2010) writes that the major causes of schedule overruns related to the owner are slowness in the decision-making process by the owner and delay in making progress payments to contractors. Furthermore, Ayudhya (2011) found that the major owner-related causes of schedule overruns include: delay in progress payment by owner, adverse weather conditions, evaluation of completed works and insufficient working drawing details. Ren et al. (2008) show that unrealistic control duration, many provisional sums and prime cost, nomination of sub-contractors and suppliers and client's irregular payment to the main contractor are the major owner-related causes of schedule overruns. The study by Theodore (2009) identified nine causes of schedule overruns in this category and ranked them as follows: delay in progress payments, delay in furnishing and delivering the site, change of orders by owner during construction, late revising and approval of design documents, delay in approving shop drawing and sample materials, poor communication and coordination, slowness in decision-making process, conflicts between joint-ownership of the project and suspension of work by owner.

Contractor-related causes of schedule overruns. Theodore (2009) identified the contractor related causes of schedule overruns and ranked them as follows; difficulties in financing project, conflicts in sub-contractors schedule in execution of project, rework due to errors during construction, conflicts between contractor and other parties, poor communication and coordination, ineffective planning and scheduling of project, improper construction methods implement, delays in sub-contractors work, inadequate contractor's work, frequent change of sub-contractors, poor qualification of the contractor's technical staff and delays in site mobilization (Theodore 2009). This was in agreement with the study by Assaf and Al-Hejji (2006). However in the study by Wei (2010), delays in sub-contractors works was ranked as the highest contractor related cause of schedule. Further, Denini (2010) revealed the following as the major contractor related causes of schedule overruns: financial difficulties faced by the contractor, poor project planning and scheduling, inadequate contractors' experience contractor-related, inaccurate cost estimation contractor-related and poor site management and supervision. The study by Motaleb and Kishk (2010) shows that late delivery of materials is a major cause of contractor related schedule overruns. Furthermore, Wong and Vimonsatit (2012) show that financial difficulties, low speed of decision, skills shortage, design errors made by designers, unforeseen ground conditions, poor organization of the contractor or consultant, difficulty of coordination between various parties, poor communication, shortage of labor and underestimation of time of completion are the most significant contractor related causes of schedule overruns. Ren et al. (2008) revealed that non-preparing the method statements, financing project by the contractor, luck of organizational chart, poor communication externally and internally and mistakes during construction are the major contractor related causes of schedule overruns.

Consultant-related causes of schedule overruns. Theodore (2009) and Wei (2010) both identify and ranked delay in approving major changes in the scope of work by consultants as the major cause of consultant related schedule overruns. Further, the work of Le-Hoai et al. (2008) showed that the major consultant related causes of schedule overruns include: poor project management assistance, inaccurate estimates, and mistakes in design, poor contract management and slow inspection of completed works. Further, Wong and Vimonsatit (2012) revealed that the major consultant related causes of schedule overruns include: changes in specifications during construction, financial difficulties, skill shortage, shortage of labor, unrealistic deadlines for project completion, underestimation of complexity of projects, poor communication, materials shortage, underestimation of costs of projects and unforeseen ground conditions. In the study by Assaf and Al-Hejji (2006), delay in performing inspection and testing by the consultant was ranked as the highest cause of schedule overrun. However, Motaleb and Kishk (2010) established that inadequate consultant experience was the major cause of schedule overruns associated with consultants. Ren et al. (2008) revealed that the major consultant related causes of schedule overruns include: incomplete drawings, delay in approval of documents, incomplete contract documents, changes in drawings and specifications and duration of inspection procedure.

Material-related causes of schedule overruns. The study by Sambasivan and Soon (2007), identified quality of material and shortage in material to be the major causes of schedule overruns that are associated with materials. Wei (2010) shows that delay in material delivery and shortage of construction materials on the market are the two major causes of material related schedule overruns, this is also reflected in the work of Assaf and Al-Hejji (2006). Further, Alwi and Hampson (2003) revealed that the major material related causes of schedule overruns include: poor quality of materials, delay of material delivery to site, poor material handling on site, poorly scheduled delivery of material to site, inappropriate or misuse of material and poor storage of material. However, Theodore (2009) identified six material related causes of schedule overruns and ranked them as follows: shortage of construction materials in market, changes in material types during construction, delay in material delivery, damage of sorted material while they are needed urgently, delay in manufacturing special building materials and late procurement of materials.

Equipment-related causes of schedule overruns. Assaf and Al-Hejji (2006) identify equipment breakdowns and shortage of equipment as the major causes of equipment related schedule overruns. However, the study by Wei (2010) identified lack of high-technology mechanical equipment and low productivity and efficiency of equipment as the top most causes of schedule overruns and they were both ranked first in the study. Low level of equipment-operators skill was also identified as a major cause of schedule overruns related to equipment.

Labour-related causes of schedule overruns. Assaf and Al-Hejji (2006) and Sambasivan and Soon (2007) reveal shortage of labor is the major cause of schedule overruns associated with labor force. Further, Theodore (2009) shows that: shortage of labor, work permits for international workers, low productivity level of workers and personal conflicts among workers. Wei (2010) identified low productivity level of workers as the second highest cause of schedule overruns on construction projects.

Causes of schedule overruns by external factors. Assaf and Al-Hejji (2006) and Sambasivan and Soon (2007) revealed that effects of subsurface and ground conditions was the major external factor that cause schedule overruns on construction projects. Further, Le-Hoai et al. (2008) found that the major causes of schedule overruns related to external factors include the following: unforeseen site conditions, price fluctuations, bad weather and obstacles from governments. Furthermore, Further, Alwi and Hampson (2003) showed that site condition, weather and damage by other participants are the major causes of schedule overruns caused by external factors. Furthermore, Theodore (2009) identified the following causes of schedule overruns cause by external factors: effects of subsurface and ground conditions, delay in obtaining permits from municipality, weather effect on construction activities, traffic control and restriction at job site, accident during construction, changes in government regulations and laws, delay in providing services from utilities, delay in performing final inspection and certification.

RESEARCH METHODOLOGY

The data used in this paper were derived from both primary and secondary sources. The primary data was obtained through the survey method, while the secondary data was derived from the review of literature and archival records. The primary data was obtained through the use of a structured questionnaire survey. This was distributed to a total of 200 construction professionals that included; Architects, quantity surveyors, civil engineers, construction mangers and project managers who are currently involved in construction works in Gauteng, South Africa. This yardstick was considered vital for the survey in order to have a true reflection of the causes construction project schedule overruns. All professionals in Gauteng province had an equal chance to be drawn and participate in the survey. Out of the 200 questionnaires sent out, 146 were received back representing a 73% response rate. This was considered adequate for the analysis based on the assertion by Moser and Kalton (1971) that the result of a survey could be considered as biased and of little value if the return rate was lower than 30–40%. The data presentation and analysis made use of frequency distributions and percentages of all the respondents.

Mean item score (MIS). A five point Likert scale was used to determine the causes of construction project cost overruns in Gauteng province with regards to the identified factors from the reviewed literature. The adopted scales were as follows: 1 = strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = strongly agree.

The five-point scale was transformed to mean item score (MIS) for each of the factors of causes of cost overruns as assessed by the respondents. The indices were then used to determine the rank of each item. The ranking made it possible to cross compare the relative importance of the items as perceived by the respondents. This method was used to analyze the data collected from the questionnaires survey. The mean item score (MIS) was calculated for each item as follows;

$$MIS = \frac{1\text{n}1 + 2\text{n}2 + 3\text{n}3 + 4\text{n}4 + 5\text{n}5}{\sum N} \tag{1}$$

Where, n1 = Number of respondents for strongly disagree; n2 = Number of respondents for disagree; n3 = Number of respondents for neutral; n4 = Number of respondents for agree; n5 = Number of respondents for strongly agree; N = Total number of respondents

After mathematical computations, the factors were then ranked in descending order of their mean item score (from the highest to the lowest).

FINDINGS AND DISCUSSION

Findings from the 146 usable questionnaires revealed that 59.6% of the respondents were male and 40.4% were female. Findings relating to the respondents' age group revealed that 29.5% of the respondents were in the age group of 20-25 years old, 26.7% of the respondents were in the age group 26-30 years old, 17.1% were in the age group 31-35 years old, 11.6% were in the age group 36-40 years old, 6.2% of the respondents were in the age group 41-45 years old, 4.1% were in the age group 46-50 years old, 3.4% of the respondents were above 50 years old and 1.4% of the respondents were between 51-55 years old. Further, results showed that 76.7% of the respondents were Black, 14.4% were White, 4.8% were either Indian or Asian and 4.1% of the respondents were Colored. Findings relating to respondent's work professional qualification, results showed that 38.4% were quantity surveyors, 20.5% were civil engineers, 11% were project managers, 10.3% were construction managers, 8.9% were construction project managers, 5.5% were architects and 5.5% selected others, which included an artisan, a building inspector, electrical contractors, a safety consultant and a site agent.

Furthermore, results revealed that 56.8% of the respondents had experience that ranged from 1-5 years, 20.5% had experience in the range of 6-10 years, 11.6% had experience that ranged between 11-15 years, 6.2% had more than 20 years' experience and 4.8% had experience that ranged from 16-20 years in the construction industry. Further, 46.6% of the respondents had bachelor's degrees, 32.2% had diplomas, 12.3% of the respondents had masters degrees, 4.1% of the respondents had doctorate degrees and 4.8% of the respondents only had metric (grade 12) certificates. Furthermore, it was revealed that 35.6% of the respondents were employees of contractors, 34.9% of the respondents were employees of consultants and 20.5% were government employee, 8.2% were employed by clients and 0.7% of the respondents were self-employed.

Owner-related causes of construction projects schedule overruns. Based on the ranking (R) using the calculated standard deviation (SD) and mean scores ($\bar{x}$) for the listed causes of construction projects schedule overruns, the study revealed that slowness in decision making process (SD = 0.802; $\bar{x}$ = 4.15; R = 1), change in design by the owner during construction (SD = 0.839; $\bar{x}$ = 4.15; R = 1), poor project coordination (SD = 0.892; $\bar{x}$ = 4.13; R = 2), late revising and approving of design documents (SD = 0.835; $\bar{x}$ = 4.08; R = 3), poor communication by the client to the construction team (SD = 0.924; $\bar{x}$ = 4.01; R = 4), delay in progress payments (SD = 0.997; $\bar{x}$ = 3.89; R = 5), suspension of workers by owner (SD = 1.105; $\bar{x}$ = 3.85; R = 6), delay in handing over the site (SD=0.929; $\bar{x}$=3.80; R=7), delay in approving shop drawings (SD = 0.854; $\bar{x}$ = 3.78; R = 8) and delay in approving sample materials (SD = 0.965; $\bar{x}$ = 3.74; R = 9) were the causes of schedule overruns related to the owner. These results are in general agreement with the study of Denini (2010) who also identified slowness in the decision making process by the owner as the major cause of construction schedule overruns related to the owners. However, the results were not in agreement with the study of Wei (2010) who showed that the major cause of construction projects schedule overruns related to the owner is late revising and approving of design documents by the client. However, they were not similar to the results in the study by Ayudhya (2011) where delay in progress payment by the owner was identified as the major cause of schedule overruns related to the owner (see Table 1).

Table 1.Owner-Related Causes of Construction Projects Schedule Overruns.

Causes of schedule overruns	σX	$\bar{x}$	R
Slowness in decision making process	0.802	4.15	1
Change in design by the owner during construction	0.839	4.15	1
Poor project coordination	0.892	4.13	2
Late revising and approving of design documents	0.835	4.08	3
Poor communication by the client to the construction team	0.924	4.01	4
Delay in progress payments	0.997	3.89	5
Suspension of workers by owner	1.105	3.85	5
Delay in handing over the site	0.929	3.80	7
Delay in approving shop drawings	0.854	3.78	8
Delay in approving sample materials	0.965	3.74	9

σX = Standard deviation; $\bar{x}$ = Mean item score; R = Rank

Contractor-related causes of construction projects schedule overruns. The study further revealed that there are causes of schedule overruns that are contractor related. It was found that the major causes included: rework due to errors during construction (SD = 0.771; $\bar{x}$ = 4.23; R = 1), poor coordination (SD = 0.769; $\bar{x}$ = 4.19; R = 2), poor communication (SD = 0.822; $\bar{x}$ = 4.18; R = 3), ineffective planning and scheduling of project (SD = 0.796; $\bar{x}$ = 4.14; R = 4), difficulties in financing projects (SD = 0.915; $\bar{x}$ = 3.99; R = 5), contractors' experience (SD = 1.034; $\bar{x}$ = 3.98; R = 6), conflicts in sub-contractors schedule in execution of project (SD = 0840; $\bar{x}$ = 3.94; R = 7), conflicts between contractor and other parties (Construction team members) (SD = 0.940; $\bar{x}$ = 3.94; R = 7), improper construction methods implementation (SD = 0.886; $\bar{x}$ = 3.92; R = 8) and delay in sub-contractor's work (SD = 0.901; $\bar{x}$ = 3.92; R = 8). These findings were not in agreement with the study by Wong and Vimonsatit (2012) where financial difficulties by the contractor was identified as the major cause of contractor related causes of schedule overruns. The results were also not in agreement with the study by Ren et al. (2008) where non-preparing of method statements was identified as the major cause of contractor related cause of schedule overruns (see Table 2).

Consultant-related causes of construction projects schedule overruns. Furthermore, the study revealed consultant related causes of schedule overruns. The causes were: delay in approving major changes in the scope of work (SD = 0.905; $\bar{x}$ = 4.14; R = 1), unclear and inadequate details in drawings (SD = 0.840; $\bar{x}$ = 4.12; R = 2), poor communication (SD = 0.823; $\bar{x}$ = 4.10; R = 3), poor coordination (SD = 0.848; $\bar{x}$ = 4.06; R = 4), delays in producing design documents (SD = 0.881; $\bar{x}$ = 4.01; R = 5), mistakes and inconsistencies in design documents (SD = 0.833; $\bar{x}$ = 4.00; R = 6), inadequate experience of consultants (SD = 0.937; $\bar{x}$ = 3.96; R = 7), insufficient data collection and survey before design (SD = 0.921; $\bar{x}$ = 3.92; R = 8) and lack of advanced engineering design software (SD = 1.008; $\bar{x}$ = 3.50; R = 9). These findings were in agreement with the studies by Theodore (2009) and Wei (2010) where delay in approving major changes in the scope of works by the consultants was ranked the number one cause of consultant related causes of construction projects schedule overruns. However, the results were not in agreement with the study by Le-Hoai et al. (2008) where poor project management was identified as the major cause of contractor related schedule overruns (see Table 3).

Table 2.Contractor-Related Causes of Construction Projects Schedule Overruns.

Causes of schedule overruns	σX	$\bar{x}$	R
Rework due to errors during construction	0.771	4.23	1
Poor coordination	0.769	4.19	2
Poor communication	0.822	4.18	3
Ineffective planning and scheduling of project	0.796	4.14	4
Difficulties in financing projects	0.915	3.99	5
Contractors' experience	1.034	3.98	6
Conflicts in sub-contractors schedule in execution of project	0.840	3.94	7
Conflicts between contractor and other parties (Construction team members)	0.940	3.94	7
Improper construction methods implementation	0.886	3.92	8
Delay in sub-contractor's work	0.901	3.92	8
Improper method statements	0.858	3.86	9
Frequent change of sub-contractors	0.960	3.78	10
Poor qualification of the contractor's technical staff	1.059	3.68	11
Delay in site mobilization	0.985	3.60	12

σX = Standard deviation; $\bar{x}$ = Mean item score; R = Rank

Table 3.Consultant-Related Causes of Construction Projects Schedule Overruns.

Causes of schedule overruns	σX	$\bar{x}$	R
Delay in approving major changes in the scope of work	0.905	4.14	1
Unclear and inadequate details in drawings	0.840	4.12	2
Poor communication	0.823	4.10	3
Poor coordination	0.848	4.06	4
Delays in producing design documents	0.881	4.01	5
Mistakes and inconsistencies in design documents	0.833	4.00	6
Inadequate experience of consultants	0.937	3.96	7
Insufficient data collection and survey before design	0.921	3.92	8
Lack of advanced engineering design software	1.008	3.50	9

σX = Standard deviation; $\bar{x}$ = Mean item score; R = Rank

Material-related causes of construction projects schedule overruns. When the respondents were asked to rank the material related causes of construction projects schedule overruns in Gauteng, the following results were obtained: delay in material delivery (SD = 0.847; $\bar{x}$ = 4.09; R = 1), lateness in material ordering (SD = 0.92; $\bar{x}$ = 4.01; R = 2), damage of sorted material while needed urgently (SD =

0.885; $\bar{x}$ = 3.97; R = 3), changes in material types during construction (SD = 0.964; $\bar{x}$ = 3.88; R = 4), delivery of wrong material (SD = 0.968; $\bar{x}$ = 3.88; R = 4), ordering wrong material (SD = 0.981; $\bar{x}$ = 3.87; R = 5), inappropriate storage of material leading to damages (SD = 0.928; $\bar{x}$ = 3.86; R = 6), delivery of sub-standard material (SD=0.916, $\bar{x}$=3.81; R=7), fluctuation in material prices (SD = 1.047; $\bar{x}$ = 3.65; R = 8) and availability of specified construction materials on the market (SD = 1.101; $\bar{x}$ = 3.63; R = 9) were the top ten material related causes of construction projects schedule overruns (see Table 4).

Table 4.Material-Related Causes of Construction Projects Schedule Overruns.

Causes of schedule overruns	σX	$\bar{x}$	R
Delay in material delivery	0.847	4.09	1
Lateness in material ordering	0.920	4.01	2
Damage of sorted material while needed urgently	0.885	3.97	3
Changes in material types during construction	0.964	3.88	4
Delivery of wrong material	0.968	3.88	4
Ordering wrong material	0.981	3.87	5
Inappropriate storage of material leading to damages	0.928	3.86	6
Delivery of sub-standard material	0.916	3.81	7
Fluctuation in material prices	1.047	3.65	8
Availability of specified construction materials on the market	1.101	3.63	9
Availability of improved materials on the market	1.028	3.52	10

σX = Standard deviation; $\bar{x}$ = Mean item score; R = Rank

These findings were in agreement with the studies by Wei (2010) and Assaf and Al-Hejji (2006) where delay in material delivery was identified as the major cause of material related schedule overruns. However, the findings were not similar to the study by Alwi and Hampson (2003) where poor quality of material was identified as the major cause of material related overruns.

Equipment-related causes of construction projects schedule overruns. Based on the ranking (R) using the calculated standard deviation (SD) and mean scores ($\bar{x}$) for the listed equipment related causes of construction projects schedule overruns, it was observed that the causes include: shortage of skilled operators (SD = 0.949; $\bar{x}$ = 3.88; R = 1), shortage of equipment (SD = 0.954; $\bar{x}$ = 3.88; R = 1), equipment breakdowns (SD = 0.966; $\bar{x}$ = 3.79; R = 2), low productivity and efficiency of equipment (SD = 0.963; $\bar{x}$ = 3.72; R = 3), use of wrong equipment (SD = 1.082; $\bar{x}$ = 3.61; R = 4), use of absolute equipment (SD = 0.970; $\bar{x}$ = 3.43; R = 5) and lack of high-technology mechanical equipment (SD = 1.071; $\bar{x}$ = 3.35; R = 6). The findings were not in agreement with the study by Theodore (2009) and Assaf and Al-Hejji (2006) where equipment breakdowns were identified as the major cause of equipment related causes of schedule overruns. Further, the results were not similar to the study by Wei (2010) where lack of high-technology mechanical equipment was shown to be the major cause of equipment related causes of schedule overruns (see Table 5).

Labour-related causes of construction projects schedule overruns. Further, the respondents were asked to rank the labour related causes of construction projects schedule overruns in Gauteng. The results obtained were as follows: low productivity level of workers (SD = 0.822; $\bar{x}$ = 4.05; R = 1), inexperience of workers (SD = 0.832; $\bar{x}$ = 3.96; R = 2), work attitude of workers (SD = 0.892; $\bar{x}$ = 3.91; R = 3), insecurity by not passing on related work experience (SD = 0.835; $\bar{x}$ = 3.80; R = 4), shortage of labour (SD = 1.142; $\bar{x}$ = 3.73; R = 5), conflicts among workers (SD = 0.999; $\bar{x}$ = 3.62; R = 6) and late approval or issuing of work permits for immigrant workers (SD = 1.079; $\bar{x}$ = 3.40; R = 7). The results were in agreement with the study by Wei (2010) where low productivity levels of workers was identified as the major cause of labour related causes of schedule overruns. However, the results were not in agreement with the study by Sambasivan and Soon (2007) where shortage of labour was identified as the major cause of labour related causes of schedule overruns (see Table 6).

Table 5.Equipment-Related Causes of Construction Projects Schedule Overruns.

Causes of schedule overruns	σX	$\bar{x}$	R
Shortage of skilled operators	0.949	3.88	1
Shortage of equipment	0.954	3.88	1
Equipment breakdowns	0.966	3.79	2
Low productivity and efficiency of equipment	0.963	3.72	3
Use of wrong equipment	1.082	3.61	4
Use of absolute equipment	0.970	3.43	5
Lack of high-technology mechanical equipment	1.071	3.35	6

σX = Standard deviation; $\bar{x}$ = Mean item score; R = Rank

Table 6.Labour-Related Causes of Construction Projects Schedule Overruns.

Causes of schedule overruns	σX	$\bar{x}$	R
Low productivity level of workers	0.822	4.05	1
Inexperience of workers	0.832	3.96	2
Work attitude of workers	0.892	3.91	3
Insecurity by not passing on related work experience	0.835	3.80	4
Shortage of labor	1.142	3.73	5
Conflicts among workers	0.999	3.62	6
Late approval or issuing of work permits for immigrant workers	1.079	3.40	7

σX = Standard deviation; $\bar{x}$ = Mean item score; R = Rank

Causes of construction projects schedule overruns by external factor. Furthermore, the respondents were asked to rank the causes of construction projects schedule overruns by external factors in Gauteng. The results obtained were as follows: delay in obtaining permits from municipality (SD = 0.835; $\bar{x}$ = 3.98; R = 1), weather effects on construction activities (SD = 0.951; $\bar{x}$ = 3.77; R = 2), delay in performing final inspection and certification (SD = 0.992; $\bar{x}$ = 3.76; R = 3), effects of subsurface and ground conditions (SD = 0.883; $\bar{x}$ = 3.71; R = 4), delay in providing services from utilities (SD = 0.931; $\bar{x}$ = 3.62; R = 5), natural disasters (SD = 1.139; $\bar{x}$ = 3.63; R = 6), political interference (SD = 1.071; $\bar{x}$ = 3.61; R = 7), change in economic factors (SD = 1.059; $\bar{x}$ = 3.60; R = 8), change in government regulation and laws (SD = 1.016; $\bar{x}$ = 3.51; R = 9) and traffic control and restriction at sites (SD = 1.019; $\bar{x}$ = 3.42; R =

10) (see Table 7).

Table 7.Causes of Construction Projects Schedule Overruns by External Factor.

Causes of schedule overruns	σX	$\bar{x}$	R
Delay in obtaining permits from municipality	0.835	3.98	1
Weather effects on construction activities	0.951	3.77	2
Delay in performing final inspection and certification	0.992	3.76	3
Effects of subsurface and ground conditions	0.883	3.71	4
Delay in providing services from utilities	0.931	3.62	5
Natural disasters	1.139	3.63	6
Political interference	1.071	3.61	7
Change in economic factors	1.059	3.60	8
Change in government regulation and laws	1.016	3.51	9
Traffic control and restriction at sites	1.019	3.42	10

σX = Standard deviation; $\bar{x}$ = Mean item score; R = Rank

These findings were not in agreement with the study by Alwi and Hampson (2003) where site conditions was identified as the major cause of external factors related causes of schedule overruns. Furthermore, the results were not similar to the results of the study by Wei (2010) where effects of subsurface and ground conditions was identified as the major cause of external factors related causes of schedule overruns.

CONCLUSION AND RECOMMENDATION

Literature revealed that there are different causes of construction project schedule overruns and they include the following; causes that are client related, causes that are contractor related, causes that are consultant related, causes that are material related, causes that are equipment related, causes that are labor related and external factors related causes. Literature further showed the following as the causes in each of the above categories; delay in progress payments, difficulties in financing project by contractors, delay in approving major changes in the scope of work, shortage of construction materials in market, equipment breakdowns, shortage of labor and effects of subsurface and ground conditions as some of the causes of construction project schedule overruns.

From the survey results obtained from the respondents, slowness in decision making process, reworks due to errors during construction, delay in approving major changes in the scope of work, delay in material delivery, shortage of skilled equipment operators, low productivity level of workers, delay in obtaining permits from municipalities and workers risky behavior on sites were the major causes of construction projects schedule overruns in Gauteng, South Africa. It is therefore recommended that all members of construction teams should be trained and educated on the factors that cause construction project schedule overruns in order to minimize these overruns. Furthermore, it is also recommended that frequent site co-ordination meetings should be held in order to flag possible schedule overruns.

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Discussion on the Construction of Project Organization Management Mode

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Abstract

The construction project is system engineering. It has its inherent laws because of the system engineering, so it need through not only the suitable management mode and management process, but also combine with the appropriate management method and management techniques to achieve. That is to say construction project need organization mode of specialized in engineering project management service. The management mode is introduced in this paper which commonly used in project management, and the advantages and disadvantages are analyzed. Finally, new ideas and proposals are put forward for its application in practice, which can be used for the engineering project management personnel for reference on the choice of organization structure mode.

INTRODUCTION

Project management mode mainly refers to projects from start to completion, (including the entire process which have the project proposal, feasibility study, engineering design, and until completion). In terms of the project stakeholders, several of skills, tools and related knowledge is used to meet the requirements. The objectives of project's cost and schedule as well as quality is realized through project planning and project control by use of project organization and management mode. It can make the project operate normally. Project organization and management mode is an organization way that the project to be constructed, and also the project is managed and controlled by this mode. In order to meet the needs of different project management, many different types of project management mode are formed through years of development are formed. For example, a parallel contracting model, design or construction of the total sub-model, the project general contracting model, project general contracting management mode are formed through years of development. Therefore, the characteristics of the engineering project construction, environment, risk profile, owners demand as well as other factors are comprehensive considered and determined. In the practical engineering application, mode selection should be combined with to above factors.

THE EXISTING ORGANIZATION AND MANAGEMENT MODE AND ITS ADVANTAGES AND DISADVANTAGES

Parallel contracting mode. The so-called parallel contract refers to the task of the design; construction and procurement on materials and equipment are respectively divided by owners (Ma 2007; Huang 2004). And then the divided task is contracted out to a number of design units, construction units, material and equipment supply units, contract are separately signed between the owners and the parties. The relationship between the various design units is parallel, and the relationship between the various construction units is parallel, as well as the relationship between the various material and equipment supply units is parallel (see Figure 1).

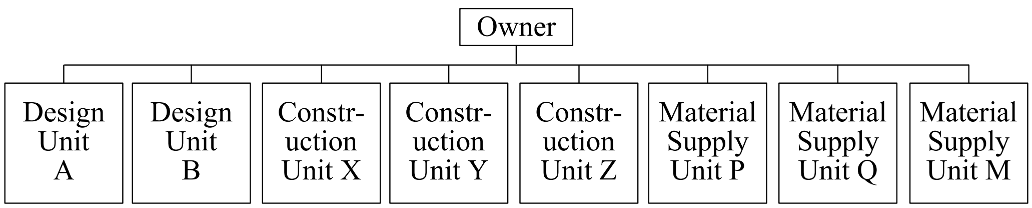

Figure 1.Parallel contracting mode.

In the parallel contracting mode, the design stage and construction stage are likely to form the overlapping relationship which is conducive to shorten the construction period. The whole project construction is decomposed and then respectively contracted out to the construction units. The quality requirements can be better achieved though contract constraints and mutual restraint to make each part, which is conducive to control quality. In the construction market of most countries, highly professional and small-scale construction unit usually accounts for a large proportion. The contents of contract in this pattern are relatively simple, the value and risk of the contract are small, so that they may participate in the competition. Therefore, no matter large construction unit or small and medium-sized construction has a chance to compete. The owner can choose unit construction in a wide range, which is conducive to improve optimality. However, parallel contracting mode also has many short-comings. The number of binding sites within the construction system is increased because of complex contractual relationship, as well as organization and coordination of workload become lager. Therefore, we should strengthen the contract management and the horizontal coordination work between construction units. The difficulty of Contract management will be caused by large quantity contract (Lu and Zhai 2002). First, the total contract price is not easy to determine which affects the implementation of investment control; second, because of large amount of project bidding tasks, a number of contracts price is needed to control, which increase the difficulty of the investment control. Third, due to many design changes and modifications in the construction process, investment will be increased.

Design or construction total subcontracting mode. The so-called design or construction of the total subcontracting refers to this mode (Yi 2005). All the design tasks or construction tasks are contracted to a design unit or a construction unit as a total package unit, then some of its mission is divided to other contractors by the total package unit, a general design contract or a general construction contract and several different subcontracts is formed to the structural mode (see Figure 2).

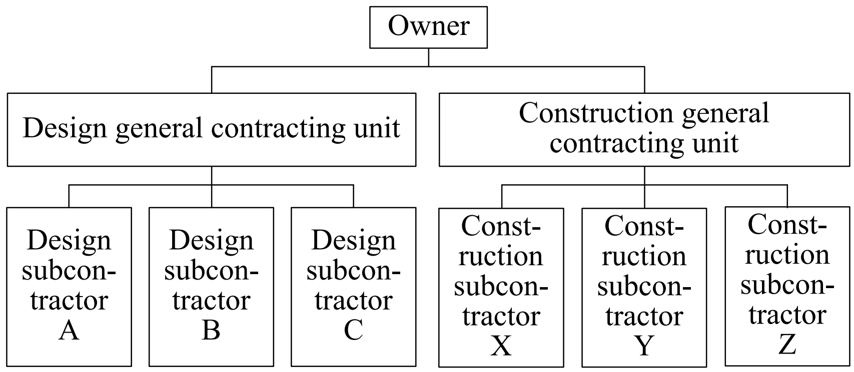

Figure 2.Design or construction total subcontracting mode.

In the design or construction total subcontracting mode, the number of engineering contract is much less than parallel contracting mode, so it is conducive to contract management for the owners, but also coordination workload is reduced, and can play the enthusiasm of supervising engineer with the total package units multi-level coordination can be produced, thus it is conducive to the organization and management of construction projects. Turnkey contract price can be determined earlier, and supervision units are easy to control, so it is conducive to investment control. In terms of quality, it not only has the self-control of the subcontractors, but also the supervision of the total package units and the check and recognition of engineering supervision unit, which are beneficial to the quality control. The total package unit with controlled enthusiasm and subcontractors also has the effect of mutual restriction between each other, which is conducive to the overall progress of coordination and control, but also conducive to control the progress of the engineer. However, design or construction total subcontracting mode also has many deficiencies, when both design and construction using total subcontracting mode, due to it is bidding for construction contractor only after the completion of all design drawings, thus it is not only the design phase cannot overlap with the construction phase, and construction bidding and need longer time. For large-scale construction project, it is usually only large construction unit that has the qualifications and abilities of the total package, the competition is relatively less intense (Li 2007); On the other hand, for the subcontracted project content, total package units add management fees to the owners offer on the basis of the subcontract price.

Project general contracting mode. The so-called project general contracting mode refers to the design task and construction task as well as equipment and materials procurement task all contracted out to a contract firm by owner, so the general contractor complete the substantive design, construction and procurement work, and finally hand over to the owner a project that has reached the use condition. The project in this contracting mode is also called "turnkey project" (see Figure 3).

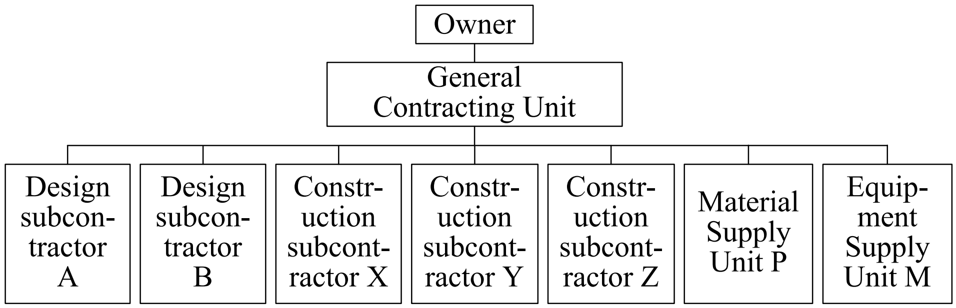

Figure 3.Project general contracting mode.

In the project general contracting mode, the contractual relationship is greatly simplified; the supervision engineer is mainly coordinated with the project general contracting unit. Many coordination works are moved to the internal of general contracting unit and between it and its subcontractors, which makes coordination of construction supervision unit is greatly reduced. The contractual relationship is simple, and the workload of organization and coordination is small. Due to the design and construction arranged by a unit, so the two phases can be organically integrated and generally can make the design phase and construction phase overlap each other, therefore it is benefit for the schedule target control. Through the overall consideration of the design and construction can improve the economics of the project, and from the perspective of the value engineering or whole life cost can achieve significant economic effect. However, the project general contracting mode also has many deficiencies, such as the terms of the contract are not easy to determine accurately, and it is likely to cause more contract disputes. Therefore, although the contract amount is the least, but the difficulty of contract management is generally larger. Due to the large range of contracting and early intervention project time as well as more unknowns about engineering information, so the contractor has to bear greater risk, but the number of contracting units who have the ability to bear great risk is relatively small, results in less competitive and higher contract price. Quality standards and functional requirements are not easy to be comprehensive, specific, accurate, and quality control standards conditionality affected.

Project general contracting management mode. The so-called project general contracting management refers to the owner makes the project construction tasks contracted to unit which is specialized in project organization and management, and then the unit subcontracts the tasks to several design, construction and materials and equipment supply units, and makes project management in the implementation (He and Chen 2007). Project general contracting management unit does not to carry on the design and construction directly, with it does not have its own power of design and construction (see Figure 4).

In the project general contracting management mode, the contract management as well as organization and coordination are more favorable, what's more schedule control is also advantageous (Yang and Wang 2000). But the economic power of project general contracting management unit is relatively weak generally, while the risk is relatively large.

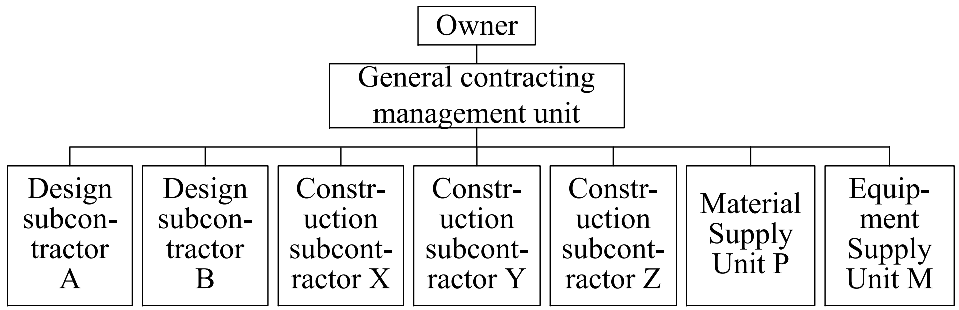

Figure 4.Project general contracting management mode.

The above mentioned modes have their own characteristics. The specific comparison is as shown in Table 1.

Table 1.The Advantages and Disadvantages of Management Mode.

	Parallel contracting mode	Design or construction total subcontracting mode	General contracting mode	General contracting management mode
Advantages	Conducive to shorten the construction period and quality control, choose the construction unit in large range	Coordination work- load is reduced, conducive to investment control, quality control and schedule control	The contractual relationship is simple; small workload of coordination, shorten the construction period, conducive to investment control	The contractual relationship is simple, the work of coordination is favorable, conducive to schedule control
Disadvantages	Large number of contracts and huge workload of organization; contract management is difficulty, investment control is difficult	Construction period is long, the total package price may be higher	Bidding work is difficulty, the difficulty of contract management is large, quality control is difficult	Confirmation of the subcontract work is critical, using this contract model should be cautious

HOW TO CHOOSE THE ORGANIZATIONAL STRUCTURE MODE

First, the project organization management mode is selected according to the scale of project. Second, the project organization management mode is selected according to different investment subjects. Third, the choice and innovation of the mode should be combined with advanced international management experience. Thus in nowadays, PCM, EPC, CM and other mode have become an international trend. The construction project of our country can be conducted in the way of imitative innovation. But no matter we choose which kind of construction project management mode, the trust and understanding are needed to strengthen between each party. A safe and harmonious working environment are created through cooperate with each other. At the same time, we must seize opportunities. On the basis of summing up the engineering project management mode in our country, and then the international advanced management experience is actively absorbed. More strengthen that we should adapt to the economic development in our country. And it is promoted, applied and innovated.

In summary, each construction project has different characteristics. The project scope, project schedule, project complexity and contract pricing model is the main factors. Which affect the selection and innovation of construction project management mode? When the engineering project management modes above are selected, we should not only consider length of the mode but also comprehensive consider the characteristics of the project itself and the parties.

CONCLUSION

The project organization management mode is mainly described in this paper. The advantages and disadvantages of the mode are analyzed. Considering its promotion and application in practice, then some new ideas and proposals are put forward. When supervisor of construction select the organizational structure model it can be used to reference.

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Research and Application of a Comprehensive Project Management System of China Construction Fourth Engineering Division in Full Life Cycle Control of a Modern Construction Project

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Abstract

Modern information technology is the foundation for construction enterprises to implement information management, and informatization management of construction enterprises is the extensive application of information technology in management of their activities, informatization management of construction enterprises entails extensive application of information technology in the management of their activities, in which modern information technology plays a major role, including computer technology, network technology, information management system and decision support system. This paper introduces a comprehensive project management system (CPMS) of China Construction Fourth Engineering Division Corp. Ltd (CCFED). With demand analyses of the system structure and business modules and a description of system design, the priority of this paper has been given to the way in which CCFED conducts "collaborative horizontal management to all sides" and "multi-stage vertical control to all ends" in the full-life cycle of modern construction project (MCP) based on CPMS. In the end, the paper is concluded with measures of improving and optimizing the system in order to achieve better application effects.

INTRODUCTION

Gainst the backdrop of emerging network information technology and fast development of informatization in the society, construction engineering projects of China have been transforming from construction projects of comparative simplicity into ones of large scale and comprehensive functions. Given the fact that modern construction projects (MCPs) entail intrinsic features of project management, such as large amount of information, various and constantly changing field conditions and multiple management targets, the management of MCPs has a fairly important role to play. In order to facilitate overall performance of construction enterprises, Ministry of Housing and Urban-Rural Development of the People's Republic of China (MOHURD) (formerly Ministry of Construction of the People's Republic of China) has successively issued Standard for Supreme Qualification of General Construction Contract Enterpriseand 2011-2015 Development Outline for Informatization of Construction Industry, aimed at establishing a comprehensive information management platform with informatized project management as its core, strengthening the information system building of construction enterprises and conducting integrated project function management of MCPs in their full life cycle.

The comprehensive project management system (CPMS) of China Construction Fourth Engineering Division Corp. Ltd (CCFED is established in order to attain construction targets of "collaborative horizontal management to all sides" and "multi-stage vertical control to all ends". In this integrated system, project management can be further divided into two major categories: enterprise-based management and project-based management; and three pillar business segments can be covered: economic segment, production technology segment and segment of other business. Additionally, the system can give play to 21 business management functions, which include contract management, cost management, technology management and conclusion management. Among them, the key functions have been informationized and performed in a dynamic manner, during which intelligent decision making process has been conducted. All of these efforts aim to effectively manage construction projects, which demonstrates the refined, standardized and informationized control and management CCFED has carried out on MCPs in their full life cycle.

INFORMATIZATION MANAGEMENT OF MODERN ENGINEERING PROJECT

Under the influence of modern science and technology development, modern engineering project management has absorbed management theory and method of integrated thinking, system theory, information theory, and control theory together. It is the latest achievement of modern science and technology, and Demonstrates trends of socialization, standardization and professionalization. The core of MCP management lies in its multi-objective system. Objective of integrated system is not unitary, instead, it pursues optimization of multiple construction project objectives covering quality, cost and construction period and requires all integrated element units to converge within the same rank or from different ranks.

Current situation of construction projects at home and abroad. With the reform that infromationize MCP management, the existing information management tools have phased out the initial manual management mode. Based on the thinking of project integration management, MCP combines the concept of integration with practice of project management by applying the method, model and tool of system engineering, which is supported by rapidly developing information technology. In this way, the whole full-life cycle of MCP can be managed in a scientific and systematic manner with a holistic view of the MCP.

Informatization integration management. Professor Liu and Cai (2001) of Tianjin University considered that mesh project organization structure and integrated information system were two foot stones to implement the new project management mode of project integration management. Professor Ding (2000) of Tongji University proposed the concept of project full-life integration management and pointed out that full-life integration was actually to coordinate and control the project through the whole process, from planning to demolition. Bisschoff and Benade (2008) proposed the conceptual model of project cooperation management informatization and discussed major issues in the realization process of informatization: information resources and project cooperation informatization objective. Berzisa and Grabis (2011) of Riga Technical University put forward a project management information system (PMIS) based on knowledge integration and applied it to equipment management module. They mainly studied two contents of realizing informatization: methods and means adopted for knowledge acquisition and knowledge application. Research of domestic and overseas experts and scholars play a role in advancing informatization progress of project management to different degrees.

Necessity of system construction and implementation. Given the fact that MCP is huge in scale, flexible and comprehensive, a combination of management theory, such as integrated thinking and system theory, with rapidly developing information technology can be an important way to perfectly achieve integration management of MCP, and it can be a form of project management that is more comprehensive, covers more areas and demonstrates greater flexibility. Based on division and process design of different business modules, comprehensive project management system can satisfy project integration management based on valid data and conduct normalized, standardized and refined MCP management. System building, implementation and promotion are the inexorable trends of combining informatization and integration means with MCP.

DESIGN OF COMPREHENSIVE PROJECT MANAGEMENT SYSTEM (CPMS)

Design of CPMS is to establish a flexible platform easy to coordinate and manage with good interaction ability and expandability based on different business segments and business processes; It is conducive to not only better user experience but also processed, standardized and integrated management of enterprise at various levels. Design and establishment of a CMPS needs to be based on existing management and organizing structure of enterprises, so as to meet the true demands of system building for enterprise management.

Demand analysis. Construction enterprises and modern construction project need to fully utilize scientific informatization technology and adopt reasonable informatization means, so as to comprehensively manage the three MCP management objectives of quality, progress and cost throughout the whole process from decision-making to operation, based on the flow of information in CPMS. With the characteristics and difficulties of CCFED construction projects taken into account of, a CMPS system is introduced on the basis of normalized and processed management, in order to meet the system building targets of "collaborative horizontal management to all sides and multi-stage vertical control to all ends". By doing so, a coordinated and integrated platform of CPMS that meets the whole-process and all-dimensional management requirements of construction projects can be set up, which will be able to coordinate different management tasks, refine management process, manage the sharing information and facilitate management decision-making process to be scientific. Therefore, the system building needs to meet the following overall demand. Figure 1 is the overall design framework of A CPMS.

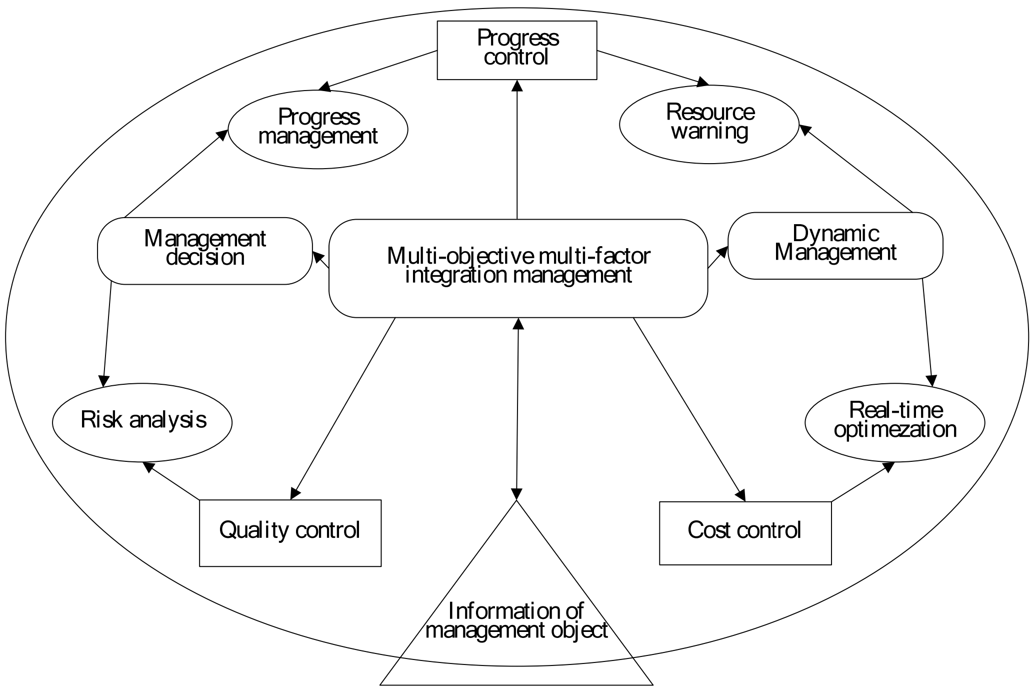

Figure 1.Overall design framework of CPMS.

(1) Conducting management of data information in the entire life cycle of the project from bidding to conclusion, including submission and confirmation of project information, bidding, contract signing, contract presentation, project planning, project production, project risk management, completion management and project evaluation after completion;

(2) Clearly defining and clarifying powers and responsibilities of various business departments: setting business processes of various functional departments in accordance with the overall framework of construction flow, achieving interconnected operation of business between different functional departments according to the logical cohesion within the flow, and meeting the system building target of "horizontal management to all sides";

(3) Connecting superior and subordinate management links covering flow of examination and approval, submission and issuance; establishing multi-stage control system in which various levels function independently but can also be connected within a task-driven mode where business processes are related; and achieving the

system building targets of “vertical control to all ends”;

(4) Conducting management of basic project business segments, forming dynamic process monitoring of the project, automatically performing and monitoring the approval process of central segments within the flow as well as automatic generation of working report, and delivering timely push of risk monitoring, real-time dynamic analysis of cost and comprehensive analysis of the project;

(5) Conducting system control with separate revenue and expenditure by setting cost management as the core and process management as the means, and realize effective combination and seamless joint between the system and other tool software.

Management organization structure. According to management structure, CPMS can be divided into rule-making layer, rule-execution layer and rule-operation layer, which is Fourth Division and the company – branch office – project department, as shown in Figure 2. In which the layer of Fourth Division and the company is responsible for strategy making, goal establishment and decision analysis; the layer of branch office is mainly responsible for decomposition and implementation of objectives and rules, overall management of the system and system application effect analysis; the layer of project department is mainly responsible for execution guarantee of objectives and rules, real feedback of information and real-time monitoring of system data entry. Through rule subsidence and real-time feedback of information, flow approval, data summarization and information transfer among different management layers can be realized.

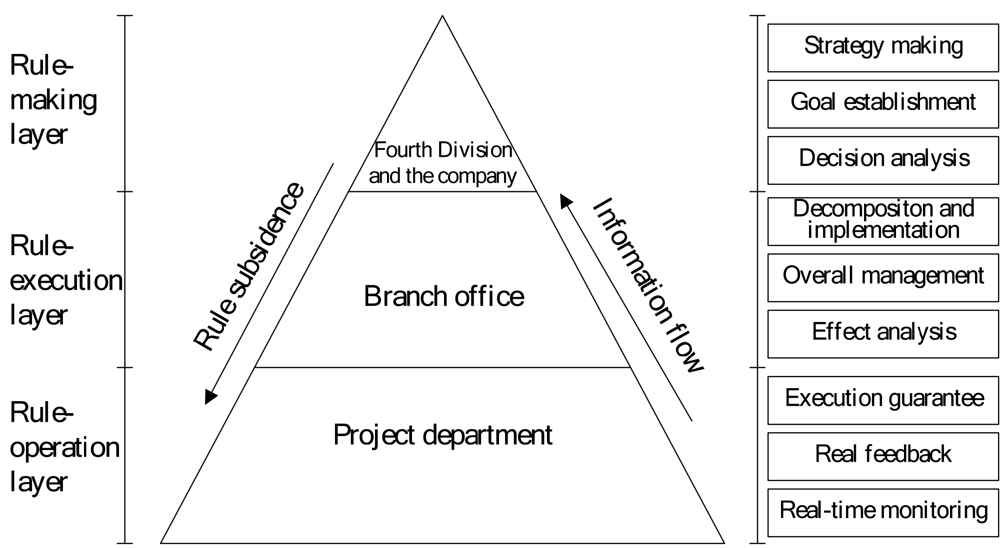

Figure 2.Management organization structure chart of CPMS.

System structure. A design mode of three-layer structure is adopted for the system, covering data access layer (DAL), business logic layer (BLL) and presentation layer (PL) from down to up. In the structure, the sub-layer serves the supper layer, as shown in Figure 3.

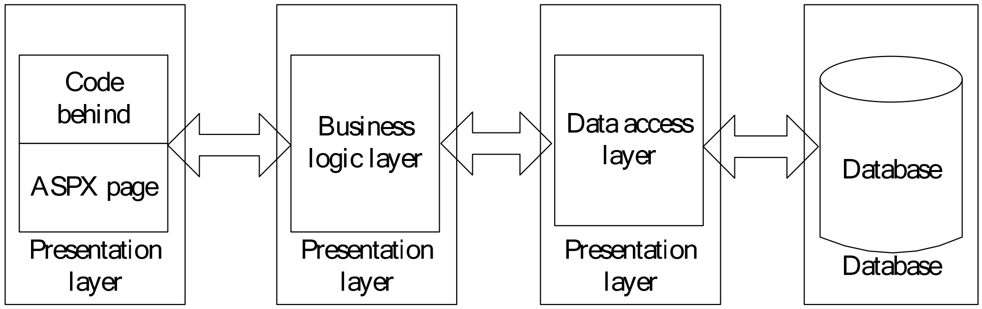

Figure 3.Logic frame of CPMS.

(1) Data access layer (DAL). This layer mainly accesses data in CPMS and the system is connected to database through this layer. SQL statement is used to operate the database.

(2) Business logic layer (BLL). Business logic layer conducts various groups of business rules according to business demands, and data can be exchange by calling access layer and data access layer via data transferring.

(3) Presentation layer (PL). Presentation layer can provide more humanized operation and friendly interface for system users, so as to help users grasp operating method of the system as soon as possible.

APPLICATION OF COMPREHENSIVE PROJECT MANAGEMENT SYSTEM (CPMS) OF CHINA CONSTRUCTION FOURTH ENGINEERING DIVISION (CCFED)

CPMS of CCFED is a system platform of realizing whole-process management that sets progress management as principal line, cost management as core, and improvement of project management as fundamental starting point. The system is composed of 21 segments including bidding management, contract management, material management and cost management. See Figure 4 for system login interface.

Figure 4.Login interface of CPMS of CCFED.

General framework of the system. Business of CPMS of CCFED mainly includes three categories of segments: economic segments, production technology segments and segments of other technology business. The system has connected relevant business relations in business detail management, such as front and back connection of project life cycle, front and back connection of business lines, horizontal connection among business lines, and connection between organization structure and upper & lower layers. Through effective detail management of business relations, fine management of enterprises and projects can be realized and the enterprise and project level can be effectively improved. See Figure 5 for business relations of the system.

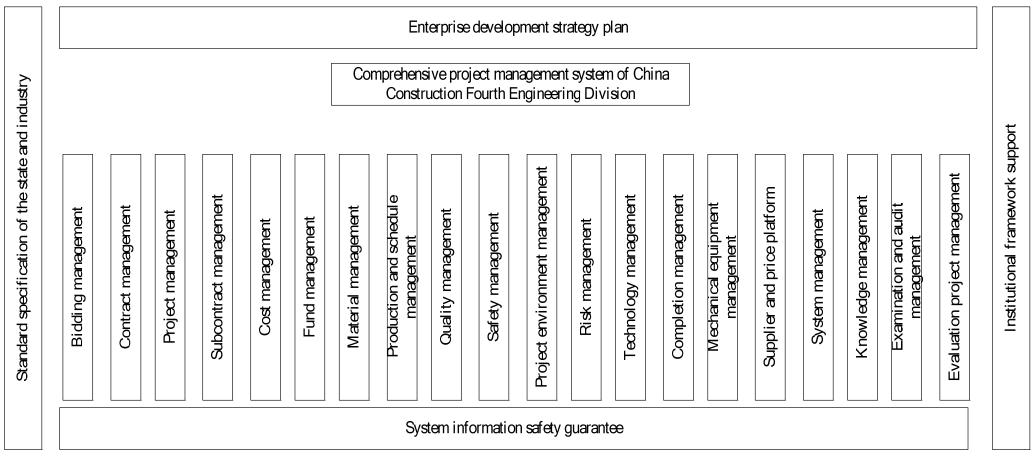

Figure 5.Overall frame diagram of CPMS of CCFED.

(1) Economic segments. Economic segments mainly includes bidding management, contract management, cost management and material management. Bidding management module is to conduct comprehensive analysis for client and market information, so as to make statistical analysis on tracking information, bidding situation and contract sighing situation of the project. In order to control the dynamic interaction between project income and expenses, statistics and analysis are made for contract sighing, performance, alteration, payment, and settlement while analysis is conducted for labor cost and labor wage issuance by taking into account of subcontract management, Real-time recording and query can be conducted for project fund preparing, planning, dealing, collection, arrival and payment through fund management module, Which exemplifies the system management thinking of “cost management as core and process management as means”. According to the system design thought of “separate revenue and expenditure”, based on four-accounting contrast (contractual income, objective responsibility cost, plan cost and actual cost), Control over economic business can be completed. Moreover, control of actual cost by construction project budgeting is realized, and dynamic management, cost overrun warning and cost penetration analysis of enterprises can be conducted for cost situations at various levels; besides, quota data can be accumulated, so as to establish and improve enterprise quota.

(2) Production technology segments. Production technology segment mainly covers production and schedule management, quality management, safety and

environment management, and technology management. Production and schedule management is analysis based on aggregate scheduling, monthly scheduling, and project schedule control point, so as to carry out construction in the optimum way by decomposing various links of construction. Quality management means to collect, analyze and manage quality information produced in the project implementation process, to record quality inspection and quality reform, and to grasp project quality and production situation in time. Safety and environment management will provide safety and environmental guarantee of construction site for the project. It can conduct dynamic tracking and management for safety check records, hidden danger rectification situation, and rectification acceptance & statistics. Moreover, it is able to effectively recognize and control environmental factors and deliver effects of environmental protection, energy conservation and emission reduction. Technology management module is mainly to manage technical work planning and technology management activities, and carry out process management for scientific and technological achievements. It can help to establish and optimize enterprise science and technology information base and improve the scientific and technical productive force of enterprises.

(3) Other business activity. Other business activity mainly includes project assessment, risk management and conclusion management. Risk management provides warning item settings for multiple businesses like contract performance, Party A's payment, fund, material consumption, cost control, schedule, quality inspection and safety as well as business functions of pushing, handling and tracking warning information. It can automatically trigger risk according to the warning conditions, inform relevant person in charge, and help the managers prevent the risk in advance. At the conclusion stage, conclusion management can provide functions like offering of records, query of completion acceptance, sort management of completion data, and automatic request of completion data, so as to satisfy the return visit management demands of the project.

System application effect. (1) Business control of construction project. With various business lines connected from the front and the back sides based on economic business, production technology business and other business activity and front and back logical relationship of various business lines formed, control of enterprises over various businesses of construction project can be conducted and three major management objectives of construction project can be reached, which means to track and query project cost, schedule and quality. Given the fact that construction projects of construction enterprises are scattered in geographical distribution, it is hard to share information between project and the company, between project and project, as well as between business and business. Besides, the collaborative work cost is high and there is information isolated island, which goes against control for various project businesses. With this system applied, company management layer and project management personnel are able to closely communicate, contact and cooperate with each other in various businesses of project management. Thus refinement, informatization and integration of construction project business control will be realized at various levels. See Figure 6 for more details.

(2) Cost control of construction project. Enterprises will carry out real-time dynamic monitoring for implementation status of the project through

system application, and cost management module applies functions like measurement, accounting, analysis, and comprehensive management based on system cost. Real-time automatic collection can be realized for dynamic cost, and dynamic analysis at company layer, branch office layer and project layer can be conducted for various costs including human, material and machine management fees. Moreover, machine account of all-around cost accounting will be provided, so as to realize cost retrospect. We can trace back to business receipts to truly grasp factors including cost generation institution, engineering position, time, resource quantity price, and handling personnel. Accuracy rate of project cost analysis will be increased and corrective actions with targets can be adopted in time. See Figure 7 for more details.

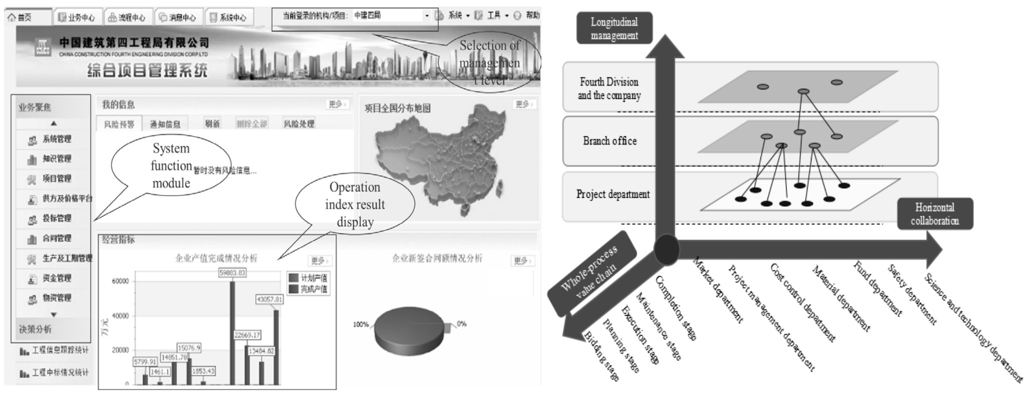

Figure 6.Chart for business control and home page interface of CPMS of CCFED.

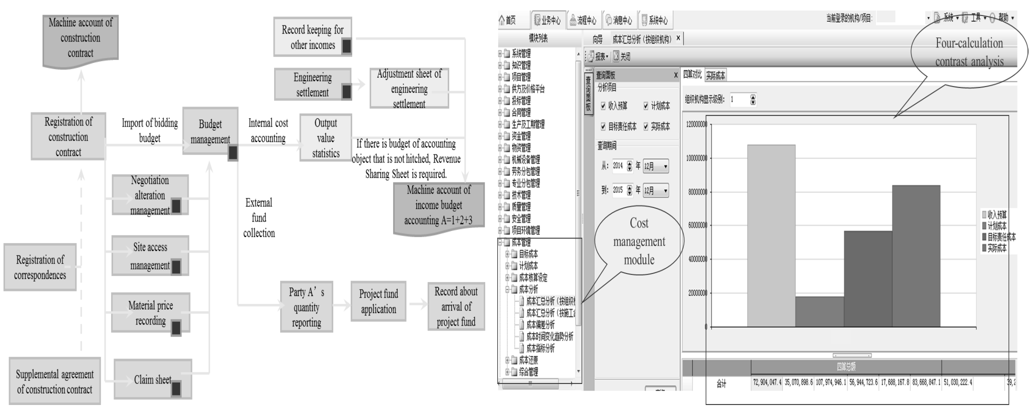

Figure 7.Chart for system income process and branch office system cost analysis of 2014.

(3) Process control of construction project. Based on business management of project full-life cycle, the system has completely reflected various business process links of project management. It goes deep into work sheet, statement, the

examination and approval flow and multi-dimensional comprehensive analysis. Through seamless joint of upstream and downstream logic in various business module processes as well as establishment of approval flow, the comprehensive application demands of project department can be met. System design is established on the basis of unified planning, overall deployment, data mining and decision support principles. A unified standard is provided on the basis of information sharing, matching between the system and management software is emphasized, and the management purpose of resource concentration, data sharing and linked cooperation is realized. At the same time, by optimizing and recombining management process, intensive management is realized. For instance, the examination and approval of special technology plan have realized collaboration management among different levels, as is shown in Figure 8.

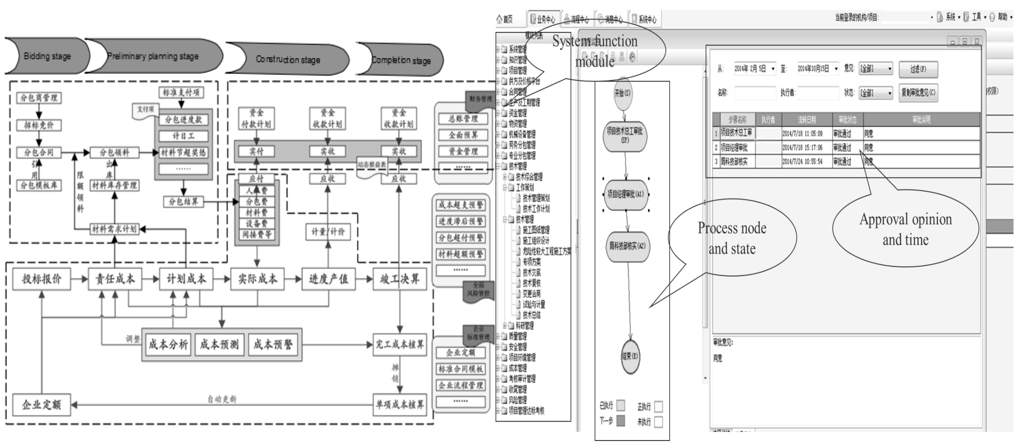

Figure 8.Core value chain management process of the system and monitoring of special technology plan approval process.

Existing problems. Application of CPMS of CCFED has made a great progress, but with continuous increase of market competition pressure, enterprises have also put forward higher and higher requirements for project management. According to the current application effect of the system and future application demands, the system still has some defects.

In company management, due to the differences in informatization cognition level, valuing degree, management foundation, and economic benefit as well as a lack of system management norm and supporting qualitative and quantitate system, regulation or method, the system has a great difference in application level and depth between branch office and project department, which will hinder the system in expression of its advantages.

At the level of project, owing to the characteristic of information barrier and field management, managers have some deviation in cognition about the system and they can hardly transform from passivity to initiative in system application meaning of the project personnel. Responsibilities of project personnel are not clear and there is a lack of corresponding incentive mechanism. Various project departments have a narrow interest concept and block their own information. As a result, system application information channel at the level of project is blocked.

In addition, due to the primary development, functions and businesses of the system have a certain limitation. Meanwhile, various functions and businesses of the system still need to be further optimized.

CONCLUSION AND PROSPECT

The application of CPMS of CCFED has helped construction project management of our company transform from traditional extensive and reporting management to refine and information management, and promoted our company to change from labor intensive enterprise to management intensive company gradually. By utilizing information technology, construction enterprises drive management innovation mechanism, conduct a standard, informationized and specialized enterprise management process, improve modern management level and modern engineering project management level, and promote normalization and intensification of modern construction enterprise management.

In the future, by collecting and analyzing the problems during the preliminary stages of the implementation and promotion process of the system, we can provide a basis for the secondary development of the system. Based on secondary development of the system, we might be able to realize functions like mobile terminal approval and flow, business intelligence, online use of seal, and online inspection. In addition, with the deepening application of the system, it will be organically integrated with OA office system, human resource management information system and BIM technology platform. Meanwhile, based on the demands of international projects, process and interface of the system will be written in English. Besides, an interface with the owner's management software can be reserved, so as to realize better resource sharing and data unification, provide good and powerful guarantee for informatization management of the project, and promote transformation and upgrading of enterprises under the big data era.

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A Study on the Behavior of Multiple Subjects in the Real Estate Development Process

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Abstract

The purpose of this study is to identify the key strategies used by economic agents during the real estate development where government's regulation and control policy introduces or not reward and punishment mechanism. Using the methods of extensive-form game and game tree, this paper analyzes economic agents' behaviors, decisions and results, thus identifies the key strategies in the process of real estate development. Results from this study indicate that while government's regulation and control policy fails to introduce the reward and punishment mechanism, most decisions made by the economic agents are in the case of local government and developers' rent-seeking; otherwise, economic agents' decision-making are under normal condition. As a consequence, to legalize the process of real estate development and help the economic agents' healthy operation, it is imperative for government's regulation and control policy to introduce reward and punishment mechanism.

INTRODUCTION

As real estate development obviously can be regarded as a kind of social situation, when research it, interaction of individuals or groups should be seen as essential elements (Adams et al. 1985; Adams et al. 1988; Adams and May 1991; Goodchild and Munton 1985). That means economic agents' decisions; outcomes and interrelationship between them should be focused when researching real estate development. However, in this case decision-making is usually a complicated process (Alexander 1985; Byrne 2003; Sorensen et al. 2004). Firstly, too many economic agents, including the government (central and local), farmer, developer, construction party, customer and commercial bank, are involved; secondly, too much complicated, the decision-making processes are. From land development and reservation to housing construction and sales, economic agents' decision-making is always influenced by their interests; besides, there is interdependency among economic agents' decisions in which the decision of one economic agent will influence or be affected by the decision of other economic agents (Samsura et al. 2010).

Due to the accelerating urbanization, short supply situation of urban land is becoming more and more serious. To meet the urban land demand, local government would not only purchase the original land of the city, but also expropriate the rural collective land to develop urban land reserve. After developing the land into construction land, local government would transfer that to the developer. Whether by bidding, auction or quotation, the land transaction price almost equals to the highest reservation price for developer. In this circumstance, developer nearly pays nothing while local government gets the largest payoff (Shen 2011; Liu and Lu 2013). However, in theory developers are independent of each other, while in reality the developer and local government will carry on rent-seeking (Pan 2010; Yu et al. 2011). In the case of rent-seeking, the infrastructure construction cost attached to land leasing price can be easily passed to customer through the price mechanism, resulting in harms of customers' interests (Wang 2006).

The game analysis on economic agents of real estate development process mainly focus on the processes of land development, land leasing, housing construction and housing sales in which there are two or three players joining this game. But this paper, based on collective decision, presents a different new analytical framework; discuss the multiple subject behavior in the real estate development process. This framework covers whole process of land development and leasing, housing construction and sales, is a game analysis with the collective as a unit.

Since the main purpose of this paper is to analyze the process of real estate development with game model, here we introduce some basic concepts of game theory, such as game, player, strategy, outcome, payoff and solution and so on.

METHODOLOGY

Game theory is the study of decision-making and equilibrium problems when economic agents interact (Myerson 1991). That is to say, when a body, like a person's or a company's behavior is affected by other people, other companies, which in turn will influence other people's or other companies' behavior. In this view, game theory can be seen as an extension of decision theory.

Since the main purpose of this paper is to analyze the process of real estate development with game model, here we introduce some basic concepts of game theory, such as game, player, strategy, outcome, payoff and solution and so on.

Game. Any game consists of two parts, a description part describing the game with details and a solution part predicting or telling the game outcomes. In game theory we describe a collective decision-making situation and try to find its solutions. Basically, three descriptive frameworks for the game are distinguished: games in strategy form, games in coalition form or characteristic form and games in extensive form. These three formats have already been constructed by Von Neumann and Morgenstern. In this paper we model the decision-making process as the game in extensive form. By this way, we can get a full figure and possible outcomes of the real estate development process structure. It is assumed that players in the game decide sequentially, like playing chess that the first player makes a move and the second responds in turn (Von and Morgenstern 1944). Thus we can structure the whole game with a game tree and this can be seen as a graphical representation of the strategic interactions of players. In Figure 1, P_1 and P_2 represent players; □ represents the start node; ○ represents decision node; ◎ represents terminal node; Alt(n) represents side branch (where players need to make a strategy or action); (U_1, U_2) represent the pay off.

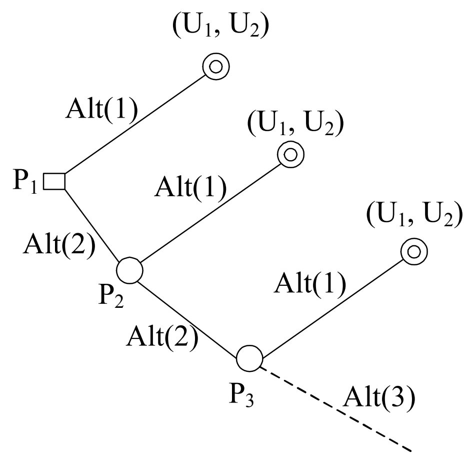

Figure 1.Game tree.

Player. In the game, players are decision makers. If a player exactly knows where he stands in the game tree, then we speak of perfect information. If a player does not know where he is in the tree and he can still estimate the probability that he is at a certain node, then we speak of imperfect information. In the latter case, the player does not know the moves made in a previous stage by other players. Players in this paper are regarded as economic agents involved in real estate development process.

Strategy. Strategy is the rules on how players act. It specifies how players respond to others' action, namely how players act in every possible situation. It is different from action, as action is the player's decision variables. Like Chinese old saying that "We will not attack unless we are attacked; if we are attacked, we will certainly counterattack" is a kind of strategy where "attack" and "counterattack" are two different kinds of action. Here the strategy specifies when to "attack" and "counterattack". All the strategies which players can choose constitute the strategy space or strategy set.

Outcome and payoff. In any game, a clear distinction has to be made between the concepts of outcome and payoff. An outcome results from the behaviors of players and a complete set of strategic choices in the game, is a result led by players collectively. Payoff of an outcome for players is what they value an outcome. In general, different players value outcomes differently and have different preferences over the set of out-comes. Players' preferences over outcomes can be represented by expected utility function and in game theory they are called payoff function (Luce and Raiffa 1957). These presumed differences in individual preferences and players' payoff function make conflict concept especially important in game theory. Thus, game theory sometimes can be called as conflict theory (Jones 2000). Payoff functions representing what player's value outcomes can be different and the outcome for a player's best can be another one's worst. Therefore the basic problem is about how to solve the different payoff functions in game.

Solution concept. There are several kinds of solution concepts in game theory. However, it is the concept of Nash Equilibrium (NE) that is certainly most frequently applied. An NE can be defined as a profile of selected strategies in which no player has an incentive to deviate from his selected strategy. The strategy selected by any player is a best response to the strategies chosen by all the other players. Hence, an NE is a kind of situation in which a player can show others his best response and a perfect strategy choice a player can choose. "Best" and "perfect" here mean that deviating from the strategy will not lead to an increase in payoff. Generally speaking, there can be multiple NEs in the games. And in theories of games in strategy form and extensive form, much attention has been paid to refinements of the NE concept. A frequently used refinement for games in extensive form with incomplete information is the notion of perfect Bayesian Nash equilibrium, which is combined with sub game perfect Nash equilibrium (SPE) of dynamic games of complete information and Bayesian Nash equilibrium of static games of incomplete information (Xie 2012). Specifically the perfect Bayesian Nash equilibrium is a combination of all players' strategies and beliefs.

ESTABLISHMENT MODEL

In this paper, we use the game in extensive form or a game tree to analyze the problem. With the solution concept, we explore the best strategy for players. Because of inconsistent ordering of players in action and information asymmetry, the game is a dynamic game of incomplete information, whose equilibrium is the perfect Bayesian Nash equilibrium.

Choosing key behavioral agents. In a broad sense, economic agents involved in real estate development process is numerous, such as government (central and local), farmer, developer, construction party, housing buyer, commercial bank, intermediary agency and pressure group and the like. But only government, developer, construction party, housing buyer and commercial bank, have a significant impact on the real estate development process. So in the following, we will focus on analysis of them.

Government is in the dominant position, is the rule maker and specific participant during real estate development process. The central government, that the country, can exert influence over real estate development process through policies like land supply policy, financial policy and tax policy etc. As real estate industry is with strong regional characteristics, the central government is policy-maker but local government is the real executor. In the local land market, local government is the real provider and executor of land.

Developer is the provider of housing product, who'd buy land from local government and then build houses by commissioning construction part and sell them to the housing buyer)in the final. It is obvious that the developer plays a key role in real estate development. Not only is the developer one of the most important economic agents, but also main interest pursuer in the market through obtaining the real estate development profits.

Construction party, who is responsible for building houses commissioned by the developer, is one of main economic agents during the real estate development process. Game relationship between construction party and developer is mainly focused on whether the latter defaults on construction cost and if the former carries actively out the construction (Li and Qian 2007).

Housing buyer is developer's important service object. Developer makes profit by selling houses to the housing buyer.

The role of commercial bank is mainly reflected in credit support for real estate development. Both the supply and demand side of building requires a lot of money to complete their transactions. Commercial bank's main fund support channel is offering loans. With that, the supply side of building, namely the developer, can solve the liquidity problems arising before the pre-sale period, such as purchase of land, building materials and workers employing etc.; and the demand side of building, namely the housing buyer, can solve the liquidity problems arising after the pre-sale period, such as the cost of housing construction, developer profits and government tax etc.

Given the commercial bank credit support plays a key role in healthy real estate development, establishing pay off functions of Game Tree should be expanded by economic agents' gains and losses. So the key economic agents we choose are: local government, developer, construction party and housing buyer.

Model assumption and parameter setting. We assume that in the game, key players that local government, developer, construction party and housing buyer can make their own rational decisions to maximize returns when they are at risk or cost minimization constraints.

Assuming that if local government doesn't seek rent with the developer, then he can gain L_1 on land leasing; when local government seeks rent, gain on land leasing is L2 and income on rent-seeking is C_1; developer obtains I_1 on loans and pay the cost C_2; in the case of rent-seeking, developer's sales revenue (housing price) is P2, or the price is P1; and the return of the loans after houses sold is I_2.According to above settings, only when $L_2+C_1<L_1$ and $P_2>P_1$, the developer will seek rent with local government. Assuming that if construction party carries actively out the construction, the full payoff he can get is M, or the developer will default on construction cost. When central government implements the regulation and control policy, C_3 is borne by local government to implement policy, C_4 is the cost if local government doesn't implement policy ($C_3>C_4$). When $L_2+C_1-C_4>L_1-C_3$, government will seek rent with the developer. In the case of introducing reward and punishment mechanism, if local government seeks rent, central government will impose "*a*" as penalty; if local government doesn't seek rent, central government will reward "*b*" as bonus. Only when $L_1-C_3+b>L_2+C_1-C_4-a$, the decision-making of economic agents can be affected and the central government's regulation and control policy is effective.

Game process. Two game models explaining government's regulation and control policy introducing or not reward and punishment mechanism are demonstrated respectively by Figure 2 and 3.The framework of these two games are the same, because in both situations economic agents can use the same strategy? However, with the introduction of reward and punishment mechanism, what player's value the outcomes during real estate development process are different. The purpose of introducing reward and punishment mechanism is to encourage economic agents to choose different strategies. Payoff function is able to show players' expect effect. Therefore, with this function, the difference between two games is obvious.

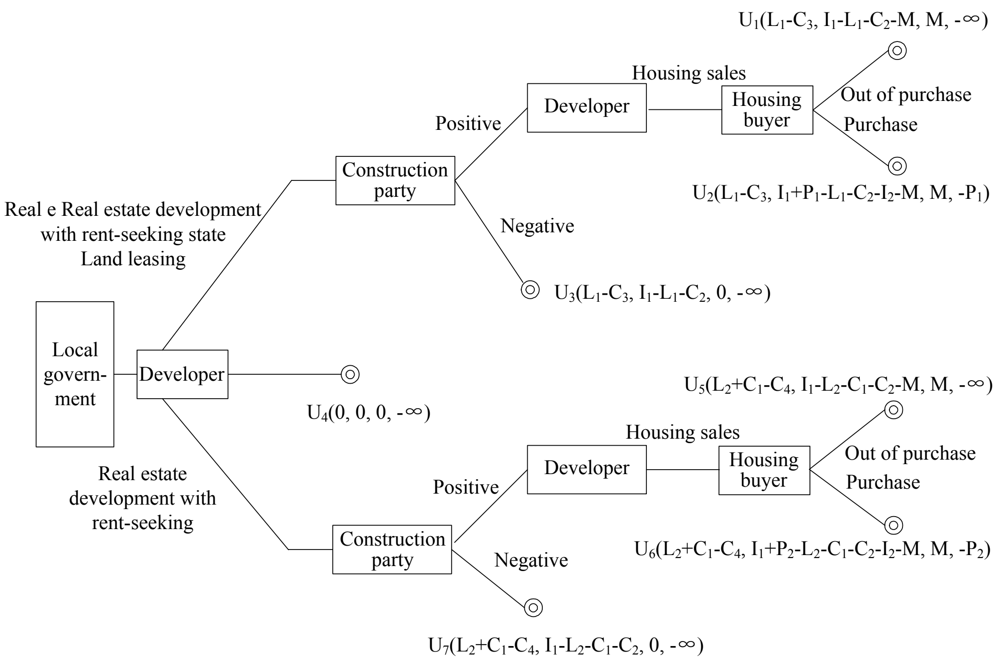

Figure 2.Game in extensive with the reward and punishment mechanism.

In this paper, local government is the initiator of the game. That means in game tree local government is the sponsor of starting node. This is because that in China local government is not only land manager, but also the real land supplier and executor. Local government supplies land for the developer through land leasing. Based on this, developer will accordingly make a respond and decide to take action. For example, facing government's land leasing, developer has an opportunity to respond on decision node to choose to buy or not to purchase the land. If the developer chooses not to purchase, then the game will end on that node; but if the developer chooses to purchase the land supplied by the local government, then there are two strategies for the developer to select: to purchase the land from local government with rent-seeking and that without rent-seeking. However, in regardless of how the developer and local government trade the land, the developer will surely develop it as long as he gets the land and the construction work will be commissioned to the construction party. On this node, construction party has to respond: carrying actively out the construction, or not. If construction party carries out the work in a negative way, then the game ends on this node. But if the work is carried out actively, developer will have the opportunity to sell the houses to housing buyer. On this node, customer's housing buyer's decision that whether buying the house or not will lead to different end points or terminal nodes as the result of the game.

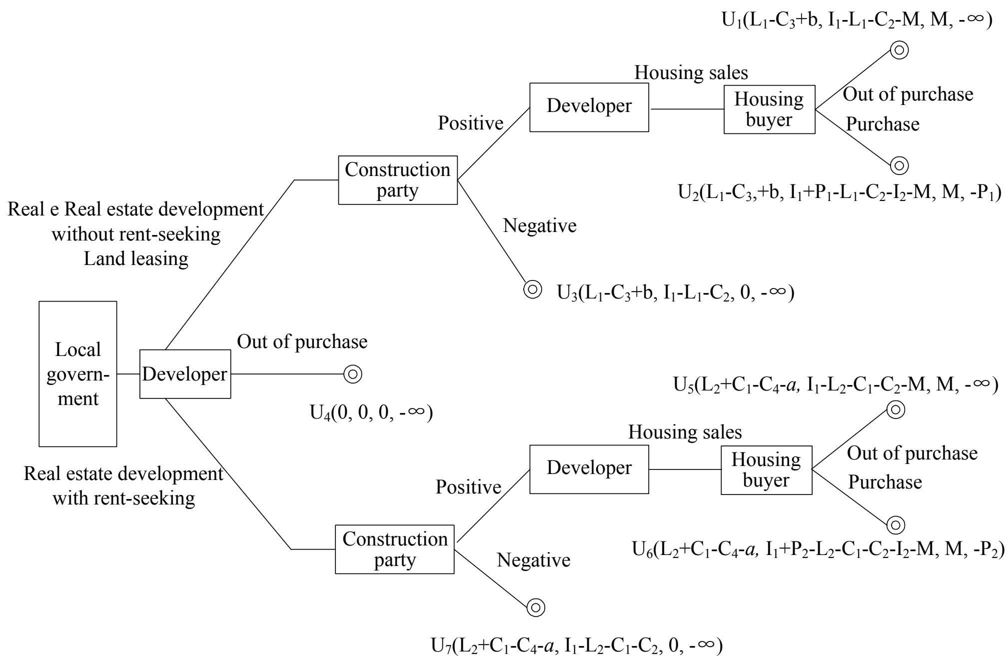

Figure 3.Game in extensive without the reward and punishment mechanism.

Result analysis. In the established game models, whether reward and punishment mechanism introduced or not, there are 7 different outcomes at which the game could end.

While government's regulation and control policy fails to introduce the reward and punishment mechanism, local government keeps treating the maximization of local interests as the first goal though it would be subject to the supervision of the central government during land leasing process. In this process, local government wouldn't get any reward or punishment whether it complies with central government's regulation policy or not. In addition, if local government and developer collaborated to form interest groups for rent-seeking activities, he can obtain a tidy profit from the developer. Therefore, at this stage, local government would most likely take the strategy of 5, 6 and 7, and the maximum payoff is $L_2+C_1-C_4$; the best strategy for developer is 6, and the maximum payoff is $I_1+P_2-L_2-C_1-C_2-I_2-M$; construction party would most likely take the strategy of 1, 2, 5 and 6, and the payoff is M; 2 is the best strategy for housing buyer, and the payoff is $-P_1$. Thus, if government's regulation and control policy fails to introduce the reward and punishment mechanism, the best strategy for local government and developer is to conduct rent-seeking activities. In this case, both local government and developer can get the maximum interests; while construction party carries actively out the construction and housing buyer purchases the house as local government and developer don't take rent-seeking activities.

Table 1 shows each player's maximum payoff and the achieved perfect Bayesian Nash equilibrium with government's regulation and control policy not introducing the reward and punishment mechanism.

Table 1.The Bayesian Nash Equilibrium without the Mechanism.

Behavioral agents	Result number	Payoff
Local government	5,6,7	$L_2+C_1-C_4$
Developers	6	$I_1+P_2-L_2-C_1-C_2-I_2-M$
Construction side	1,2,5,6	M
Housing buyer	2	$-P_1$
Nash equilibrium	6	$(L_2+C_1-C_4,I_1+P_2-L_2-C_1-C_2-I_2-M, M, -P_2)$

While government's regulation and control policy introducing reward and punishment mechanism introducing reward and punishment mechanism, local government, facing the pressure of being punished by the central government, wouldn't take risks collaborating with developer to form interest groups for rent-seeking activities during land leasing process. In addition, local government can obtain incentives from the central government as well political reputation and social capital if it can impartially manage the land transaction relationship with the developer. Thus in this case, the best strategy local government wills most likely take is 1, 2 and 3, and the maximum payoff is L_1-C_3+b. The best strategy for developer is to abide by the market rules, which means not taking rent-seeking activities with local government and positively responding to the political strategy. Result 2 is the best strategy showing that the developer prefers not taking rent-seeking strategy. Here his maximum payoff is $I_1+P_1-L_1-C_2-I_2-M$, while the optimal strategy for construction party is still 1, 2, 5 and 6 and the payoff is M. The strategy housing buyer most willingly takes is still 2 and the payoff is $-P_1$. Therefore, with introducing reward and punishment mechanism, the rent-seeking behavior between local government and developer won't exist, and the construction party will work actively as well the housing buyer is willing to purchase the house.

Table 2 shows each player's maximum payoff and the achieved perfect Bayesian Nash equilibrium with government's regulation and control policy introducing the reward and punishment mechanism.

Table 2.The Bayesian Nash Equilibrium with the Mechanism.

Behavioral agents	Result number	Payoff
Local government	1,2,3	L_1-C_3+b
Developers	2	$I_1+P_1-L_1-C_2-I_2-M$
Construction side	1,2,5,6	M
Housing buyer	2	$-P_1$
Nash equilibrium	2	$(L_1-C^3+b, I_1+P_1-L_1-C_2-I_2-M, M, -P_1)$

From the above analysis we can know that in these two cases where government's regulation and control policy introduces or not reward and punishment mechanism, the optimal strategies for local government and developer are changed. With introduction of the mechanism, local government will justly lease the land to the developer and the developer is able to purchase land abiding by the law then sell the house at a reasonable price to the housing buyer). For the housing buyer, the optimal strategy in both cases is purchasing the house without government and developer's rent-seeking. As with rent-seeking, the developer will transfer partial costs in housing price to the housing buyer, resulting in unreasonable prices rise which harms housing buyer's interests. Meanwhile, construction party's strategy also keeps the same that carrying actively out the construction. For a developer, who pursues maximum profits, it is very difficult to make timely payments to the construction party in one-time game. Usually he would use the funds to do other investments to obtain additional profits, thereby defaulting on construction cost. In addition, when the housing buyer chooses not buy the house, there is a moral hazard that defaulting for the developer. So there's no doubt that central government has to take appropriate measures to prevent some economic agents' disorderly operation.

CONCLUSIONS

Local government, developer, construction party and housing buyer are the key economic agents in real estate development process. As with local government and developers rent-seeking, housing buyer has to buy the house without choosing his optimal strategy. This indicates that whether central government's regulation and control policy introduces the mechanism or not) will influence economic agents' decision-making. Therefore, it is necessary for government's regulation and control policy to introduce the reward and punishment mechanism to correctly guide the economic agents' behaviors. Firstly, the central government should strengthen the macro monitoring and warning system, take a long-term follow-up examination to ensure the legitimacy of land transactions. Secondly, local government should be endowed with the executive power of land supply, and a well-defined reward & punishment standard to guide the behaviors. In order to strengthen the constraints on local government, it is a must to establish an accountability mechanism to discipline local officials who are against the macro-control with "local policies". Finally, the method of rent-seeking recognition should be identified to regulate local government and developer's behaviors, thus to legalize the process of real estate development and help the economic agents' healthy operation.

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Applying Policy Network Theory to the Decision Making Process of the Three Gorges Dam Project

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Abstract

Policy networks theory has been used a lot to analyze concrete policy in western countries and many Chinese scholars also try to interpret policy networks theory. Till now, most of the Chinese scholars focus on how policy network was organized and what's the function of those actors. There is less research about how the actors' interaction process affects the policy outcomes. The authors regard policy network as a multi-actor game, policy making process is the process that actors keep on interacting with each other. They use the Three Gorges Dam project as a case; to analyze the whole policy making process and they try to find what factors affect the actors decision and why it take so long to make the final decision. The authors conclude that besides external factors, like war, culture revolution, two other major factors inside the policy networks cause the delay of the decision making process.

INTRODUCTION

In recent decades, the economic level of China has developed at an unbelievable speed. Part of reasons is the fast development of large infrastructure. Western observers tend to see the reason of the fast development as that the political power and decision making process are very centralized (Groenleer et al. 2012). In practice, however, not all large infrastructures went smoothly as many expected in the centralized context. It took 73 years for the Three Gorges Dam (TGD) project plan to be finally demonstrated since the first idea of the project was initiated by Sun Yat-sen. It is the largest dam project in China, as well as in the world. And thus, this paper tried to explore why this dam project has a delay as long as 73 years by applying the policy network theory. It is obvious that policy network theory is one of the useful methods to analyze the decision making process in the academic field. Since China is a very centralized country, many western scholars wonder whether the network theory can be efficiently used to analyze the decision making process in the Chinese special context. This paper aims to analyze what factors caused the delay of the decision making process of the TGD project by apply the policy network theory. It consists of three major parts. First, the motivation of this research and the background of the TGD project are given. Second, the theoretical background about network theory is summarized. Third, policy network theory is applied to analyze the selected case and the conflicts between different actors are clearly analyzed based on their interests and power. Finally, the conclusions are drawn based on the above analysis and recommendations for the future similar projects in China.

Background about the TGD project. The Three Gorges Dam (TGD) project is located in Yichang, Hubei province of China. It spans along the Yangtze River and is the largest hydroelectric dam in the world, with the installed capacity of 22,500 Mw. This project serves for two major goals: electricity generation and flood management. Besides that, it also increases the shipping capability along the Yangtze River. What makes the TGD project interesting is not only about its scale but also its high controversy. Actually it is the most controversial project in China, as well as in the whole world. On the one hand, it has a significantly positive influence on the whole country in terms of electricity generation, economy, flood management, etc; on the other hand, it has caused some disaster to the local ecological system and other potential disasters, like earthquake, at least many scholars think that cause them.

Flood control and management has been a very important issue for several thousand years. To solve the problem, Sun Yat-sen, the founder of the Nationalist Party, first came up with idea of constructing a large dam along Yangtze River in 1919 (Shu 2007). In 1944, the Water Resources Committee of China invited American dam expert Savage to do field research at the Three Gorges, and one preliminary report was drafted by him. In 1946, the agreement was signed between China and American counterpart to jointly design and construct the dam project. Due to economic and political reasons, the agreement was dropped in 1947. After 1949, the idea was recall again, till 1992 the Three Gorges Dam was finally passed on National People’s Congress.

Policy network as a multi-actor game. According to the policy network theory, the real-world decision making process involving different actors has many characteristics. Primarily these characteristics can be summarized as a multi-actor game, that is, “a series of interactions among actors focused on influencing public decision making on certain issues or on the implementation of policies” (Alison 1971). In this multi-actor game, different actors with different interests are involved in the decision making process. They interact with each other at different arenas and the whole decision making process involved in different rounds, marked by the breakthroughs and impasses (Teisman 1992; Teisman 2000). The interactions at different arenas between different actors can be in any formal or informal form. With the development of the decision making process, the relations between different actors become more complex and important with more and more interactions. The stable relations developed in the decision making process is known as the "network". Due to the game characteristics of the policy network, the decision making process does not involve smoothly but nonlinearly in many rounds. These rounds are characterized by the impasses and breakthroughs. The nature of whole decision making process in different rounds is erratic and slow. Due to the erratic nature of the policy network, the outcome of the decision making process is a joint one, which is not the best result but can still be accepted for every actor. Every actor compromises to some extent and uses its own power and resources efficiently to maximum their interests. In other words, the outcome is a trade-off and best practical result for every actor and it will not be the same if anyone can make the decision only by its own (Groenleer et al. 2012).

The network has many implications about how the government can operate in a case like TGD project. Hierarchical intervention from the central government is neither practical nor efficient because it lacks the cooperation and compliance of other actors. This naturally links to a concept, process-based decision making. It stresses the importance of the collaboration of other actors. By contrast, the project-based decision making relied on control and command strategies is not as successful as the process-based one.

THE DECISION MAKING ROUNDS OF THE TGD

The decision making process of the TGD project is summarized in different phases based on rounds model.

Round 1-Initiate of the construction of the TGD project. Flood has been a big issue in the long Chinese history. After the independence of the People's Republic of China, the Chinese government paid special attention to the flood control and management. Especially the flood in 1949 and 1954 (Fearnside 1988; Dai 1994), Mao Zedong wanted to control the flood in the lower regions of Yangtze River and urged that a big dam should be built to prevent potential disasters caused by the flood in the future. From 1955, the feasibility of the TGD project was investigated at the requirement of Mao. At that time, the experts from Soviet Union were invited to be involved in the research. However, there was a disagreement between Lin YiShan, the office head of the Ministry of Water and Li Rui from the Ministry of Electricity. Lin proposed to build a dam as high as 250 meters, setting the flood control as the major goal. Li, however, doubted the flood control ability and applicability of a big dam like that and preferred the construction of several small dams, which were also better for the electricity quality and flood control at that time. The debate between these two leading persons went on until a meeting was held in 1958 by the Central committee. In that meeting, the suggestion to construct the TGD was made. However, the great Chinese Famine occurred in the first half of 1960, which postponed the construction plan. Unfortunately, the deteriorating relationship with the Soviet Union and the occurrence of "cultural revolution" made the plan fail again (Sutton 2004).

Round 2-Discuss the TGD project. In 1979, the TGD project was put on the agenda again to meet the increasing demand of the electricity (Jackson 2000). Sandouping was officially chosen as the location for the dam by the Yangtze Valley Planning Office (later name is Yangtze Water Committee) the same year. After that time, the economic level increased significantly due to the economic reform policy introduced by Deng Xiaoping. He urged to proceed with the construction plan of the TGD project. The construction of a dam with the height of 175m was approved by the state council based on the first feasibility study conducted by the Yangtze Valley Planning Office in 1983 (Barber 1993). A more detailed and reliable feasibility study was asked by the local government bodies in 1984, like the Municipality of Chongqing. However, there were critics from both domestic and international voices. More environmental concerns were mentioned by scholars. Furthermore, some serious technical problems were reported by the Chinese People's Political Consultative Committee (Barber 1993). During that period, the main debate was whether to construct the TGD project or not; or to construct it earlier or later. The State Council noticed the disagreement and decided to make the discussion further.

Round 3-Demonstrate the feasibility of the TGD project. In 1986 the Central Committee and the State Council published a policy about demonstrations of the TGD project. An organization was set up as the Three Gorges Leadership Small group to lead the work of demonstration. At the same time more than 400 specialists were invited by the Ministry of Water and Electricity (Integrate Ministry of Water and Ministry of Electricity) and they were divided into 14 groups to demonstrate the feasibility of the TGD project from technical, economic and timing perspective. Universities, academics, exploration institute, design institute also applied for relative research program. Till Nov. 1988, all the demonstration work had finished. Among them, 9 demonstration reports passed without any disagreement and 5 demonstration reports had some disagreements which focus on ecology, environmental protection, preventing flooding and overall economic evaluation among the specialists. The Yangtze Water Committee rewrote a "second" report and suggested that the TGD project was both technically and economically feasible. During this period, democratic party members, non-party members, commissioners of Central People Political Conclusive Conference made many field investigations and gave good suggestions about the TGD project. In July 1990 a Censorship Committee was organized by the State Council. It consist 163 specialist and 63% of them were the first time to participate in the demonstration work. In August 1991 the Censorship Committee made final demonstration report and claimed that the TGD project was necessary, technological feasible, economic reasonable. New wave of critics came again because of the book *Yangtze! Yangtze!* by Dai Qing. Nonetheless, those opposing the project were excluded from the Three Gorges Project censorship committee (Ponseti and López-Pujol 2006). The final demonstration report was proved by Standing Committee of the State Council and finally legalized by the fifth session of the seventh National People's Congress with 1767 deputies agree, 172 oppose and 664 abstention vote.

MAJOR ACTOR AND FOUR MAJOR ARENAS

The major actors involved in the TGD project will be analyzed in terms of their interest, resources and power as shown in Table 1. Primarily the actors can be divided into two groups, one supporting the TGD project and one against it. The actors' power can be divided into three types, production power, supporting power and blocking power. Production power will directly influence the policy decision, supporting power will not directly influence the policy decision, but they can show their positive attitude, blocking power here means that the actors can show their negative attitude.

Table 1.Interests, Resources and Power of the Involved Actors.

Actors	Major Interests	Resource and Power
The Central Government	Construction of dam; Gaining public acceptance	Authority of the country; Production power.
Ministry of Water /Minister Lin as representative	Flood control; Proposing a larger dam.	Expertise knowledge; Production power.
Ministry of Electricity/ Minister Li as representative	Adequate supply of electricity; Against one large dam.	Expertise knowledge; Blocking Power.
Ministry of Water and Electricity	Flood control and produce electricity	Authority of its own area; Production power
Yangtze Water Committee	Implementation of the construction	Legal position; Production Power.
Specialist (support)	Beneficial to the countries development	Support; Knowledge; Supporting Power.
Specialist (oppose)	Protection of the environment	Protests; Knowledge; Blocking Power.
Local government	Maximize local benefits	Local authority; Supporting or Blocking power.

These actors interact in four major arenas (Zheng 2010). They are feasibility arena, population resettlement arena, environment arena, dam size arena.

Feasibility arena. Even though many dam had been constructed, there was no experience of constructing a huge dam like the TGD. The core issue in this arena is whether it is technically and economically feasible to construct the TGD. The technological feasibility is mainly about whether it can prevent flooding, how to solve siltation problems, can we produce such big hydroelectric generating sets, etc. Economic feasibility is mainly about whether our country has enough finance capacity, whether we can produce electricity by other ways instead of constructing such big dam, how much money will be paid to solve problems causing by the construction. This arena happened throughout the whole decision making process.

Population resettlement arena. The construction of TGD project will cause huge scale of population resettlement, roughly estimated there would be 1.2 million local residents affected. Where to resettle those populations, the inundated area causes less cultivated land and how to get enough plantation for immigrants to plant, what the immigrants make living for and how to compensate for them. Provincial governments will have to solve these problems by following the instructions from the central government, but still tried to maximize their own interests.

Environment arena. The major actors involved in this arena are the environmentalists and independent specialists. They questioned the need to construct a huge dam like the TGD when it can cause potential environment disasters: modification to the physical environments, influence on the rivers and marine system, cultural heritage in the inundated area and tourism, etc (Shu 2007).

Dam size and water height arena. The major debate in the dam size arena at earlier stage is the need to build a huge dam or small dam. The Ministry of Water prefer a huge dam like the TGD to achieve the goal of flood control, while the Ministry of Electricity proposed to build several small dams, taking the electricity quality into account. Later the discussion focus on water height, different water storage height can cause different influence and what kind of water height is the best choice.

FACTORS THAT AFFECT THE POLICY MAKING PROCESS

China is a centralized country and normally the government is very efficient in policy making. That is why China develops so quickly after 1980s because the government can motivate and distribute social resources to realize its goals. There is no other project except TGD that takes so long to decide. According to the Network theory, the following factors can cause the delay of the policy making process.

Actors perception about certain issue. In policy networks, the involved actors have different perceptions about certain issue. Because the rational limitation of human beings, actors cannot get all the knowledge to know the nature of things, find solutions, predict the effects of problems, which cause the uncertainty of perceptions. Diverging perceptions and knowledge conflicts may cause “dialogues of the deaf” (Van-Eeten 1999) where the actors talk to each other but don’t listen to each other. TGD project is such a huge project, there are fewer experiences the actors can track, and all they can do is to use the limited knowledge to demonstrate the program. Because the project is so important to the country, the central government tries to involve as many actors as possible. The actors who support the project and those who oppose the project are both strong. None of them can give clear information and persuade the other side to accept what they have said.

Strategic behavior of different actors. In the policy network, different actors, with different resources power and interest, try to behave strategically to maximize their own interests. The strategic behaviors lead to extensive interactions at different arenas in different rounds, which results in the delay of the decision making process naturally.

In the first round, the major debate was between Lin and Li. Note that the debate was not restricted to the two persons, but they two were the two representative figures. Mao with the personal preference for the TGD played the role of the referee between them. They both used the technique of "issue framing" and tried to label the problem for their own interests. For example, Lin tried to label the flood as the core problem, and thus, a huge dam was needed while Li tried to label the problem in a broad context, taking more concerns, like the electricity quality and environment issues, into account.

In the second round, the construction of the TGD has become more urgent because the electricity shortage problem due to the economic recovery from the Cultural Revolution. However, the Ministry of Water and the Ministry of Electricity still had different preferences for the dam size and height. To solve the conflict between them, the central government acted strategically and merged these two ministries into one new Ministry and elevated those supporting the construction into high positions in the new Ministry. At the same time, the different provincial government bodies interacted with each other in the local interest arena. To solve the stagnation in this arena, the central government tried to create a new province "Sanxia" and promised to give some compensation to Sichuan province, the loser of this game. But later, central government gave up.

In the third round, the opponents against the TGD project used the tool of "negotiated knowledge" to question the reliability of the reports that demonstrated the plan of the TGD project. This forced the central government to do more feasibility studies again and again, which delayed the decision making process. Furthermore, most of the participants in the final voting for the TGD project in the government were the supporters, which indicate an employer-employee relationship. Even though the central government finally managed to make the final decision to construct the TGD, the public acceptance of the project and the trust on the central government was damaged to some extent.

CONCLUSIONS

This paper tries to use the policy network theory to investigate the decision making process of the TGD project. In general, we can say that the policy network theory is suitable for the analysis of the decision making process of the selected case. The major actors and the interaction between them are identified. Besides external factors, like war, culture revolution, two other major factors inside the policy networks are identified to cause the delay of the decision making process. The first one is the perception difference of different actors, which leads to the "dialogues of the deaf" and the actors cannot reach an agreement, let alone to take concerted action. The second one is the strategic behaviors of different actors, which leads to extensive interactions at different arenas in different rounds between the proponents and opponents. The tool of issue framing has been adopted by both groups. The central government achieved its primary goal of the construction of the Three Gorges Dam project, but the public acceptance and trust on the central government were damaged due to the fact that the opponents were not treated equally as the proponents. Even though the network theory can successfully describe the decision making process of the TGD project, it seems that the power imbalance between the proponents and opponents and the proponents had too much power compared with that of the opponents. The influence of the opponents was still quite limited.

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Effects of Relationship and Contract Governance on Construction Project Performance: Review and Prospects

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Abstract

The techniques and tools from traditional project management theory, which are prompted to enhance project performance are not as that they were before. Project governance has gradually become a new important approach to improve project performance. Many research have been conducted for project governance from different perspectives. This paper reviews and summarizes the existing literatures. Then discussion is made from three aspects: contractual governance, relational governance and the relationship between them. The definition of key concepts, research methods and the limits in existing literatures is listed out especially. Future research direction is suggested finally. The studies in China are mentioned specially. Because China has a very large scale of construction market and the relation is a very important factor that must be considered during project stages.

INTRODUCTION

Project governance has gradually attracted researchers' interesting in construction project management in recent years. There are so many studies about project governance that even form a project governance boom (Patel 2007). The project governance based on the institution-level gradually become a new way to improve project performance (Winch 1989; Winch 2001; Du and Yin 2012). Relational governance and contractual governance have become an indispensable part of project governance for their remarkable impacts on project performance (Yin et. al. 2011; Badawi 2009). From the perspective of economics, the project is a temporary contractual organization that the contracting is formed in the market legally (Yan and Zhao 2005). Formal contracts can improve project performance successfully through a strict mechanism that distributes the responsibilities, profit and rights to all parties of the project. This contract can also decrease the exchange risk, such as uncertainty, complexity and asset specificity, which may lead to reduction on transaction cost (Ruuska et al. 2011; Zheng et al. 2008; Yin et al. 2011). According to sociological analysis, project, embedded in their social network, will be affected by corresponding relational rules (Deng and Mao 2008; Poppo and Zenger 2002; Griffith and Myers 2005). For example, trust among parties can cut down the transaction cost significantly by mitigating project risk of uncertainty, complexity and asset specificity (Ho et al. 2009; Maurer 2010; Eric and Jessica 2006; Laan et al. 2012). Therefore, the function of these relational rules is called relational governance (Chen 2004; Brown et al. 2000). The relational governance and contractual governance not only have a close relationship during project stages (Zheng et al. 2008; Poppo and Zenger 2002; Maurer 2010; Eric and Jessica 2006; Marjolein et al. 2012), they also make a joint effect on project performance (Yin et al. 2011).

The following questions must to be considered when improving project performance through project governance mechanisms: What happens to the closely connected relational governance and contractual governance when the project is progressing gradually? How they influenced each other what's the impact of their relationship on project performance?

Researches on project governance are always from several perspectives, such as, TCE, Principal-Agent Theory, Property Right Theory, RBV, Contract Theory, and Social Network, etc. Based on the existing literatures, this paper reviews and discusses the contractual governance, relational governance and their relationship. Especially, the definitions of key concepts, research methods and the limits are analyzed. The possible research directions in future are also discussed at the end of this paper.

CONTRACTUAL GOVERNANCE

Early project governance research focused on the different project exchange attributes and related governance mechanisms analysis under TCE heuristic-model. Researchers found the uncertainty, complexity and asset specificity in construction exchanges, and argued their meanings, forms and influences on the selection of project governance mechanisms. Eccles (1981) claimed that technology uncertainty during construction exchange was the key attribute for owner selecting integrated governance structure to reduce the transaction cost and lower the implications of construction technology uncertainty. According to the data from the shipbuilding project, Masten et al. (1991) proved that the time specificity was the key factor affecting the project-based-organization to choose the business pattern. He innovatively identified the asset specificity, as the time specificity, is immateriality and is not one of the traditional forms advanced by Williamson (1985). Turner and Simister (2001) argued that the uncertainty of the products and process can affect the selection of the contract pricing terms. By systematic analysis on the assets specificity during project exchange, Chang and Graham (2007) suggested that financial protection, such as performance bonds and patent company guarantees, and contractual protection, such as damage clause and the reward for early completion are all responses to the hazards of the opportunism bring by the temporary specificity during construction exchanges. They defined these asset specificities as the process specificity and proved the level of them was decided by the amount of owner's loss when the construction project transaction was break. It's also found that researchers' attention pay on project contractual governance is earlier than that on the relational governance.

In China, researches also began with contractual governance study (formal governance mechanism). Yan et al. (2004) proposed the concept of project governance and this concept became the foundation of Yin and Du (2010) works about public project governance and project performance improvement. Ding et al. (2012) built a P-R4 model, where P meant process, R4 meant project stakeholders' requirements (1R), the governance roles (2R), the risks of governance roles (3R) and the relationships of governance roles (4R). Their samples were some science research projects which are funded by government. Sha (2011) and Sha (2013) set up a 4C model regarding to construction project governance based on the construction project vertical and horizontal governance structure proposed by Winch (2001). In their model, 4C refers to Client, Conception, Construction and Controllers. Sha (2013) considered that TCE and Principal-agent Theory should be used to explain vertical governance structure. The collaboration and competition theory should be used to explain horizontal governance structure. Besides the scientific achievements mentioned above, there are also many other studies in this field.

RELATIONAL GOVERNANCE

Projects are embedded in their current social network, where the corresponding relational rules would take effect. Rational norms include social process and social rules. Social process includes social interaction and information exchange. While social norms include trust, solidarity, flexibility and so on. Flexibility can enhance the adaptability to the contingence in future. Solidarity can help to establish and adjust the relationship of the parties to act in concert. Information exchange enables both sides like to share private information about relevant plans and goals as they can solve the problems and adjust the plan efficiently (Griffith and Myers 2005). With the increasing of the mutual understanding and trust among the parties, they will adopt more mutually cooperation behaviors (Poppo and Zenger 2002). When the rules are decided and building among the parties, more attention will be paid on long-term benefits. The short-term opportunism behaviors will be reduced. As a result, the transaction cost will also be cut down (Adler 2001). With the data from off shoring software which is outsourced from Japanese clients, Deng and Mao (2008) proved that some important relational norms, such as communication, trust, and inter-firm adaptation, were expected to play a significant role for the outsourcing success of off shoring software.

It can be found that relational norms change with time and situation in different relational exchanges. In some cases even the contract type is same, relational norms are different because of its current social economic environment, phases and even individuals that involved in the project (Ring et al. 1992). In fact, relational norms is dynamic and diverse. As a key factor in relational norm, trust has been studied by many Chinese researcher in project management. Jiang et al. (2011) established an integral model which included the antecedents of trust, trust and project success. They discussed trust in project from the owner point of view and confirmed trust played an important role for project success. Moreover, based on the trust studies of PPP project, Du and Wan (2012) and Du and Yan (2013) proposed four dynamic attributes of trust, which included trust level, trust dimension, trust driving factor and trust transmission. And they also pointed out that the key to strengthen and keep trust are a high level of initial trust and the identification of trust driving factors. Based on a study about the inter-firm relationship in a project, Yang and Shuai (2011) indicated that trust during project exchanges, including competence trust, *guanxi* trust and intuitive trust, would be influenced by personal ties, geography and relatives.

Although researchers have paid more attention on trust, no final conclusion can be drawn regarding to the relationship between trust and relational governance (Sun and Yu 2010). Few research focused on whether trust is one part of the relational norms or the medium variable between relational norms and transaction performance. Some researchers even use trust as a governance mechanism in their empirical studies (Eric and Jessica 2006). Based on the study of a lot of classic papers, Goles (2001) found out that trust, information exchange and flexibility were three wildly used norms. Researchers often use these relational norms or social norms as indicators of relational governance in their empirical studies (Chen 2004; Brown et al. 2000).

According to the relevant empirical studies on relational governance, it can be found that when measuring relational governance, researchers prefer to discuss the relational governance under two dimensions, the internal rules and external behaviors (Chen 2012). Internal rules include trust, information exchange, and flexibility etc. While external behaviors include joint-problem solving (Claro et al. 2003; Heide and John 1990), collaboration, goals and plans sharing, conflict resolving, focused relationship and power restraint (Fink 2009). Internal rules are prone to rigid and need continued adjustment on external behavior to make up the flaws in internal rules and to preserve the flexibility of relational governance (Grandori 2006). Hence, study on the operation mechanism of internal rules and external behaviors is an important problem for further researches in relational governance (Chen 2012).

THE RELATIONSHIP BETWEENCONTRACTUAL GOVERNANCEAND RELATIONAL GOERNANCE

Because of the exchange relationship's social embeddedness character, it seemed that relational governance must be involved in contractual governance researches. But until 2002, when Poppo and Zeeger (2002) used the data from information service industry to study the impact of relational governance and contractual governance on transaction performance, empirical researches concerning relational governance and contractual governance started to emerge constantly. Expect the significant conclusions by Poppo and Zeeger (2002), they also developed an important guide and a basic model for relational governance and contractual governance research. This model has been used to many kinds of transaction environment soon.

After the important work by Poppo and Zeeger, some representative researches in the field of project governance, which include both relational and contractual governance, have been done. According to the data from 122 ERP projects, Eric and Jessica (2006) discovered that under the effect of uncertainty and relationship specific investment, four mechanisms, which were explicit contract, implicit contract, reputation and trust, formed a balance of governance. And this governance balance had an obvious positive correlation with project success. Based on the data from 300 PPP projects, Smyth and Edkins (2007) suggested that project performance can be improved by strengthening relational governance when trust was lack among the participants. Miller and Hobb (2005) demonstrated that a combination of appropriate governance mechanisms was needed for different phases of the project.

Based on the data from projects in China, Liang found that project performance reached its peak in a composite governance mechanism when the levels of contractual governance and relational governance are high. The research conducted by Xie and Chen (2013) indicated that relational governance had a more remarkable positive effect than contractual governance on customer satisfaction and other traditional performance indicators of project performance. Nevertheless, when consider improvement, innovation and organization growth, relational governance had a significant positive influence, while contractual governance had a negative influence.

With more researches about project governance, a new direction and perspective emerged based on the paradigm of sociological research. It is establishing a two-dimension (relational governance and contractual governance) theoretical framework and integrating it into the public project governance paradigm. Now researches on project governance leaning towards relational governance mechanism and contractual governance mechanism are a sign of a deep understanding of project.

If the study conducted by Poppo and Zeeger (2002) is a good example of using cross-sectional-data to study relational governance and contractual governance, the work conducted by Klein et al. (2005) should be another good example of employing longitudinal study method to analyze relational governance and contractual governance. Klein et al. (2005) pointed out that most of the current researches succeed in displaying the relationship between relational governance and contractual governance by study on representative data, but they failed to demonstrate why it existed and how it evolved and developed. Following Klein et al.'s work, Zheng et al. (2008) studied two PPP-project-based cases, they argued in an explorative way that during the project execution, relational governance and contractual governance complemented each other dynamically and accumulated in pace of the project unfolded. Compared to contractual governance, relational governance accumulated more slowly and was more susceptible to emergency events. The research also indicated that both two governance mechanisms have a positive impact on project performance (Zheng et al. 2008). In the field of project governance, current literatures show that high level of trust or trust-based relational governance has a significant effect on project performance improving. In this case, it is important to figure out which factors or by what means can promote the level of trust among the parties during project execution. Maurer (2010) found that complicated procurements, a stable team and an appropriate rewarding mechanism can help trust forming easier. Laan et al. (2011) also proved that the initial cooperating experience, cooperating expectation, the bidding process and contract selection had an enormous influence on trust between contractors and owners. However, the bidding process and project delivery system had an obvious effect on contractors' trust formation rather than owners' trust formation.

Although in the field of construction project, there are few evidences indicated that relational governance and contractual governance are substituted to each other, in the field of management science, there is "a foundational disagreement" (Lane 1998) on the relationship between relational governance and contractual governance. One of the two points of "complementary" and "substitution" has a great number of supports and empirical evidences (Poppo and Zeeger 2002). Researches in favor of "substitution" insist that contract, as a sign of distrust, is an obstacle to the formation of relational governance. Meanwhile the self-enforcement mechanism of trust can reduce the presence of opportunistic behaviors at a low cost and consequently the existence of relational governance made it possible to reduce the need (Gulati 1995; Badawi 2009) for guarantees from formal contract (Uzzi 1997). Studies in favor of "complementary" argue that a complex and strict contract is the foundation of trust (Poppo and Zeeger 2002; Williamson 1985) and trust made it easier to draft a formal contract and contract negotiation, what is more, can contribute to a more detailed and complex contract and a successful execution of the contract (Zheng et al. 2008).

With the debated over the relationship between relational governance and contractual governance, some researchers also wanted to settle the argument by subdividing relational governance and contractual governance. For example, Tiwana (2010) divided contractual governance into behavior control mechanism and result control mechanism and then used 120 outsourced system developing projects as samples to carry out an empirical study. They found out that the relationship between relational governance and behavior control mechanism was complementary and the relationship between relational governance and result control mechanism governance was substituted. Therefore, they came up with a third opinion that the relationship between relational governance and contractual governance were both complementary and substituted. Through study on different cases, Olander et al. (2010) discovered that despite both contractual governance and relational governance played as a part in R&D collaboration, their relative importance changed under different collaboration phases. In the phase of collaboration exploration, the relationship between relational governance and contractual governance can be substituted. In the stage of collaboration development, they complement each other. In the stage of collaboration decision-making, their relationship is both complementary and substituted but contractual governance had a more significant effect.

CONCLUSIONS

In general, current researches concerning relational governance and contractual governance mainly focus on the factors that affect relational governance and contractual governance, especially on the antecedents or influencing factors of trust between owners and contractors, and on how relational governance and contractual governance impacting project performance. There are few researches focus on the evolution path of relational governance, contractual governance and the dynamic relationship between them. There are two main researches methodologies, one is cross-sectional-data-based analyses and the other is longitudinal study method. Various research perspectives are involved such as transactional cost theory, principal-agent theory, property theory, resource-based-value, relational contract and social network, and so on.

Although many achievements has been get for project governance, some aspects of the research regarding relational governance and contractual governance in construction area are still needed to be studied further.

(1) The Characteristics of the relationship between relational governance and contractual governance are dynamics obviously. But there are suffered from lack of research literature about this problem. There is a decent quantity of literatures on the relationship between relational governance and contractual governance. But most of them explored the relationship by adopting cross-sectional-based study (Poppo and Zeeger 2002; Chen 2012). In fact, during the project execution, the status of relational governance and contractual governance change constantly and there is a significant difference in the evolution patterns of them. Meanwhile, the inter-relationship between the two mechanisms varies from phase to phase. It can be "substitutes", or "complements" or "two elements coexisting" (Olander et al. 2010). In addition, many researches proved that relational governance played an important role in assisting formal contract against exchange hazards. However, few literatures mentioned about how relational governance worked as the substitutes or complements of formal contract (Du and Yan 2013). Therefore, relational governance is often considered as a "black box" in the studies of its impact on contractual governance.

(2) Researches that focus on how a composite governance mechanism improving project performance are scarce. A hybrid governance mechanism contains many heterogeneity governance mechanisms (Williamson 1985), such as, unilateral and bilateral governance, contractual governance and relational governance, relational governance and non-relational governance. In fact, the governance mechanism of project exchange is a composite form where more than one mechanism taking effect at the same time. For example, contractual governance and relational governance can improve project performance effectually as composite governance mechanism. It has become a new research paradigm to improve project performance. Therefore, including project performance into research framework at the same time, and considering the improvement of project performance under the composite governance mechanism of relational governance and contractual governance can give us a better understanding on the development and operation of project transaction relation. On one hand, it requires scholars to include relational governance and contractual governance into their study scope, in which case, researchers need to discuss the problem from multiple perspectives, like transactional cost theory, relationship contract theory and so on. On the other hand, scholars should include project performance into their research framework and establish an integral model including influence factors, governance mechanism and project performance (based on the transactional-cost-theory-heuristic-model).

(3) The research findings from inter-organizational relationship need to be proved and developed in project governance. Based on transactional cost theory,

principal-agent theory, property theory, resource-based-value theory, relationship contract theory and social network, many researches discus the influence factors of relational governance and contractual governance, the form of the two governance mechanisms and how these influence factors affecting the two governance mechanisms. They also argued the forms and measurements of transaction attributes like asset specificity, uncertainty, transaction frequency (Williamson classic transaction analyses dimensions). They further divided asset specificity into material specificity and nonmaterial specificity (human resource, knowledge, intangible asset), and uncertainty into behavior uncertainty and environment uncertainty. They argued the impacts of each influence factor in different exchanges, but failed to come to agreement (Claro et al. 2003; Hoetker and Mellewigt 2009). It indicates that the impacts of each key factor on relational governance and contractual governance are still ambiguous and needed more researches in future.

Construction projects have some special attributes, such as that mobile location, product customization, endogenous design, no inventories in its production process and so on. Besides, the enormous uncertainty, increasing complexity and obvious nonmaterial asset specificity along with the uniqueness of project made it different transaction relationship with other industries. Such difference offers new research direction for governance theory testing and development.

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Optimization of Construction Project Cost Management Based on the Smart Construction Theory

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Abstract

According to development and needs of construction industry in China, the conception of Smart Construction Theory is illustrated. In the paper, questionnaire survey is used to collect data needed for analysis, as an effective method. And then the structure of AEC (Architecture, Engineering and Construction) projects information management model was concisely described. Furthermore, the paper takes cost management function to reason by analogy other functions of the model, and Smart Cost Management is proposed. The research takes cost management function to reason by analogy other functions of the model, and is an implementation example of construction project information management model. The cost management problem could be solved with dynamic programming method. The research strengthens and optimizes information management of AEC projects and improves the efficiency and competitiveness of construction industry in China.

INTRODUCTION

Informatization is an important part of AEC projects, and the key to improve management level and core competitiveness of construction industry. AEC projects informationization is an important part of construction industry informatization (Han and Micheine 2000). With rapid development of construction industry in China (Yacine and Alain 2006), the amount and complexity of construction project information are growing (Kang et al. 2008), because the construction project scale is much larger and the process of construction project is more complicated than before (Zhu 2010). Nonetheless, theoretical vacancy and methods obsolete of construction project information management, and low level of emerging information technologies application result in the problem of “information islands” in construction projects (Xue et al. 2010). Application efficiency of emerging information technologies is low in China, although construction industry in China has an increasing investment in informationization research and application of emerging information technologies in recent years.

Under the background, many scholars study on “digital construction”, “information management” and “information technology application” of AEC projects for a long time, for example, BIM (Building Information Modeling), BLM (Building Lifecycle Management), ubiquitous computing, 4D visualization, smart city, internet of things etc. To some extent, the studies contribute to development of construction industry informationization. But, theoretical vacancy and methods obsolete of AEC projects information management are not fundamentally solved, and information technology application and management have a great gap in home and abroad. According to the research status at home and abroad, AEC projects information management model for information management of BLM and based on Smart Construction Theory is built. The research provides solutions and suggestions for improvement of AEC projects information management model, and further research of Smart Construction Theory.

EMPIRICAL RESEARCH

Questionnaire survey. The paper use questionnaire survey and expert interview to collect data. Questionnaire is a survey method to collect research material in writing indirectly by issuing a survey questionnaire to investigators. The questionnaire is based on the previous evaluation scale of the model. Since the study is to solve the problem of construction project information management, so the investigation object is mainly from all participants of construction project management, senior management personnel, and other related professional members from scientific research institutions, colleges and universities (Nora and Tamer 2010).

The questionnaire is mainly divided into two parts: one part is information about research and person’s basic information; the other part is research content. In the first part, a small amount of multiple choice questions and fills-up topics are set up for objective recording natural conditions of respondents. Moreover, in order to minimize differences from familiarity with the information tools, people who have experience in using related information management tools are respondents of questionnaire. In second part, research content contains two aspects: evaluation of emerging information technologies applied in AEC projects information management, and functional evaluation of AEC projects information management model. There are 51 questions in this part. They are designed by 5 levels Likert Scale, and each topic grades five levels standard from 1 to 5: 1 Very conform, 2 conform, 3 general, 4 not conform, 5 not conform to very much (Wu and Wang 2013).

Basic hypothesis of the model. Application and integration of a variety of emerging information technologies are technological base of AEC projects information management model; functional design plays an important role in the model; the model can reflect the four main features of Smart Construction Theory, and the model can guide the functions of AEC projects information management platform (Temera et al. 2012). Based on these, put forward 11 basic hypothesis related the model are divided into following three levels, as shown in Table 1 (Wu and Wang 2013).

Table 1.Basic Hypothesis Related the Model.

Hypothesis level	Contents of hypothesis	No.
Application and integration of a variety of emerging information technologies influence on AEC projects information management model	Application of BIM has a significant positive correlation to the model	H11
	Application of internet of things has a significant positive correlation to the model	H12
	Application of ubiquitous computing has a significant positive correlation to the model	H13
	Application of 4D visualization has a significant positive correlation to the model	H14
	Integration of emerging information technologies has a significant positive correlation to the model	H15
Functions system of the model influence on AEC projects information management model	Information management function has a significant positive correlation to the model	H21
	Information management function of BLM has a significant positive correlation to the model	H22
	Effectiveness of information management function has a significant positive correlation to the model	H23
	Needs of information management from different parties have a significant positive correlation to model	H24
Main features of Smart Construction Theory and functions of the platform influence on the model	Main features of Smart Construction Theory have a significant positive correlation to the model	H31
	Function system of AEC projects information management platform has a significant positive correlation to AEC projects information management model	H32

Data gathering. Three methods are used in the survey: paper-based questionnaire, email-based questionnaire and telephone-based questionnaire. The survey work is from May to December, 2012. After seven months survey, totally 396 questionnaires are sent out, and 307 questionnaires are got back. Among them, 254 questionnaires are effective, yet 53 questionnaires are invalid. The recovery rate is 77.53%, and effective rate is 64.14%. Details about the survey are shown in Table 2.

Table 2.Questionnaire Distribution and Recovery.

Methods	Questionnaires distributed	Questionnaires recycled	Effective	Recovery rate (%)	Effective rate (%)
Paper-based	157	125	101	79.62	64.33
Email-based	175	119	95	68.00	54.29
Phone-based	64	63	58	98.44	90.63
Total	396	307	254	77.53	64.14

Description and limitation of sample. In the process of research, age, educational background, employer, number of years worked for employer and regional distribution of the respondents in 254 valid questionnaires are analyzed. Sample characteristics description as a whole is shown in Table 3.

Table 3.Sample Characteristics Description.

Characteristic	Classify	Number of samples	Rate (%)
Age	Under the age of 30	46	18.11
	30 to 39 years old	62	24.41
	40 to 49 years old	68	26.77
	50 to 59 years old	59	23.23
	More than 60 years	19	7.50
Educational background	College degree	78	30.71
	Bachelor degree	92	36.22
	Master degree	44	17.32
	PhD degree	26	10.24
	Other	14	5.50
Employer	Owner	38	14.96
	Designer	41	16.14
	Supervisor	32	12.60
	Contractor	51	20.08
	Supplier of materials	23	9.06
	Scientific institutions	54	21.26
	Other	15	5.91
Number of years worked for employer	Less than 5 years	39	15.35
	5 to 10 years	67	26.38
	10 to 20 years	75	29.53
	20 to 30 years	62	24.41
	More than 30 years	11	4.33
Regional distribution	Harbin City	52	20.47
	Mudanjiang City	39	15.35
	Jilin City	33	12.99
	Hefei City	30	11.81
	Xi’an City	25	9.84
	Tianjin City	24	9.45
	Beijing City	18	7.09
	Nanjing City	13	5.12
	Shanghai City	12	4.72
	Guangzhou City	8	3.15

In Table 3, collected samples are in line with research need, and sample size meet representativeness. However, due to the limitation, such as research ability, time and money, randomness of the samples is insufficient. On regional distribution, a large number of samples are in the three northeast provinces, but small number of samples is in other provinces and sample size is less than expected. In some extent, these may cause lacking generalization of research conclusion.

AEC PROJECTS INFORMATION MANAGEMENT MODEL

Smart construction theory. Smart Construction Theory can be defined as a bran-new engineering management theory for BLM, which build smart environment of the project construction and operation, and improve and manage effectively all the processes of engineering project in life cycle through technical innovation and management innovation. It takes BIM, internet of things, ubiquitous computing, 4D visualization and other advanced network and information technology as implementation tools, and to meet the requirements of smart project function and the individuality purpose of the different parties as aims (Wang and Wu 2012).

According to the above definition, supportive system of Smart Construction Theory is from three aspects at least: Smart City provides concept support for Smart Construction Theory, and meanwhile Smart Construction is an important part and the way of implementation of Smart City; AEC projects management, BLM, Lean Construction (Xue et al. 2012) and Sustainable Construction provide theory basis for Smart Construction Theory; lots of technology such as BIM, internet of things, ubiquitous computing and 4D visualization provide technical support.

The core idea of Smart Construction Theory is to make full use of advanced information and network technologies, to integrate every link of BLM, to achieve smart response to the personalized needs of different parties, to provide convenience for parties of different stages, to realize sustainable development of Smart Construction from the point of view of economic and environmental protection.

AEC projects information management model. The whole life of AEC projects is filled with all kinds of information. That is shown in Figure 1.

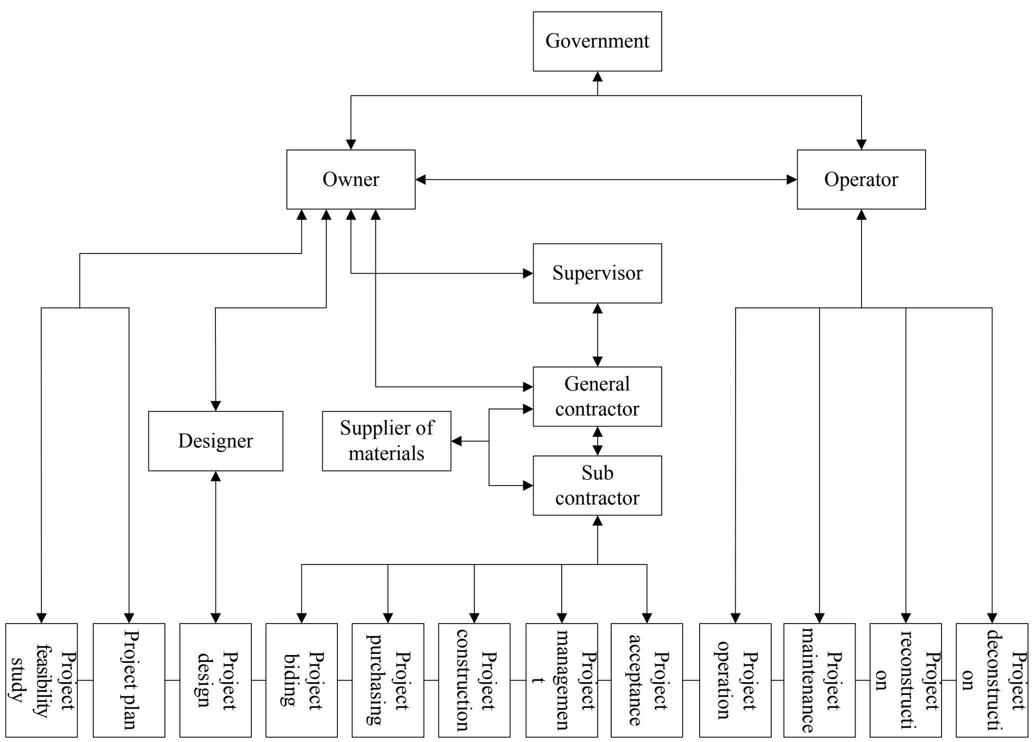

Figure 1.Information flow in the whole life cycle of AEC projects.

BLM of AEC projects contains 12 processes: project feasibility study, project plan, project design, project biding, project purchasing, project construction, project management, project acceptance, project operation, project maintenance, project reconstruction and project deconstruction. Meanwhile, there are 8 participants in the figure: government, owner, operator, supervisor, designer, supplier of materials, general contractor and sub contractor.

The modeling process of the research is mainly top-down, and divided into six steps: feasibility study, demand analysis, model design, model building, model test and model implement. The 6 steps are gradually in-depth, detailed and cycling. According to the above analysis, AEC projects information management model includes all kinds of products and process information of life-cycle project management. It forms dynamically in construction. Architecture and main body of model includes application layer, network layer, platform layer and data layer which structure a framework, as shown in Figure 2.

(1) Application layer. Application layer is composingd by various application software that serve different stages of projects. They are planning analysis software, structure design software, construction management software and property management software, etc. In application layer, AEC projects information management model is responsible for accumulating, integrating, expanding and applying information. Through integrating application software, son models of Smart Construction Information Modeling are shaped up.

(2) Network layer. Network layer gather all kinds of engineering information from internet space by Internet of things. Thus, the distributed users can share and deliver information of AEC projects information management model online. Network layer is foundation of application and sharing of model. Users can manage information on the network conveniently, and cost is reduced very much.

(3) Platform layer. Platform layer is AEC projects information management platform, and its functions are structured information management, unstructured information management and process information management. The platform can realize the fusion between engineering information and AEC projects information management model, support constructive process of model and keep original work patterns of most professional systems and users.

(4) Data layer. Structured information is stored by database under IFC standard. Unstructured information is stored and managed by document management system and database. Process information is stored by relevant process database temporarily.

REALIZATION OF THE MODEL: COST MANAGEMENT FUNCTION AS AN EXAMPLE

Smart cost management. The paper researches on realization of AEC projects information management model: cost management function as an example, and Smart Cost Management is proposed. Compared with traditional cost management methods, research background, concept and range of Smart Cost Management are analyzed. By summarizing advantages, organization and operation of Smart Cost Management, lots of smart cost information management methods are put forward, including extraction mechanism, integration, parametric modeling, and dynamic programming model of smart cost information. The research is based on AEC projects information management model and emerging information technologies integration platform, takes cost management function to reason by analogy other functions of the model, and is an implementation example of construction project information management model.

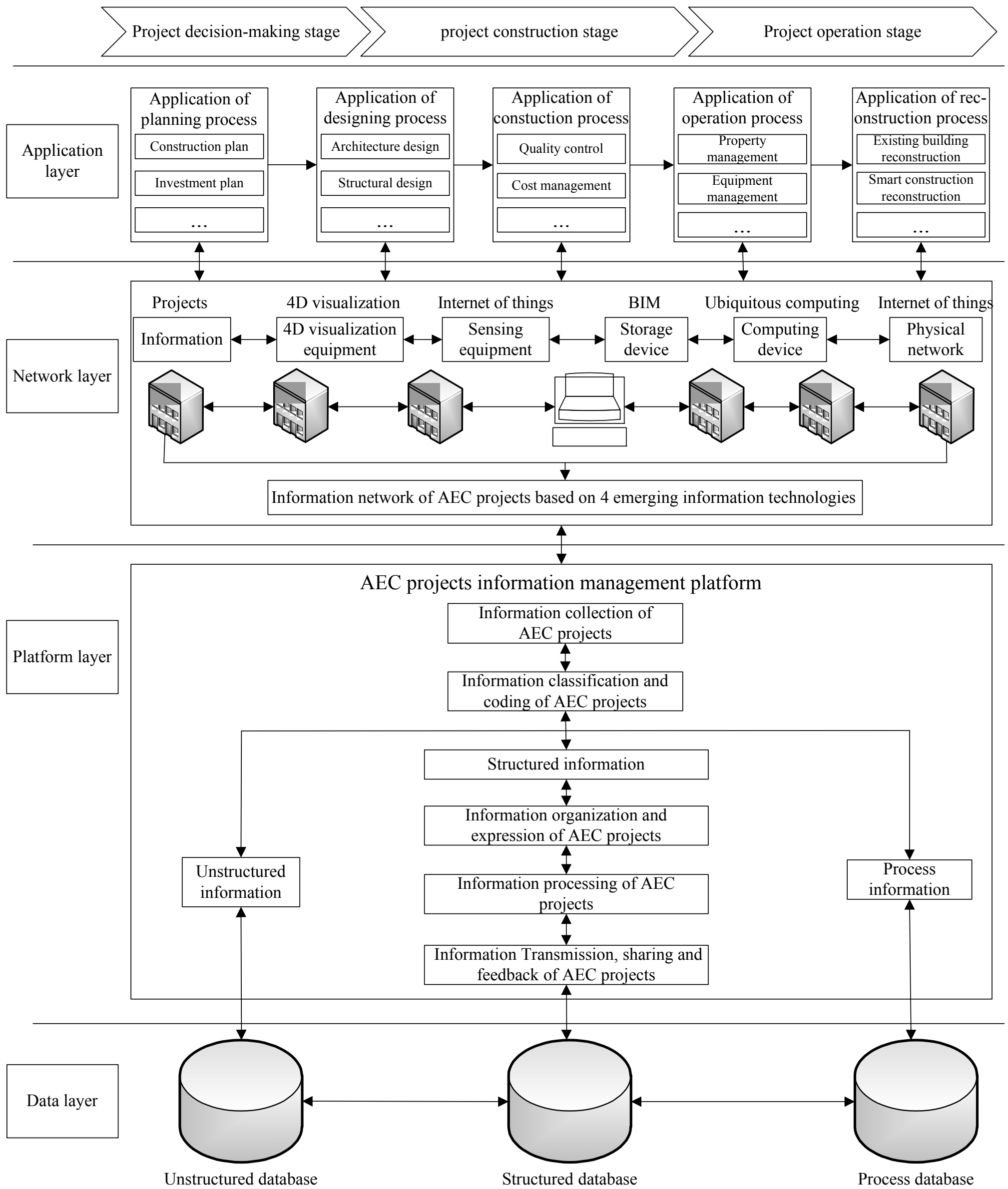

Figure 2.Basic framework of AEC projects information management model.

The differences between Smart Cost Management and the traditional construction project cost management are including (1) From the perspective of information management, (2) The whole life cycle cost management, (3) Meet demands of the parties of AEC projects, and (4) Realize the dynamic cost management.

AEC projects information management model based on Smart Construction Theory has incomparable advantages. They are building components by using the parametric modeling method, automatic quantities calculation based on parameters, greatly enhancing information level and efficiency of cost management: (1) To improve the accuracy of the calculation of quantities, (2) Reasonable arrangement of resources plan, to speed up the project schedule, (3) Control design change, (4) Support multiple AEC projects contrast, (5) Historical data saving and sharing, (6) increase cost control capability of the parties, and (7) Conducive to the implementation of Smart Construction Theory.

Unilateral smart cost information dynamic programming model. Under Smart Construction Theory, combining AEC projects information management model and emerging information technologies integration platform, Smart Cost Management can work well. Since design change can timely manifest in the 3D drawings and data by the model, combining emerging information technologies integration platform, quantities change information can be automatic calculated by advantage of the pervasive computing technology, and the change of the life cycle cost information is offered. The overall scheme of AEC project is optimized. Plans and related information are transferred to all relevant parties by Internet of things technology, and optimize the each participant cost plan. Due to Smart Cost Management conforms to the dynamic programming principle and no after effect principle; the cost management problem can be solved with dynamic programming method.

The basic assumptions are (1) Aimed at the optimal construction project life cycle cost, (2) Individual participant as management main body, (3) The feasibility of the AEC project, and (4) Multiple alternatives exist. According to the research needs, the whole life cycle of the AEC projects are divided into four main processes: decision-making, design, construction and operation. Assuming the variables for four processes $k(k=1,2,3,4)$, as shown in Figure 3.

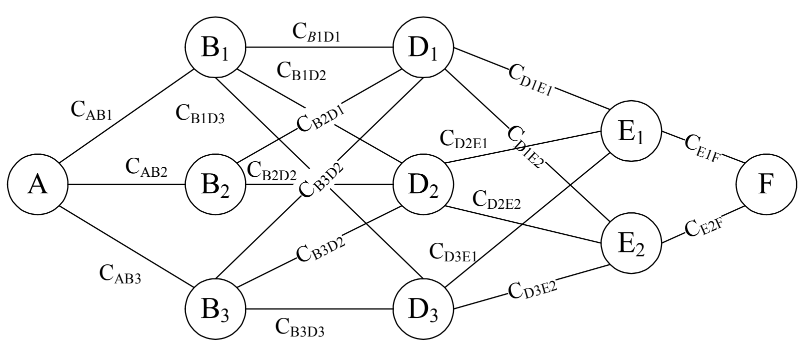

Figure 3.Cost dynamic programming model.

In Figure 3, Points A, B, D, E, F are nodes between the processes of AEC project. B1, B2, B3 said the three routing from A to B; D1, D2 and D3 said three path from B to D; E1 and E2 said the three paths from D to E. Assuming that S_k is objective condition impact on cost, such as Social and economic environment, natural conditions, etc. Thus, $S_1=\{A\}$, $S_2=\{B_1,B_2,B_3\}$, $S_3=\{D_1,D_2,D_3\}$,

$S_4 = \{E_1, E_2\}$, $S_5 = \{F\}$. $U_k(S_k)$ is decision variable, on behalf of cost information management method and alternative plans of the process k. $U_k(S_k)$ is from $D_k(S_k)$, so $U_k(S_k) \in D_k(S_k)$. Optional path by Starting from B_1 is (D_1, D_2, D_3), so $D_2(B_1) = \{D_1, D_2, D_3\}$. If D_3 is chose, $U_2(B_1) = D_3$.

Equation $S_{k+1} = C_k(S_k, U_k)$ can represent the change of AEC projects status. $V_j(S_j, U_j)$ is each process index function. Among them, $j = 1,2,3,4$ are decision-making cost, design cost, construction cost and operation maintenance cost. $V_{1,4}(S_1, U_1, S_2, U_2, ..., S_5)$ is the whole life cycle index function of AEC projects. S_k is state variable of process k, and $f_k(S_k)$ is index function when S_k is optimal. Thus, Smart cost management recursive model is as shown in Figure 4.

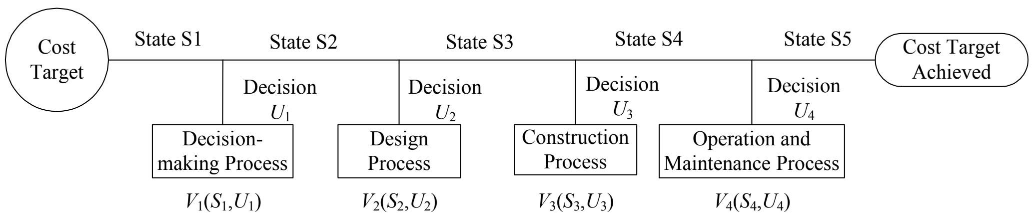

Figure 4.Smart Cost Management recursive model.

Basic equation of Smart Cost Management recursive model is:

$$\begin{cases} f_k(S_k) = \min\{C_k(S_k, U_k) + f_{k+1}(S_{k+1})\}, k = 5,4,3,2,1 \\ f_5(S_5) = 0 \end{cases} \tag{1}$$

By formula (1), the essence of Smart Cost Management is most short circuit problem. Because the cycle of AEC projects is long, the time value of money must be considered, especially in using stage of projects.

Model adjustment. When AEC project design change occurs, plan of Smart Cost Management should be changed accordingly, and need to adjust smart cost information dynamic programming model. There are three main consideration changes: change of time points, change of cost value and generation of new alternatives. Completed work of AEC project has sunk cost, and change of time point said how to achieve the optimal cost management without considering sunk cost in past. The selected scheme has a certain degree of path dependence. When cost value changes, need to add new paths. When new alternatives, need to build the model of solution path. Accordingly, model adjusted and increase new path E3, as shown in Figure 5.

CONCLUSION

In sum, the paper breaks through the present academics research perspective, and has not only scientific and reasonable research process but also effective research results. Smart Construction Theory is proposed in the paper. Through literature research, the paper analyzes idea origin, theoretical basis and technical support of

Smart Construction Theory, and puts forward the connotation of it. Based on Smart Construction Theory, the paper builds AEC projects information management model. The paper researches on realization of the model - cost management function as an example, and Smart Cost Management is proposed. Compared with traditional cost management methods, research background, concept and range of Smart Cost Management are analyzed. By summarizing advantages, organization and operation of Smart Cost Management, smart cost management methods are put forward, including extraction mechanism, integration, parametric modeling, and dynamic programming model of smart cost information.

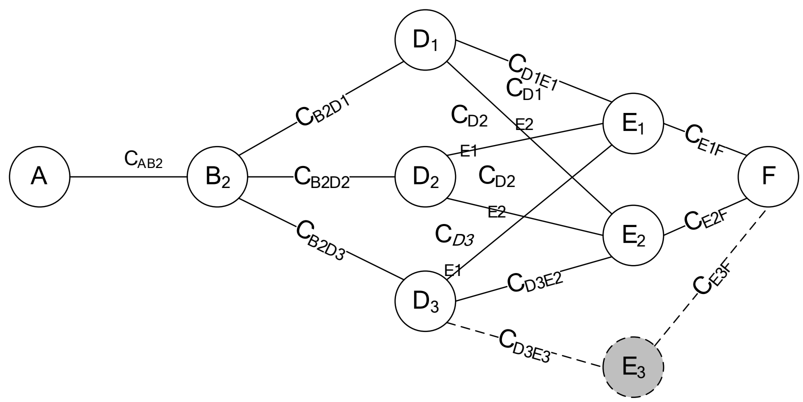

Figure 5.Adjustment of smart cost dynamic programming model.

The process and results provide a new theoretical guidance and realizing approach to study AEC projects information management. Meanwhile, subsequent research on Smart Construction Theory based on the model has support of empirical data. The results prove that study of AEC projects information management model is necessary and valuable, improvement of practicability and functionality of the model require development of integration of 4 emerging information technologies, functions system of the model, and main features of Smart Construction Theory and functions of the platform influence on the model. Especially, information management function, information management function of BLM, effectiveness of information management function, and needs of information management from different parties are critical. In addition, research on Smart Construction Theory and the model will be effectively direct effect, and avoid unnecessary waste and loss.

At present, the research is still in infancy stage, no matter Smart Construction Theory or AEC projects information management model need to improve and deepen content and depth constantly. Although the research is theoretical and practical, it also has a few limitations, due to subjective and objective conditions. In addition, there are many researches to work on AEC projects information management model and Smart Construction Theory, and subsequent research work will be more innovative and challenging.

ACKNOWLEDGMENTS

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Research on the Evaluation of Project Management Maturity in a Hydropower EPC Project

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Abstract

Currently the organizational project management capacity in EPC project has become more and more concerned. The focus of the project management capacity is about a dynamic process that improves the organization and coordination, and enhances the scientific and standardized degree in project management. Evaluation of project management is the foundation for improving the project management capabilities for organization. The project management maturity model (PMMM) is proposed in this context to evaluation project management maturity of the hydropower EPC contractor. By the PMMM and combining with the specific characteristics and the current study situation hydropower project management at home and abroad, here we built a maturity framework and the evaluation system for Hydropower EPC contractor on Project Management. And propose the evaluation method based on gray comprehensive evaluation. The empirical analysis of the EPC contract practices in SOPLADORA hydropower project shows that it is feasible and effective to analyze the maturity of the management.

INTRODUCTION

The Organizational Project Management capacity is becoming the key in the research of the management science and project management, though specific studies are still at a starting stage in the construction. Project management capacity focuses on the dynamic process that improves the management organization and coordination, enhancing scientific and standardized management degree (Tian et al. 2014). As the hydropower EPC projects have become increasingly large and complicated, and the schedule requirements of owners are increasingly stringent, the traditional management modes in construction are falling to meet the demand of the organizational project management capacity in reality.

The characteristics of the hydropower EPC projects are long construction period and large investment demand, as well as the many participants, complex working conditions and vulnerable natural environment (see Figure1), which make tremendous uncertainty of the schedule and cost control. The general contractor has to bear all the risk caused by the possible changes in hydropower EPC project that presents a huge challenge and requirement to contractor's management capacity. Actually the accurate assessment of the general contractor's management capacity will be the prerequisite and basis for risk management and control. At present, risk management of China's general contractor in the international EPC still relies on accumulated experience in the initial stage, the ability to resist risks is weak, and lack of tools and objectives for the systematic, clear project management system. With the application of project management theory and in-depth in practice, research on project management model of hydropower enterprise has become the magic to improve their management performances (Li et al. 2007).

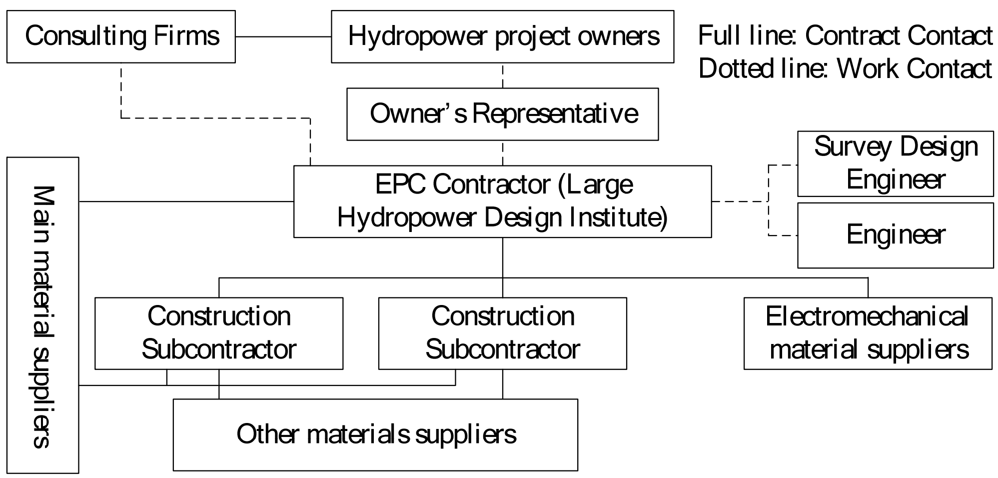

Figure 1.The Hydropower project management of EPC.

As a new concept, Project Management Maturity Model (PMMM) was point out. PMMM provides a framework to assess and improve the organization's project management capabilities. It is able to demonstrate the overall capacity of an organization that successfully and reliably implementing project in accordance with the intended target and conditions, and provides a method for the quantitative assessment of the project to achieve the desired goal (Li and Bai 2004).

In hydropower EPC project, it not only can show hydropower companies' project management condition as contractor, but also further identify the weak links in management process, then assess their project management capabilities and final point out the direction of improvement. However, currently the evaluation for project management maturity is relatively scarce, and lack of a unified, authoritative, scientific and long-term, effective assessment models and methods to measure the pros and cons of the project management in hydropower project (Yuan and Chen 2009; Ghoddousi et al. 2011).

Thus in view that great practical significance for hydropower project management, this research proposes a framework of the maturity model for the management of hydropower EPC project by Grey Comprehensive Evaluation. Final reach to improve the project management, enhance project management capabilities with the evaluation.

DIMENSIONS OF THE MATURITY FRAMEWORK FOR PROJECT MANAGEMENT

Based on the hierarchical structure of the Capability Maturity Model (CMM) and key process area of Organizational Project Management (OPM3), and combined with the practice of hydropower EPC project management, we proposed the framework of the maturity model for the management of hydropower projects. The model is divided into three dimensions, including life cycle, functional areas and levels of maturity:

(1) Dimension of life cycle areas (the example of contractor including design): design consulting, procurement, construction and supervision, commissioning and handover.

(2) Dimension of functional areas: integrated management, quality management, schedule management, expense management, contract management, risk management, security management, human resource management, purchasing management.

(3) Dimension of levels of maturity areas: systematic management level, quantitative management level, standardized management level, effective management level and management level initialization.

THE INDEX OF MANAGEMENT MATURITY

There are many factors which affect the management maturity of the EPC contractor. Evaluation index system is one of the most direct and effective methods and tools to evaluate the level of organizational project management maturity, also is an important mean that can quantify the factors of project management maturity. Learning from Kent Crawford's project management maturity model, this article puts the nine functional areas as the primary index in hydropower project management evaluation system; Secondary indicators are sub-processes of the nine functional areas. Secondary indicators are divided into the following three categories: describing indicators, primarily for the description of critical content in project, measured by quantifying or logical way; analyzing indicators, mainly to analyze and judge the key elements of the project, can be quantified or qualitative; indicators between the first two categories, both the description and analysis. The results are shown in Table 1.

Next, to determine the weight of each indicator in Index System, there is a combined method including the simplified Delphi and AHP (Cheng 2014) will be used. First of all, expert scored and recovered scoring questionnaires. Then calculate the questionnaires for seeking weights. The calculation steps are following.

$$\bar{\varphi}_{ij} = \sum_{k=1}^{x} \left(\varphi_{ijk}\right) / x \tag{1}$$

Here: x is the total number of experts; φ_{ij} is the average of index U_{ij}; φ_{ijk} is the score of the index U_{ij} from the *kth* expert; and φ_{ij} is the ultimate expert scoring. Building judgment matrix $D=[d_{ij}]$ via three scale method, d_{ij} is the result of a comparison between φ_{ij}. If U_{ij} is more important than the other, then $d_{ij}=2$; if not, then $d_{ij}=0$; and if they are equally important, then $d_{ij}=1$, namely when compared with itself, $d_{ij}=1$. Calculating eigenvalue of judgment matrix D, wherein the eigenvector corresponded to the maximum eigenvalue set θ^*, then

Table 1.Index System of Evaluation for the Maturity Model.

Target layer	Primary layer	Weight	Secondary layer	Weight
Maturity of project management	Integrated management U_1	0.112	Preparation of management plan or organization design U_{11}	0.039
			Integrity project management system U_{12}	0.037
			Control of change U_{13}	0.036
	Quality management U_2	0.121	Qualified rate U_{21}	0.035
			Quality accident rate U_{22}	0.037
			Quality supervision U_{23}	0.029
			Quality improvement U_{24}	0.017
	Schedule management U_3	0.123	Schedule variance and convergence U_{31}	0.043
			Network diagrams and Gantt application level U_{32}	0.039
			Rated project duration rate U_{33}	0.041
	Expense management U_4	0.122	Cost performance index U_{41}	0.031
			Cost implementation rate U_{42}	0.030
			Project cost rate change U_{43}	0.033
			Perfect degree of cost control system U_{44}	0.028
	Contract management U_5	0.118	Contract compliance rate U_{51}	0.035
			Terms of the contract and bidding documents U_{52}	0.037
			Specification for process of contract changes U_{53}	0.029
			Specification for process of claims U_{54}	0.017
	Risk management U_6	0.107	Risk planning U_{61}	0.021
			Risk identification u_{62}	0.022
			Risk assessment U_{63}	0.021
			Risk response U_{64}	0.023
			Risk monitoring U_{65}	0.021
	Security management U_7	0.105	Safety accident rate U_{71}	0.035
			Equipment vandalism rate U_{72}	0.036
			Environmental satisfaction U_{73}	0.034
	HR management U_8	0.094	Level organizational planning U_{81}	0.024
			Optimize staffing levels U_{82}	0.024
			Team building level U_{83}	0.023
			Team management U_{84}	0.029
	Purchasing management U_9	0.098	Preparation of rationality for procurement plan U_{91}	0.032
			Level of implementation of the procurement plan U_{92}	0.034
			Inquiry counteroffer management mechanism U_{93}	0.033

$$\theta^* = (\theta_{i1}, \theta_{i2}, \ldots, \theta_{in}) \tag{2}$$

So we get the weight of each index weight

$$a_{ij} = \frac{\theta_{ij}}{\sum \theta_{ij}} \tag{3}$$

THE PROCESS OF THE EVALUATION BASING ON GREY CORRELATION METHOD

Determine the evaluation level. This article will divide the maturity level into five categories: systematic management level, quantitative management level, standardized management level, effective management level and management level initialization, namely five gray classes. Grading vector M = (5, 4, 3, 2, 1). Score range of each level respectively is [4, 5), [3, 4), [2, 3), [1, 2), [0, 1). According to the gray theory, the corresponding whitening functions are:

$$f_1(x) = \begin{cases} \frac{1}{5}x, 0 \le x < 5 \\ 1, x \ge 5 \end{cases} \qquad f_2(x) = \begin{cases} \frac{1}{4}x, 0 \le x < 4 \\ 5-x, 4 \le x \le 5 \end{cases}$$

$$f_3(x) = \begin{cases} \frac{1}{3}x, 0 \le x < 3 \\ \frac{5-x}{2}, 3 \le x \le 5 \end{cases} \qquad f_4(x) = \begin{cases} \frac{1}{2}x, 0 \le x < 2 \\ \frac{5-x}{3}, 2 \le x \le 5 \end{cases} \tag{4}$$

$$f_5(x) = \begin{cases} 1, 0 \le x < 1 \\ \frac{5-x}{4}, 1 \le x < 5 \end{cases}$$

Calculating index levels of Gray evaluation right. (1) Expert scoring. According to the different types of indicators, designing the different methods: qualitative index score by five-point method, quantitative indicators are divided into five levels. This is part of the five levels of maturity were divided into five levels.

(2) Calculating. (i) Evaluation of Secondary indicators. Gray evaluation found that each score is a gray number. The secondary evaluation U_{ij}, scoring given by all the reviewer are $p_{ij1}, p_{ij2}, \ldots, p_{ijx}$, So evaluators can consider that indicator U_{ij} belongs to *eth* ($e = 1, 2, 3, 4, 5$) ash class, its Whiten of the total ash class C_e recordes as α_{ije}, then $\alpha_{ije} = \sum_{k=1}^{x} f(p_{ijk})$. And the gray Whiten set of U_{ij} denoted as α_{ij}, and

$$\alpha_{ij} = \sum_{e=1}^{5} \sum_{k=1}^{x} f_e(p_{ijk}) = \sum_{e=1}^{5} a_{ije} \tag{5}$$

The ratio of the two indicators reflected reviewers' strong willing that indicator U_{ij} which belongs to eth gray class C_e, and the greater the ratio, the more degree of willing that U_{ij} should belong to gray class C_e. This ratio is called the gray evaluation that U_{ij} belongs to gray class C_e, denoted r_{ije}, and

$$r_{ije} = \frac{a_{ije}}{a_{ij}} \tag{6}$$

$$r_{ij} = \left(r_{ij1}, r_{ij}, \ldots, r_{ijs}\right), i = 1,2,\ldots,m; j = 1,2,\ldots,n \tag{7}$$

Setting matrix R_i as the gray evaluation weight vector of U_{ij}, gray evaluation weight R_i:

$$R_i = \begin{bmatrix} r_{i1} \\ r_{i2} \\ M \\ r_{ini} \end{bmatrix} = \begin{bmatrix} r_{i11} & r_{i12} & \cdots & r_{i15} \\ r_{i21} & r_{i22} & \cdots & r_{i25} \\ & & M & \\ r_{ini1} & r_{ini2} & \cdots & r_{ini5} \end{bmatrix} \tag{8}$$

(ii) Evaluation of primary indicators. Easy to draw that Primary indicators $U_i = \left[U_{i1}, U_{i2}, \ldots, U_{in}\right]$, and the weight vector of indicators U_i denoted as A_i, $A_i = \left(a_{i1}, a_{i2}, \ldots, a_{in}\right)$, we make a comprehensive evaluation for U_i, the weight vector for the gray comprehensive evaluation of U_i can be denoted as B_i, $B_i = A_i \bullet R_i = \left(b_{i1}, b_{i2}, \ldots, b_{in}\right)$. And setting matrix $B = \left[B_1, B_2, \ldots, B_m\right]$, then

$$B = \begin{bmatrix} B_1 \\ B_2 \\ M \\ B_1 \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{15} \\ b_{21} & b_{22} & \cdots & b_{25} \\ & & M & \\ b_{m1} & b_{m2} & \cdots & b_{m5} \end{bmatrix} \tag{9}$$

Grey comprehensive evaluation value. The weight vectors matrix B reflects the gray class that U_{ij}. For matrix *B*, we can determine its rank of the gray class according to the principle of maximum weight, which if $b_l = \max\left\{b_1, b_2, \ldots, b_5\right\}$, then assessed as the class *l*.

According to this principle, the judgment sometimes is effective, sometimes invalid for losing too much information. So we make the further improvement, to $B = \left[B_1, B_2, \ldots, B_m\right]$, denoting final evaluation results as *W*.

$$W = B \bullet \left(M_1, M_2, \ldots, M_5\right)^T = b_1 M_1 + b_2 M_2 + \cdots b_5 M_5 \tag{10}$$

Marked five evaluation gray classes $C_1, C_2, \ldots, C_5$. Whiten function threshold value $\lambda_1, \lambda_2, \ldots, \lambda_5$, so the gray comprehensive evaluation value: W is gray number, we calculate W belongs to each whiten evaluation gray classes $f_1(W) f_2(W) \cdots f_5(W)$, and according to the largest ash class whiten W decided the belong.

EMPIRICAL ANALYSIS: A CASE STUDY IN SOPLADORA HYDROPOWER PROJECT

SOPLADORA hydropower station is located in western Ecuador Morona - the province of Santiago (Morona-Santiago) east Paute River, the project is planning to develop the four river power plant in a top-down level 3, the upper reaches of the Moreno station, downstream to Card Niyou (Cardenillo) Station. The station is run-of-power plants, using diversion type development, no Sluice (dam), the use of underground chambers interconnected directly connected to a cascade hydropower Moreno tail water diversion tunnel through pressure, which pressures piping underground powerhouse power supply unit. Power station installs three units with a total installed capacity of 486MW, is intended to be 5 back 230kV qualify.

Index system of evaluation. 50 questionnaires distributed to project-related personnel, 44 questionnaires were recovered. The reliability coefficients of the survey for the primary layer and secondary layerα1 both are more than 0.7, so it can be used in this research. According to the survey, the final results of the nine primary indexes and 33 secondary indexes. The final index system and the weight are shown in Table 1.

Results and analysis. Using the gray comprehensive evaluation method, this research first to obtain a gray evaluation weight vector for each secondary indicator via the questionnaires. Basing on it, this research also get the comprehensive evaluation index weight vector of the primary indicators, final, the project management maturity gray evaluation weight matrix *B* of this project is as following:

$$B=\begin{bmatrix}B_1\\B_2\\B_3\\B_4\\B_5\\B_6\\B_7\\B_8\\B_9\end{bmatrix}=\begin{bmatrix}0.1995 & 0.2468 & 0.3033 & 0.2539 & 0\\0.1336 & 0.2633 & 0.3341 & 0.2324 & 0.0367\\0.1694 & 0.2106 & 0.2790 & 0.3081 & 0.0313\\0.2044 & 0.2540 & 0.3153 & 0.1719 & 0.0544\\0.2246 & 0.2806 & 0.3341 & 0.1597 & 0\\0.1941 & 0.3062 & 0.3094 & 0.1213 & 0.0690\\0.1494 & 0.0958 & 0.2574 & 0.2751 & 0.0321\\0.2037 & 0.2544 & 0.3160 & 0.1720 & 0.0541\\0.1405 & 0.1723 & 0.2244 & 0.3244 & 0.1383\end{bmatrix}$$

Then to determine the belong level according the maximum degree of membership of Primary indicators, the results are presented in Table 2:

Table 2.The Level of Maturity for Primary Indicators.

Index	U_1	U_2	U_3	U_4	U_5	U_6	U_7	U_8	U_9
Level	[2,3)	[2,3)	[2,3)	[2,3)	[2,3)	[2,3)	[1,2)	[1,2)	[2,3)
Maturity	St	St	Eff	St	St	St	Eff	St	Eff

St: standardized management level, Eff: effective management level

According to equation (9), we get the gray comprehensive evaluation weight vector of project management maturity in S hydropower: $B = A \bullet R = (0.1798, 0.2319, 0.2977, 0.2241, 0.0449)$.

Via the gray class vector $M(M_1, M_2, \ldots, M_5)$, and according to equation (10), the gray comprehensive evaluation value is 3.2128. For $f_{\max} = f_3(W) = 0.9291$, so W is most likely belongs to the third ash category. We can consider project management maturity of the SOPLADORA Hydropower EPC project is "standardized management level".

In the nine elements have been adopted in the primary layer for SOPLADORA project management maturity, schedule management, security management and procurement management only reach the standardized management level, the other all reach the standardized management level. However, this three elements always is very important, so it should draw the EPC contractor's attention. However, the assessment shows that the EPC contractor had done relatively better on the project management, and had reached a certain level of institutionalization. But there is still a gap between the highest levels of systematic management level. The improvement on management also is needed for the contractor in future.

CONCLUSION

The introduction of project management maturity model and the gray comprehensive evaluation method in the analysis of hydropower contractors' project management capabilities in the SOPLADORA hydropower project has been shown is effective to assesses the performance of the contractor in EPC project management. It is also an effective tool to improve its management performance for the Hydropower EPC contractor, which is able to find their weaknesses and make targeted recommendations for improvement. So it will have a good prospect in hydropower EPC management practice.

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Real Estate Financial Risks Caused by Aging and Its Precautions

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Abstract

According to related data, China has been turning into an aging society since 2000, which keeps aggravating bolstered by the sixth Census. In the long run, the population of potential house owners will maintain decreasing, which reduces house purchasing demand and raises the hazard of financial turmoil of real estate industry. Thus, great negative impact might occur in economy, since the financial risks of real estate in china are highly concentrated in the banking system. By establishing the model in demand of population of distinct ages with related data, we analyze the hidden jeopardy of real estate financial risk brought by aging in this article. To make the potential financial issues better resolved in real estate, practicable schemes are proposed as well.

INTRODUCTION

The global population structure is showing the trend of aging since the 21st century. According to the UN World Population Prospects report (2008), the proportion of people over the age of 60 in developed countries account for more than 20% of its total population proportion in that year, and is expected to reach 30% by the year of the 2050. Although this proportion in the developing countries are now mostly below 10%,it is expected that in 2050, the above ratio would rise to 20 percent on average. The extent of China's aging population is also growing. This phenomenon has brought great impact on many other aspects. Among them, the biggest impact is mainly reflected in the real estate industry out of the depopulation of buyers in need of the housing purchase, which makes it imperative to solve the problem of credit contraction, reduced consumption and investment caused by aging. In the face of the aging population, it's a major problem on how to reduce the impact on this change in population on existing real estate market in our long-term future.

LITERATUREREVIEW

Foreign literature review. The demand for real estate is driven by many factors behind. In a population-based perspective, theoretical research focuses on the following aspects: the discussion on the relationship between the structure of the population and the housing demands is started in the late sixties by Campbell (1963) and Easterlin (1965). Both of them are all involved in related research on terms of the population age structure. As to empirical research, Mankiw and Weil (1989) did more systematic empirical study on the impact of the future housing market caused by aging structure change for the first time. It’s stated that 30-year-old man contributes the most in housing demand, while after the age of 40, people tend to reduce housing demand. Based on the annual data from 1970 to 2003 in 18 industrialized countries and the quarterly data from 1980 to 2004 in 13 other countries, Terrones and Otrok (2004) found that the population growth has a significant rise affected in house prices by using the multivariate models.

From the perspective of the life cycle theory, Modigliani and Brumberg (1954) proposed many different kind of combination of assets held by people throughout the life cycle. Davis (2005) found that the age structure of population has a very significant impact on housing prices in OECD countries. Lind and Malmberg’s (2008) research showed that the more the young exists, the higher rate of housing construction is conducted. In this way, the aging population has a negative impact on housing construction. In addition, Malmberg (2010) considered that the age structure of population is also possible to affect the housing demand by per capita income, inflation and taxes indirectly, or the demand for housing caused by the influencing housing supply, such as labor productivity by different people of different ages.

Domestic literature review. Domestic research work on the relationship between aging and housing started relatively late and mostly focused on the qualitative research and some kind of simple quantitative research. The earliest research on housing demand population in view of the age structure is conducted by Gu (1997), he claims that changes in population age structure and its future trends are an important factor that would affect the housing market demand. And he also proposes that different impact would be brought about by people in different age groups. Xing (2000) argues that the majority of purchasing population is mainly aged between 30 years old and 45 years old. If the population in this group decreases, together with the increase of the elderly, housing demand would be reduced greatly. From the view of empirical analysis, basing on gray theory, Chen, Yuan (2010) studied the impact on the real estate needs out of the age structure of the population, it’s stated that people aged between20-23 and 36-40 have the greatest demand for housing in this paper. Li, Gao (2011) using China's macro data in 1995-2009 to study the impact on the age structure of population on housing demand. They found that people in age of 15-29 year-old because of marriage, and people in age of 50-64 year-old with the peak of life time income account for greater housing demand. Overall, most scholars believe that aging may have an adverse impact on housing demand.

Researches on the status of real estate financial risks are focused on the following views: Xie (2003), Wang (2004) considered that China's real estate prosperity presents an irrational exuberance in recent years. The rapid growth of the real estate industry is at the price of credit coexist with a high violation rate, liquidity risk and displacement of the asset-liability structure, all of which make China's real estate market a bubble economy. It's pointed out that the presence of pre-review of the real estate banking loans and residential mortgage loans as well as credit risk management loose bring extensive operational risks to the real estate financial system in Mao (2007), Hu (2010), Tan (2010), Song's (2010) articles. Risks caused by overheated real estate market, real estate companies with overexpansion of credit risk, asset-liability structure emerged dislocation and liquidity risk may become the trigger point of the real estate financial systemic. By using of some international index system to indicate China's existing real estate financial risks, Wang (2006) and Li (2010) pointed out the irrational structure of China's real estate financing structure may lead to systemic financial risk.

At present, our theoretical research in this field has not reached a common understanding yet .In the conclusions of empirical research, there are some shortcomings from the point of the research: there is no whole or global linkage analysis of the changes in population structure, demand for real estate, and no research on real estate finance crisis's trigger point that is conducted among the three. Overall, the conclusions are mostly fragmented, and lack in systematic integration research. From the perspective of the research methods, they mainly use induction and deduction combined with comparison of the historical experience, but lack of systematic empirical analysis. Basing on these researches, this article construct an dynamic analysis system among aging population, changes in housing demands and potential real estate financial risks , then study the interaction mechanism and the conduction process among them, after that we make an empirical analysis between aging and housing price, and finally put forward the conclusion and corresponding countermeasures.

THE CONDUCTION MECHANISM OF AGING TO REAL ESTATE FINANCIAL RISK

There are characteristics of large amount of financing, long production cycle and a wide range of other industries involved in real estate industry. And the real estate industry plays an important role in the promoting of national economy. In 2013, China's total GDP is $10.4 trillion, and the real estate investment proportion of GDP was 15.8 percent. Therefore, once the real estate market is in risk, it would pass through two conduction paths: the financial one and the real estate industry one, and would largely affect the healthy operation of the entire economy system.

When the real estate market was initially open, China promulgated the corresponding reform policy. The physical housing allocation system is cancelled in the policy, so that the group purchase was withdrawn from the market. At the same time, the government opened the trading market, and China's real estate market just became active. The bank also extend more loans to both the real estate company and individual housing loans out of profit motive in the investment environment, Driven by both factors, the real estate market began to boom, and prices began rising. Some people think that housing price would continue to rise, so they choose to buy more houses and resulting in an increase in the frigid demand and also an increase in investors hedging purposes for speculative demand. Financial support to the market from a large number of investors who has brought positive market expectations, which further makes the commercial banks be in favor of the real estate business. Due to the inter-bank competition effect, some unqualified companies also got their loans issued. At this point, this credit expansion was totally irrational and full of risks. Coupled with a lot of speculative demand from the consumer's market, investment bubbles had already been formed, as shown in Figure 1.

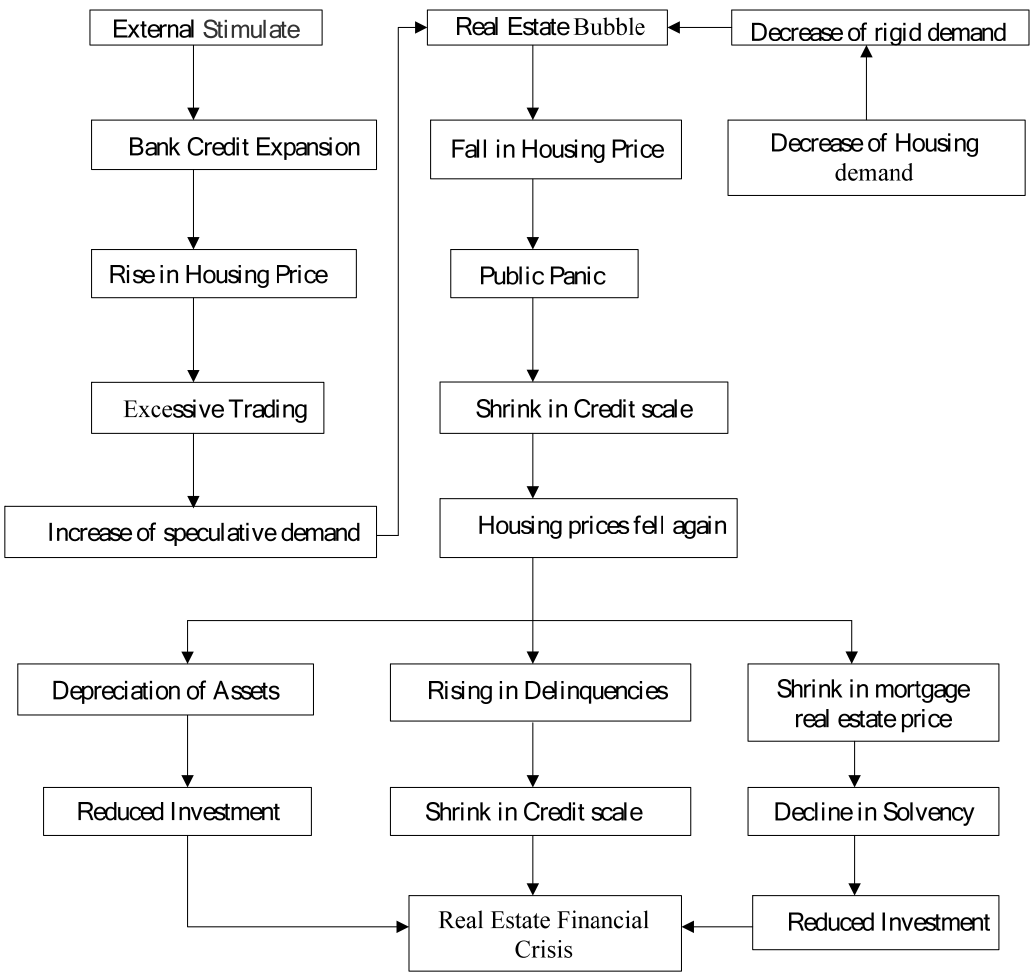


Figure 1.The conduction schematic from aging to real estate financial crisis.

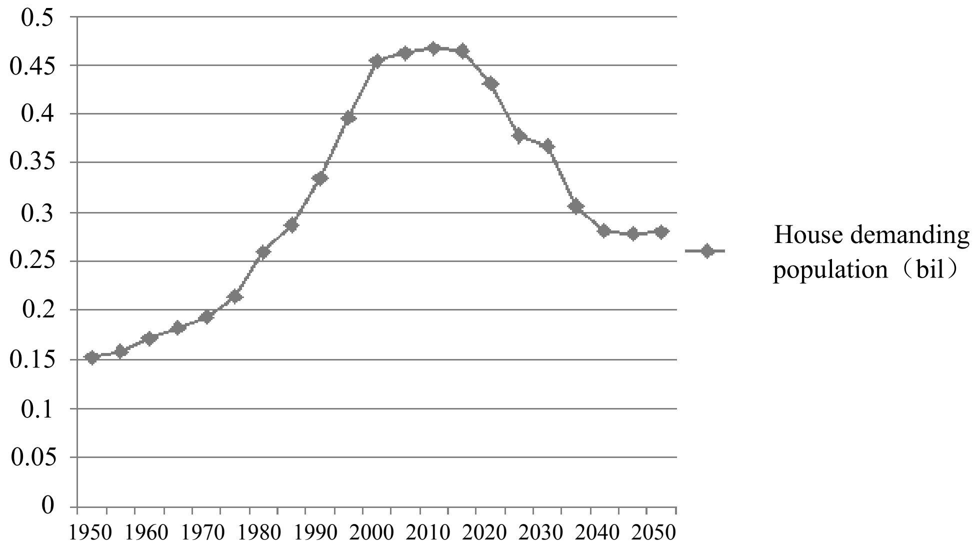
In Figure 1, the housing demand population is now experiencing an inflection point from a quantitative change to a qualitative change. And a decreased quantity of the housing demand population would make the rigid demand consumption decrease significantly. Due to the decline in rigid demand, the real estate price would go down, which would cause public panic. The panic causes the public to generate negative attitude towards the real estate market, thus some investors in speculative demand would choose to sell part of the property to reduce the actual loss. The banks would be affected by the adverse trend, and begun to shrink the scale of credit. Both actions from investors and banks would cause a further decline in real estate prices.

The sharp decline in real estate price will continue its conduction mechanism in three following directions. Firstly, it's analyzed that the sharp decline in housing price will greatly improve their probability of the loan default from companies and individuals who bear real estate mortgage loans. Thus, the bank would experience a lot of bad debts, and the financial crisis could even be caused. The case of the US subprime mortgage crisis in 2008 is just an example. Under this circumstance, the bank would evaluate the qualification of individual housing loans strictly, which could cause the bank credit reduces substantially and restricts the development of economic growth. Secondly, the decline in real estate prices would lead to a shrink in wealth kept by ordinary consumers with real estate. When personal financial situation becomes pessimistic, people would choose to reduce some unnecessary expenditure, and reduce the total spending to maintain the financial balance. The decline in total social spending would cause the economic growth slow, and cause the real estate financial crisis. Finally, the decline in real estate prices would result in lower real value of the mortgaged property. To a certain extent, reducing part of the investment could make some companies be unable to support their operations, which would increase the unemployment, and finally induce the systemic real estate financial crisis.

ANALYSIS OF THE IMPACT OF AGING ON REAL ESTATE FINANCIAL MARKET

Generally, the housing purchase behavior is driven by two kind of demand----the speculative demand and the rigid demand. The majority of rigid demand population is mainly aged between 20-year-old and 35-year-old because of marriage and work, While the main body of speculative demand is concentrated in people in age of 35 year-old to 50-years old with certain purchasing power and investment interest, and also include people who wishing to improve housing condition. The rigid demand is less affected by the housing price, but the speculative demand has greater elasticity in demand. The distribution of our housing demand population is as follows:

From Figure 2 and Table 1, we can see China's housing demand population increased rapidly from 1980 to 2005 and basically peaked in 2005. Because of the high birth rate in the 1980s, the housing demand population were in a steady peak period from 2005 to 2015. The total number of working-age population (aged between 15 and 59) declined in 2012 for the first time from the 1950s according to the annual report of the National Bureau of Statistics released in 2013, and decreased 3.45 million people compared with 2011. From 2015 to 2050, due to the one-child policy and low birth rate from the 1990s, the housing demand population declines significantly. The decline of the housing demand population would result in a decrease in the real estate purchase demand, and a structure transform from the quantitative change to qualitative change would be likely to come.



Data source: UN population division.

Figure 2.Housing demand population.

Table 1.Housing Demand Population.

Year	Housing Demand Population(Bil)	Year	Housing Demand Population(Bil)
1950	0.152	2005	0.462
1955	0.158	2010	0.467
1960	0.171	2015	0.464
1965	0.182	2020	0.431
1970	0.193	2025	0.378
1975	0.214	2030	0.367
1980	0.259	2035	0.306
1985	0.287	2040	0.281
1990	0.334	2045	0.278
1995	0.396	2050	0.280
2000	0.454		

The impact of aging on the housing demand. Demand for housing can be divided into two kinds, the rigid demand with the owner's actual use, and the speculative demand with investment and hedging purposes. The rigid demand is often less affected by the housing price, while the speculative demand has greater price elasticity. Our housing purchase population is now experiencing a turning point from a quantitative change to a qualitative change in 2015, and the reduce of the housing purchase population would result in a significantly decreased in rigid demand consumption, and a decline in housing prices.

The drop of housing price causes the public to generate negative attitude towards the real estate market, thus some investors in speculative demand would choose to sell part of the property to reduce the actual loss. The banks would also be affected by the adverse trend, and begun to shrink the scale of credit. Both actions from investors and banks could cause a further decline in real estate prices, and make it difficult for the real estate company to maintain their capital chain.

Analyze of the impact of aging on housing demand. To further analyze the impact of aging on housing demand, we selected housing prices as the most direct reflection of housing demand, and constructed a model as follows to analyze the relationship between aging and housing demand:

$$\ln HP_t = \alpha + \beta \cdot Aging_t + \gamma X_i + \mu_i$$

Among them: $\ln HP_t$ represents the housing price index, $Aging_t$ stands for the proportion of the aging population, μ_i stands for the residuals, X_i represents a series of control variables, includes: (1) rate of urbanization, (2) the growth rate of GDP per capita, (3) the ratio of M2 supply to GDP, (4) the real interest rate (5) the ratio of stock market transaction volume to GDP (6) the ratio of domestic consumption to GDP. The main research is to define the coefficient β of $Aging_t$, and the economic significance refers to when the aging population increases each 1% , whether the housing price index will rise or decline in some percentage .

We assume that the housing price is negatively related with aging rate. Housing prices and aging rate are collected from the China Economic Information Network database, and other data are collected from the World Bank WDI database. The statistics of the variables are as follows in Table2.

Table 2.Statistics of the Variable.

variable	Num. of samples	Min. value	Max. value	Mean value	Standard deviation	Kurtosis	Skewness
HP	22	1.83	326.08	80.50	98.83	0.42	1.25
Aging	22	6.15	9.70	7.52	1.09	-0.81	0.50
UBT	22	27.63	53.37	38.54	8.92	-1.46	0.19
PCG	22	6.69	13.57	9.39	2.06	-0.63	0.62
MDG	22	90.36	194.52	142.7	31.17	-0.96	-0.12
RR	22	-1.27	20.63	5.37	5.53	1.53	1.23
IR	22	-8.00	7.34	1.79	3.88	0.31	-0.59
SDG	22	3.95	223.00	63.71	59.54	1.19	1.36

Data source: WDI database.

For the analysis of the time series data, we select the housing price index as the dependent variable and aging as the explanatory variable with the help of the multiple linear regression, and gradually added each control variable to the model to make a regression analysis. The result is shown in Table 3 based on the above data and formula. We can see from Table 3 that the housing price is negatively related with aging rate. Each percentage of increasing in aging makes housing price index fell about 4 to 5 percent. That is to say, housing prices would fall with the increasing rate of aging. Although the extent of the impact is not very significant, due to the high leverage in real estate financing mentioned previously, the risk would be hugely magnified, and then impact the entire real estate industry.

Table 3.Result of Multiple Linear Regression.

Variable	Model 1	Model 2	Model 3	Model 4
α	5.61	6.81	17.18	9.08
	(0.41)	(0.95)	(4.03)	(1.17)
Aging	-5.83	-6.11	-5.91	-4.68
	(0.60)	(0.52)	(0.85)	(0.21)
UBT		3.78	2.18	5.20
		(0.33)	(0.04)	(0.56)
PCG		3.35	1.71	1.37
		(0.84)	(0.11)	(0.09)
MDG			2.09	1.75
			(0.58)	(0.04)
RR			-2.04	-5.65
			(0.33)	(0.10)
IR				8.14
				(0.52)
SDG				-0.21
				(0.01)
N	22	22	22	22
Adjusted-R^2	0.3682	0.6895	0.8630	0.9041

Impact of aging on the real estate financing cost. From the perspective of life-cycle consumption theory, people need to balance expenses and income in his lifetime. In the working age of 20 to 60 years old, apart from living expenses, it's also required for people to keep apart some savings for the retirement. After the age of 60, we steps into a stage that could only spend the saving without any new income. This makes in the whole, a large proportion of the labor force is usually accompanied with high savings rate, and adequate deposit would result in low interest rate and high investment income. However, together with the increase of the aging population, the deposit rate would decline significantly. And our commercial banks are still rely on the interest rate difference to make a profit. Once the aging population step into the rising channel, current situation of low interest rates would be changed, and the real estate business financing costs would rise sharply.

From Table 4, we can see that real estate loans almost tripled its growth in just six years from 2007 to 2013, and the growth rate is maintaining at a high level. Comparing with the international level of loan balance, our situation is not serious, but considering that bank loans take up the majority share in the real estate financing market in our country, this situation is worthy of attention. Statistics has shown that about 60% to 70% of real estate capitals are from the bank loans, and 90% of all individual would choose housing mortgage when buying a house, of which 80 percent would choose to sign the mortgage contract with the bank. The reasons why this could happen are as follows: firstly, compared with other means of financing cost rate that around 10%, the commercial loan rate is merely 6% to 7% or even lower. Secondly, by the end of 2013, China has 168 listed real estate companies, which only takes up 1% in the total number of real estate companies. Real estate companies have little choice in financial channel.

Table 4.Domestic Loans and It's Growth rate in 2000 to 2013.

Year	Domestic loans（billion）	Growth rate
2000	138.508	0.225030
2001	169.220	0.221734
2002	222.034	0.312103
2003	313.827	0.413419
2004	315.841	0.006418
2005	391.808	0.240523
2006	535.698	0.367246
2007	701.564	0.309626
2008	760.569	0.084105
2009	1136.451	0.494212
2010	1256.370	0.105521
2011	1305.680	0.039248
2012	1477.839	0.131854
2013	1967.266	0.331177

CONCLUSION AND RECOMMENDATIONS

The risk in real estate system is very complicated and protracted in a long-term, and also is highly centralized in the banking system currently. So we need to work from both the regulation of the real economy and the real estate finance market to prevent the risk. In order to avoid the formation of the real estate financial risks and its conduction, we can take measures in following three aspects.

Firstly, in order to solve the problem of structural demand in the real estate market in China, the transformation of the real estate industry is imminent. During the transitional period, we can start the from two aspects: Firstly, for the old people we can develop suitable house with convenient supporting facilities such as clinics and the elderly community care service to stimulate the demand from the aging population. Secondly, the development of intellectual city on the existing property would be a revolutionary new intelligent upgrade, by referring to the development mode from traditional phone to smart phone, we can enhance the quality of life. With the cross-border cooperation of electronic industry and communications industry, the new buildings would be built with intelligent remote control, which could stimulate new housing demand in the high-income groups.Secondly, in order to resolve the current problems of the restricted credit scale from the bank, we can draw lessons from the operational experience of the mature real estate financial market in Europe and America. By guaranteeing the security and stability of financial market, we can gradually try to implement the real estate securitization. In so doing, we can split the risks from the real estate market to the entire capital market in order to weaken the risk. And we also can enhance the liquidity of assets, ease the financial problems precipitated by the structural contradictions caused by the tension of capital chain, and settle the vacancy of the backlog of funds as well.

Finally, China should establish a national third-party authority: the credit rating system to solve the problem that some mortgaged property lack the ability to resist risk in price. By using the above system, asset valuation of each region will have a fair unified standard, which could identify the bad assets from the source at the beginning of the mortgage, and give its fair price in a reasonable assessment to provide support and protection for the healthy development of the real estate finance. In the early establishment of the system, we can choose to cooperate with foreign mature large rating agencies, and then set up several national rating agencies in the first-tier cities, and form the same system from top to bottom finally.

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Research on Construction Multiemployer Health Insurance

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Abstract

Although construction accidental insurance (CAI) is mandatory in China, the really holding rate is under 30%. The reason of low purchasing rate and deficiencies of CAI remain unexplored. Our analysis shows employment size, the attitude of the proprietors and turbulence of the business cycle influence the prevalence of CAI. The deficiencies of CAI result in inefficient protection for farmer-labors. Compared to the deficiencies of CAI, Construction Multiemployer Health Insurance (CMHI) is an efficient and effective way to provide security for farmer-labors. It can stimulate the holding of health insurance by exploiting cross-firm economies of scale in the purchase of health insurance services. And multiemployer health insurance contain cross-employer portable health benefits that do not require second probation period when labor enroll another employer after leaving , at the same time it cover spells of unemployment. Additionally, construction multiemployer health insurance is a beneficial supplement for the construction accident insurance in China.

INTRODUCTION

Construction is a highly hazard industry around the whole world, especially in China. In 2009, construction accidents killed 2760 people in China. The number of deaths of construction accidents located second, just less than the number of people killed by traffic accidents and more than the number of people killed by coal mining accident. In 2009, construction accidents caused more people died than coal mining industry, and firstly became the most hazard industry in China. On the other hand, the number of construction workers is 44,993,100 people, occupied 5.85% of the workers in whole society. There are not precise statements about the source of construction workers in 2014 China Statistical Yearbook. However, the construction industry recruits most peasant-workers than any other industry; as a result almost 41.4% of all the rural migrant workers work in construction industry in cities (Li 2003). Construction blue collar in China roughly are all peasant-workers. The question is whether migrant workers can get effective protection in such a dangerous construction industry.

It is well known that farmer-laborers are vulnerable group in China. Social security system for farmer-laborers is inadequate, especially for construction industry workers (Xu 2004). The root reason for this problem is a dual division of social structure between urban and rural area. Civilians in urban receive higher protection from social security system than people in rural area. Scholars concentrate on construction accident insurance system. Research shows that the firm size and nature positively influence the purchase of construction accident insurance. It remains true that farmer-workers in larger firms and state-owning firms are more likely to receive construction accident insurance. There is not a full competitive market for construction accident insurance in China (Song 2011). Operating model varies from one city to another, failed to develop a unified mature one. Scholars provide a scientific way rating construction accident insurance premium (Fang et al. 1999). Although construction accident insurance is compulsory insurance in China, the prior literature show the prevalence of construction accident insurance is under 30%. Little attention has been paid to the reason and deficiencies of construction accident insurance. Construction accident insurance (CAI) is forcible in China; some reasons cause some firms not to purchase CAI for farmer-laborers.

THE REASONS FOR LOW PREVALENCE OF CAI

According 2014 China statistical yearbook, construction industry is populated by 79528 firms as shown in Figure 1. State-owning firms are 4607, accounting for 5.79%. Collectively-owned enterprises are 4572, accounting for 5.75%. Hong Kong, Macao and Taiwan invested enterprises are 389, accounting for 0.489%. Foreign funded enterprises are 280, accounting for 0.35%. And other enterprises are 69680, accounting for 87.62%. In China, state-owning enterprises, collectively-owned enterprises, Hong Kong, Macao and Taiwan invested enterprises, and foreign funded enterprises are generally larger than other enterprises. So we assume other enterprises are small firms. Small firms account for 87.6% of this volatile industry.

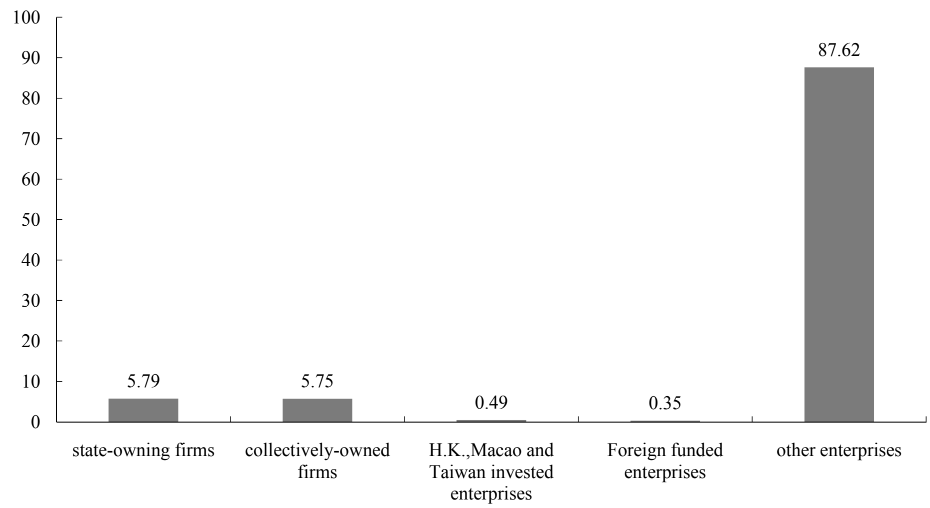

Figure 1.The ownership of firms in construction industry.

Generally across the economy, small firms are less likely to provide CAI due to economics of scale including the costs associated with the purchase of CAI. CAI premium for larger firms roughly equals 0.5‰ of the project cost, compared with 2.25‰ for small firms.

Small firms probably stand a higher overall firm-labor turnover. Small firms naturally don't purchase CAI for the unstable group. Even small firms and larger firms have the same turnover; small firms maybe have a small core of stable workers due to employment size. Larger firms may have a larger core of stable workers combining the advantage of stability and size in the purchase of CAI.

The prevalence of CAI is influenced by the attitude of the proprietors. Although CAI is mandatory by law in China, there is no tighter regulation system in practice. Some projects are required to purchase CAI by the proprietors. Some projects don't mandatory requirements of CAI by the proprietors. We interview 45 contractors in Beijing construction sites. Figure 2 shows 19.61% of contractors never purchase CAI for any projects, and 7.84% of contractors purchase CAI for all projects. So changing the attitude of the proprietors and supervising the proprietors are the effective ways to improve the purchase of CAI.

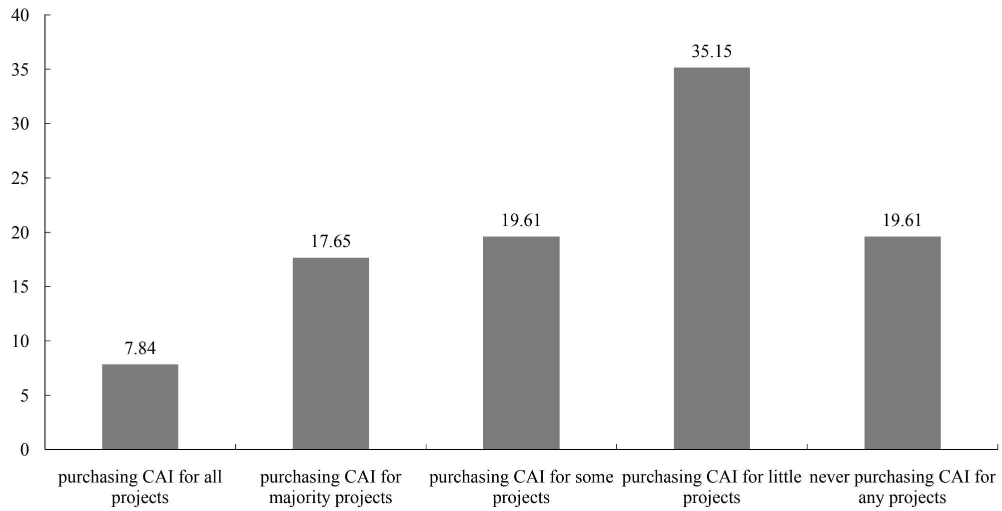

Figure 2.The status of CAI purchased by construction contracting enterprises.

The prevalence of CAI is influenced significantly by the turbulence of the business cycle, especially for small firms. During the boom, small firms enter the industry and expand their workforce. During the downturn, small firms lay off their marginal workforce and some exit the industry. The prevalence of CAI is higher in the boom than downturn.

DEFICIENCIES OF CAI

In this research we use questionnaire method to study the deficiencies of CAI. In December 2014, we interview workers of Jindi Huiyuan Real Estate Co.Ltd on construction site of Jindi Yuejingtai. Jindi Group is now one of the top three on the Chinese real estate company's comprehensive strength list. This construction company purchased CAI for all the farmer- workers. The first-line workers on this construction site include urban laid-off workers and farmer-labors. Because we are interested in the effects of CAI on farmer-labors, we restrict our sample to farmer-laborers on the construction site. In addition, we only select fulltime farmer-laborers entering our sample. Unfortunately, our data do not measure the different coverage of CAIs. Nonetheless, we believe that if we could measure the gap, the results of our model would be stronger than those we report here.

There are 1140 surveyed individual in this construction site. Table 1 shows 15.8% (180 farmer workers) under 25 years old, and 65.8% (750 farmer workers) between 26 and 40 years old , 18.8% (210 farmer workers) over 40 years old. From the perspective of the age distribution of farmer workers, construction industry is filled with young and middle-aged people in China.

Table 1.Sample of the Surveyed Individuals.

Age (years)	Number of observation	Percent
≤25	180	15.8
26~30	320	28.1
31~40	430	37.7
41~55	160	14
≥56	50	4.4
Total	1140	100

The wage in Table 2 is the surveyed worker's monthly wage in 2014, including overtime pay. Table 2 shows 79% (900) of farmer-laborers' wage from 3000 to 5000 yuan. The mean of wage is 4311yuan, slightly higher than the national construction average wage level (4272 yuan).

Table 2.The Surveyed Individual's Wage Level.

Wages (yuan)	Number of observation	Percent
≤3000	35	3.1
3000~4000	467	41
4000~5000	433	38
≥5000	205	17.9
Total	1140	100

Table 3 shows 57% (650 farmer-laborers) of the surveyed individuals having illness during working. However Table 4 shows only 42% (273 farmer-laborers) of the sicken individuals seek medical advice. On this construction site where every worker has CAI, the reasons that 58% of the sicken individuals don't seek medical advice are complex. The upper limit of reimburse benefit of the CAI on this construction site is 3000yuan. Table 5 shows 89.7% (245 farmer-laborers) of the sicken individuals who go to see the doctor can use CAI to cover hospital bill. The 58% of the sicken individuals hesitate to see the doctor for three reasons. First, the term of CAI is from the beginning of the construction to the end of the construction. The construction industry is filled with heavy pressure and high strength jobs. The contractors urge to shorten the construction period, and farmer-laborers are intimidated that they would be fired if they take time off whatever they do. When the construction period is over, farmer-laborers have idle time to see the doctor but CAI is invalid. Second, if farmer-laborers go to see the doctor, they need to pay the bill by themselves in advance. They can be compensated their hospital bills by CAI until the medical treatment is over. Claim settlement also will consume farmer-laborers at least one day. Owning to know less about the operation of CAI, farmer-laborers worry that they will lastly pay the hospital bill if they go to see the doctor. Third, CAI only compensates the hospital bill caused by construction accidents, so the cost of ill-health doesn't be covered by CAI.

Table3.Health Status of the Surveyed Individuals.

Health status	Number of observation	Percent
No illness during working	490	43
Have illness during working	650	57
Total	1140	100

Table 4.The Status of Seeking Medical Advice.

The status of seeking medical advice	Number of observation	Percent
Not seeing the doctor	377	58
Seeing the doctor	273	42
Total	650	100

Table 5.The Hospital Bill of the Sicken Individuals.

The hospital bill (yuan)	The number of observation	Percent
≤500	133	48.7
501~1000	74	27.1
1001~3000	38	13.9
3001~5000	25	9.2
≥5001	3	1.1
total	273	100

In Chinese construction industry, most contractors are small and their development is confined by their capital. Thus the prevalence of CAI is under 30% in China. Even for a construction site where every farmer-laborer has CAI, 58% of the sicken individuals abandon the chance to see the doctor. The farmer-laborers without CAI will more likely abandon the chance to see the doctor. Farmer-labors in the risky construction industry urgently need healthy security.

Construction industry requires a considerable amount of industry-related human capital. If contractors provide human capital investment, they can harvest the internal and external benefits originated from industry-specific human capital investment in construction. The internal benefits mean high output. The external benefits mean not only benefit the individual workers but also benefit other workers of this firm and other firms as well, because other workers can learn industry-specific knowledge from the trained workers. However the CAI can't provide job lock or industry lock for contractors, so contractors invest training for farmer-laborers without passion.

CONSTRUCTION MULTIEMPLOYER HEALTH INSURANCE (CMHI)

Health insurance is an effective and efficient supplement to CAI, especially thinking about the low prevalence of it. Research on health insurance has shown worker characteristic, wages and firm size are important factors influencing the prevalence of health insurance. For construction industry, these factors are also important. Thus, small employment size, high turnover and limited capital set barriers for small firms as the majority of the construction industry to purchase health insurance.

Construction Multiemployer Health Insurance (CMHI) refers many contractors as a whole collectively bargain on health insurance for construction industry. The presence of construction multiemployer health insurance significantly alters the dynamics associated with economics of scale in purchasing health insurance. CMHI have a key advantage of economies of scale by shifting size constraints from the firm to the multiemployer group in purchasing health insurance. So CMHI can reduce the costs of providing health insurance and the importance of firm size as a factor will be reduce substantially in influencing the prevalence of health insurance in construction.

In CMHI, workers typically experience a probationary period only once before qualifying for health insurance. Suppose a worker leaving his prior job, and he can take the portability of coverage to another participating contractor. There is no a new probationary period for him. However, if the worker leaves construction industry, he cannot take away his multiemployer health insurance policy. If the worker has accumulated a certain number of working hours in the past, he don't need immediately get hired by another participating contractor owing to hours banks in the program that permit policy valid during spells of unemployment. Thus, the costs of enrolling workers new to the firm are reduced because he has prior experience in another participating contractor.

CMHI may motivate contractors invest more in industry specific human capital than would the individual contractor, because it locks farmer-laborers into the group of multi-employers participating to some extent. If farmer-laborers leave the construction industry, their multiemployer health insurance will invalid. Larger contractor may invest more in industry specific human capital because they are easy to keep their workers occupied by moving them to another projects, however small contractors will fail to find another projects.

On the construction site, construction workers aren't only vulnerable to construction accidents, but also some diseases owing to unhealthy environment. CAI can only cover the cost coursed by accidents. Additionally, CAI is a kind of insurance concentrating on the results of accidents. Thus the compensation can be received only at the end of medical treatments. The farmer-laborers should pay by themselves during the medical process. So construction health insurance is imperative for farmer-laborers.

CONCLUSION

Social security of farmer-laborers is very special and imperative in China. Construction industry attracts most farmer-laborers working in cities. The characteristics of construction industry let farmer-laborers in a more dangerous situation. The low prevalence and the deficiencies of CAI can't provide sufficient protection for the farmer-laborers. Construction Multiemployer Health Insurance will solve many problems caused by CAI and become the beneficial supplement.

ACKNOWLEDGEMENTS

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Pre-Control Study of the Falling Risk in Construction Based on Fault Tree Analysis and a Reason Model

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Abstract

In this paper, with the fault tree analysis of high altitude falling accidents in construction, we get three minimum cut sets and sort the events into four important levels on the basis of basic events importance. Then we create a reason pre-control model with five levels to avoid falling accidents in construction, which concludes organizational factors, unsafe supervision, unsafe operating conditions, provided that unsafe behavior and unsafe behavior. By combining the optimal feedback paths basic event importance sort, we proposed targeted risk control measures, so as to achieve pre-control of falling accidents in construction.

INTRODUCTION

In recent years, whether national or Jiangsu Province has a high priority of safety production in the construction. According to the data from the incident report of Jiangsu Province accidents, Jiangsu Province has a total of 148 accidents occurred concluding the collapse of 11 cases, nine of lifting injuries, 88 falling accidents, 8 mechanical injuries and 29 accidents attacked by falling objects, 3 fires incidents in 2013. For the falling accidents have the highest proportion, the object of our study was identified as high-altitude fall accident and we hope it can provide some reference value for better implementation of the high-altitude operations.

At present, domestic and foreign scholars have various study of the falling accident. American scholar Weisgerber (1999) verified the approach "to ensure safety by design" that has a strong role in guiding practice on the construction site. Security experts of US National Institute for Occupational Safety and Health (NIOSH) also found more alert and effective way to prevent falls for the employers and workers, and developed and designed protection procedures to ensure the safety of workers at risk of exposure (Shen 2007). Whereas the domestic scholars mainly concentrated on the cause analysis and prevention measures. In their studies (Yu 2013; Huang 2011; Liu and liu 2010; Zhang 2012), qualitative analysis of the main factors affecting the falling accident was given, then they proposed measures to strengthen safety education which are nothing more than a sound safety management agency staff and management systems, strengthen safety management as long as people eliminate unsafe acts, unsafe condition eliminates material, security management in place, and we can avoid falling accidents to some extent. With the combination of fault tree analysis and Reason model, this paper established falling risk pre-control model. By more targeted pre-control measures, we can reduce the probability of the high-altitude falling accidents in construction work.

FAULT TREE ANALYSIS OF FALLING ACCIDENTS IN CONSTRUCTION

Fault Tree Analysis (Fault Tree Analysis, FTA) is a representation of causality and logic diagrams. By analyzing various insecurity factors (including hardware, software, environment, people, etc.), the logic diagram was drawn to determine the cause of system failure with all possible combinations (Hadipriono and Wang 1986; Khan and Haddara 2004; Zhang 2006).

Construction of fault tree. To construct fault tree of falling accident, falling accident risk factors should be identified firstly. By using Preliminary Hazard Analysis and combined the construction work related accident inspection in JGJ59-2011 construction safety checklist, the fault tree was built in Figure 1 on the basis of risk factors then, and falling accident risk factors were analyzed in Table 1.

Qualitative fault tree analysis. The minimum cut set means the collection that if all the events occur, the top event will occur inevitable. With the accident analysis, minimal cut sets (dangerous path or control path) is to be obtained. After construction of falling tree, using Boolean algebra to simplify the method for solving the minimal cut sets (Zhang et al. 2008; Li 2009), we can get 4884 minimum cut sets, set $a = 52,\ldots,54$、$b = 55,\ldots,58$, $d = 29,\ldots,33$, $e = 34,\ldots,37$, there are 4080$\{X_a, X_b, X_c, X_d, X_e (c = 1,\ldots,17)\}$ minimum cut sets; 660minimal cut sets $\{X_a, X_f, X_d, X_e (f = 18,\ldots,28)\}$, the last remaining 144 minimal cut sets can be represented as $\{X_{38}, X_{39}, X_a, X_b, X_j (j = 40,\ldots,51)\}$.

Quantitative fault tree analysis. Importance analysis of fault tree has been focused on quantitative analysis. Fault tree analysis, including structural importance, the probability importance and critical importance (Su and Tian 2008). To study the risk pre-control of falling accident in construction work, this paper considers only structural importance when the contribution of the event is equal. If the basic event appears less in the minimum cut with fewer events, while occurs more often in the minimum cut sets with more basic events, or other complex cases, its structure importance can be get approximated in the following formula.

$$I_\phi(j) = \sum_{x_j \in G_r} \frac{1}{2^{n_j - 1}} \tag{1}$$

Where $I_\phi(j)$——approximate value judgment of basic structure importance of the event x_j, $I_\phi(j)$ is greater, then the structural importance is bigger;

$x_j \in G_r$——basic event x_j belongs to minimum cut set Gr;

n_j——the number of basic events that the minimum cut set x_j contains;

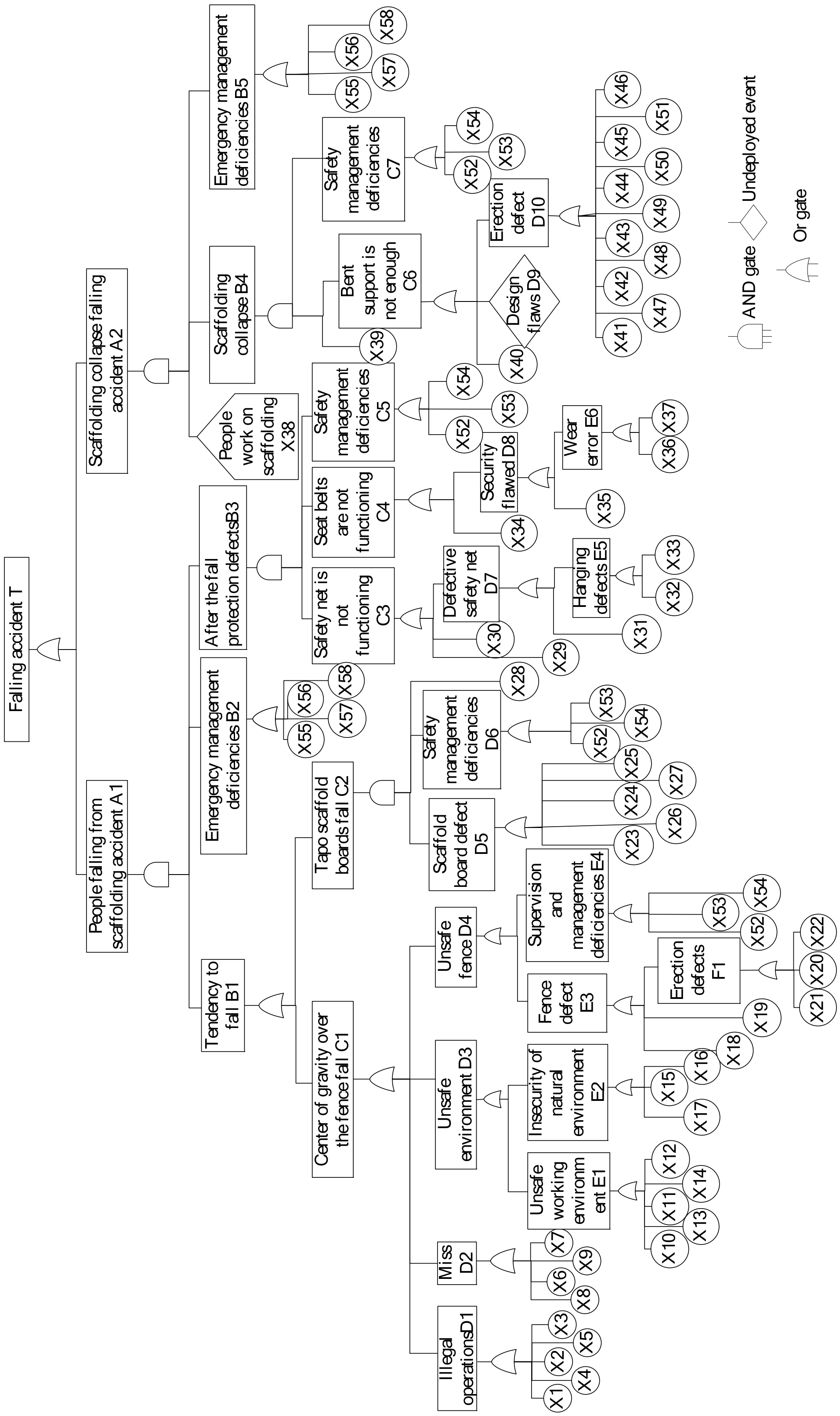

Figure 1.Fault tree of falling accident.

Table 1.Falling Accident Risk Factor.

Number	Risk factor	Defense level	Number	Risk factor	Defense level
X_1	Not wear slip-resistant shoes	5	X_{22}	Fence not high enough or too large gap	3
X_2	Illegal command	5	X_{23}	Scaffold board specifications or materials defects	3
X_3	No operation within the fence	5	X_{24}	The existence of the probe panel	3
X_4	Standing on the steel skeleton or skeletons climbing	5	X_{25}	Use crack scaffold boards or board spacing is too large	3
X_5	Drunk construction	5	X_{26}	Thickness does not meet the load requirements	3
X_6	Negligenceordistracted	5	X_{27}	Scaffold boards are not covered or instability	3
X_7	Emergency health	5	X_{28}	Overweight of people	3
X_8	Overexert or step on slipping items	5	X_{29}	Not use safety net under the operational scaffold board	3
X_9	Avoid other objects accident	5	X_{30}	Not set dense mesh safety net closed out side of the frame body	3
X_{10}	Nighttime illumination light is dim	4	X_{31}	Safety net quality defects	3
X_{11}	Work surface slippery	4	X_{32}	Anti-hang or angle is too large	3
X_{12}	Work surface space is small	4	X_{33}	Hanging not strong, damaged or closed lax	3
X_{13}	Work surface footing unreliable	4	X_{34}	Not wearing seat belts	3
X_{14}	Construction machinery runaway hit at the job	4	X_{35}	Seatbelt quality defects	3
X_{15}	Dust too seriously affecting sight	4	X_{36}	The connection point is not strong	3
X_{16}	Inclement weather (lightning storm)	4	X_{37}	Unbuckled	3
X_{17}	Unpredictable natural disasters	4	X_{38}	People work on scaffolding	3
X_{18}	No fence	3	X_{39}	Heap objects overweight	3
X_{19}	Fence material defects	3	X_{40}	Scaffolding material used defective	3
X_{20}	No block feetboard	3	X_{41}	Pole or frame Basics uneven, yet, does not meet the special requirements of the construction program	3
X_{21}	Fence strength is not enough	3	X_{42}	Pole or the base plate at the bottom of frame body's missing or pad specifications do not meet regulatory requirements	3

Table 1.(Continued).

Number	Risk factor	Defense level	Number	Risk factor	Defense level
X_{43}	Body and frame structures Rachel way or spacing does not meet the regulatory requirements	3	X_{51}	Horizontal level is not set in the pole at the intersection of the longitudinal horizontal bar	3
X_{44}	Fastener tightening torque is less than or greater than 65N.m 40N.m	3	X_{52}	Security management not staffing in place	2
X_{45}	Failure to specifications set vertical and horizontal sweep shot	3	X_{53}	Lack of supervision and inspection of the construction site to monitor the strict enough or thoroughly	2
X_{46}	Setup and fixed sweep shot does not meet regulatory requirements	3	X_{54}	No seriously implement preventive measures against security risks rectification of deficiencies	2
X_{47}	Pole, vertical horizontal bar, horizontal bar spacing exceeds the design or specification	3	X_{55}	Failure to develop safety and emergency rescue plan	1
X_{48}	Failing to set the vertical or horizontal bracing scissors	3	X_{56}	Emergency rescue organizations or Failing is not established with rescuers	1
X_{49}	Scissors not set continuous along scaffolding height or angle does not meet regulatory requirements	3	X_{57}	No regular emergency rescue drill	1
X_{50}	Diagonals of scissors or scissors to take a long diagonals with rods fixed frame body does not meet the regulatory requirements	3	X_{58}	Emergency rescue equipment and devices are not configured	1

According to the above structural importance analysis, in accordance with the number of basic events minimum cut contained, basic events can be sorted and analyzed.

By solving the above-mentioned structural importance values of minimum cut sets, basic events can be divided into five levels ordered from small to large degree of importance (see Table 2).

Table 2.The Values of Basic Events Structure Importance.

Basic Events	Values of Structure Importance(I_ϕ)	Rating
X_{38}、X_{39}、$X_c\,(c = 1,\ldots,17)$、$X_j\,(j = 40,\ldots,51)$	0.20	Five
$X_f\,(f = 18,\ldots,28)$	0.25	Four
X_a	0.65	One
X_b	0.40	Three
X_d、X_e	0.45	Two

FALLING RISK PRE-CONTROL MODEL

Reason model is a conceptual model proposed by James Reason, professor of psychology at the University of Manchester, and presented in his book "Human Error" (Reason 1990). The model considers that isolated factors do not cause accidents, accidents are failures at all levels of the system at the same time, the result of joint action. All levels of the model are like a layer of cheese, the holes of the cheese is on behalf the defects of each layer. When the accident occurred, just as there is a light to penetrate all the cheese holes of each layer, a multi-level system loses defensive protection (Geng et al. 2013; Zheng et al. 2013). This article will use the idea of classical model of Reason into the pre-control of high-altitude falling accident. According to the dangerous path (minimal cut sets) obtained, the pre-control model is constructed so as to pre-control falling risk accordingly.

Construction of falling risk pre-control model. Combined with the identified risk factors of falling accidents, pre-control model can be established including organizational factors, safety supervision, safe operating conditions, the premise of safe behavior, the behavior of the five levels of defense security. The meaning of five defensive layers in pre-control falling accidents model is as followed.

(1) Organizational Factor Level. Organizational error refers to the individual behavior of people in the decision-making due to the lack of knowledge and experience. No errors were found in time so as to control timely and thus transformed into management systems, rules, procedures, policies, strategic decision-making and other defects or errors. Any deviation of the above aspect can be called organized error.

(2) Safety Supervision Level. The main task of the safety oversight layer is to ensure the smooth realization of the established program and planning goals to reinforce construction work. This level of insecurity supervision is prone to human errors include improper management, unreasonable task allocation, imperfect institutional measures, and the potential risk factors are not founded or not solved and other aspects of irregularity.

(3) Safe Operating Conditions Level. Unsafe operating conditions are unsafe hardware which construction workers are in. This level includes insecurity in actual construction process, such as erection of scaffolding, setting defect of fencing and safety net and so on.

(4) Premise of Safe Behavior Level. Premise of safe behavior factors are

related personnel and environment which can lead to unsafe behavior. While specific to the construction work, these factors include individual and environmental factors. Personal factors include poor physical condition and poor psychological condition of construction workers. Environmental factors include the natural environment due to limitations, such as low visibility, bad weather and other threat factors for construction workers.

(5) Safe Behavior Level. Unsafe behavior is divided into errors and irregularities. Errors include lapse in the decision-making skills and cognitive error. Irregularities consists habitual violations and contingency violations. Therefore, this level of safety behavior risk pre-control should focus on both violations and operator error.

By combining the identified risk factors, all risk factors corresponding to the levels of defense could be shown in Table 1 (Organizational level is the number 1, safety supervision level is the number 2 and so on). And all of the risk factors of the falling accident in construction operations in pre-control model can be reflected in Figure 2.

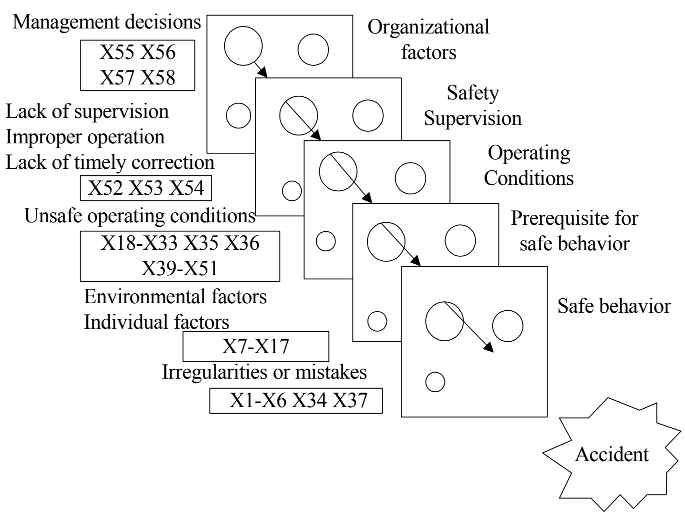

Figure 2.Risk pre-control model figure.

RISK PRE –CONTROL

In the application of risk pre-control model, the basic events of each level of defense should be monitored according to their level of importance, which means to focus on monitoring the basic event of the first important level. When finding one basic event occurs, prior attention should be taken to the corresponding minimal cut sets, and have a real-time monitoring of other essential events in the minimal cut set. For the overall risk pre-control of falling accidents in construction, following the above principles, review of the risk should be taken constantly in order to have the loop pre-control of the risk.

Measures to control the risk of pre-accident are to prevent the formation of an accident chain, but the chain to form a line of accidents is not only in the construction work of this study. As we know, there are about 5000 minimum cut sets of scaffold falling accident cut sets and three types of fault chain in pre-control model in Figure3. Therefore paths need to be chosen according to the structural importance of different paths, ease of control vulnerability and cost.

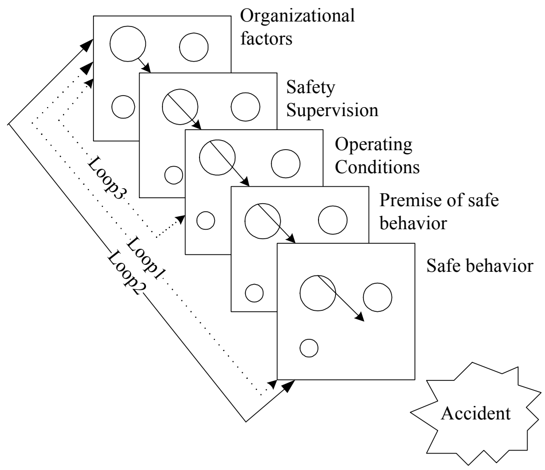

Figure 3.Control path analysis diagram.

Firstly, the overall structure importance of three types of cut sets can be obtained according to the basic importance of the event, minimum cut sets of {X_a, X_b, X_c, X_d, X_e (c = 1,…,17)} is 0.0105, minimum cut sets of {X_a, X_f, X_d, X_e (f = 18,…,28)} 0.0146, and {X_{38}, X_{39}, X_a, X_b, X_j (j = 40,…,51)} is 0.0021 respectively. Thus the degree of structure importance of the second minimum cut set (path) 2 is the highest which should be controlled most.

At the same time, according to the prerequisite of controlling human errors (Zheng et al. 2013), unsafe behavior is dominant mistakes and is easy to be spot. So the paths 1 and 2 could be more appropriate. With no need of control for safe behavior and organizational factors levels, the path 2 as a feedback path is more reasonable.

CONCLUSION

(1) Through the use of fault tree analysis for fall accident, the accidents path is obtained. And basic events on the path can be sorted into five levels according to structure importance.

(2) By combining the results of the fault tree analysis and Reason model, pre-control system of falling risk has been more perfect, including organizational factors, safety supervision, safe operating conditions, prerequisite for safe behavior and security behavior of five defensive levels. To control the falling risk by through the pre-control system should follow these two points: (i) Controls of each defensive level should be taken based on the importance level of each basic event. And once a basic event occurs, the rest basic events of its minimum cut should be controlled rapidly, in order to prevent the formation of an accident chain. Pay attention to loop pre-control, which requires strict review, so as to pre-control basic events immediately. (ii) With multiple paths for an accident, in actual risk pre-control process, control path should be

merited considering pre-operability of risk control and importance of the path as well as costs. The selection of the optimum control paths in this article only focused on the former. Controlling costs could be considered in future study so as to obtain a more reasonable and economical control path.

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Claim Management of Construction Engineering

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Abstract

Claim is a special component of project costing. It is important to increase owner and contractor understands of it, to strengthen research on claim theory and method, to treat and manage engineering project claim seriously. When facing claim or realizing the potential possibility of claims in construction engineering project, the contractor will first need to send written notice to the Field Engineer appointed by the employer (the owner), according to the timeline set by the mutually signed construction contract. The contractor will then need to strengthen the engineering project construction plan and construction contract management.

INTRODUCTION

Claims are indispensable in a construction contract. Some project management experts said that whether a project is profitable largely depends on if the contractor can use the claims clause with ease. Claims in construction market are important and effective means that contractors can use to protect their rights and interests, reduce their loss, and improve economic efficiency. There are many international construction projects of which the income was improved about 10% to 20% of the cost by successful claims (Geng 2004), some claimed amounts were even over the total amount of contract. Claims management is an important part of contract management, and project management as well.

Claims are that one party of a contract demands economic compensation from the other parties of the contract when the other parties fail to perform the contract correctly. In practice, both construction owner and construction contractor have rights to bring forward a claim. Claims are for economic compensation rather than punishment. In construction projects, we must take claims seriously by assigning specific person to be responsible for claims management, and running claims management through the whole process and each stage of the project implementation to improve the construction business management and project management (Yu 2009).

CLASSIFICATION OF ENGINEERING CLAIMAS

Classification according to the cause of claims. Claims caused by construction preparation, schedule control, quality control, cost control and management can be easily reviewed and analyzed by project owners and engineers as the cause of each claim can be pointed out clearly (Liu 2010).

Classification according to the purpose of claims. Claims can be divided into duration claims and cost claims according to the purpose of claims. Duration claims are to require owners to extend the construction duration and postpone the original completion date of project to avoid the occurrence of a default fine; expenses claims are to require both owners and contractors compensate incurred loss and then adjust the contract price (Yu 2009).

Classification according to the basis for claims. Claims can be divided into contracted, non-contracted claims. The basis of a claim can be easily found in contracts if the claim is contracted claim, therefore owners or contractors can bring forward a claim accordingly. Such claims are less prone to controversy; non-contracted claims are claims not specifically described in a contract, but can be inferred according to the meaning of certain terms in the contract.

Classification according to the relevant parties of claims. Claims can be divided into claims between contractor and owners; claims between general contractor and sub-contractor; claims between contractors and suppliers; claims that contractor requests from insurance companies and transportation companies.

Classification according to the nature of claims. Claims can be divided into engineering claims and business claims. Engineering claims are claims caused by changes of construction conditions, construction technology or construction scope. This kind of claims happens with high frequency and claims amounts are usually high as well; business claims are claims caused by activities of material purchasing, transportation and storage in the process of construction implementation.

Classification according to claims processing. Claims can be divided into individual claims and total claims. Individual claims are to claim compensation per event, which is to submit claim notice and file claim report per event so that each event can be resolved individually without mixing with other events; total claims, also known as comprehensive claims, are claims combining all events related to claims in a whole project together to make a total claim.

ENGINEERING CLAIMS CAUSES

Design. During the process of engineering, differences between the original design and the actual practice can cause claims on duration, labor, materials etc.

Construction contracts. During the process of engineering, the two parties signed construction contract without fully consideration and clarification about the impact of various factors on the construction, which caused contradictions during the performance of contract and led to the construction claims (Chang 2005).

The risk of accidents and unforeseen factors. During the process of engineering, natural disasters such as earthquakes, typhoons, quicksand mud, geological faults, natural cave, subsidence and underground structures and other unforeseen factors can cause claims.

Fails to perform the construction contract. During the process of engineering, the parties of a contract failing to fulfill the construction contract due to different opinions, financial interests and other human factors can lead to claims too.

Project construction contracts management model change. In current construction market, construction contract can be main contract, subcontract, nominated subcontract, labor contract, equipment and materials supplying contract. The complexity of contracts increased the difficulty of contract management. Any contracts which cannot be successfully performed or managed will lead to claims on schedule, quality, quantity, and financial condition (Qi 2004).

Construction projects and contracts management mode changes. From above, some unforeseen events could happen due to the long project duration and complexity of technology. Because of this, more or less claims will occur even the preparation of contract is very detailed, the content of contract is very comprehensive and rigorous, the parties of contract perform the contract with great credibility.

SIGNIFICANCE AND FUNCTION OF CLAIM MANAGEMENT

Function of claim management. The claim is the legitimate owner, according to own authority proposed that to related some qualifications, finance, money and other right authority requests, is interdisciplinary science that the social sciences and natural sciences merge into one organic whole, can be said as "art". Related to the business, finance and accounting, law, the public relation and engineering technology, the project management and other special disciplines, have the sectors of factory society, such as traveling, trade, medical service, transportation, commodity business, real estate, house repair, engineering construction and so on. In engineering construction, because time is long, technology is complex, inevitably many some event occurrences of signing stage impossible foresight. Although contract preparatory work is careful, the contract terms content is rigorous and comprehensive, the owner and construction enterprise also keep the prestige in the performance of contract process, but as a result of the complexity and person of engineering project construction limited of foresight ability, more or less will still have the claim. Therefore, construction enterprise must attach great importance to suing for damages, the strengthened claim management, establishes and improves the claim control panel account, records each claim that in the contract time has promptly in detail, the project finishes forms a volume of complete stage account, as the constituent of completion approval material; Enhances the project manager and technical head's claim consciousness, overcomes, only pays great attention to sue for damages statement of intention, does not attach great importance to suing for damages in the process the collection of evidence and makes the claim reported the bad custom promptly; Strengthens the study, masters the principle, method and skill claim diligently, reduces and prevents, to neglect have the counter-claim because of the work fault the opportunity, maintains the enterprise interests, guarantees the normal fulfillment of success and contract of claim. The claim is the right that both parties enjoy respectively. But the claim is not.

Claim management significance. The claim is also a wide range of knowledge and technology, complex and meticulous work, not only to be good at discovering and understanding the claim opportunity, but also good at collecting, sorting and construction claims about the basis and the material, such as contracting construction contract signed in accordance with the law and relevant laws, regulations and letters, the construction organization design, construction drawings the bidding documents, bidding, bid summary, drawings, design change notice, the construction site visa, construction schedule, construction engineering, the memorandum photos, concealed records, acceptance certificate and the owners designated site engineer instruction book and exchange and so on, understand and familiar with the construction site, take the necessary regular project meeting. More important is to handle claims, to distinguish between those who belong to the claim in construction, can claim under what circumstances, how to calculate the claim, the claim report timely.

In the market economy system in the construction market, construction claim work to control the cost of construction, economic losses, strengthen project construction plan and construction contract management, improve project cost personnel professional ability and construction document management of water project, has the important significance and role.

CLAIMS STEPS

Claim number of days. When events causing claims happened, the letter of claim intent should be submitted to the supervision engineers within the time line prescribed by contract, and the letter of claim intent based on the requirements of the contract should be copied to the relevant parties at the same time.

The claim events happened → in 28 days, the contractor should submit the letter of intent to the supervision engineers and copy to relevant parties → claims events continued → in 28 days, the detailed claim form should be submitted and copied to the owner → supervision engineer (Yi 2007).

Claim management. Construction enterprises should pay attention to claims, strengthen claims management, establish and improve claims management ledger, record each claim event occurred during the period of contract timely and in details, so that a complete ledger can be formed as part of the completion and acceptance data when project is completed; improve project manager and technical director's awareness of claims, overcome the habits of focusing on the claims only but not paying attention on collecting evidence for the claims timely; study and work harder to master the principles, methods, skills of claims, reduce and prevent the chance of counter-claims due to the errors and negligence in work, protect the interests of enterprises, guarantee the successful claims and fulfillment of contract. Staffs Involved in claims management should be not only familiar with the provisions of relevant laws and various regulations, but have experiences on construction management and can completely control all aspects of construction, they also need certain knowledge about accounting, public relationship etc in order to perform claims rationally and accordingly.

Claim processing. After found claims or realized the potentialities of claims in a project construction, the contractor should firstly send a written notice to the field engineer assigned by the owners within the time line of construction contract signed by both parties. When it happened, claims should be processed as soon as possible in accordance with the construction contract and relevant laws. Any claims shelved in the payment interim will affect the project duration, quality, payment settlement, and division of responsibilities, quality of treatment, interest and expected compensation of profits. Therefore, when the claim event is encountered, the owner and the contractor of project should not avoid claims when claims event happen. Instead they should actively cooperate together and hire professionals with good quality, quick thinking, logical efficiency and coordination ability, like experienced lawyer, technicians, cost engineers and accountants, to handle and solve claims.

The claim reported. Preparing a complete and convincing claims report is the key for a successful claim. When a claim event happens, even with the basis, the facts and charges calculated, the parties which are demanded with compensation may not pay the compensation if they could not understand or know the specific circumstances of claim events and the contents of claims in a claim report if the report is with no detailed and convincing description or the presentation of report is not good enough to be understood, therefore the parties demanding compensation will not achieve their purpose on getting compensation, and it is also impossible to reduce the loss of construction project due to the claim incident (Cheng 2008). Therefore, preparing a good claim report is a complicated work which involves the knowledge about law, finance, technical and language. Whether a claim can be successful or failed is closely related to the quality of the claim report in construction claims. If the contractor's claim report is written badly, the contractor will lose the favorable status and conditions in claims which meet the requirement of contract, and the claim might be compromised even fails. In this sense, a contractor who can perform claims rationally and successfully must be a contractor with high comprehensive management skill (Li and Liu 2008). Therefore, Chinese construction enterprises should learn theories of international engineering contract management and claims management; and study related cases to get experiences; and linked the experiences together with their own projects, so that they can be prepared to participate in international competition. In a summary, claims are indispensable in project management to contractors or construction owners, attention should be paid to claims management, and claims awareness should be strengthen (Wang 2004). Good claims management is very important to improve the operational capacity of project management and project construction management, and help business to integrate into the market and achieve sustainable development goal as well.

CONCLUSION

In a conclusion, construction and engineering claims are a systematic project and a comprehensive work involving knowledge and skills of management, technology, quality, construction, economic regulations etc. It needs to be managed in the whole process of a project, including stage before a project starts, stage during the project is constructed, and stage after the project is completed. Enterprises should work effectively on claims during the construction process; improve their profitability; so that they can be invincible in current intense market competition.

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Barriers Analysis and Risk Assessment Methodology of an Energy Services Company in China

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Abstract

The ESCO (Energy Services Company) industry in China is on the early start-up stage, lacking of relevant risk management methods, which frequently leads to failures. In order to improve this situation and promote its development, sixty-five policies on ESCO promulgated in China have been reviewed and existing cases have been summarized at first. Then the current tendency of ESCO is analyzed by using TRIZ mode and the main barriers of ESCO doing business in the building sector are identified, including factor in market, law, technology and financing. Finally, the risk assessment methodology of ESCO is proposed, by which a more complete model contracts or risk prevention mechanism is recommended to improve the risk control of ESCO.

CURRENT SITUATION OF ESCO IN CHINA

EMC (Energy Performance Contracting) started in 1970s. For the oil energy crisis, energy cost of developed country increased by a large margin, thus all country turned to search energy saving strategies and energy saving promotion (Dai 2005). Based on EMC mechanism, ESCO signs energy-saving contract (ESPC) with client who would like to accept energy management service, and provide them with energy audit, scheme design for energy conservation retrofit, construction design, raw materials and equipment procurement, construction, energy monitoring and benefit guarantee, equipment operation, maintenance, project financing, personnel training project, sharing the project profit with customers, or commitment energy-saving profit to customers, and some other service method.

In 1998, the national development and reform commission, ministry of finance, the World Bank and global environment facility united to promote EMC in China. In accordance with Chinese “11th Five-Year Plan” on energy conservation service industry development report, the energy conservation service industry expands rapidly in China. From 2006 to 2010, EMCA member increases from 89 to 560, increased by 5 times; ESCO that implements energy saving project with EMC mechanism increases from 76 to 782; Energy saving service industry practitioners increased from 16000 to 175000, increased by 10 times; Energy saving service industry increased from 4.73

billion yuan to 83.629 billion yuan; EMC project investment increased from 1.31 billion yuan to 28.751 billion yuan, increased by 22 times; carbon dioxide emissions reduction increased from 2.15 million ton to 26.62 million ton (Zhou 2009).

First of all, during the period of "11th Five-Year Plan", the energy conservation service industry output continues to grow, the average annual growth rate is over 60%, which has been an important force in promoting energy conservation and emissions reduction in China. According to investigation statistics, by the end of "11th Five-Year", the output value of energy conservation service industry is 83.629 billion yuan, increased by 16 times from "10th Five-Year", which is shown in Figure 1.

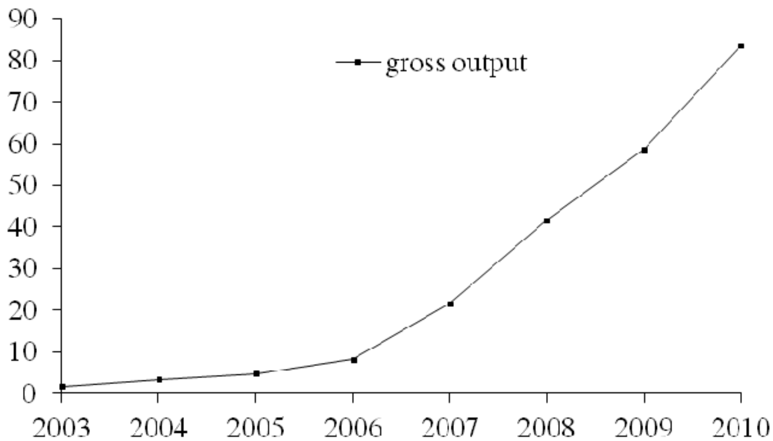

Figure 1.Change of gross output.

Secondly, during the period of "11th Five-Year", total investment of EMC project is 68.395 billion yuan, resulting in 61.07 billion tons of carbon dioxide emission reduction. Compared with the "10th Five-Year", total investment of EMC projects increased by 15 times.

Thirdly, as it can be seen in Figure 2, by the end of 2010, energy services industry practitioners increased by 159,000 compared with 2005. The annual average growth rate is 60% with an accelerating speed.

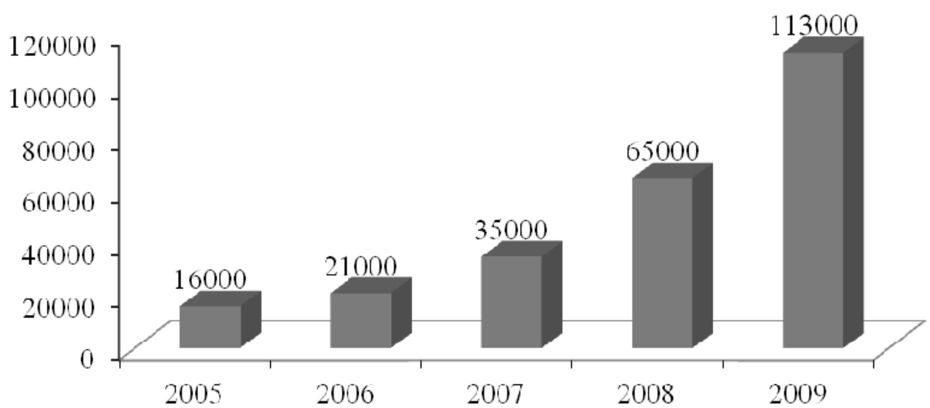

Figure 2.Quantity of practitioners in energy conservation service.

RESEARCH DEVELOPMENT ON ESCO

TRIZ model is used to confirm the current Chinese academic attitude and the status of EMC. Based on scholar.google.com search engine, literatures published in different times are analyzed, and the number of literature is used as indicators to get the result of the development stages (Chun 2011).

In accordance with the cumulative number of the literature in Table 1, charts and polynomial fitting are plotted in Figure 3.

Table 1.Cumulative Number of Literature on ESCO by "scholar.google.cn".

Start time	Final time	EMC		Increase quantity of literature
		Literature quantity	Cumulative quantity of literature	
2012	Now	993	14800	993
2011	Now	1850	13807	857
2010	Now	2910	12950	1060
2009	Now	4070	11890	1160
2008	Now	5410	10730	1340
2007	Now	7240	9390	1830
2006	Now	9230	7560	1990
2005	Now	11000	5570	1770
2004	Now	12300	3800	1300
2003	Now	13400	2500	1100
2002	Now	13600	1400	200
2001	Now	14000	1200	400
2000	Now	14300	800	300
1999	Now	14300	500	0
1998	Now	14400	500	100
1997	Now	14500	400	100
1996	Now	14700	300	200
1995	Now	14800	100	100

As it can be seen from Figure 3, difference between quartic polynomial fitting results and the original data is small. Based on TRIZ model and the maturity of literature number indicators, the current academic research on EMC is still in infancy stage (initial stage). But it can be seen clearly, the growth rate has changed a lot, and began with a period of rapid development.

The proportion of the literature on case studies of all literature has been plotted in Figure 4.

Because the statistics period started from 2002, it can be seen that, from 2002, proportion of case study shows a decreasing trend, and declines significantly after 2010. The results are consistent with that in "Google Scholar research".

It can be found in the analysis above, from 2002 to now, case studies and theoretical research on the ESCO in the building field show an isolated situation. Although absolute quantities of both have increased, the proportion of case studies has decreased gradually (Chang et al. 2011). Therefore, it can be considered that the ESCO

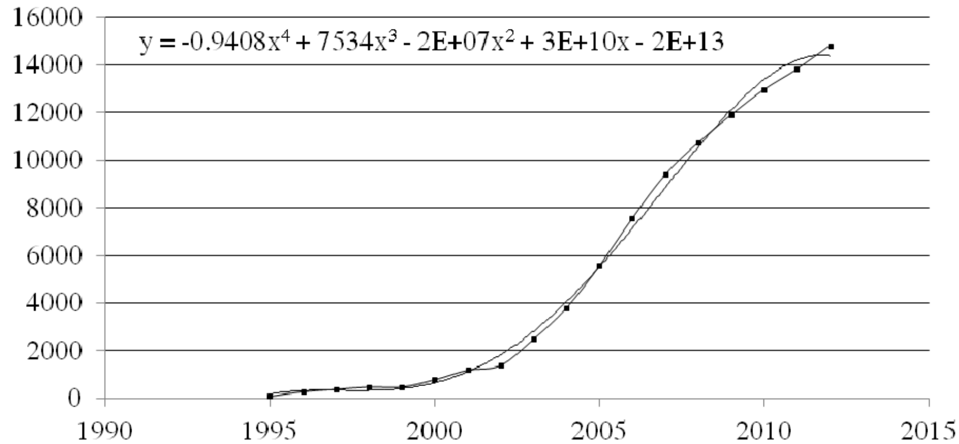

Figure 3.Literature quantity on ESCO.

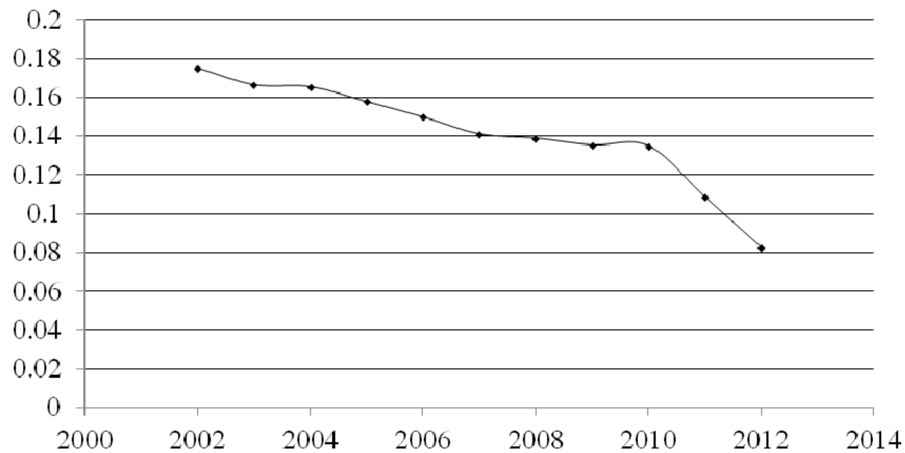

Figure 4.Case study accounting for the ESCO literature.

industry researching in building field are not entirely linked with actual ESCO operators, in other word, current researches are mainly based on theoretical level, giving less effort on the actual operation level, which should be taken seriously.

BARRIERS ANALYSIS

Market demand and policy analysis. Recently, since energy saving standards for new town construction are strengthen, national continue to encourage ESCO which indicates that China has a very strong demand for energy services (Su 2013). Market demand can be used as a criterion to determine the development potential of the industry and market-level policy, contributing to the development of the ESCO industry directly.

Policies play a crucial role in the promotion and protection of the development of the ESCO industry. The government promotes the development of the ESCO industry. At the same time, energy saving requirements for other industries will also enhance the ESCO market potential greatly, thus to promote the development of ESCO.

From 2002 to 2013, there are total of 65 policies issued. In the aspect of time span, the attitude of the government for the ESCO industry development in China has been clear, and the government also supports ESCO industry in China in different files at the same time. Major policies, including policy measures and incentive measures , are as following: notice of the State Council transmitted the Development and Reform Commission and other departments to expedite the implementation of EMC for energy services industry; the Ministry of Finance and the State Development and Reform Commission issued the EMC projects financial incentives fund management Interim Measures; national Development and Reform Commission, the General Office of the Ministry of Finance about supplementary notice on financial incentives to EMC projects related matters; EMC technology General Clauses; the Ministry of Finance and the State Administration of Taxation about the promotion of energy services industry value-added tax business and enterprise income tax policy issues notice; the Ministry of Finance and the State Administration of Taxation, the State Development and Reform Commission on the published environmental protection, energy and water conservation projects enterprise income tax preferential directory (Trial) notice.

For matching degree of complementary policies to subject policy, only two of three aspects of policy measures get support by additional policy, that is financial assistance and tax breaks which also belong to policy measures. However, related files are lacking to support policy incentives. Thus, as to the integrity of the policy, the conclusion shows that the current policy can't support main policy perfectly which needed further research, specification and modification (Ning 2013). Although EMC is emerging industry in China, the efficiency of policy determines EMC rapid development in China to a large extension.

Another fact is that the existing policies for financial and tax incentives support are strong, but for the other aspects are weak, further exploration and research are needed to set other relevant policies and establish complete policy system.

Laws for ESCO analysis in building field. In EMC project operation, laws provide strong guarantee for project operation. On one hand, the establishment of a sound legal system can provide technical guidance on a certain degree, to ensure the correct selection and implementation of technology to the maximum extent. On the other hand, a sound regulatory legal system can also avoid disputes and reduce risk.

In the building EMC project development stage, ESCO is mainly responsible for building energy audit, for which energy audit contract or project development contract should be signed, and there is no relevant content in the existing national norms and standards to avoid risks and possible problems (Kaygusuz 2011).

In construction phase, the project is mainly responsible for the construction, and renovation, during which "energy services master contract", need to be signed, as well as "energy-saving equipment and materials procurement contract" and "construction contract". Existing laws only cover "energy services master contract", while the other two contracts are not involved.

Compared to the actual project operation, "energy services master contract" is not perfect, of which there is a certain degree of duplication and redundancy.

Technical level analysis on building technology. At this stage, ESCO industry has penetrated into various sectors in industrial production and technology used in the different industries are with characteristics. In building energy saving field, energy-saving technologies can be roughly summarized as the following two aspects: Energy-saving design technologies and energy-saving running technologies (Ning 2014). ESCO practical technology is more than building energy saving technology, which should be combined with comprehensive and stratified energy services, and not aims at just using one energy-saving transform method. Energy-saving transformation that based on level of the whole building energy consumption for integrated building is comprehensive, which focuses on a combination of energy-saving technologies and ultimately to achieve energy saving and emission reduction. ESCO practical techniques tend to be combination of technologies, which means finding assembled technology to ensure energy savings for the existing building energy consumption conditions. These impede ESCO to sound development in the current stage (Edward 2003).

Most of the current ESCO projects need EMC, because of equipment operation failure or aging facilities result in high energy consumption. Although the use of aging facilities in EMC projects leads to high profits, high energy-saving rate in a certain period of time, and promote the development of ESCO to a certain extent, this development pattern is not healthy, because the actual EMC includes not only energy-saving transformation, but the optimization of energy by optimizing the configuration and energy efficiency. Based on normal equipment operation, the optimization can limit energy waste usage phenomenon and realize the integrated configuration for energy saving.

Financing analysis. (1) Financing mode summarization. (i) Energy savings-guaranteed financing mode. In energy savings-guaranteed financing mode, ESCO sign loan contracts with third-party independently, who don’t bear the repayment obligations directly. ESCO guarantee the results of energy-saving projects, and ensure that users have the ability to repay their loans on schedule. The contract is known as a type of energy savings guarantee.

In this mode, energy using unit bear financing (repayment) risk, while ESCO bear the risk of energy-saving performance of the project.

(ii) Shared energy-saving benefit mode. Compared to the energy savings guarantee mode, shared savings-saving benefit mode bring more returns for ESCO as the risk premium. In addition, some laws and policies require or encourage shared savings-saving benefit mode (Xia 2014).

In this mode, energy using units don’t need to bear the risk of financing, while ESCO need to take performance risks and financing risks of project. The risk will be further amplified once users default.

(iii) Third-party financing model. Third party financing is a kind of project financed by other units beside the main energy using units and ESCO, called “Special Purpose Company”, as SPE.

(2) Financing model analysis. According to the sources of funding, EMC project financing channels can be divided into debt financing, equity finances, convertible bond financing and so on. The main differences between equity financing and debt financing are concluded in Table 2.

Table 2.Main Differences Between Debt Financing and Equity Financing.

Financing channel	Debt financing	Equity financing
Financing terms	The period is general short (some bond is longer)	In general condition, investors cannot ask for redemption option with long-term
Finance costs	Debt interest closely linked with the of market interest rates, and with low cost of issuing bonds and tax shield effect	The cost of issuing shares is higher, shareholders tend to demand high returns, shareholders may intervene business excessive
Investor risk	Companies need limited debt payments, once insolvency happen, the creditor has a limited right to obtain corporate assets	If bankruptcy liquidation happen, the reputation of the shareholders the right come after that of creditors

Below in combined with the situation of China, EMC financing is analyzed in the next context, due to equity financing and property rights, of which bond financing is only discussed.

Main financing channels include bank loans and guarantee funds, issue bonds and special funds credit. For bank loans and guarantee funds, ESCO have a certain degree of difficulty in getting credit, for the following reasons: First of all, since most of domestic ESCO that established in a short time, not yet gain a good credit record in the bank, with limited scale，it is unlikely for them to get loans from bank directly . Secondly, currently Chinese bank lack of professional capabilities to assess EMC project, whatever in terms of technical level，risk identification or management. There is a certain gap with the developed countries, based on which banks are more cautious for EMC projects loan. Thirdly, for Chinese credit system is not sound, commercial banks require third-party guarantee, which increases the financing threshold and cost.

As to issue bonds, China promotes direct financing vigorously and the bond market continues to expand, but higher qualification is still needed, which may be not very useful for small and medium-sized enterprises in Chinese ESCO industry (Zhang 2010). As to special funds credit, the proportion and intensity of special funds credit mainly depends on the government, which is providing green channel to ESCO project financing. Thus the government needs both “visible hand” and “invisible hand” to promote market in the health and sustainable development.

ESCO RISK ANALYSIS IN BUILDING FILED

There are some special risks for EMC, and the source of these risks include project design standards, content controversy, installation controversy, acceptance controversy, maintenance and upgrade issues, service level controversy, energy consumption baseline, energy-saving baseline adjustment method, amount of energy savings, pricing and price adjustment mechanism, measurement and verification, payment controversy, early termination, responsibility for breach of contract and damages, loss controversy, regular reconciliations and coordination controversy and significant changes relating to the powers and duties that without written record. All risks have been involved from the beginning of the project, but 'EMC Technology General' doesn't cover risk analysis or regulations.

According to the summary and analysis of EMC technology General, ownership and risk-sharing are just mentioned in Section VIII of the 'General', for contractual risk-sharing (risks of property destruction, stolen, man-made damage of the project) is only mentioned before, which did not mentioned in other parts of the full text. For other risks, the "General" define the scope of force majeure, measures and shared responsibility that two sides should take once that happened (Lu and Sun 2012).

Take a step back to see, the General did not make detailed and adequate rule for the entire process of the EMC projects (which have been discussed in the previous paper). Thus compared to the sources risk of the project, the existing risk control strategy is imperfect, which need more complete model contracts or risk prevention mechanism from the point of view of process or the operation of the project.

CONCLUSION

Starting from the "11th Five-Year", China has witnessed a period of rapid development of the ESCO industry and a booming trend of ESCO study in building fields. Since most of the current study is not closely linked with the reality, the paper aims at analyzing the current study of the ESCO and providing some practical instructions to ESCO business, by investigating the scientific research of the main barriers of ESCO from aspect of market, law, technology and financing work. The main conclusions are as following:

(1) With 65 policies published on ESCO since 2002 in China, the existing policies for financial and tax incentives support is strong, but for the other aspects are weak, further exploration and research are needed to set other relevant policies and establish complete policy system.

(2) Due to limitations of ESCO professional and other factors, the development of integrated technologies in ESCO industry is not so well, which has become one of the main obstacles for the development of ESCO industry.

(3) Since the policies do not give guidance or risk plan in ESCO, a recommend that the two sides need to sign a specific contract to agree on the solution of problems that may occur is given to avoid risks to the maximum extent.

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Simulation Research on an Airport Terminal Building from the Perspective of Roof Safety under Strong Wind

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Abstract

Roof insulation damage in large scale terminal buildings under strong wind happens frequently, which is not only related to the circumstance where the building located but also related to the configuration of building itself which influence the micro wind climate and the way building roof response the wind pressure. 3D models of typical layout of terminal complexes were extracted out based on key elements such as efficiency of flows organization at first; Then the models were simulated in a Computational Fluid Dynamics (CFD) plate-form and the simulation results about distribution of wind pressure over roof surface were analyzed in order to find out the influence of building forms. The roof damage accident of Beijing T3 terminal is taken as a case in the research process. The paper ended with suggestion that the wind effluence should be considered seriously and comprehensively in form design of large-scale terminal complex.

INTRODUCTION

As a landmark, the roof surface of Beijing T3 terminal has been damaged 3 times over the span from 2010 to 2013 under strong wind. The most powerful one happened in 9th March 2013, which was approximately 30m/s (Kumar and Stathopoulos 1997). The metal roof system of Beijing T3 terminal is consisted of steel bracket plates, insulating layer, inner liner, sound-absorbing layer, dust-proof layer and roof boarding. Destruction of metal roof system appears at the occlusion between roof boarding and T-type supports. Under strong wind, due to the negative pressure effect, wind would suck the roof upward. Wind suction constantly effects on the roof, leading to the roof surface damage at the occlusion between ribs of roof boarding and T-type supports. Due to destruction, the panel and T-type support disconnect with each other and arch, driving along with other panels to arch together, eventually causing the roof ripped and destroyed. Other than the natural circumstance where the building located, the configuration of building would influence the wind pressure distribution. In this essay, the element of roof configuration which is about the arched height will be studied.

With the rapid development of computer technology, computational fluid dynamics (CFD) has been widely used in the simulation of wind pressure distribution of buildings. The technology can be used in accurate simulation of building wind environment in a short period of time with the actual scale digital model, avoiding the wind tunnel test only in accordance with the experimental scale, high-cost, long study period and other shortcomings (Neofytou et al. 2006). The technology can be well applied to forecast building environment and building wind pressure distribution, as well as analyze the architectural form design.

Currently, in the field of CFD, there are lots of research on indoor environment, construction of large buildings, and wind environment in cities, but a few numerical simulations studies on the influence of configuration design on the roof safety under strong wind.

COMPUTATIONAL DOMAIN AND BOUNDARY CONDITIONS

In this study, a comprehensive CFD simulation of wind pressure distribution on the roof of Beijing T3B terminal was performed by considering various configurations. In order to be able to create a numerical model of an airport one needs to know the location (Krüs et al. 2003) and corresponding environmental parameters. The general appearance of the building was entered into Gambit, a CFD pre-processor for mesh generation. A rectangular computational domain was then developed to accommodate the airport terminal building model to perform the CFD simulation (Figure 1). The size of the computational domain was 6000m (length) × 5000m (width) × 300m (height). Because of the finite-sized domain, entrance or boundary may affect the replication of the atmospheric wind conditions in the CFD model. Hence, the size of the computational domain was large enough to eliminate the entrance and boundary effects. The building model was located in the 1/5 of the length and 1/2 of the width.

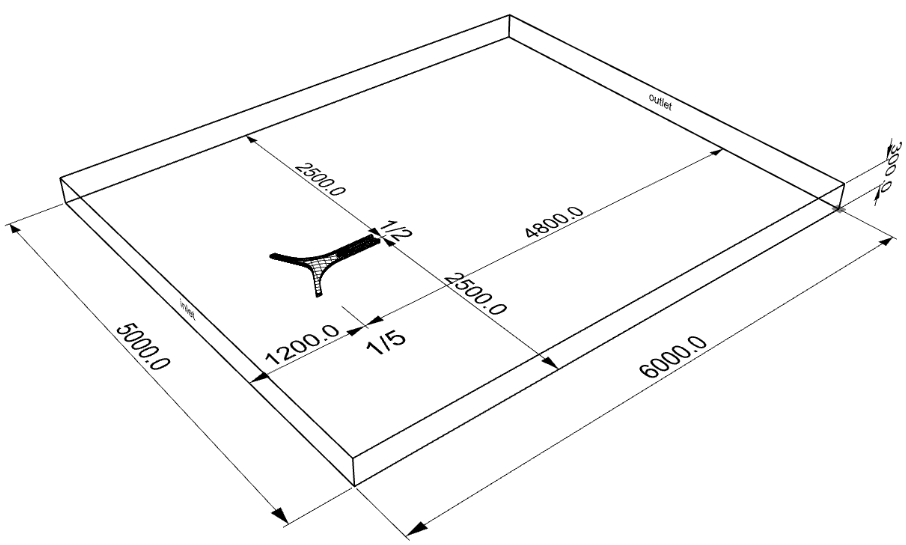

Figure 1.3D CFD model of the Beijing T3B airport terminal building and the size of the computational domain.

Next, meshes were built for the computational domain. Since rapid changes of wind flow near an airport terminal building are expected, highly refined spatial resolution was applied near the building using unstructured meshes. The total number of elements of the computational domain was about 0.2 million.

The setting of boundary conditions included the parameter and computational method of inlet, underlying surface, atmospheric boundary layer, and building surface. The wind came from the inlet surface and wind direction is –y. Table 1 showed the boundary conditions setting when the numerical simulation with Fluent was in process.

Table 1.Boundary Conditions Settings.

Inlet	Velocity inlet
Outlet	Outflow
Ground, Walls, Roof	Wall
Sides, Top	Symmetry

METHODOLOGY

Various objects are the obstructions in the atmospheric boundary layer, and various air collision, separation, reattachment, circulation and other phenomena constitute the turbulence. Because this experiment is to simulate buildings taking air as boundary (blunt-body flow field), the Reynolds-averaged viscous incompressible Navier-Stokes equation was chosen as control equation, and standard k-ε model as turbulence model, which is recommended by Launder and Spalding (1974). The turbulence equations based on standard k-ε turbulence model is as follows.

$$\frac{\partial V_i}{\partial X} = 0 \quad (1)$$

$$\frac{\partial \rho V_i}{\partial_t} + \frac{\partial\left(\rho V_i V_j\right)}{\partial X_j} = -\frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j}\left[\mu_{eff}\left(\frac{\partial V_i}{\partial X_j}\right) + \frac{\partial V_j}{\partial X_i}\right] + \rho\beta\left(T - T_\infty\right) g_i \quad (2)$$

$$\frac{\partial \rho K}{\partial t} + \frac{\partial\left(\rho V_i K\right)}{\partial X_j} = \frac{\partial}{\partial X_j}\left[\left(\mu + \frac{\mu_t}{\sigma_k}\right)\frac{\partial K}{\partial X_j}\right] + \mu_t \frac{\partial V_i}{\partial X_j}\left(\frac{\partial V_i}{\partial X_j} + \frac{\partial V_j}{\partial X_i}\right) - \rho\varepsilon - \beta g_j \frac{\mu_t}{\sigma_T}\frac{\partial T}{\partial X_j} \quad (3)$$

$$\frac{\partial \rho\varepsilon}{\partial_t} + \frac{\partial\left(\rho V_j \varepsilon\right)}{\partial X_j} = \frac{\partial}{\partial X_j}\left[\left(\mu + \frac{\mu_t}{\sigma_\varepsilon}\right)\frac{\partial \varepsilon}{\partial X_j}\right] + c_1 \frac{\varepsilon}{K}\mu_t \frac{\partial V_i}{\partial X_j}\left(\frac{\partial V_i}{\partial X_j} + \frac{\partial V_j}{\partial X_i}\right) - c_2 \frac{\rho\varepsilon^2}{K} \quad (4)$$

The various empirical constants about the calculation above can be based on the recommendation of Launder and Spalding (1974). As shown in Table 2. This mathematical modeling procedure was implemented using the CFD code Fluent 6.3.26, pre-processor Gambit 2.4.6 and guiding by Fluent.

Table 2.Empirical Conditions in k-ε Model.

C_μ	C_1	C_2	σk	$\sigma\varepsilon$	σt
0.09	1.44	1.92	1.3	1.3	0.9

RESULTS AND DISCUSSION

No.3 terminal building of Beijing Capital Airport includes T3A and T3B, which both are long-span space structure. T3B was chosen as the original model named Model A (see Figure 2), whose length is approximately 960m, width is 780m and highest point is 44.5m. The other three Model B (see Figure 3), C (see Figure 4), D (see Figure 5) arched in different height, and B arched less than A, C arched less than B, D did not arch with a flat roof. All these models contained the same planar contour of the building and were simplified. The highest point of Model B is 41.5m, C is 39.2m and D is 27.1m.

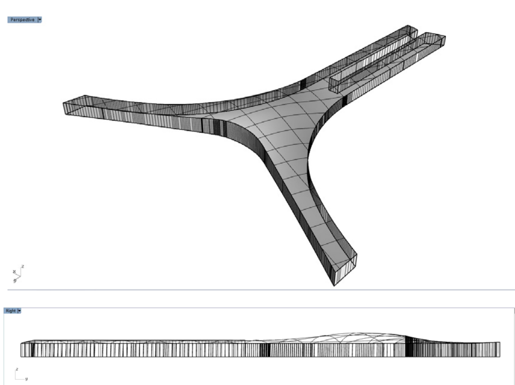

Figure 2.Model A 44.5m in height.

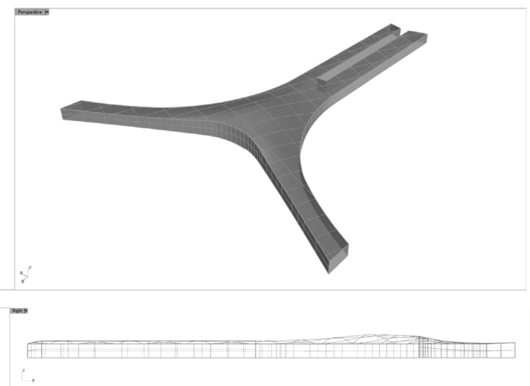

Figure 3.Model B 41.5m in height.

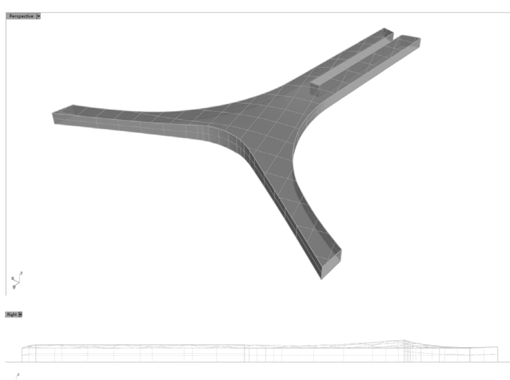

Figure 4.Model C 39.2m in height.

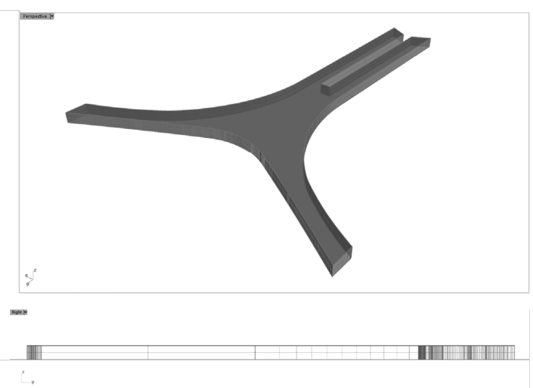

Figure 5.Model D 27.1m in height.

In this experiment the main element which is to be studied is the arched height which is also an important element affected the configuration of the building. The wind pressure distribution should be analyzed with the change of arched height. Setting the arched height as variables, Model A, B, C, D are simulated as computational models in computational domain, obtaining experimental data as Figure 6 to Figure13.

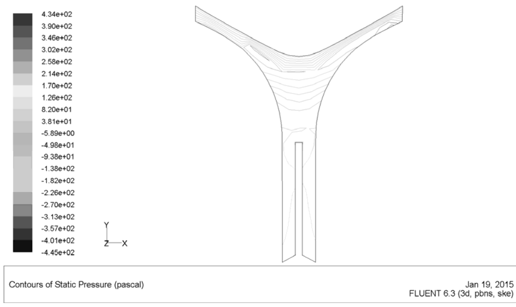

Figure 6.Model A wind pressure distribution (contour).

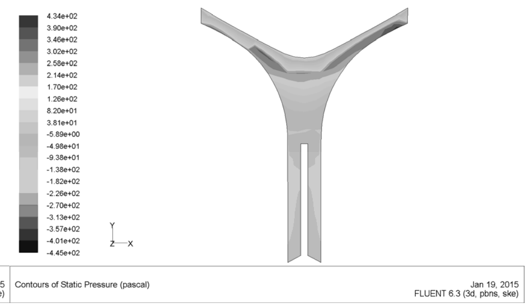

Figure 7.Model A wind pressure distribution (filled).

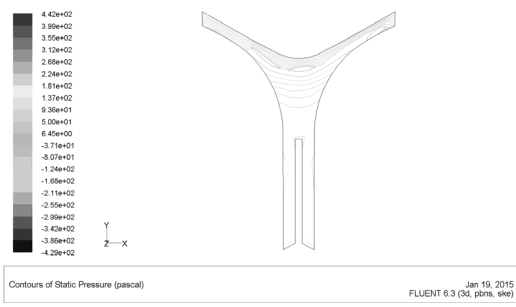

Figure 8.Model B wind pressure distribution (contour).

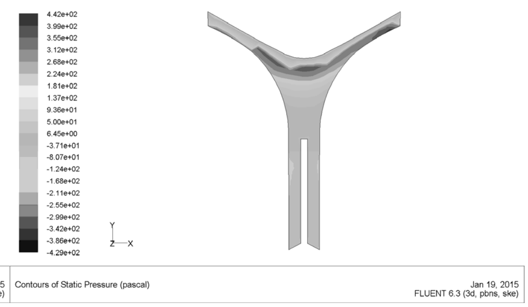

Figure 9.Model B wind pressure distribution (filled).

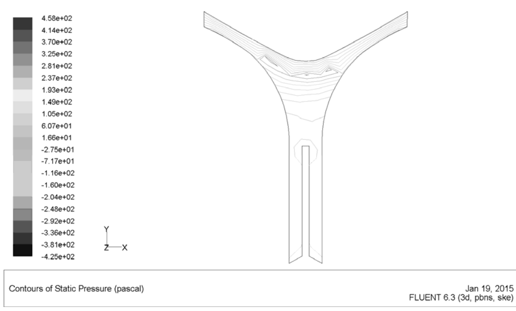

Figure 10.Model C wind pressure distribution (contour).

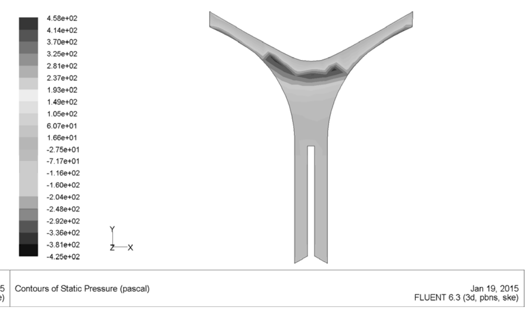

Figure 11.Model C wind pressure distribution (filled).

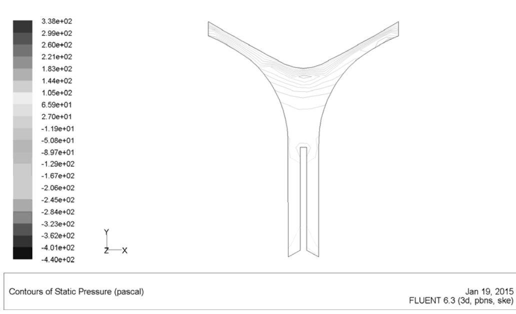

Figure 12.Model D wind pressure distribution (contour).

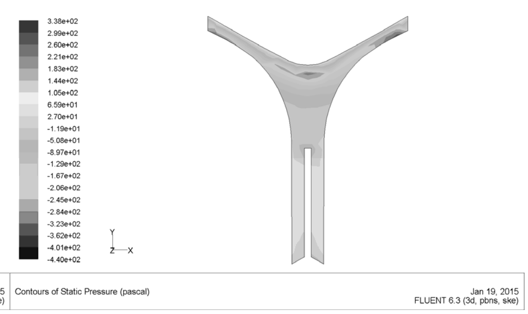

Figure 13.Model D wind pressure distribution (filled).

After comparison the results presented in Figure 6 to Figure13, it can be figured out that the maximum negative pressure on the roof declines as the arched height decreasing except Model D. Figure 6-7 show that the pressure on the roof of Model A ranges from -445Pa to 434Pa. The highest positive pressure locates the edge confronting the wind and the highest negative pressure locates on the highest point of the roof. The negative pressure area distributes the arched area. Figure 8-9 show the similar information as Figure 6-7. Because of the less arched height, the maximum negative pressure decrease to 429Pa and positive pressure increase to 442Pa in Model B. The negative pressure distribution of Model B is almost same as Model A. Considering the data of Figure 10-11, the maximum negative pressure of Model C decrease to 425Pa and positive pressure increase to 456Pa constantly. However the area of negative pressure decreases. From Figure 12-13, what is surprising is that the maximum negative pressure of Model D increase to 440Pa which is almost the same as Model A and positive pressure decrease to 338Pa. And the area of negative pressure declines dramatically. The wind pressure distribution of Model D with flat roof is quite different from the other three configurations with hyperbolic roof.

CONCLUSION

From the above study, the arched height of hyperbolic roof affects its wind pressure distribution. Higher arched height induces higher negative pressure around arched area and lower positive pressure along the edge confronting the wind. This conclusion is not applicable for flat roof. The further study is necessary to figure out the different wind pressure distribution of hyperbolic roof and flat roof.

According to the results of this simulation, rational configuration design is necessary to be encouraged especially when people pursue higher and bigger too much in the landmark building design. The generalization of this simulation platform which can be used to test the configurations' reasonableness is necessary in the design process. According to the simulation platform which the environmental parameters of buildings have been set up, it is possible to compare the wind pressure distribution of different configurations when the building is going to be placed under strong wind and confronted wind suction and then the more reasonable configuration could be considered by designers. The more rational one should be relative safer and the possibility of damage is lower than others which will induce much more wind suction.

Modeling the wind pressure associated with proposed or existing buildings is of great importance for the configuration design and the potential benefit and market for the relationship of wind pressure and configuration studies is large. Other elements of configuration design affected the wind pressure distribution need to be studied in the following research.

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Research on Risk Allocations of a Construction Project

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Abstract

With the continuous development of the construction industry, construction projects involved in increasingly uncertain factors, and the loss caused by the risk is also larger and larger. So it is necessary to provide a reasonable risk allocation to ensure the smooth progress of the project. Started with the basic principles of risk allocation, a risk bearing comprehensive ability evaluation system is established, with the contract parties' attitude to the risk allocation. Then, the paper used the possibility degree method for ranking interval numbers to compare the risk bearing comprehensive ability of the contract parties. In this way, the paper gives a method to determine the optimal undertaker of the risk of construction project.

INTRODUCTION

Risk is a possibility of loss (Shen 2010). Risk throughout the whole process of project construction, both the owner and the contractor will face a series of risk. Currently in the engineering practice in China, the owner is generally inclined to let the contractor to take risks blindly. While the contractor at first reluctant to accept the contract, then tried to gain a higher settlement price by means of modification, variation and claims in the process of construction. This confrontation thinking between the contract parties often leads to delays, investment out of control, or even the poor quality of the project and other problems (Du and Yin 2012). The research by the team of dispute prevention and solution of the Construction Industry Association of America shows that the unreasonable risk allocation in the contract is the most common reasons for dispute in the construction phase (He 2000). So we can see that the reasonable risk allocation between owner and contractor is one of the important factors in project smooth implementation, and it is also the key to the risk management.

LITERATURE REVIEW

Risk allocation is an important part of the process of risk management. Risk allocation is that when the risk occurs, which part shall shoulder the responsibility of risk and how to distribute the ownership of risk. Scholars' researches on risk allocation mostly focus on the basic principles of risk allocation, the models and methods of the risk allocation.

Many scholars have made an in-depth study of the principles of risk allocation, such as Loosemore et al. (2006), Medda (2007), Liu and Wang (2006) and so on. How to reasonably divide the project risk between the parties to the contract, although the academia has not yet given a unified understanding, sum up the above scholars' research results we can have the following basic principles: One should be responsible for its own malicious behavior or the risk caused by his malpractice; Fair and reasonable, the responsibility and right should balance; When a risk happens, one should be responsible for it, if he is the direct victim; Conform to the practice and usual processing methods.

Currently at home and abroad the methods of risk allocation can mainly conclude: statistical method, game theory method and economics method, such as Song et al. (2010) identified the key risk factors of BOT project by analyzing the data collected by the questionnaire; He et al. (2011) took advantage of the different risk appetites between parties to the contract, constructed a game model of risk allocation; Medda (2007) thought of the PPP project risk allocation process as a bargaining process, and it is suitable for final offer arbitration model; according to the economics theory of risk allocation, Zhou (2013) established a risk allocation model based on LaGrange to have an effective allocation between the parties to the contract.

Scholars' studies on the principle of risk allocation and the model of risk allocation put forward the reasonable allocation methods theoretically, but the research on the parties' attitude to the risk is obviously lacking. For example, using game model to allocate the project risk is to determine the risk bearer by the size of the expected net income, although it embodied the principle of responsibility and benefit balance, the willingness to take risk of the responsibility main part is not taken into account. Also in practice, we only understand the principles and methods of risk allocation are not enough, because to achieve the desired effect, a reasonable risk allocation principle needs the parties to the contract to perform in a positive way. So we need to know the risk attitudes of the two parties, and then combined with the specific situation to apply these principles and methods flexibly.

RESEARCH OBJECTIVE AND METHODOLOGY

From the above analysis, we can see that it is more advantageous for the risk management to allocate the risk combine the basis of the basic principles, the project specific conditions, and the parties' attitudes to risk. So the purpose of this paper is to find a method of risk allocation, which can both satisfy the basic principles and consider the parties' attitudes to risk, so as to make the risk allocation between the parties to the contract more scientific and reasonable.

The research method of this paper is to establish a risk bearing comprehensive ability evaluation system. The indicators of the system include both the actual ability to take risks of the parties and the parties' attitudes to risk. The actual situation of the indicators of the two parties can be got by the expert evaluating method, and then the paper used the possibility degree method for ranking interval numbers to compare the comprehensive indicator points of the two parties, so as to compare their risk bearing comprehensive ability, and finally determined the optimal undertaker of the risk.

RISK ALLOCATION MODEL OF CONSTRUCTION PROJECT

Establish the risk bearing comprehensive ability evaluation system. Whether the risk of the project is assigned to the project participants, first depends on his actual risk bearing ability. The complexity of the engineering project risk, determines the systematicness of the risk bearing comprehensive ability evaluation indicator. So it cannot measure with a single indicator in the evaluation, we must have a comprehensive study of the factors of the two parties related to risk. Based on the analysis of relevant literatures, the paper extracted four first-level indicators of the actual risk bearing ability. They are the risk prediction ability, risk management and system establishment ability, risk response ability and risk monitoring ability.

The attitude to risk of the two parties will affect their willingness to take risks and their decisions when the risk occurs, and this will affect the risk allocation problem. For example, if the attitude to the risk of the two parties is neutral, namely neither risk aversion nor risk preferences, then based on the principle of the risk allocation, the risk will be distributed to the party who has more ability or obligation to take the risk and the party who take the risk will also make a good risk management. But if one party's attitude is averse to risk, he will try his best to assign the risk to another party, even if it is not necessarily the best choice.

So in such a manner, it is obviously more reasonable to assign the risk to the other party. So when we allocate risk to the two parties to the contract, not only their actual ability to take the risk, but also their attitudes to the risk should be taken in to account, so we can be sure that they share the risk with a positive attitude, so as to achieve the purpose of the reasonable risk allocation. So the attitude to the risk of the two parties to the contract should also be included in the risk bearing comprehensive ability evaluation system. In view of the above analysis, this paper finally confirmed that the risk bearing comprehensive ability evaluation system consists of 5 first-level indicators and 12 second-level indicators (see Table 1).

Table 1.Risk Bearing Comprehensive Ability Evaluation System.

Target set	First-level indicators	Second-level indicators
Risk bearing comprehensive ability	Risk prediction ability	Information collecting ability
		Communication ability
		Risk evaluation ability
	Risk management and system establishment ability	Risk management information system construction
		Risk management organization
	Risk response ability	Flexibility of dealing with risk
		Relevant constructive Suggestions
		Risk coordination ability
		Risk response experience
	Risk monitoring ability	Risk aversion measures
		Risk information feedback
	Risk attitude	The enthusiasm of taking risks

Use analytic hierarchy process to determine the indicator weight. A, the decisive goal of the risk bearing comprehensive ability; B, the evaluation indicators, $b_{ij}(i, j = 1, 2,_{\dots}, n)$ represents the relative importance of B_i to B_j for A. Then according to the size of the relative importance of each evaluation indicators, the judgment matrix is constructed. Then use the square root method to calculate the characteristic vector and maximum characteristic root of the judgment matrix. The calculation principle is as follows:

(1) Calculate the product (M_i) of the elements in judgment matrix (B) of each row.

$$M_i = \prod_{j=1}^{n} b_{ij} (i = 1, 2,_{\dots}, n) \tag{1}$$

(2) Calculates the nth root of M_i.

$$\overline{W_i} = \sqrt[n]{M_i} (i = 1, 2,_{\dots}, n) \tag{2}$$

(3) Normalized the vector $\overline{W} = (\overline{W_1}, \overline{W_2},_{\dots}, \overline{W_n})^T$

$$W_i = \frac{\overline{W_i}}{\sum_{j=1}^{n} \overline{W_j}} (i = 1, 2,_{\dots}, n) \tag{3}$$

Where $\overline{W} = (\overline{W_1}, \overline{W_2},_{\dots}, \overline{W_n})^T =$ characteristic vector.

(4) Calculate the maximum characteristic root of the judgment matrix.

$$\lambda_{\max} = \sum_{i=1}^{m} \frac{(BW)_i}{nW_i} \tag{4}$$

Where $(BW)_i$ = the i th element of vector BW

(5) The consistency test of the judgment matrix. When the judgment matrix satisfies $CR = CI / RI < 0.1$ (where CI = the consistency indicator; RI = random consistency indicator), the judgment matrix pass the consistency test, otherwise we need to adjust the judgment matrix, and analyzed again (Wang 2008).

Using the analytic hierarchy process, we can conclude the indicator weights in the risk bearing comprehensive ability evaluation system. The indicator weights of the 5 first-level indicators is $w = (w_1, w_2,_{\dots}, w_5)$; the indicator weights of the 12 second-level indicators is $w' = (w'_1, w'_2,_{\dots}, w'_{12})$.

Structure the decision matrix. In the risk bearing comprehensive ability evaluation system, most indicators belong to qualitative indicators, which need the experts to give the score according to the actual situation of the parties to the contract. Because of the complexity, uncertainty of the objective things, and the fuzziness of human thought, the experts score is usually not a precise numerical, but fall within a range, namely to express in the form of interval numbers (Xu and Da 2003). Mark the indicator score interval $a = \left[a^-, a^+\right] = \left\{x \mid a^- \le x \le a^+\right\}$ as a scope of a certain indicator score of the parties to the contract given by expert group.

The scoring mechanism in this paper is according to the pre-qualification information and bidding documents provided by the contractor and the actual situation of the owner, the scores of the 12 indicators of the risk bearing comprehensive ability is given by the expert group. The full score is 10 points, and the grading standard of the first 11 second-level indicators is excellent in 8 points, good in 6 points, middle in 4 points and poor in 0 points.

For the risk attitude indicator, experts will give scores after considering their personality characteristics, the project expectations (how much profit, the urgency of the project, the purpose of the project), and whether there is a risk-taking incentive in the contract. The grading standard is the enthusiasm of taking risks: very positive in 8 points, positive in 6 points, middle in 5 points, negative in 3 points and very negative in 0 points. After the experts finish scoring, select the lowest and the highest score of all the scores of every indicator of the parties, and these two scores constitute the left and right boundary value of the indicator score interval.

Mark $N=\left\{N_1,N_2\right\}$ as the set of the two parties to the contract, where N_1= owner, N_2=contractor. Mark $Q=\left\{Q_1,Q_2,_{\dots},Q_{12}\right\}$ as the set of the 12 second-level indicators. According to the above grading method, we can get score intervals of each indicator of the two parties, marked $a_{ij}=\left[a_{ij}^{-},a_{ij}^{+}\right]$ (where a_{ij}= the score interval of the indicator Q_j of N_i), in this way we can get the evaluation decision matrix of the two parties to the contract.

Identify the comprehensive indicator of the two parties to the contract. After getting the score intervals of each indicator of the two parties, we can use the following formula (see formula (1)) to calculate the score of the comprehensive indicator of the two parties to the contract, marked $c_i=\left[c_i^{-},c_i^{+}\right]$ (where c_1= owner, c_2= contractor), with the consideration of the different impact of the indicators for the risk bearing ability.

$$c_i^{-}=\sum_{j=1}^{n}a_{ij}^{-}\times w_j, c_i^{+}=\sum_{j=1}^{n}a_{ij}^{+}\times w_j \tag{5}$$

Where n= the number of the indicators; w_j= the weight of the j th indicator.

Evaluation method of risk bearing comprehensive ability based on the possibility degree method for ranking interval numbers. For evaluate the risk bearing comprehensive ability of the two parties, we need to compare their comprehensive indicators, that is, to compare the two interval numbers. Mark $c_i=\left[c_i^{-},c_i^{+}\right]$, $c_j=\left[c_j^{-},c_j^{+}\right]$ as the comprehensive indicators of the risk bearing ability of the two parties, and $l_{c_i}=c_i^{+}-c_i^{-}$, $l_{c_j}=c_j^{+}-c_j^{-}$ as the length of c_i and c_j, so the possibility degree of the indicator value (interval numbers) $c_i \geq c_j$ is:

$$p(c_i \geq c_j)=\frac{\min\left\{l_{c_i}+l_{c_j},\max(c_i^{+}-c_j^{-},0)\right\}}{l_{c_i}+l_{c_j}} \tag{6}$$

And mark $c_i \geq c_j$ as the order of c_i and c_j (Xu and Da 2003).

Using the formula (6) to calculate the comprehensive indicator of the risk bearing ability of the owner and contractor, marked $c_1 = \left[c_1^-, c_1^+\right]$, $c_2 = \left[c_2^-, c_2^+\right]$. By comparing these two interval numbers, we can get the corresponding possibility degree $p(c_i \geq c_j)$, marked p_{ij}, $i, j \in N$. In this way the possibility degree matrix ($P = (p_{ij})_{2\times2}$) is established. This matrix contains the possibility degree information about the comparison between the two parties. Therefore, the evaluation of the risk bearing comprehensive ability of the two parties is converted to prioritize interval numbers.

To prioritize the interval number is to solve the sorting vector of the possibility degree matrix P. Here we use a simple sorting formula given by the literature (Xu 2001) to solve this problem.

$$\omega_i = \frac{1}{n(n-1)}\left[\sum_{j=1}^{n} p_{ij} + \frac{n}{2}\right] - 1\left(i \in N\right) \tag{7}$$

Where n = the number of the indicators.

After calculating the sorting vector ($\omega = (\omega_1, \omega_2)^T$) of the possibility degree matrix P, we can get the order of the risk bearing comprehensive ability of the two parties, as well as its possibility degree, by prioritizing the interval number c_i with the ω_i. Then according to the results, we can determine the optimal undertaker of the risk.

Here is a simple engineering calculation example. A construction project of a teaching building selected the contractor through the open tender. During the course of the final negotiations on the terms of the contract with the preliminary selected contractor, in order to determine the engineering geologic risk taken by which party is more advantageous, they invite the experts to score the 12 second-level indicators of the two parties according to the pre-qualification information and bidding documents provided by the contractor and the actual situation of the owner.

Using the analytic hierarchy process, the indicator weights of the 5 first-level indicators of the risk bearing comprehensive ability of the engineering geologic risk is $w = (0.3, 0.1, 0.2, 0.2, 0.2)^T$, the indicator weights of the 12 second-level indicators is $c_{11} = 0.23$, $c_{12} = 0.25$, $c_{13} = 0.52$, $c_{21} = 0.53$, $c_{22} = 0.47$, $c_{31} = 0.28$, $c_{32} = 0.31$, $c_{33} = 0.26$, $c_{34} = 0.15$, $c_{41} = 0.67$, $c_{42} = 0.33$, $c_{51} = 1$.

After getting the scores of the 12 second-level indicators, we can get the scores of the 5 first-level indicators (namely a range of values to express in the form of interval numbers), by using the weights of the 12 second-level indicators and the formula (5) (see Table 2).

Table 2.Decision Matrix.

First-level indicators	Owner	Contractor
Risk prediction ability	[6.6, 7.1]	[6.3, 7.3]
Risk management and system establishment ability	[6.7, 6.9]	[7.4, 7.6]
Risk response ability	[8.8, 9.1]	[7.3, 8.0]
Risk monitoring ability	[8.6, 9.1]	[8.9, 9.2]
Risk attitude	[7.6, 7.8]	[8.4, 8.7]

Using the formula (5) to calculate the comprehensive indicator scores of the risk bearing ability of the owner and contractor, shown as the follow interval numbers: $c_1=[7.65,8.02]$, $c_2=[7.55,8.13]$. In order to rank the risk bearing comprehensive ability of the parties to the contract, first we use the formula (6) to calculate the possibility degree matrix of the comparison between c_1 and c_2.

$$P=\begin{bmatrix} 0.5 & \cdots 0.4947 \\ \vdots & \ddots & \vdots \\ 0.5053 \cdots & 0.5 \end{bmatrix}$$

Then we use the formula (7) to calculate the sorting vector of the possibility degree matrix P:

$$\omega=(0.4974,0.5027)^T$$

With the sorting vector and the possibility degree in the matrix P, we can get the ranking of the interval numbers c_1 and c_2, that is, $c_2 \geq c_1$. If mark the symbol "$\succ$" as the order of the risk bearing comprehensive ability of the two parties, then the order of the owner and the contractor is $c_2 \underset{0.5053}{\succ} c_1$, namely the geological risk bearing comprehensive ability of the contractor is stronger than the owner. So let the contractor take the geological risk is a proper handling for the execution of the entire project.

CONCLUSION

The reasonable risk allocation of the construction engineering project is a key issue for a successful project. In this paper, the evaluation model of the risk bearing was established, based on the basic principle of the risk allocation, which considered the comprehensive ability of the parties to the contract. On the basis of the risk bearing comprehensive ability evaluation system, this model uses the possibility degree method for ranking interval numbers to compare the risk bearing comprehensive ability of the parties to the contract, and determine the optimal undertaker of the risk by the comparison result. In the model, the parties' attitude to the risk is also taken into account, which makes the evaluation result more rational, and more realistic.

The introduction of interval numbers and the possibility degree method for ranking interval numbers makes the evaluation result more intuitive and accurate. All of these above have a certain guiding significance for the practical construction project.

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The Relevance of a Chief Financial Officer's Characteristics and a Real Estate Company's Financial Risks

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Abstract

The financial risk of enterprise has caused concerns in the field of corporate operating and society economic development. With the integration of the global economy, professional and ethical standards of the CFO play a subjective role in company's financial risk. Based on the CFO's data of 2011-2013 Chinese listed real estate companies, this paper uses normative and empirical study methods to explore the correlation between corporate financial risk indicators and CFO's characteristics that is from eight aspects such as age, gender, education, job title, tenure, salary levels, ownership, and whether to enter the board of directors. It can be seen that the CFO's features really have certain influence on the enterprise financial risk. Furthermore，this paper expounds the role of positioning and the development trend of CFO, and then proposes some suggestions to reduce the financial risk of the real estate enterprises. From these states, strengthen the ethics and experiences of CFO construction, the financial performance will be out of the loss and confusion, thus maximum reduce financial risk from the enterprise internal.

INTRODUCTION

CFO stands for chief financial officer who takes part in a significant position between the shareholders and the management in the modern enterprise senior management model, they are one of important strategic decision makers and executives of the company as well (FMAC 2010). The introduction of the CFO system helps to reduce the company entrusted agency cost between shareholders and managers, also to promote the maintenance and appreciation of the wealth of shareholders. At present, the research of CFO in the real estate industry mostly adopts normative research method instead of using the empirical study gradually. In addition, most of the researches focus on the CFO's positioning function and legal responsibility. To be specific, it is explored from the aspects of the capability to deal with the information economy era and the trend of future development. However, it is rarely mentioned that financial risk is closely related to the characteristics and qualifications of the CFO, also seldom research the performance and examination of the CFO.

LITERATURE REVIEW

Shehzad (2001) used event study for the first time to find 2227 cases about the CFO change during the period of 1984 to 1997, pointing out the correlation between the company's performance and CFO' change. Edward and Hadlock (2004) analyzed the samples from 1993 to 1998 among 443 big companies, found that changes of executives including the CFO have relationship with corporate performance, but the correlation is less than the CEO. Du and Zhao (2005) used the information of financial executives which disclosed by China's A share listed companies as the foundation analyzed the CFO system characteristics and its influencing factors of listed companies. Li et al. (2005) pointed out that was not a significant decline for the company's performance before the financial controller changes, while after the changes the company's performance has a substantial improvement. Su (2006) constructed a model of the parent company, subsidiary and CFO, which was on the basis of agent theory, pointed out that the parent company should build a regular assessment system of chief financial officer to help the company achieving control function.

THEORETICAL ANALYSIS AND THE RESEARCH HYPOTHESIS

As the company's CFO, the increasing of age represents the growth of practical experience. A great deal of extensive working experience is seen as an extremely important qualifications，which can reduce the financial risk of the enterprise. So this paper puts forward the following hypothesis:

H1: enterprise CFO's age related to the financial risks.

The education level and job title on behalf of the capital formation of training CFO, high education level and high title means CFO has a professional competence, that is beneficial to the company's financial functions and reduce financial risks. Tihanyi et al. (2000) found that the higher average level of education of the senior management team the more effective information they can get and therefore the team is more likely to come up with strategies according to enterprise development. So this paper puts forward the following hypothesis:

H2: CFO's education background and financial risks are related.

H3: the CFO's title and financial risks are related.

Salary incentive mechanism is the important mechanism to solve the problem of agent, compensation and financial risks influence each other, encourage operators to create more value for the enterprise. Employees holding shares are an effective way of incentive. CFO served as director of the company entering the decision-making level, they will understand the direction of enterprise development better. That makes the CFO and shareholders to have consistent goals. So this paper puts forward the following hypothesis:

H4: the CFO's compensation and financial risks are related.

H5: CFO served as director of the company is helpful to reduce the financial risk.

H6: CFO owns the company's shares are helpful to reduce the financial risk.

Appointment time represents the accumulation of human capital of CFO; it also can show the CFO familiar degree of the company. Frequent replacement of

CFO will be detrimental to the stability of the enterprise group and the internal conflicts will increase. The new CFO need make relationships with new colleagues and this undoubtedly cause waste of resources. The longer the CFO's tenure can improve the capability of the operational enterprise resources, understand the enterprise deeper and find problems easily, so they can use their professional knowledge and experience to reduce the financial risk. So this paper puts forward the following hypothesis:

H7: CFO’s appointment time and financial risks are related.

Most of the CFO in the real estate industry is male. In recent years, more and more women grow into corporate CFO; this seems to be part of the preferences of the enterprise. So author guess, it is because female CFO can lead to better control of the financial risks. So this paper puts forward the following hypothesis:

H8: Female CFO can control the financial risks better.

THE EMPIRICAL ANALYSIS

Sample selection and data source. The sample data used in this study were selected from Shanghai and Shenzhen listed real estate companies with the observation period of 2011 ~ 2013. Notably, the T type of listed companies and the companies whose CFO information were incomplete have been excluded. Samples retained by the company disclosed its financial reporting during the investigation after a CPA audit and issued a standard audit opinion. After screening the sample, a total of 279 samples were incorporated in the analysis, including 85 samples in 2011, 94 samples in 2012, 100 samples in 2013 respectively.

The selection and measurement of variable indicators. Variable measurement as shown in Table 1.

Table 1.Measuring Instruments of Variable Indicators.

Variable	Age	The age of the CFO
Independent variable	Education background	College 1; University undergraduate 2;Graduate 3; PHD 4
	Professional qualifications	Accountants, economist, auditors 1; Senior accountants, senior economist 2;ACCA 3; No professional title 0
	Remuneration	The CFO’s compensation
	Serve on boards of directors	As the company director 1; Otherwise 0
	Number of shares	The CFO in the number of shares of the enterprise
	Tenure	By the end of the study time, the CFO in its corporate office time
	Gender	Man 0;Woman 1
Dependent variable	Quick ratio	The ratio of quick assets to current liabilities

Table 1.(Continued).

Variable	Age	The age of the CFO
Dependent variable	Quick ratio	The ratio of quick assets to current liabilities
	Asset-liability ratio	The percentage of the total liabilities divided by total assets
	Long-term capital debt ratio	The percentage of non-current liabilities divided by long-term capital
	Tobin's Q ratio	The market value of assets divided by the replacement cost
Control variable	Enterprise scale	Natural logarithm of total assets

Descriptive statistics analysis. Regarding SPSS19.0 descriptive statistical results, there are 213 male CFO samples in total, accounting for 76.3% of the total sample. Female CFO, a total of 66 samples, accounting for 23.7% of the total sample. It can be seen that men as a chief financial officer in the listed companies of China more than women. From the current situation of CFO degree, education for the college accounted for 20.4% of the total sample, degree of bachelor of accounting for 39.2% of the total sample, degree of master of accounting for 36.6% of the total sample, PHD degree for accounted for 3.8% of the total sample. The data above reflects most CFO of listed company in our country has a bachelor's or master's degree, enterprise generally asked finance director for high degree. Samples of CFO of listed company has accountant, economist or auditor titles accounted for 32.8% of the total sample, senior accountants, senior economist titles accounted for 36% of the total sample, the CFO Who has ACCA accounted for only 1.6%, most of China's real estate industry of CFO have professional titles. In all the sample data, there are 49 samples of the CFO as company directors, accounting for 17.6% of the total sample; the CFO has a certain position in the board of directors. There are 61 samples of CFO holding the company's stock, accounting for 21.9% of the total number of samples, it can be seen that most of Chinese listed real estate companies did not pay much attention to equity incentive.

The construction of model and regression analysis. (1) Build a model. In view of the above assumptions, the following model:

$$Y_{QR/ALR/LCDR/TOBQ} = \beta_0 + \beta_1 x_{age} + \beta_2 x_{edu} + \beta_3 x_{pro} + \beta_4 x_{rem} + \beta_5 x_{boa} + \beta_6 x_{sha} + \beta_7 x_{ten} + \beta_8 x_{gen} + \alpha z_{sca} + \varepsilon$$

(2) Regression analysis. This paper used SPSS19.0 analysis linear statistical between all the variables, variance inflation factor VIF based values are less than 10, so there is no multiple co linearity problem. In this paper, using statistical software SPSS19.0 author processes the collected data to make multiple regression analysis, the specific results are shown in Table 2 and Table 3.

Table 2.The Fit of the Model Under Different Variables.

	Quick ratio	Asset-liability ratio	Long-term capital debt ratio	Tobin's Q ratio
R Square	.207	.486	.398	.569

Table 3.CFO Characteristic Variables Relate to Regressions of Financial Risks.

	Quick ratio		Asset-liability ratio		Long-term capital debt ratio		Tobin's Q ratio	
	B	Sig.	B	Sig.	B	Sig.	B	Sig.
Age	-.001	.911	.000	.536	.002	.241	.044	.000
Education background	.097	.414	-.004	.810	.009	.647	-.055	.582
Gender	.456	.026	-.039	.154	-.029	.400	.349	.041
Professional qualifications	-.071	.501	-.002	.882	-.022	.228	-.078	.373
Remuneration	4.014E-7	.039	-6.673E-8	.010	-3.444E-8	.299	4.732E-7	.004
Serve on boards of directors	-.199	.362	-.009	.758	-.075	.047	-.186	.313
Tenure	.099	.003	-.011	.011	-.010	.068	-.032	.238
Number of shares	-1.676E-7	.465	6.008E-8	.051	1.036E-7	.009	-5.114E-9	.982
Total assets	-.338	.000	.094	.000	.096	.000	-.589	.000

When the dependent variable is Tobin's Q, age was significantly associated with financial risk. When the larger changes in the external environment competitive market conditions, the older CFO in real estate industry insists that the financial security is more important, which tends to be conservative. The older CFOs have many years of financial experience that can help enterprises to avoid the risk of finance, in contrast, younger CFOs tend to seize the strategic opportunity, grasp the new ideas and behaviors, which make enterprise suffering more financial risk. This study shows that the older CFO can reduce the financial risks of the real estate listed companies better.

The real estate listed company that CFO is woman, its Tobin's Q ratio and the quick ratio is higher than man. That is to say, female CFO can control financial risks better than male in the average degree. This phenomenon can be explained that men and women have equal education opportunities in recent days, while most of women shows the intensely ability of accountant by natural endowments. In practice, women are more careful and cautious than men in the office, so they can avoid the financial risk. Therefore, when enterprise considering the CFO candidates had better not have preference for men.

When the dependent variable is Tobin's Q ratio, quick ratio, asset - liability ratio, the payment will support the assumption. Quick ratio refers to the ratio of quick assets to current liabilities. If the CFO's job pays well, the enterprise's current assets can be converted into cash immediately to repay current liabilities. Asset-liability ratio is the debt to asset ratio, which is negatively related to the salary, the higher the salary, the lower the asset-liability ratio. The financial risk will be reduced due to have less debt for an enterprise. That salary incentive effect can reduce the financial risk of real estate enterprises, and then the business performance can be improved by the higher compensation.

CFO is on board or positive correlated with long-term capital debt ratio, that is to say, if the CFO in enterprise board of the company, its long-term capital debt ratio will be relatively low. It can be illustrated that company's financial risk is lower than others if the CFO served as a director.

When the dependent variable are quick ratio and asset - liability ratio， the tenure supports the assumption. The reason is that the CFO have longer terms, they understand their enterprise deeply and have good relationships with the corporate executives team, which capabilities are benefit to reduce the financial risk of the company.

Financial risk indicators long-term capital debt ratio positively related to number of shares of CFO. It shows that the higher the number of shares of the CFO will lead to a higher long-term capital debt ratio. The result of this phenomenon can be explained into two aspects. First of all, the right proportion of debt increases the flow of enterprise funds, which may bring more benefit for the long-term development of enterprises. Secondly, due to the imperfection of the CFO of listed company equity incentive in our country, CFO as the enterprise decision-makers does not play a role. The untrue of accounting information and the lack of representatives of CFO will result in investment decision-making blunders, so that investment cannot obtain the expected benefits and the enterprises have huge financial risks. Thus, the regression results did not support the hypothesis.

There was no significant correlation between financial risk and the CFO's education background. In terms of education, it is generally considered that the CFO needs profound professional basis and the ability to apply theory into practice and some certain experiences. However, the record of education background only represents the CFO theory knowledge, and it doesn't mean the highly educated CFO who can do their job better. There is no significant correlation between enterprise financial risk and professional qualifications, thus, it does not support the hypothesis. This maybe the result of getting certified public accountants, certified or certified asset appraiser and other authentication means that the improvement of the CFO knowledge framework does not represent the actual using ability is better than that of other CFO. The financial risk of the enterprise will not be reduced by CFO with good professional qualifications.

EMPIRICAL STUDY CONCLUSIONS

In view of the real estate industry, companies with female CFO have less financial risks than that of other companies. The older the management officers, the better the financial risk can be controlled. Furthermore, the salary incentive system can also reduce the financial risk of real estate enterprises. The CFO, who plans a longer development prospect in his enterprise, can manage the financial risk in a right direction. Regression results show that the CFO of education level and professional qualifications do not affect the company's financial risk.

In this paper, the empirical study proves that the CFO serve on boards of directors has significant correlation with enterprise financial risk, the CFO not only meet the needs of the knowledge structure of the board of directors, but also make full use of human resources, which is helpful to realize the integration of the CFO financial supervision and the risk control.

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Research on the Conflict Management of Stakeholders in a Construction Project

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Abstract

Stakeholders have different benefit demands at each stage in the life cycle of construction project, therefore conflicts between stakeholders are inevitable, and this will affect on the realization of goals of project schedule, quality, cost and safety. Firstly, this paper defines the concept of construction project stakeholders and conflicts between them. Secondly, it analyzes the factors causing conflicts between construction project stakeholders and the main categories of conflicts at each stage in the life cycle of a construction project. In addition, it studies the main processes of conflict management, and then it puts forward the related mechanisms of conflict management.

INTRODUCTION

The implementation of construction project involves a number of main bodies, needs multi-cooperation, stakeholders of a project have different benefit demands at each stage in the life cycle of construction project，therefore conflicts between stakeholders are inevitable, and this will have impact on the realization of goals of project schedule, quality, cost and safety. In this sense, conflict management between construction project stakeholders is one of the important contents of the project management. Therefore it is necessary to manage these conflicts effectively, analyze the main conflicts that may occur in different stages of project life cycle and the factors causing these conflicts, and then propose corresponding mechanisms to deal with them. Only in this way, can we effectively reduce the adverse impact of the conflicts on construction projects and ensure that construction project to be implemented smoothly.

CONSTRUCTION PROJECT STAKEHOLDERS AND CONFLICTS BETWEEN THEM

Concept of construction project stakeholders. Stakeholder theory was advanced in the 1960s, and scholars make the definitions of the stakeholder, but there is still no consensus even today. Freeman (1983) defined a stakeholder as "any group or individual who can affect or is affected by the achievement of the organization's objectives". Charkson (1995) defined it as "stakeholders are persons or groups that have, or claim, ownership, rights, or interests in a corporation and its activities, past, present, or future". And a definition of a project stakeholder proposed by PMI (Project Management Institute) is: "Individuals and organizations who are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or successful project completion". Project stakeholders usually include the project manager, the customer, users, team members within the performing organization, and the project sponsor. However, there are more than just these few.

These scholars defined stakeholders from different angles, in the paper from the broad sense construction project stakeholders is defined as "persons or groups that can influence the realization of construction project goals, or are affected by the project throughout the life cycle of the project."

Classification of construction project stakeholders. In previous studies, researchers classified stakeholders from many different perspectives. As to whether the relationship between corporate market transactions occur directly as a standard, the stakeholders are divided into direct and indirect stakeholders by Frederick (1988), the direct stakeholders with the enterprise market transactions occur directly between stakeholders, including shareholders, employees, suppliers, etc. indirect stakeholders, is the occurrence of non-market relations and corporate stakeholders, including governments at all levels, the general public, social organizations, the media. Cornell and Shapiro (1987) divide stakeholders into two groups; those that have an explicit contract with the firm (e.g., stockholders, bondholders) and those that have implicit contracts with the firm (e.g., customers, employees). According to the tightness of relevant groups and corporate, stakeholders are classified into primary stakeholder group and secondary stakeholder group by Clarkson (1995). Mitchell et al. (1997) propose that classes of stakeholders can be identified by their possession or attributed possession of one, two, or all three of the following attributes: the stakeholder's power to influence the firm, the legitimacy of the stakeholder's relationship with the firm, and the urgency of the stakeholder's claim on the firm, and they divide stakeholders into definitive stakeholders, latent stakeholders and expectant stakeholders. From three dimensions (active tendency, importance and urgency), Chen and Jia (2004) classified stakeholders into core stakeholders, dormant stakeholders and marginal stakeholders.

Consistent with Clarkson (1995), the paper divide construction project stakeholders into primary stakeholders and secondary stakeholders according to the closeness of stakeholders and construction projects. Primary stakeholders are persons or groups that put human, money, materials and other factors of production, they have benefits rights and carry some risk, e.g., the owner, survey and design enterprise, construction enterprise, consulting enterprise, bank and so on. Secondary stakeholders are persons or groups that don't put factors of production, but they are affected by project construction activities or can exert influence over the project and its results, e.g., related governmental departments and community residents.

Concept of conflict between construction project stakeholders. Conflict is a disagreement through which the parties involved perceive a threat to their needs, interests or concerns. There are conflicts in all construction projects, and conflicts between construction project stakeholders are inevitable outcome of a project's organization. Conflicts may originate from various conditions in the course of a project, and especially when something changes, conflicts are more prone to occur.

Conflict between construction project stakeholders is a series of behaviors occur for the interests' inconsistency of different stakeholders in the process of project implementation, and these behaviors can influence and control each other. Relationship between stakeholders is more complex in large-scale and complex projects generally, and interest conflicts of stakeholders are tending to be more obvious and intense.

If these conflicts are not dealt with properly, it is likely that the project cannot operate smoothly and even fail. So it is necessary to manage, control and solve conflicts effectively to promote the smooth implementation of construction projects and meet the demands of the interests of different stakeholders.

Source of conflict between construction project stakeholders. The source of conflict between construction project stakeholders mainly lies in the mutual dependence and difference between stakeholders. On one hand, the realization of a construction project objective requires project participants to make joint efforts, and project participants play different roles, the owner pays to build the project, design enterprises provide drawings and consulting services, construction enterprises build the project, and supervision enterprises provide consulting services , only they cooperate together, can the project be completed.

Indeed, conflicts between stakeholders are inevitable by the interdependence of project participants. On the other hand, project participants have some differences: imbalance of interests, no coincidence of the aim, information asymmetry and so on, and the more differences there are, the greater the probability of conflicts occur is.

CONFLICT MANAGEMENT OF THE STAKEHOLDERS IN CONSTRUCTION PROJECT

Main factors causing conflicts. Through field investigations and interviewing some project managers, we see factors that cause the conflicts between the construction project stakeholders originate from the aspects of the owner, construction enterprise, construction supervision enterprise, force majeure and others in general (see Table 1).

Main categories of conflicts. Based on the hierarchy and different characteristics, conflict between construction project stakeholders can be classified into four kinds: (a) Interpersonal conflict occurs between individuals within a group. When two or more than two individuals have different opinions on an issue, the kind of conflict will occur. For example, project manager and associate project manager may have different understanding of the contents of the contract. (b) Group (or department) conflict occurs between a group and another group (or a department and another department) due to various reasons. For example, the owner hopes that the construction project can be finished with less investment, short construction period and high quality, but construction enterprises may not service for the owner's interests, and they will even seek personal gains through slowing down or using inferior materials. (c) Conflict between individuals and groups including the inconsistent of individual behaviors and perception with the rules and goals of formal organization, and conflict of interest between individuals and informal organization. For example, some community residents are unwilling to relocate, but in order to implement the new project; the government and enterprises tell them to move quickly. (d) Conflict between internal and external stakeholders is a series of inconsistent behaviors that occur between construction project, the public and the government. For example, there are some organizational activities of the project stakeholders contravene the law.

Table 1.Main Factors Causing Conflicts between Construction Project Stakeholders.

Subject	Main factors
Owner	Remaining issues of previous work, delay of drawings, engineering change, delay of building materials, fittings, and equipment provided by the owner, payment is not timely
Construction enterprise	Construction period delay, materials and equipment provided by construction enterprise are not qualified, shortage of engineering quality
Supervision enterprise	Instruction or notification issued by the supervision engineer is wrong, unreasonably interfere with project construction and so on
Force majeure	Natural disasters, such as earthquakes, floods, etc. Risk of accidents, such as war, social unrest, riots and flying object fall
Others	Unforeseen Factors, such as protection of historical relics, adverse external conditions; adjustment of laws, statutory regulations and policies

Main processes of conflict management. The main program of managing conflict of between construction project stakeholders is shown in Figure 1.

Analyze who are the stakeholders and identify their demands. For one thing, each construction project has unique characteristics, therefore the first step of conflict management is to analyze the specific situation of the construction project, including the project nature, project organization, financing collection, financing management, project contract and land property adjustment models, especially its unique characteristics need more attention, and then make clear who are the stakeholders of the construction project and what are their main demands. In particular, primary stakeholders and secondary stakeholders are different to some extent in different construction projects. On the other hand, at each stage in the life cycle of construction project, stakeholders involved always change. Different stakeholders have different benefit demands, the degree of participation, their impact and risk-taking varies, but they always seek to maximize their own interests, thus conflicts between them are inevitable and complex. Analyze who are the stakeholders and identifying their demands is the premise of conflict management. Primary stakeholders involved in the four main stages of a common construction project are shown in Table 2.

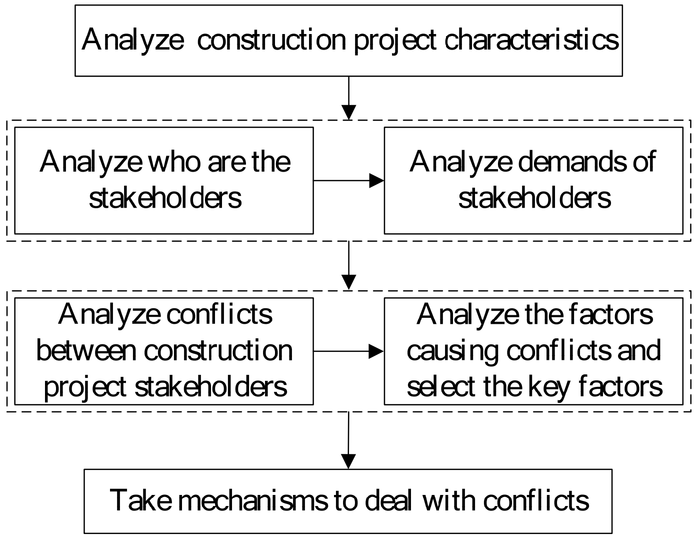

Figure 1.Main processes of conflict management.

Table 2.Primary Stakeholders Involved in the Main Stages of a Project.

Stage	Primary stakeholders involved
Decision-making stage	Investors, the owner, relevant government departments, consulting enterprise, banks and other financial institutions
Preparation stage	The owner, relevant government departments, survey and design enterprise, community residents, construction enterprise and consulting enterprise
Construction stage	The owner, construction enterprise, consulting enterprise, survey and design enterprise, suppliers of materials and equipment, supervision enterprise and community residents
Acceptance stage	The owner, construction enterprise consulting enterprise, survey and design enterprise, suppliers of materials and equipment and supervision enterprise

Analyze the factors causing conflicts and select the key factors. Conflicts between construction project stakeholders and the factors causing conflicts are different to some extent at each stage in the life cycle of construction project, and managers should make clear of this. At preparation stage a project that may pollute the environment would be devastatingly unpopular, so the conflicts between community residents and the owner, relevant government departments are fierce. At construction stage the relationship of stakeholders is most complex and conflicts are the most concentrated, because at this stage all kinds of resources are put into the project construction and the project is gradually built, the owner , construction enterprises and other participants have explicit requirements for the schedule, quality or investment, and they take measures to achieve their goals, but imbalance of interests, no coincidence of the aim, information asymmetry and other problems will lead differences and disagreements, so conflicts occur regularly. At other stages the distribution, frequency, and intensity of conflicts change too. So it is very important to analyze what conflicts may occur at each stage in the life cycle of construction project, then analyze the factors causing these conflicts, and select the key factors.

Take measures to deal with conflicts. After the above two steps, a dynamic measures to deal with conflicts should be taken. Because as the project environment and specific conditions change, conflicts between constructions project stakeholders change, measures to management conflicts should be adjusted in time properly. In general, there are two kinds of conflict management styles, one is to eliminate the conflict, that is to say project participants take measures to solve the conflict; and the other is to control the conflict within a limited range as not to affect the project implementation.

MANAGEMENT MECHANISM OF CONFLICTS BETWEEN CONSTRUCTION PROJECT STAKEHOLDERS

In order to reduce the adverse effects of the construction project stakeholders' conflicts on project implementation, maximize the degree of project objectives achievement and satisfaction of every stakeholder, more efficient objective coordination mechanism, contract constraint mechanism, communication mechanism and trust mechanism should be established.

Objective coordination mechanism. Construction project stakeholders have a common objective that is to achieve the project goals efficiently. If the project is ended for some reasons, the owner is unable to obtain pre-determined project, and construction enterprise will not get all contract amount. However, stakeholders have their own goals too, and this will lead to conflict with different objectives. Thus, in order to achieve the win-win goal, each stakeholder's demands and goals should be analyzed unambiguously. Then an objective system including each stakeholder's interests should be set up, and project participants go about trying to achieve their objectives on the premise of balance of interests. Only in this way would stakeholders draw together, create the atmosphere of equality and trust, and ensure the success of the whole project.

Contract constraint mechanism. The project owner establishes economic relationship, responsibility and rights relationship through contracts with consulting enterprise, construction enterprise, survey and design enterprise, suppliers of materials and equipment, supervision enterprise, so an effective contract constraint mechanism is an important way to manage the conflicts between them. In order to avoid conflicts caused by ill-defined stakeholder's responsibility and rights or conflicts that have happened increase, an effective contract constraint mechanism should be established. Specifically, project participants need to select an appropriate contract model and describe clearly what rights and responsibilities participants have. In particular a contract should clearly define the cooperation areas of stakeholders, content of responsibility and rights, time limit, interests' distribution and conflict processing method etc. In the event of conflicts arising from the implementation of this contract between the parties, party a and party b shall use their best endeavors to settle such conflicts in accordance with the contract, and conflicts will be managed reasonably in the way.

Communication mechanism. Construction projects are complex and organizationally characterized by a high degree of fragmentation (e.g. multi-disciplinary stakeholders, many suppliers and contractors or sub-contractors) and each project consists of different sectors and each sector contains many activities, and these results in a need for clear communication and collaboration between the project participants in order to ensure the success of a project. Planning, organizing, leading, and controlling the implementation process of a construction project need information communication. A failure of communication in the project will likely to lead the project to delay, overspending or even failure, hence an effective information communication mechanism should be established to find the problems timely and make a decision as soon as possible, thus conflicts can be avoided or handled correctly and timely. In addition to the formal communication channels (e.g. administrative instruction, meeting), a variety of informal channels of communication can be helpful too, both formal and informal channels of communication should be used to promote the information interaction between stakeholders. And through communication stakeholders will fully understand the situation of construction project, discuss the problems and solve them quickly, so conflicts can be managed properly.

Trust mechanism. Trust is seen as being particularly important in construction projects, since it is viewed as necessary for stable relationships, essential for the maintenance of cooperation, vital for any exchange and essential for even the most routine of everyday interactions. And trust may be even more predictive of behavior in situations involving a larger, compared to smaller, conflict of interests. Insinuations that contain a larger conflict of interest, people have a strong selfish temptation to behave against others' best interest, and in this context benevolent motives are stronger determinants of cooperation, compared to situations that contain less conflict. Since construction project stakeholders may have little or no prior knowledge of the other parties' technical or fiduciary standards, and there is a lack of time for familiarity to develop from shared experiences or demonstrations of non-exploitation of vulnerability, they need to strengthen communication to develop from a low-trust base to a high-trust base in their relating to achieve well-working relationships, and to reduce conflicts occur in the various stages, keep trading costs down, then realize the win-win objective of stakeholders.

CONCLUSION

Conflict management of stakeholders is an important part of construction project management, and allocating stakeholders' interests properly is not very easy, so managers should pay more attention to it. The paper analyzes the factors causing the conflicts between construction project stakeholders and the main categories of conflicts at each stage in the life cycle of construction project, and then it puts forward the main processes and the related mechanisms of conflict management, including objective coordination mechanism, contract constraint mechanism, communication mechanism and trust mechanism. And it is useful for managers to understand and manage conflicts between stakeholders more effectively, and thus to promote the realization of the objectives of the project and to meet the demands of different stakeholders in a construction project.

ACKNOWLEDGMENTS

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Methods Based on the Bayesian Network for a Construction Accident Pre-Warning System

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Abstract

Through analysis of the current situation of construction safety, most of the warming system and index system of construction safety are based on the traditional methods, which cannot meet the need of accuracy. As the methods of civil construction safety management are constantly improved, the precise and effective pre-warming system is desperately needed. Thanks to the development of the industrial informatization, artificial intelligence technology can forecast and assess the tendency based on effectively analysis of construction safety data. As an important branch of artificial intelligence research, Bayesian network can manage uncertainty problems, express and fuse multi-source information. Therefore, researching the construction safety pre-warming system based on Bayesian networks has notable theoretical and practical significance. This paper aims to build an improved construction safety pre-warming system and provides references for minimizing construction accidents.

INTRODUCTION

As it is well known that the construction process has characters such as the long-term production cycle, the flexibility of workers and the large amount of highly outdoor procedures and manual operations, it has a certain risk. Besides, the construction process is always considered as the high-risk phase of safety accident, which can not only cause the huge civil property loss and also bring negative effects into the development of related enterprises and the construction industry. According to the Reports of Civil Construction and Municipal Engineering released by Ministry of Housing and Urban-Rural Development of the People's Republic of China (MOHURD2013; MOHURD 2015) from 2012 to 2014, the year of 2012, 2013 and 2014 saw 487, 524 and 522 construction accidents respectively, while the amounts of death caused by the accidents are 624, 670 and 648. Therefore, though the situation seems to remain stable, the latent risks still exist. Liu and Zeng (2008) said the gross of accidents is still large while the death toll declines slowly and in some regions the situation remains grim with the more danger accident happening occasionally. Hence, it is necessary to analysis the construction risk level and to strengthen the theory study.

Nowadays, the methods used in construction safety assessment mainly are Safety Checklist Analysis (SCA), Fuzzy Comprehensive Evaluation, Fault Tree Analysis (FTA), and Support Vector Machine (SVM) and so on. Lapp (2005) proposed the concept of the Fault Tree Analysis and pointed out it is a system based on the latent accidents or accidents that have happened to seek for the causes and conditions that are related to the occurrences. However, it cannot reflect connections and interactions between the index factors.

The Bayesian Network (BN), which is also called the Reliability Network, proposed by Pearl in 1988, is a statistical analysis technology that developed from the Bayesian Decision Method (Kevin 2002). It is based on the probability theory to study the regularity of multiple variables or factors in the objective things and can use Graph Theory to demonstrate the relationship between random variables intuitively (Wang and Sun 2010). This paper will make a risk analysis through the BN Model based on FTA, which can consider the correlation between variables and avoid drawbacks caused by strong assumptions in FTA, and enhanced the accuracy of the construction safety evaluation. What's more, it not only can make the forwards prediction but also the backwards diagnosis (Li 2013).

ESTABLISHMENT OF BN MODEL BASED ON FTA

The statics of the construction safety accidents occurred from 2010 to 2013 released by MOHURD are shown in the Table 1. It can be seen that fallings, collapse, strikes, lifting injury and equipment damage accounted for the proportion of 91.87%, 91.68%, 93.63% and 96% of all damage types from year 2010 to 2013 respectively. Hence, the main types of construction safety accident can be divided into five classes. According to this, the concept of building BN based on FTA can be described as Figure 1.

Table 1.The Statics of the Construction Safety Accidents from 2010 to 2013.

Types of Accidents		Year			
		2010	2011	2012	2013
Fall	Amount	297	314	257	310
	Proportion (%)	47.37	53.31	52.77	59.16
Collapse	Amount	93	86	67	70
	Proportion (%)	14.83	14.60	13.76	13.36
Striking	Amount	105	71	59	63
	Proportion (%)	16.75	12.05	12.11	12.02
Lifting Injury	Amount	44	49	50	42
	Proportion (%)	7.02	8.32	10.27	8.02
Damaged caused by equipments	Amount	37	20	23	18
	Proportion (%)	5.90	3.40	4.72	3.44

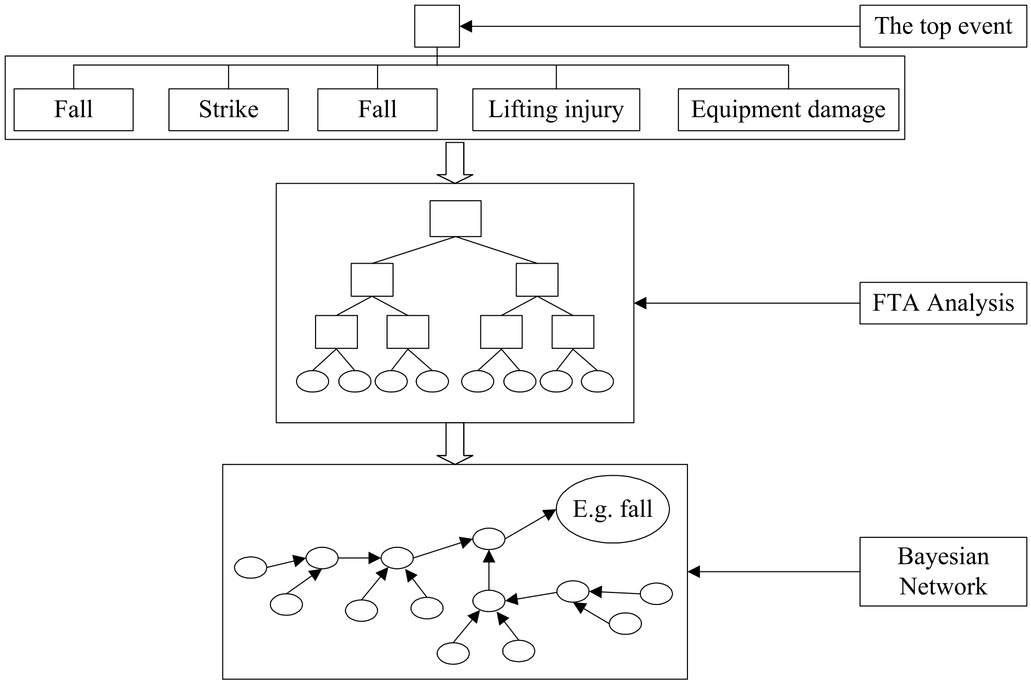

Figure 1.The the concept BN model based on FTA.

Establishment of FTA. According to the construction risk analysis and causality analysis, the Fault Tree can be established, which includes the top event and cause events and is composed by input and nexus notation. The specific procedures can be described as following rules:

(1) Be Familiar with the system and learn various parameters to draw up the process flow diagram.

(2) Investigate accidents, collect accident cases and imagine potential faults caused by given system in order to make the statistics analysis.

(3) Determine the top event. Conduct a comprehensive analysis of investigated accidents and find out the consequence that is severe and more likely to happen as the top event.

(4) Determine the target. According to the experience and accident cases, get the probability from the accident based on the analysis and use it as the target.

(5) Survey the causes which are related to the accidents.

(6) Draw up the Fault Tree. Find out the direct causes of the accidents by logical relationship step by step until reach the standard of desired depth of analysis. Then the Fault Tree can be concluded.

(7) Conducted the analysis. Simplify the tree structure and determine the occurrence probability of all events and the structure importance of basic events in order to solve the probability of the top event. It is necessary to make the mathematical expression of the Fault Tree when it refers to qualitative and quantitative analysis. Therefore, the top event's Boolean algebra can be demonstrated.

Establishment the BN model based on FTA. BN method is a directed acyclic graph (Bayesian network structure). Each node in the graph has a probability table to show the dependence between variables. In the Bayesian Network the top event's occurrence probability can be solved by joint probability distribution without solving the cut set. Hence, compared with the FTA, the polymorphism and logical uncertainty of Bayesian Network can build a more accurate model. The FTA can be transferred into Bayesian Network, according to the main mapping relationship between them such as event-node, the logical gate-connection strength (Zhou et al. 2006).

(1) Establish the Fault Tree composed by basic events and intermediate event. Build a root node in the Bayesian Network. As to the recurring events, they should only be established once.

(2) In accordance with the failure distribution between the relevant accidents and intermediate events, the prior distribution of the cut-off point in Bayesian Network can be determined.

(3) When it comes to the logical gate, it should be established as a corresponding node as well and named after the output events.

(4) The intermediate events and basic events should be connected by the node in Bayesian Network.

(5) Determine the non-root node's probability distribution in the light of logical relationship.

Figure 2 shows the logical relationship in FTA that reflects on the topology structure and the conditional probability distribution in Bayesian Network. In the Fault Tree, the logical gate usually deals with the certainty relationship. For example, when Event X_1 and Event X_2 occurred at the same time, the top Event T is inevitable. However, the Event T doesn't have to set up in practice. BN can combine the actual situation with the conditional probability table to revise the unreasonable status by dimorphism amendment and to correct the logical uncertainty. Therefore, the BN model can be more practical and improve the accuracy of the early warning system.

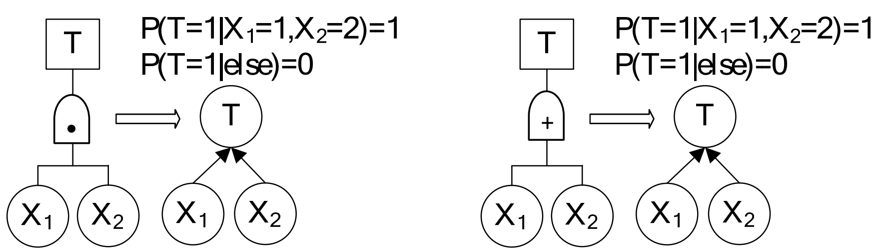

Figure 2.The logical relationship reflected on BN.

APPLICATION IN BAYESIAN NETWORK IMPROVEMENT

It can be seen from table 1 that the fall have accounted for more than 50% for three consecutive years, which shows the high occurrence and the severe damage it can caused. Therefore, in this section we will focus on the falling accidents and dig out the latent factors. By studying those factors, we can formulate preventive measures.

Establish FTA model of falls accident. Through the study of the falls accidents in recent years, according to accident causation theory and Yang et al.

(2010) studies various factors can be summarized. The casualty accidence of operation staffs falling from the high place was named as the top event T in Fault Tree. The basic events in Figure 3 are the foundations of the Fault Tree and can lead to the occurrence of Event T. Names and symbols of the basic events are shown in Table 2.

Follow the principle of Boolean representatives to solve minimum cut set and get the expression of the Boolean fault tree shown as follows:

$$\begin{aligned} T &= A_1 \bullet A_2 \\ &= B_1 \bullet B_2 \bullet (B_3 + B_4) \\ &= C_1 \bullet C_2 \bullet (C_3 + C_4) \bullet (X_9 + X_{10} + X_{11} + X_{12} + X_{13}) \\ &= (X_1 + X_2) \bullet (X_3 + X_4) \bullet (X_5 + X_6 + X_7 + X_8) \bullet (X_9 + X_{10} + X_{11} + X_{12} + X_{13}) \end{aligned} \quad (1)$$

We could receive 80 minimum cut sets from Formula 1. Each of basic elements influences the accidence of falling from the high place. The arranges of the influence from high to low be presented as follows:

$$X_1 = X_2 = X_3 = X_4 > X_5 = X_6 = X_7 = X_8 > X_9 = X_{10} = X_{11} = X_{12} = X_{13} \quad (2)$$

Observing the logic of fault tree, the relation of "or" is 62.5%, the relation of "and" is 37.5%. 80 minimum cut set represents 80 possible methods of falling accidences. Thus it can be seen that the conditions needed for accidence of falling from the high place are relatively simple, while the possibilities of occurrence of falling from the high place are high. The largest influence to the top event is damage of basic accidence attached to operation platform.

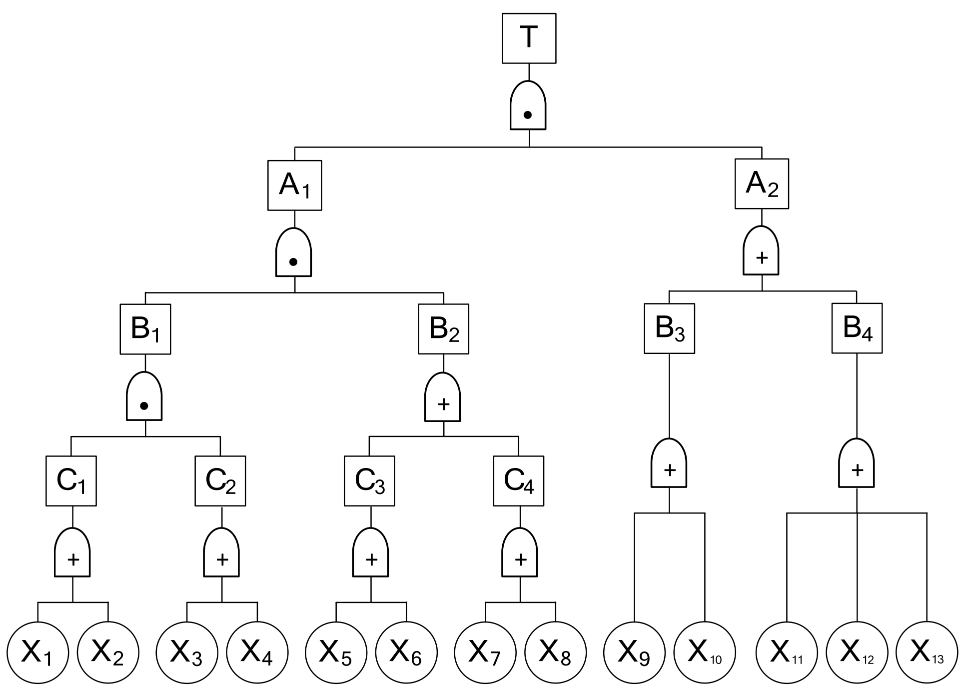

Figure 3.The transformation from FTA model to BN model.

Table 2.Names and Symbols of the Basic Events.

Name	Symbol
T	Falling Accident
A_1	High-place Operation
A_2	The invalid safety protection
B_1	Damage of operating deck
B_2	Improper operation
B_3	Detect of protective measures
B_4	Using the protective measure improperly
C_1	Damage of Supporting platform
C_2	Invalid Guardianship
C_3	Operation miss
C_4	Violation Operation
X_1	The failure erection of supporting platform
X_2	Flaw in supporting equipment
X_3	Improper tutelage
X_4	Lack of onsite supervision
X_5	Occasional mistakes
X_6	Lack of experience
X_7	Safety Consciousness
X_8	Night Operation
X_9	Using the protective equipment improperly
X_{10}	Damage of protective equipment
X_{11}	Not wearing protective equipment
X_{12}	Taking off the protective equipment while walking
X_{13}	Not equipping with protective equipment

Covert FTA model to BN model. Based on the principle mentioned above, we can covert the FTA model to BN model. Obtain the status of falling from high place, combine common sense and historical data by using Bayesian network, and eventually add prior data to GeNle software. The accidence of falling from the high place can cause extremely serious consequence and weaker surviving opportunity, which can be seen from the experience. So the probability value of falling from the high place received from calculator is considered the risk value of the accidence, thus severity of falling from the high place could be set full value. Calculate as mentioned above. Then we can obtain the posterior probability shown in Figure 3.

Comparing with prior probability, posterior probability is closer to the probability estimate of actual situation. From the calculation, we could see that in the posterior probability of falling from the high place basic accidence , the first three items of likelihood occurrence are "the fault usage of safeguard procedures"、"taking down the safeguard procedures" with getting around and "the damage of the safeguard procedures". At the same time, it can be concluded from the reduction of

Bayesian Network that though disqualification of supporting platform (Scaffolding) causes lower probability than the damage of the safeguard procedures, but it has a higher posterior probability. Therefore it plays a decisive role in the accidence.

Revise the model by BN polymorphism. According to the fault tree, BN polymorphism, conditional probability and other features to build a more reasonable model for causation of the accident. Figure 3 nodes C_4 protective measures on behalf of the unused; the reasons cause the X_7: security monitoring, X_8: night improper operation. However the actual working hours include “morning”, “afternoon” and “night”. Therefore, X_8 should be replaced by three kinds of states as “morning”, “afternoon”, and “night”, which can respectively be represented by “M”, “A”, “N”. Corresponds to the fault tree of “or”, reconsider and amend the conditional probability as shown in Table 3.

Table 3.The Conditional Probability of Node C_4.

X_7		T			F	
X_8	M	A	N	M	A	N
C_4=1	1	1	1	0	0.4	1
C_4=0	0	0	0	1	0.6	0

The above question was under the assumption that either the two sub-nodes of “or” occurs, the parent node certainly happens. But the fact is that the sub-nodes are not necessarily occurring to the occurrence of the parent node. Therefore, with the BN probability table, the above problem can be modified by GeNIe software. As it is shown in Table 4, it means though X_7 or X_8 cannot guarantee the occurrence of C_4, they may lead to C_4.

Table 4.The Revised Conditional Probability of Node C_4.

X_7		T			F	
X_8	M	A	N	M	A	N
C_4=1	0.8	0.85	1	0.1	0.4	0.95
C_4=0	0.2	0.15	0	0.9	0.6	0.05

Thus, events that are difficult to describe both in logical relationship and polymorphism of certaintyin a fault tree model, can easily be demonstrated by simply changing the corresponding conditional probabilities in the BN model table. What’s more, it can also be used as an alternative to the traditional psychological testing and expert evaluation.

CONCLUSION

FTA is an effective tool for accident analysis and risk assessment. But it also has the limitation of logical relationship. In this paper, the Bayesian Network based on FTA model can enhance the practicability of FTA and more useful in actual situation. Based on the fact that the falling takes the largest proportion among all types of accidents, this paper only makes a detailed analysis of falling accident. In the view of the simplicity of the BN model, the method mentioned in this paper can also be used into other kinds of accidents and is expected to make a great contribution to the risk analysis.

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PFI Risk Management Research

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Abstract

Being different from traditional means for the finance in public projects, PFI cooperates with the government procuring from private finance to provide resources to the project in the public sectors. In the United Kingdom, PFI is widely used in many governments' public projects. This article describes the current situation of PFI in China and the necessity of introducing PFI to China. It also includes the connotation of PFI and the different types of PFI. Then it describes eight kinds of risks that PFI will go through in China. Depend on PFI projects' risk sharing principles and mechanisms, The PFI project risk management measures are proposed to promote PFI develop in China.

INTRODUCTION

Currently PFI are introduced to China' public construction project. These models in the country are just beginning in China, especially PFI, studied by Xie and Hu (2003). PFI has been well developed in the UK as an important mean of infrastructure financing. Engineering Project Risk Management is researched by Wang (2003a). PFI mode project develops rapidly in China, effectively promoting the development of public construction projects. But generally PFI projects have many participators, long construction period and a large number of uncertainties. There is a huge investment and high sunk costs in the PFI project, making the project very risky. Therefore, the study of PFI financing model risk management has important practical significance for the promotion and application to PFI financing model.

IMPLICATION OF PFI

Private Finance Initiative (PFI) means government gives the opportunity to private sector to participate in production of infrastructure and public goods rather than that the government is responsible for providing the output of public projects in a traditional way, which is a new way of public project outputs. In this way government cooperates with the private sector. Private sector undertakes the production of public goods or provides public services while government purchases products or services from the private sector or gives concession to private sector in public projects, or operates project with the private sector in a co-operating mode. PFI helps government achieve the optimization in allocation of government public goods resources output (Kwak 2002).

PFI is currently a advanced way to output public product used by developed countries. This method is currently used in the Hong Kong's first undersea tunnel, Japan's Kansai International Airport, American California PFI project, Australian Sydney M4 western Expressway and French the Orret airport light railway and so on.

THE CURRENT SITUATION OF PFI IN CHINA

Infrastructure projects play an important role in the process of national economic construction and social development. A large number of scholars and practitioners have done fruitful researches in the commonalities of infrastructure projects' construction. There are few researches in applying PFI in infrastructure. The direct cause is that PFI is still in its infancy, people cannot accept the concept of infrastructure privatization. China also has a small number of public service infrastructure projects tried PFI mode and achieved good economic and social benefits, for example in construction of Amoy city real estate information management platform government used PFI building mode (Yang and Huang 2007).

THE CONNOTATION OF PFI

The private sector makes the government become services buyers from the owner of the property under the PFI (Ren and Li 2004). PFI includes the following four elements: Design - The private sector is responsible for the design of public facilities and engineering. Construction - Facilities are built by private sector. Finance – the rent to infrastructure are used as the repayment to Private sector 'loan. Operations - in general case, many public services are operated by the administrator of public institutions, most of who are experienced and know how to effectively serve the public. In order to enable investors and governments are benefit from PFI project, they should take reasonable risk control, risk analysis.

PROJECT RISK ANALYSIS OF PFI

United States' project management institute defines project risk as unfavorable results to project objectives generated from uncertain events on the process of project implementation. As there PFI projects have a long life cycle with multiple participants and relationship between the parties is complex, risk exists in Figure 1. Uncertainty and Cash Flow of the Various Stages of PFI Project the whole process of the project (Wideman 1992). In the entire process of project implementation, the uncertainty of project showed a decreasing trend as the project proceeds and the demand of capital investment and the outflow of profit are very uneven. We can see uncertainty and cash flow of the various stages of PFI project from the Diagram (see Figure 1). According to the development status quo of the PFI in China's development, we can divide the risks faced by PFI project for eight areas: political risk, legal risk, financial risk, natural risk, environmental risk, construction risk, operational risk and force majeure risks (Sun 2004).

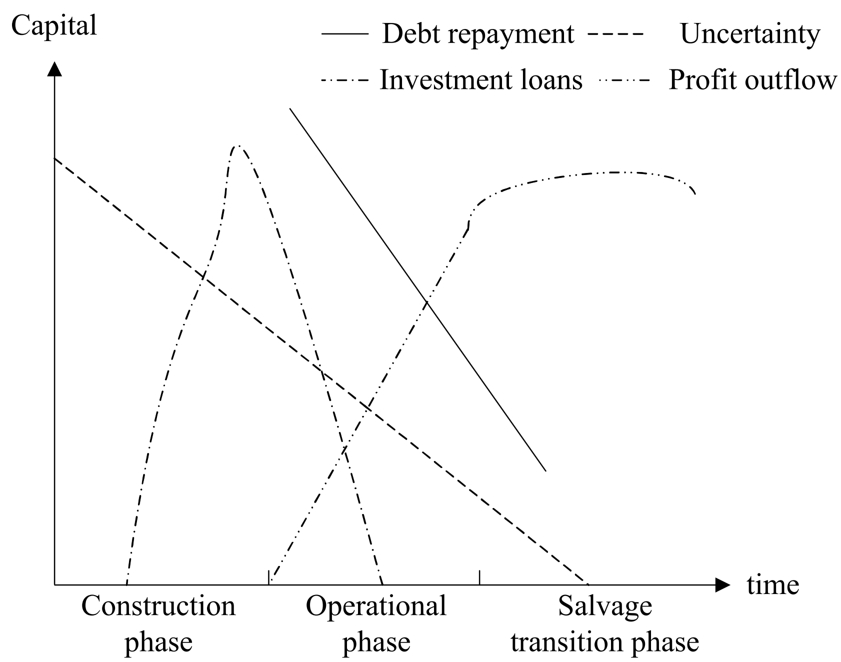

Figure 1.Uncertainty and cash flow of the various stages of PFI project.

Political risk. Political risk is a type of risk that the country has adopted an unfavorable policy to PFI normal operation due to the war, and mandatory or discriminatory policies and measures results in different degrees risks to PFI program in assets and interests .For our country's PFI projects, changes in national economic policy or system, and breach of contract all will affect the returns to investors. And political risks are often comprehensive with related effect. So once the political risk appears, PFI projects will face the risk of failure.

Legal risk. Legal risk is the risk raised by changes in terms of the sensitivity of the legal system, the tax system, labor relations. PFI projects rely heavily on government franchises, specific tax policy and so on. Government franchises and related policy play as an important credit support for project financing. China's current law is not very completed, so for our PFI projects, legal risk is particularly important.

Financial risk. Financial risks of PFI project model include mainly the following three kinds of risk.

(1) Interest rate risk. Interest rate risk is the risk of the value of the project reducing or benefits eliminating caused from changes in interest rates. It is mainly

manifested in the process of raising capital and operations. For example, investors will have loss of opportunity because of falling interest rates if investor got a long-term financing loan when interest rates are higher (Zhang 1998).

(2) Exchange Risk. Fluctuations in exchange rates will affect the cost of production in PFI projects. For example, when our interest rates fall, the price of imported raw materials will rise, which may affect the cost of the entire project? Because the analysis of PFI project' payback period, internal rate of return, return on equity and net present value after tax are based on the exchange rate and the discount rate, exchange rate risk would adversely affect the project in financial base and SPC (Special Purpose Company) debt structure .

(3) Inflation Risk. Inflation may make wage and price levels rose sharply, leading operating costs rising, which have a tremendous impact on the financial feasibility of PFI projects.

Natural risks. Natural risk is the harsh natural conditions objectively existed in PFI project site such as harsh climatic conditions and poor site conditions, which will constitute a potential threat to investors. It includes impact of weather conditions, geographical environment of construction site, ecological environment and impact of construction site conditions.

Environmental risks. With the rapid development of China's economy and the implementation of sustainable development policy, environmental pollution and ecological protection get more and more attention from government and the public. For PFI project of our country, to meet the requirements of environmental protection legislation, we need to increase the project cost of production or increase investment to improve Production environment. Moreover, in the case of lenders making the project site and project assets as collateral, if the lender uses the right to take over the project, he will bear the pressure and responsibility for environmental protection. In addition to the fines for pollution, environmental costs may include environmental audit program costs, environmental impact assessment fees and so on.

Construction risk. Construction risk mainly refers to a number of risks associated with construction projects including the risk from failed projects, delayed completion project, construction project which cannot achieve the expected operating standards after construction is completed, construction project whose Supporting infrastructure is imperfect .For investors, construction risk means increasing in interest expense and extending the loan repayment period. Technical requirements of the project design, contractors' build capacity, ability to use funds rationally, the ability of contractor to provide a security contractor and the ability to fulfill commitments are the main factors to influence construction risk. If the project is not in accordance to go into operation, basis for the survival of project finance will be fundamentally damaged, causing construction delays, cost overruns and quality issues.

Operational risk. Operational risk is the core of PFI projects risks in China. It refers to the risk that due to the negligence of the operator or significant operational problems, which ultimately affect the profitability of the project. The operation period after the completion of the construction period is a critical stage of cash flow recovery. It has Market Risk, Technical risk and Energy and raw material risk (Zhou 2007).

(1) Market Risk. Market risk is the risk of losses in positions arising from movements in market price. The risk will come from oscillation in the price of goods or services, Competition between competitors and Changes in market demand.

(2) Technical risk. The development of technology make completed PFI projects lose advantage, resulting in relatively high cost and relatively poor service, which is technical risk. The risk is affect by technology innovation and technical improvements.

(3) Energy and raw material risk. For PFI projects which rely on certain energy and material, if there is not supplement guarantee of enough energy and material in operational period, these projects will face pretty large risk. The fluctuation of energy and material's price and reliability both can affect the whole project operation.

Force majeure risk. Force majeure risk is the risk that the PFI projects' participants cannot forecast and get over the events which can damage and disaster the whole project. Generally, Natural phenomena about force majeure include volcano eruption, earthquake, flood and lightning etc. Force majeure risk cannot be bored and controlled by any participant and the result is unforeseen. Though force majeure risk is rare, its danger is great.

PFI PROJECTS' RISK SHARING PRINCIPLES AND MECHANISMS

PFI projects' risk sharing principles. Specificity of PFI financial mode is its risk diversion and sharing. The participant shall bear risk that can influence and control risk most effectively and produce most overall effectiveness. If any participant cannot bear the risk, insurance will do it. If insurance cannot diverse risk, all participants shall share the risk. In the ideal situation of PFI financial mode, all participants and government can achieve "win-win", All mentioned above decide the succeed of PFI projects (Wang 2003a). According to theories mentioned above, PFI risk sharing principles are: Risk commensurate with the affordability; Control force should symmetrical to control force; Risk coordinates with participation of investors; Risk management commensurate with impact of projects economy; Income corresponds to the risk; No treatment for risk corresponds to caused damage.

PFI projects' risk sharing mechanisms. For PFI projects' risk sharing mechanisms, Political risk and Legal risk is mainly borne by the government, and construction risk and operation risk is mainly beard by SPC on behalf of participant. Moreover, financial risk, natural risk, environmental risk and force majeure risk are avoided and transferred mainly through risk management technology of SPC. Establishing a fair and reasonable clear risk sharing mechanism is crucial for the success of the project. It can make SPC to improve the production means and its efficient management to reduce the risk, rather than rely on transferring risk to the government, which can ensure the smooth implementation of the project and Prevent inefficient management caused by Risk constraint. And this way The government take the risk Actively will bring great confidence for private capital investment in public goods production, making the operation of PFI develop rapidly and healthy in China (Hu et al. 2004).

RISK MANAGEMENT STRATEGIES AND COUNTERMEASURES OF PFI FINANCING MODEL PROJECT

Risks diversion, risk retention, risk aversion, risk mitigation and risk use are main risk management strategies and countermeasures of PFI (Wang 2003b). Now risk management strategies and countermeasures of PTI projects are listed in table (see Table 1).

Table 1.Measures to Risk.

Risk types	Risk management strategies	Measures to risk
Political Risk	Risks diversion or risk retention	Buying insurance to reduce political risks; Written agreement with government or concession contract to formulate specific work they should do; Multilateral institutions in the project financing process, and try to let the government involved; Establish pipeline to communicate and coordinate with government departments; Regulate countermeasures and compensation measures in concession contract; Write imposed conditions, imposed price, compensation measures clearly in the concession contract.
Legal Risk	Risks diversion or risk retention	Signed a security agreement with the government; For the special case, lose legislative restrictions and develop applicable approaches for it.
Financial risk (1) Interest rate risk. (2) Exchange risk (3) Inflation risk	Risk aversion, risks diversion or risk retention	Check the feasibility of bidders' financing plan and bank financing commitment, required bidders to submit a performance bond; Use fixed-rate financing, reducing the proportion of foreign currency financing and use derivative to avoid the risk; Seek subsidized mechanism of interest rate and currency fluctuations; Consider inflation rate in Rate adjustment mechanism and use fixed-price contracts as far as possible; Have a loan guarantee of fixed rate; Use multiple currencies; Work closely with the banks and other financial institutions; Use hedging techniques such as interest rate cap, interest rate range, minimum-guarantee to reduce the impact of changes in interest rates.

Table 1.(Continued).

Risk types	Risk management strategies	Measures to risk
Natural risks	Risks diversion or risk retention	Purchase insurance to reduce nature risk; Sign related compensation agreement with the government, and claims in accordance with the relevant regulations; Take precautions to guard against natural risks;
Environmental risks	Risks diversion or risk retention	Take rigorous environmental impact assessment, and gain review and approval of the EIA; Adopt clean technologies and establish pollution prevention fund; Standardize contingency provisions of changes in environmental standards in concession contract;
Construction risk	Risks diversion, risk prevention or risk retention	Plan the pre-operation of bidding, develop accreditation standards prudently, choose successful bidder carefully and establish project risk reserve; Do good project feasibility study, use a relatively mature technology and The project sponsor provides completion guarantees; Government avoids completion delay risk through taxes and financial tilt; Sign completed construction contract to minimize the risk that contractors will mistakes, in particular building strict penalty clause and provide an final award to minimize the risk of delay completion; Use sophisticated technique, award in EPC contract. Demand the contractor provide performance bond issued by a bank or insurance company. Demand parent company of contractors to provide security. Require the contractor to provide the compensation of delay completion, which is sufficient to cover the interest to increased for delayed completion; Adopt a fixed completion date and a fixed price for contract work.
Operational risk (1) Market Risk (2) Technical risk	Risk aversion, risks diversion or risk retention	Commission a professional consultants predict operational capacity, and make clear guaranteed the operation amount in concession contracts; Set up clause to prevent competition, and ask the government to provide security; Signed a contracts of periodic and quantitative payment and direct purchase; Standardize reward and punishment for operations in contract. require operators to provide performance guarantee;

Table 1.(Continued).

Risk types	Risk management strategies	Measures to risk
(3) Energy force majeure risk		Buy insurance to transfer the risk of force majeure; Seek government's funding and guarantees; Encourage sophisticated and advanced technology, and introduce of key technologies; Signed long-term supply contracts with suppliers, and establish a perfect supply and storage systems; Develop subsidies for update and strict penalty clauses in fixed-price contracts; Carefully select channels and modes of transportation for raw materials and machinery; Sign take-or-pay contract; Develop contingency plans for alternative raw materials as well as other alternative arrangements.
Force majeure risk	risks diversion and risk retention	Buy insurance to transfer the risk of force majeure; Seek government's funding and guarantees;

CONCLUSION

Due to most of PFI projects are public projects, which is related to people's livelihood, have a overall planning and careful research for PFI project is very important. Only in this way, can investors and contractor avoid, reduce, transform, or even eliminate project risk. Taking advantage of PFI financing mode can safeguard the interests of the State, users and investors, as well as promote the development of public construction projects, which will advance and support the development of China's economy.

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Strategy of Bidding under the Engineering Bill Pricing Mode

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Abstract

Now the competition of construction market is becoming more and more fiercely and China adopted engineering quantity list valuation for the construction market traction. Our country lastly introduces the 2013 edition of "code of valuation with bill quantity of Construction Engineering"(GB50500-2013) as the basis of list valuation. The owner issues tenders and the construction unit bidding for the project. This article aims to study how to choice fitful engineering by the construction unit and how to bidding effectively to increase the rate of win the bid maximally in the range of qualifications, then enterprises can made healthy and orderly progress.

INTRODUCTION

We usually say the market, broad sense refers to the commodity exchange places, and the construction market as part of the market, occupies a pivotal position in the national economy. The Architectural Engineering market is also called the construction market, the construction process is the sum of the relations of production and the elements, the whole process of the transaction market of engineering construction in construction production. China's Construction will be included in the category of market economy, not only includes the engineering contracting, but also includes the design, survey, material supply and supervision. With the acceleration of economic globalization, market competition is based on the construction market which showed the following characteristics: the transactions of construction market throughout the whole process of production; construction engineering trading activities in the market is fierce, it relates to the price, quality, reputation and time limit for a project, construction project bidding activity is the main way to do the transactions of construction market; constraints and supervision of construction engineering market transactions is by the construction method, the tendering and bidding law, real estate management law and other related laws and regulations. Construction units want to be an invincible position in the market economy system, we must make trading activities of the construction market, make the bidding activities as the main way, it is the construction unit to contract project in the construction market transaction priority. Our country began to implement the bill of quantities from July 1, 2003 , in order to adapt to the reform of China's construction project management system and construction of market development, aimed at both sides regulate the behavior of the construction trade, preparation of tender documents to the owners provide the main in accordance with. China promulgated the latest version of the 2013 "Construction Quantities inventory valuation norms" (GB50500-2013) as the most authoritative pricing norms are still in use.

BILL OF QUANTITIES MODE

The main contents of BOQ have sub-part construction projects, action items, other items, fees, taxes and the corresponding number. Bidding people based on national standards, tender documents, design documents, the actual situation of the construction site preparation of tender BOQ, and then determine a bid to control prices, the price ceiling construction units as the tender offer to do it. BOQ valuation model, according to the government's macro-control business independent quoted market price formation principles to strengthen market supervision, with distinct characteristics. implement BOQ, the formation of prices through market competition, a reasonable share of the risk in favor of the owners receive a reasonable construction project cost,, promote independent offer, improve management, improve competitiveness, thereby regulating the construction market, participate in international competition (Zhou 2014).

In the BOQ, sub-part of the project shows the name and number of the whole part of the entity projects proposed project, part of the project cost mainly depends on the domestic list price model specified in the determination of an integrated unit, are labor costs the sum of the cost of materials of construction equipment use fee management fee profits. Under normal circumstances, based on consideration of force manure risk also includes the risk of an integrated unit costs, labor costs can be considered in the cost of materials of construction equipment use fees. Measures for the completion of the proposed project activities occur in life safety technology and environmental protection aspects of the project, project costs including security measures civilized construction costs into the appearance of large machinery and construction demolition charges rainfall drainage facility fee nighttime construction secondary transportation fee winter rainy season construction costs. Other facilities fee includes the amount of the provisional valuation and behind Day work bidders part of the tendered parts and general contracting services. Fees and taxes in this section is not cost competitive bidder in the tender BOQ , with its own conditions, to fill out the price, to participate in the tender offer independent competition.

SELECT THE OBJECT OF RATIONAL BID

The construction side of the market trading activity during the first thing to do is a reasonable choice for the transaction object, what from the perspective of the bidding is bidding decisions. To choose what kind of project to bid, select the appropriate project to tender in favor of the construction side winning rate increase competition in the market, thereby enhancing corporate reputation.

Objective factor. Objectively, first of all, some hard and fast rules must comply with the quality. Level of enterprise can undertake single take a value of not more than five times the cost enterprise registered capital of housing construction project of the construction of the following: (1) the under layer and 40, all kinds of span of housing construction project; (2) the level of 240 meters and the following structures; (3) the construction area of 200000 square meters and the following residential area or building group. Secondary enterprises can undertake single take a value of not more than five times the cost enterprise registered capital of housing construction project of the construction of the following: (1) single span across 28 layer and below 36 meters and below the housing construction project; (2) the level of 120 meters and the following structures; (3) the construction area of 120000 square meters and the following residential area or building group. Level 3 companies can undertake single take a value of not more than five times the cost enterprise registered capital of housing construction project of the construction of the following: (1) single span under 14 layer and 24 meters below the housing construction project; (2) the level of 70 meters and the following structures; (3) the construction area of 60000 square meters and the following residential area or building group (Wang 2012). Within the scope of this undertaking engineering, more than not be considered. Construction of the second, supervision engineer is fair and just to understand the owner's ability to pay and performance ability, the contract may occur in the late had a greater influence on the engineering claim, it can reduce the risk to a certain extent. Third, there is a ballpark knowledge of competition as competition situation can make full use of its own in the economy, personnel and technology superiority. Such as rivals have projects under construction and nearing completion, eager to get a new contract opportunities, participate in price will not high according to the appropriate quality lower prices. On the other hand, if your opponent from the completion date is still under construction projects is very long, it may be not affected by the lower price.

The subjective factor. The strength of construction units is to choose what kind of the main factors of engineering bid. The enemy and know yourself, fight, those who say is this truth. Contractor did the number of engineering construction project quality, usage, etc all can become the owner choose the bidding unit reasonable reference; In this project, the contractor can input the number of technical management ,personnel quality and ability is appropriate for the project to meet the needs of the project; Financially, the device can meet the needs; The strength of the subcontract team is able to undertake the projects; Technical support system , quality management system and safety management system can meet the requirements of the owner; Can an important factor of contractor should consider whether to bid?

If the project is the international project, the risk may be much larger. Whether or not to bid, the contractor should consider various aspects reason, extensive investigation and study, the accumulation of data to conduct a comprehensive analysis don't miss opportunity of winning and waste bidding opportunities to make the right bidding decisions.

THE BILL OF QUANTITIES VALUATION MODE ANALYSIS OF THE TENDER OFFER STRATEGY

After the bidding project, the most important job is to prepare the tender documents to make contractor selection. The tender offer is the top priority in the links of the whole. In practice, many factors that affect the evaluation of the benchmark price, including the tender control price, other people's bidding, bid base price calculation method using different will lead to different result of winning bid (Shen 2014). The bid or not, is directly related to the rationality of the offer also determines the corporate earnings. In the modern market economy mode, generally USES the lowest bid, but it is not recommended in practice. Tender offer is too low, it may bring enterprise capital turnover in the late bad or profit is too low, even some people think that the bid by low price, profit on the claim, but there is no complete set of perfect modern mechanism of claim for compensation, brings to the enterprise risk is very big. High price may make the enterprise loses the winning chance, so the price should be reasonable rather than the lowest. Only offer low and moderate bid is the basic principles.

Reasonable use of listing fees. (1) To reduce project cost. In listing fee, partial construction cost, material, machine according to the quota plan take the most, not as compression cost object (Wang 2013). Measures the project cost can be reduced. Measures the project safety civilization construction costs in the fees cannot be discounted, not as compressed objects. The content of the object can be used as the price is reasonable to consider are shown in Table 1:

Table 1.The Content of the Object Can Be Used as the Price Is Reasonable to Consider.

Content	Write-downs	Free counter
Temporary facilities fee	Large quantities of engineering or construction project follow-up project in batches	
Nighttime increased construction costs	Not tight schedule requirements, no rush	No night construction
Winter rainy season increased construction costs	But there are fewer winter rainy season	No winter rainy season construction
Large equipment into the game and the demolition charges	Construction companies high level of technical equipment	
Secondary transportation fee	Transport facilities or adequate manpower	

(2) Meter day work. Meter day work commonly known as “workers”, in the process of construction, complete the employer put forward the construction drawings of sporadic project or work, belong to other project cost. The bidder can according to the number of the renderer to provide complete price. It can be reimbursed and more profitable.

(3) Unbalanced quotes. Unbalanced offer is a modern enterprise in the total price change on the basis of a reasonable offer sub-projects to be apportioned, the

purpose is to earn extra income in capital flows. This is a form specifically applies to the Table 2.

Table 2.Unbalanced Offer Projects.

Unit price Project	Increase	Lowered
Project period to recover funds	Early stage	Late stage
Project estimated future	Increase	Cut back
Content	Drawing content is not clear or there is an error	project content is not clear

In addition, there is another quote form for corporate information. If you want to contract the construction unit of all major engineering projects, and large-scale projects often use phased construction approach, the construction companies can offer a project to reduce the start-up costs properly allowable to the latter part of the project, the project forms through analysis to obtain best of both worlds.

(4) Increase the risk of unforeseen expenses. Construction engineering contracting business in the construction process, suffered natural disasters, weather effects such as engineering change is inevitable. To change the project or do not grasp of the larger projects, such as project specification and contract terms you ambiguity, missing inventory items, deviations or changes to quantities, may be appropriate to increase the risk of unforeseen expenses, in order to expand the price, reduce the risk of it. Under this method, the price is the settlement price, it does not cause unnecessary trouble, but the total price will be slightly higher. To address this situation, the two projects can be reported in the tender price, an origin alone can be annotated, such as engineering specification or contract clause to do some changes, how much costs can be reduced. In this way, you can attract the owners to modify the specification and contract terms.

(5) Reduce profits and management fees. Part of the project cost is determined depending on the integrated unit domestic inventory valuation mode, integrated unit labor costs, material costs, including construction equipment usage fee management fees and profits. Most talented machine by a fixed accrual, not as compressed objects. And, as the engineering companies it can appropriate circumstances, such as large projects, their time is abundant, high total price or labor-intensive projects that can be appropriately reduced profits and management fees, in order to reduce the offer. Although designed to offer low here, but through the latter part of the project claim to earn high profits. The so-called bid by low-cost, profit by the claims. You can also help the contractor to enter the local contracting market, establish credibility.

Analysis of the spiritual dimension. (1) Attract owners. First, from the contracting structural form, you can take the consortium bid, several strong price control contractor together with one of the bidders to come forward, and then some of the projects in which the transfer of other contractors. This selection of the company has expertise appreciated by the owners as a subcontractor.

Second, hiring an agent bidding, bidding agent here refers to the location of the project bidding tender side to employ familiar with local customs, familiar with the philosophy and structure of the tender side, the main purpose is to make plans for the contractor to comply with the wishes of the owners. Pro-competitive bid.

Third, the contractor may submit preferential conditions in the tender documents, such as shorter duration, quality improvement, introduce new technology and new design, provide and other supplementary materials and equipment, in order to attract the attention of the owners.

Fourth, the Contractor may actively in the project site with the renderer PR exchange activities, contact the feelings, establish a good image, and achieved good local reputation, publicity and self-promotion.

(2) Confuse competitors. Contractors in the bidding process, in addition to offer is a key consideration, but also consider some tips to get the bid. For example, before preparing a quote, can be properly considered a good price range, deliberately publish false information submitted or intend to abandon high standard, and then when the competitors off guard, suddenly went to the tender offer or reduced in order to achieve the purpose to confuse competitors.

CONCLUSION

Our bidding has twenty years of history, twenty years, Bidding Construction Engineering Bill of Quantities norms established, so that our bidding system of continuous improvement, has made remarkable development. However, today there are still many problems. Construction companies in the bidding process, will still take place in order to make profits squeezed rivals to bid below cost price, so that the latter part of the project claim deliberately continue to occur. In Western countries, the market has been fairly standardized bidding, supervision and service organizations are quite robust, construction companies bidding, not just focus on the lowest price, but also pay attention to the best value. China should strengthen the legal system to be standardization, prohibit price lower than the cost of the approved and tender price. Construction companies to bid, (Qu 2014) follows a fair and impartial principle of good faith, comprehensive use of various pricing strategies to improve the successful rate.

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Research on China's Mortgage System

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Abstract

Mortgage loan is one of the great innovations in real estate and financial sector. It entered the stage of rapid development since it was introduced from Hong Kong, which promoted the prosperity of the real estate industry. However, China's mortgage history is very short. Based on the qualitative research of the international comparison, we found that the China's mortgage system has the shortcomings of imperfect supporting system, unreasonable design, lacking of support for the low income earners etc., which creates a lot social frictions. We must perfect the mortgage system to give full play to the mortgage system and promote the healthy development of the real estate market. In reference to the foreign practice, this paper put forward some reform ideas: establish and perfect the personal credit system, innovate the loan products, provide preferential policy for the low and middle income earners etc.

INTRODUCTION

With the development of reform of housing commercialization and urbanization in China, the real estate industry developed rapidly. Since the housing prices went up quickly, some households could hardly pay the commercial house in a lump sum, which made mortgage loan from the bank become the main mode of the general urban families to persuade a house. From the practice of China's mortgage, the implementation of this mortgage system not only effectively enhanced the purchasing power of urban residents and expanded the scale of demand, which brought great impetus to the real estate industry, but also improved the living environment of farmers in rural areas and accelerated the urbanization process of China, which brought benefits to both the economy and society (Ye and Zhao 2010). Although the mortgage system is widely used in China and is developing well, there are still many shortcomings compared with the mortgage in developed countries, such as the imperfect system construction and the unreasonable design etc. For the fields of real estate and financial sector, it is a meaningful work to improve the system of mortgage by analyzing both the foreign experience and the current situation in China.

THE POSITIVE EFFECT OF MORTGAGE LOAN

The concept of "Mortgage" is derived from the UK. It is introduced from Hong Kong to China mainland in 1990's and blended into the legal system, which produces a unique system model that is different from the systems in western countries and Hong Kong. Mortgage in China mainland is a guarantee way, which refers that the person who buying a house is the borrower and takes the house itself to be a guarantee to pay for the principal and interest of the bank, and the developer of the real estate plays the guarantor of the buyers. After the borrower pay off the loan, the bank should give the mortgage right of the house back to the borrower. If the borrower cannot repay the principal and interest to the bank on time, the bank will have the right to discount or auction the house to get preferred compensation, or the developers (the guarantors) repurchase the house and repay the principal and interest to the bank (Li 2010; Wulan 2012; Yang et al. 2006; Zhang 2000; Yu and Yuan 2000; Zhu and Zhang 2003; Sun 2009; Chen 1999; Sun 2013). The positive effects of mortgage are significantly obvious from the practice of China.

Mortgage loan could enhance residents' purchasing ability and improve the family utility. Living quality is an important symbol of social progress. It is a main focus of every government to make the citizens have comfortable homes and to improve homeownership prates. The housing itself has great value, and if there is no means of finance, the ordinary families could not offer enough money to buy it. Even if they can afford it, they also need to accumulate money for more than 10 years or longer, which will greatly shorten the use time of the building. Coupled with the situation that China is in the real estate industry rising, the house price is soaring fast. Some families may never be able to buy houses because of the inflation and currency devaluation (Li 2006). The mortgage loans allow people to use the financial market's function of inter-temporal allocation of resources, which is called "spend tomorrow's money for today's use". People could satisfy their housing needs in advance with a small amount of down-payment, which can both solve the problem of liquidity constraints and effectively expand the real estate capital markets.

In addition, based on the life cycle hypothesis proposed by Franco Modigliani et al., the rational consumers arrange their own life consumption and saving according to the income, which makes the income equal the consumption. When the expected revenue increases, families will increase the current spending by borrowing. This is especially beneficial to young people, since buying a house through a mortgage will greatly increase their family welfare.

Mortgage loan could promote the real estate market prosperity and speed up the urbanization process. Real estate industry is a typical capital-intensive industry, which has the traits of large investment, less labor saturation, slow capital turnover and slow investment effect refection, which needs a great amount of capital investment. The financial innovation degree and the development speed are slow in China, so there are few alternative financing methods except the conventional bank loans and fiduciary investment (Guo 2011). The current financing source of the real estate development can be divided into the following four kinds: domestic loans, self-raised funds, foreign capital and other capitals. The proportion of other capitals is the dominant one, which has been maintained at more than 40%, and this part mainly comes from personal bank mortgage loan programs.

Individual mortgage loans have greatly improved the people's purchasing capacity, stimulated the real estate trade, and expanded the scale of demand, which provide a great amount of capital for the real estate industry. The individual mortgage loan not only helps the masses to realize the housing dream in advance, but also promotes the development of the real estate industry. Meanwhile, mortgage provides a reliable means of financing for many investors, increases the real estate holdings and rental market supply, and provides the living place for migrant workers and young graduates in big cities who temporarily cannot buy a house. This retains their work and development opportunities in big cities, and it also advances the process of urbanization, changes the urban appearance, and improves the regional industrial structure.

Mortgage loan could drive economic growth through the industrial connection effect. The real estate industry is not only the pillar industry, but also is the leading industry with a strong vertical and horizontal economic correlation (Zhang and Wu 2011; Liang et al. 2006). As a result of the long and complex real estate industry chain, the real estate industry combines the decoration of the construction industry, renovation industry, the building materials industry, household appliance industry, textile industry and property management together through the forward linkage, backward linkage and lateral relationship, which occupies more than 60% of the industry directly and indirectly, and then associates with more than 40% of the employment. We found that the real estate investment effect is much stronger than the hot fields that the government investment focuses, such as railway, highway, water conservancy, electricity, airports and other infrastructure. Moreover, even the output value and revenue of salt industry and tobacco industry are subject to the condition of the real estate market.

In the world level, the rapid real estate development period is also the peak period of economic growth and the real estate industry bust is also the national economic crisis or recession. This fully proves the influence of the real estate industry to the national economy. Even in the developed countries such as the United States, the real estate industry is still the first pillar industry. In 2011 the contribution rate of the real estate reached 13%, while the financial and insurance industries only have a contribution rate of 8%.

Mortgage loan could improve investment returns to avoid price risk. Real estate is a special commodity with heterogeneity, which is easy to form certain supply monopoly, coupling with truth that the purchasing behavior is usually associated with the surrounding environment quality (including natural environment, security situation, neighborhood, etc.) and the supporting facilities (including schools, hospitals, transportation, commercial facilities, sports facilities, etc.). The demand to real estate generally shows a trend of steady rise because there is almost no substitute for real estate. These characteristics determine the trend of prices rising under normal circumstance. The People's Republic of China implemented the planned economy since 1949 and adopted the housing system model of welfare housing distribution pattern; in that case the supply growth was very slow, which accumulated a lot of demand. Until 1998 that the former premier minister of the state council Zhu Rongji decided to vigorously develop the real estate industry, which was aimed to cope with the impact of the financial crisis. After that, the housing supply entered the adequate market; meanwhile the demand was also released because of the credit policy support.

In recent years, with the improvement of residents' living standard and the acceleration of population mobility, people's need for housing is increasing urgently. But the land supply is always limited and the supply and demand condition has not reached the long-term equilibrium, which leads to property prices increasing year by year and the growth rate is much higher than the wage growth level. The national commodity house average price had reached to 6323 Yuan in 2014, which was 408 Yuan in 1987, and the average annual compound growth rate is 10.68% during the past 27 years. In the long term, the high-speed development of China's real estate industry is far from closure. Many factors determine that the price will continue increasing. There is no doubt that once the mortgage loans go into the market, it can not only save a lot of money, but also share the appreciation income of land and avoid price rises along with the risk of inflation effectively.

Mortgage loan could improve the bank loan structure and ensure financial security. China's banking credit assets quality is always the concern of the financial industry and academia. It is generally believed that the change of the quality of credit assets is the outcome of combined action of inner and outer factors. The external macro factors include economic cycle, shadow banking and local government debt paying ability. The internal factors include the direction of loan investment and bank internal risk management level. The direction of loan investment has great influence on the quality of credit assets. In most countries around the world, half of credit assets are concentrated in the field of real estate. In addition to the basic reason that the great amount of the industry value, the low risk is also an important reason.

We can also see the low risk and stable income through China's credit business. The defective rate is 1% or less, which is far less than the other areas such as agriculture, forestry and fishing, hotel catering, trade, water conservancy, environment, mechanics, etc. Firstly, as the land belongs to the fixed assets with only appreciation, it is very different with the other fixed assets. The ownership of the house attached to the land use right. As the land is not depreciated so the value of the house is hard to discount. As a result, the bank's mortgage can be guaranteed. Secondly, there is no substitute for the real estate so that the demand is very difficult to move, which ensure the price stability or even an upward trend. Thirdly, China's mortgage down-payment requirement is high. The risk of bank can be effectively avoided. Even if there appears a default, the banks can sell the houses in accordance with the law to recover the full specified amount of the loan funds. At the same time, the developer as a guarantor has an obligation to buy real estate once there are borrowers' defaults. Banks have the priority of compensation to minimize the risk. Numerous financial institutions are gradually adjusting and optimizing the internal loan structure and expand the business actively because of the great advantages of the mortgage loans.

DRAWBACKS OF THE MORTGAGE SYSTEM IN CHINA

China's mortgage history is very short, the competent authorities and the commercial banks have many drawbacks in understanding the mortgage, preparing the supporting system, setting the loan condition, rights and interests of borrowers, the contract content, and reimbursement means etc., the most prominent problems are as follows:

The personal credit system is imperfect. The personal credit systems in the developed countries have been quite perfect and the financial institutions may solve the problem of asymmetric information according to credit evaluation, which make the capital use more flexible and can avoid the inefficient utilization of resources effectively, at the same time, reduce the loan risk (Song 2014).

Building and perfecting the personal credit system can bring huge influence to the innovation and development of financial industry. But in China, it is still in its infancy with a lot of drawbacks, which has been the restriction of the development of mortgage loans. Without the sophisticated credit system data as a supporter, banks can't make reasonable and flexible mortgage loan policy for individuals. It is unable to effectively carry out financial business. Loan conditions were determined only through the social average credit evaluation; otherwise it has to develop conservative lending conditions. The "make no exception" practices make the borrowers with good credit under stringent loan conditions. Some people even exit when they are facing the complex loan procedures, which lead to loss to both creditors and borrowers. Moreover, they increase the risk of the banks themselves when some borrowers with poor credit status get the chance to claim credit.

The mortgage system and product design defects are obvious. There are at least three defects of China compared with the mortgage system of developed countries:

(1) The ratio of down payment is too high. In recent years, the house price is rising under the effect of multiple factors. The country is taking a strict limitation of credit policy to avoid overheating property market in 2010. Down-payment reaches to 30% from the original of not less than 20%. Although the new policy allows an open loan policy, the down payment ratio is still not adjusted. The down-payment in China is definitely too high compared with the European and American countries. Most American banks can set the mortgage down-payment be as low as 5% for customer with good credit, and the TD (Toronto-Dominion bank) can have a minimum down-payment of 3% for first-time home buyers and low-incomes. Australia has a down-payment of 10% for its people, which can pay in two stages with paying only 5% first at the submitted time. Switzerland's down-payment is only 20%, which is a relatively high proportion. The high down-payment requirements will block many buyers out of door, delay their purchase time and are unable to give full play to the advantages of the mortgage system (Kong et al. 2010).

(2) The down payment varies by the quantity of houses. The residential mortgage down-payment changes by the quantity of housing in China. The first set of housing down payment proportion is 30%, and the second set of housing loans down payment proportion increases to 50%. Some regions even cancel housing loans of buying a third and above when prices are rising too fast and the supply are tight. But with the speeding up of urbanization and the evolution of people's lifestyle,

every family needs more than one set of housing whether it is a chance to get their children to school or it is for supporting the elderly. The practice that the high down payment ratio increases by the quantity of housing, keeps many families out of buying second houses, which is easy to cause social contradictions in the long run.

(3) Lack of product innovation. The situation is that China's housing mortgage secondary market is not mature, the customer group is large and complicated, and the product innovation space is huge. The innovation of mortgages mainly lies in the way of repayment, but the existed commercial banks are launching similar mortgage business, with the main reimbursement means of "equal installments of principal and interest" and "the matching principal repayment". These ways adopt the unified standard, which is lacking of flexibility and practicability. This leads to a very small customer's choice range, cannot meet the demand of the consumers, limit the market development and also limit their development severely (Zhao 2008).

Limit the loans of the low and middle income earners. Real estate itself has great value. From a long-term perspective, banks have a strict qualification review of the borrowers in order to avoid loan risks. This makes the low and middle income earners completely isolated from the housing market even they can gather enough for a down payment. There are a lot of irrationalities. First of all, China is in a rapid development period of the real estate industry with the price rising so fast. Under this circumstance the house is not only the necessity of people's life, but also the best investment. Residents need to mortgage the house in order to obtain the support from the banks. The borrower will not easily give up the real estate for the incomes brought by the rising price, even if there is a foreclosure situation for special reasons. The bank will also be able to get compensation after they sell the housing at a discount. Together with the developers' collateral, the bank barely has risks of lending. It is not wise to strictly audit and narrow the own market. Secondly, the most important index of effecting the bank lending is the proportion of their monthly income, which makes the monthly minimum payments. Taking the industrial and commercial bank of China for example, the monthly repayment is not allowed to exceed 50% of their monthly income. In the developed world, a person's wages quality can reflect his repayment capacity, but China has its own income situation. In addition to the wage income in China, most people still have a part-time income, welfare income and so on. These incomes cannot be reflected in the salary proof, but it can be converted into purchasing power. For the low and middle income earners of new graduates, they have just started to work and their income level is not high, but with the development of their follow-up, they also have enough ability to pay loans. That is to say, some of the low and middle income earners can completely afford the subsequent payment through their own savings and efforts. Finally, in today's housing prices soaring, the house has evolved into a direct orbit to wealth. If the mortgage loans only help the class with higher income, it will only cause further gap between the rich and the poor, which will affect social justice and create more social contradiction.

PERFECT THE SYSTEM OF MORTGAGE LOANS

Based on the above analysis, in view of the problems existing in the mainland

China mortgage loan system, and combining with the reality of China, this paper proposes thoughts as follows:

Speed up the construction of personal credit system. Although since 1999, China had successively promulgated "the implementation of personal consumption credit guidelines" and "individual savings account real-name regulation" and other series of rules and regulations, and tried to establish personal credit system, the progress was slow and caused obstacles to economic development. Learning from the experience of the developed countries, there are some suggestions for China:

(1) The new system should be established on the model of dominating by government and the central bank, combined with the development of personal credit system in China. The government should adjust and guide the social resources, organize the departments to make the information online with the bank credit registration system, establish common database, and set up a special management and supervision.

(2) Establish the personal interactive information network gradually. The authorities may learn from the United States to set up a social security number (SSN) and assign each resident an account to connect the various business applications in life, such as employment, insurance, payment, etc. which can record the behavior of the residents and feedback in time. It can establish the personal credit evaluation system on the basis of the personal credit information sharing on the internet.

(3) Perfect the personal credit laws and regulations gradually. In our current laws, there are only "general principles of the civil law", "security law" and a few laws and regulations involved in part of the terms of the personal credit, which has not adapted to the development and need to be changed. It can also give the break-promise various harsh sanctions, to improve people's emphasis on personal credit degree. At the same time, the government should enhance the promotion of personal credit education and cultivate citizen credit consciousness to form a good social atmosphere.

The establishment of the personal credit system can provide more information to the bank, promote the innovation of the mortgage system change, reduce costs, improve work efficiency, make mortgage ways more flexible, and help to circumvent the risk of loans to Banks.

Improve the design of mortgage loans. We should take the action of learning the mortgage system of developed countries and reducing the down-payment, cancelling the way of combining the down payment with the purchase volume, giving full play to the role of the mortgage loans, in order to attract more people to enter the real estate market. At the same time, according to the regional characteristics and the change of the market, we should constantly accelerate the upgrading of products and innovation and get close to the borrowers' needs from their perspective, the following is three ideas:

(1) For the middle-income groups with urgent housing need and good potential economic development, the authorities can provide some strong targeted supporting policies, such as interest rate subsidies, reduction of taxes and fees, etc. which will help to encourage residents into the market.

(2) If the daily balance of the mortgage customers in a bank can achieve a certain level for a period of time, it can exempt the interest.

(3) Create a second account, which can absorb the consumer surplus funds for repayment and avoid formalities prepayment.

In addition, the authorities should protect the financial innovation and patent at the national level, which can improve the degree of positive innovation and make mortgage business a rapid development.

Increase support for low and middle income earners. China should learn from international successful experience, the government could set up specialized agencies to provide mortgage loan guarantees for low and middle income earners, in order to improve the bank's profit margin, disperse the bank's credit risk and meet the low-income families purchase needs. At the same time, a purchase tax preferential policy is needed, which can provide low-interest loans to lower income families, take the form of monetary subsidies, improve bottom earners in purchasing power to encourage them to enter the market and give them more choice when they buy. To further improve the housing accumulation fund system, the authorities need to design a variety of accumulation fund loan portfolio for participants to choose from, especially for low and middle income earners to choose preferential loan way, which will make interests lean more to low and middle income earners. In addition, they should appropriately adjust the mortgage loan scheme, deal with the process of low and middle income earners' mortgage demand flexibly, focus on reform and reimbursement way, such as the practice that the borrower can only pay for the interest without repaying the principal in a certain period of years, or a flexible interest rate and so on, which can solve the social problem that low and middle income earners cannot buy housing.

CONCLUSION

Mortgage loan is a great innovation in real estate and the financial sector. It not only helps the living demands of residents with short term funding limitations, but also enlarges the scale of the real estate market, promotes the urbanization process, and promotes the development of Chinese economy. However, there are still many shortcomings of the mortgage system in China mainland since its application is quite short. By constantly perfecting the relevant system, speeding up product innovations, the mortgage system could better fit people's actual needs and enrich its value.

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Analysis on Impact Factors of Real Estate Price Based on the Factor Analysis Method

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Abstract

With the rapidly economic growing rate, the price of the household ranks to the top and becomes the current issue in Chinese. In this study, it will give interpretation through different angles such as the eastern, middle, and western market. Then, study analyzes the representative 15 cities and then extracts into the 11 indexes of the price of housing. During the analyzing, the information of common factors are identified from 11 indexes and named into 3 common categories in order to obtain composite scores of the 15 cities and seek the root causes that influence development of real estate beyond the expected.

INTRODUCTION

The real estate industry is a pillar and foundational industry in China; it has direct relation with employment, income, and consumption (Wang 2010). For this reason, real estate has been drawn broad scholars' attention：Huang Huang (2010) gives the explanation about the formation of the current high prices from the perspective of psychological expectations; Yi (2009) interprets 4 factors to analyze the impact of price as the structure of house, accessibility, area, and landscape; Lu (2009) makes an appropriate argument in term of the fixed cost for housing; Wu (2007) gives an sequence to display which element is important for the price though the priority factor method; Liu (2008) claims that she labels the variable cost for real estate price index, which can be divided into the price of land, GDP, the supply of money, the disposable income per capita, and the mortgage rate; Chen (2009) analyzes the real estate financial indicators of listed companies; Shen (2008)concludes that the high cost of sales and implicit needs the income causes the housing prices to rise; Liang and his colleague (2009) consider that the state of real estate regulation term of guiding rational expectations, increasing the supply, and refraining speculation.

In recent years, there has been an increasing trend on the price of real estates. This problem has created pressure on people who want to buy their own houses these days. Actually, the demand of real estates in China are still large, but the high prices on real estates has made many people back off. Facing the situation now, the government has set up some measures to control the prices of real estates. For example, try to increase the loan interest rate, at least in a short term, interest rate will have a negative impact on the real estate prices. But from the perspective of the effect of macroeconomic regulation and control, the price of real estates doesn't come down but keep increasing instead. In the 18th National Congress of the Communist Party of China, the government has brought up the issue about the investment of real estates which has led to the housing problem in the country. Macroeconomic regulation and control is estimated to be continued for a certain period of time(Chu 2009).

In a long term, the increasing trend of real estate price and the serious problem of the burst of the real estate bubble have a huge negative impact on the healthy sustainable development of the Chinese market. Due to this, macroeconomic regulation and control will still continue for a certain period of time in China's future policy. Real estates are heterogeneous types of product (it refers as a product that has the quality of typical products, but also contains its uniqueness inside). There's has been noticeable differences between the construction and the usage of the product. There are various factors which affect its price: Firstly, it should consider the impact of the demand of housing affect the real estate's price. Secondly, it should consider the impact of the supplement of the housing to the real estate's price. Lastly, it should consider impact of both demand and supplement to the real estate's price.

Real estate value is the unity of building construction value, land and natural resource value and labor value invested in the land. Real estate price is the currency performance of this comprehensive special value. Because building construction value and labor value invested in the land take the most part, basically real estate price is the currency performance of real estate value. In the light of its definition, real estate price is influenced by construction material price, land price, income per capita level, GPD, CPI and industrial structure. Factor analysis method provides good threads and means for achieving the study goal of estimating influential factors of real estate price and satisfies the demands to objectively and truthfully estimate influential factors of real estate price. Therefore, the factor analysis method is chosen as the estimation method in this paper.

INTRODUCTION OF FACTORS ANALYSIS METHODS

Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. There are many methods of factors analysis, principal component analysis, which is a widely used method for factor extraction, was brought up by Charies Spearman in 1940. When the structure of initial factor is not simple enough, and the typical representative variables of common factor are not obvious, there is no real meaning. Therefore, it's necessary to simplify the structure by rotating the factor. Orthogonal rotation is always used. Set the original variables: X_1, X_2, X_3,…, X_n. Therefore, the relationship between original variables and potential factors can be expressed as Orthogonal rotation model.

(1) Model:

$$X = AF + \varepsilon \rightarrow \begin{cases} X_1 = a_{11}F_1 + \cdots + a_{1m}F_m + \varepsilon_1 \\ X_p = a_{p1}F_1 + \cdots + a_{pm}F_m + \varepsilon_p \end{cases}$$

(2) Assumption:

X is an observable random vector, $E(X) = 0$;

F is an unobservable random vector, $E(F) = 0$, $D(F) = I_m$ (m<p):

$$E(\varepsilon) = 0, D(\varepsilon) = diag(\sigma_1^2, \cdots\cdots, \sigma_p^2) \triangleq D;$$

$$Cov(\varepsilon, F) = 0.$$

(3) Covariance structure:

$$D(X) \triangleq \Sigma = E(X^{X'}) = E((AF+\varepsilon)^{(AF+\varepsilon)'}) = A^{A'} + D;$$

$$Cov(X, F) = E(X^{F'}) = E((AF+\varepsilon)^{F'}) = A$$

(4) Statistical significance:

If X is standardized, the factor loading is $a_{ij} = \rho(X_i, F_i)$;

$$Var(X_i) = Var(\textstyle\sum_1^m a_{it}F_t + \varepsilon_i) = \sum_1^m a_{it}^2 + \sigma_i^2 \triangleq h_i^2 + \sigma_i^2$$

Here h_i^2 is called the community of X_i or common factor variance of all the common factors for X_i; σ_i^2 is called residual variance.

FACTOR DATA REDUCTION ON DATA

Index selection. Following the principle of the system integrated and index availability, select 11 indexes: X_1 represents the amount of investment completion in real estate development(10^8 yuan); X_2 represents area of housing in construction (10^4 m^2); X_3 represents sales area of commercial housing (10^4 m^2); X_4 represents rate of housing price growth (%);X_5 represents per capita GRP (10^8 yuan); X_6 represents total population at year-end (10^4 people); X_7 represents average wage of urban employed staff and workers (yuan per); X_8 represents per capita consumer spending in province of urban residents (yuan per); X_9 represents per capita area of paved roads in city (m^2); X_{10} represents per capita area of green land (m^2); X_{11} represents tertiary industry as percentage to GRP (%). Meanwhile, select 5 representatives of the cities respectively from the eastern, middle and western as sample to be analyzed. The eastern cities are Shenyang, Beijing, Shanghai, Hangzhou and Guangzhou; the middle cities are Hefei, Nanchang, Zhengzhou, Wuhan, Changsha; the western cities are Chongqing, Chengdu, Kunming, Xi'an and Lanzhou. The data are followed as Table 1.

Table 1.Impact Index of 15 Representative Urban Housing Prices.

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
Shenyang	1942.96	11002.63	2469.65	7.43	80480	724.80	50743.89	16593.60	12.73	392315.12	43.99
Beijing	3153.44	13122.49	1943.74	1.01	87475	1297.50	86163.48	24045.86	7.53	484524.08	76.46
Shanghai	2381.36	13249.97	1898.46	-3.71	85373	1426.90	80404.89	26253.47	7.15	870446.42	60.45
Hangzhou	1597.36	8288.95	1089.62	1.21	88962	700.50	57547.25	21545.18	11.86	237644.54	50.94
Guangzhou	1370.45	7845.62	1333.13	8.75	105909	822.30	69464.67	22396.35	14.96	1587547.12	63.59
Hefei	913.80	6071.64	1242.48	-2.68	55186	710.50	52795.26	15011.66	21.85	184729.06	39.17
Nanchang	344.36	3123.29	689.86	8.08	58715	507.90	46791.65	12775.65	15.70	172199.25	38.65
Zhengzhou	1095.14	8253.94	1441.87	9.78	62054	1072.50	43991.69	13732.96	6.07	119142.19	40.98
Wuhan	1574.86	6862.97	1576.11	2.10	79482	821.70	51064.44	14495.97	17.60	208567.60	47.89
Changsha	1034.35	7376.26	1526.93	4.07	89903	660.60	52958.87	14608.95	9.96	140675.14	39.61
Chongqing	2508.35	22009.03	4522.40	7.31	38914	3343.40	46327.81	16573.14	6.71	141042.05	39.39
Chengdu	1889.23	14150.98	2844.09	8.51	57624	1173.30	45761.56	15049.54	13.43	157836.87	49.46
Kunming	919.07	5885.00	1051.35	21.83	46256	543.50	42690.77	13883.93	14.36	238712.05	48.93
Xi'an	1269.93	9893.11	1532.90	7.78	51166	796.00	48048.31	15332.84	11.06	170728.64	52.42
Lanzhou	209.74	2342.49	190.35	20.01	43175	321.50	45123.22	12847.05	10.48	165443.23	49.53

Data processing. In order to ensure that different dimensional indexes can be effectively synthesized, it is necessary to process raw data in the same direction and measuring (data standardization). Firstly, process the two indexes of X2 and X3 in the same direction with counting backward technique. And then standardize all the indexes, following as Table 2. Do factor analysis with principal component analysis and orthogonal transformation through SPSS.

Table 2.Impact Index of 15 Representative Urban Housing Prices after Processing.

	ZX_1	ZX_2'	ZX_3'	ZX_4	ZX_5	ZX_6	ZX_7	ZX_8	ZX_9	ZX_{10}	ZX_{11}
Shenyang	0.5765	-0.5475	-0.4773	0.0931	0.5719	-0.3772	-0.2918	-0.0959	0.1435	0.1038	-0.5111
Beijing	2.0849	-0.6930	-0.3872	-0.8060	0.9118	0.4227	2.3484	1.6222	-1.0344	0.3380	2.5394
Shanghai	1.1228	-0.7002	-0.3771	-1.4669	0.8096	0.6034	1.9191	2.1311	-1.1205	1.3183	1.0353
Hangzhou	0.1459	-0.2526	-0.0556	-0.7780	0.9840	-0.4111	0.2153	1.0456	-0.0536	-0.2890	0.1418

Table 2.(Continued).

	ZX_1	ZX_2’	ZX_3’	ZX_4	ZX_5	ZX_6	ZX_7	ZX_8	ZX_9	ZX_{10}	ZX_{11}
Guangzhou	-0.1369	-0.1850	-0.1935	0.2779	1.8075	-0.2410	1.1037	1.2419	0.6486	3.1397	1.3303
Hefei	-0.7059	0.1840	-0.1485	-1.3227	-0.6572	-0.3971	-0.1389	-0.4607	2.2092	-0.4234	-0.9640
Nanchang	-1.4155	1.7247	0.3816	0.1841	-0.4858	-0.6801	-0.5864	-0.9762	0.8162	-0.4553	-1.0128
Zhengzhou	-0.4799	-0.2475	-0.2400	0.4222	-0.3235	0.1084	-0.7951	-0.7555	-1.3651	-0.5900	-0.7939
Wuhan	0.1178	-0.0042	-0.2885	-0.6533	0.5234	-0.2418	-0.2679	-0.5795	1.2466	-0.3629	-0.1447
Changsha	-0.5557	-0.1047	-0.2717	-0.3774	1.0297	-0.4668	-0.1267	-0.5535	-0.4840	-0.5353	-0.9226
Chongqing	1.2811	-0.9979	-0.6284	0.0763	-1.4479	3.2800	-0.6210	-0.1007	-1.2201	-0.5344	-0.9433
Chengdu	0.5096	-0.7478	-0.5211	0.2443	-0.5388	0.2492	-0.6632	-0.4519	0.3020	-0.4917	0.0028
Kunming	-0.6993	0.2358	-0.0282	2.1096	-1.0912	-0.6304	-0.8921	-0.7206	0.5127	-0.2863	-0.0470
Xi’an	-0.2621	-0.4464	-0.2738	0.1421	-0.8526	-0.2777	-0.4927	-0.3866	-0.2348	-0.4590	0.2808
Lanzhou	-1.5832	2.7823	3.5093	1.8548	-1.2409	-0.9404	-0.7108	-0.9597	-0.3662	-0.4724	0.0093

KMO and Bartlett’s test. Test data through SPSS. The test’s result as followed Table 3 is that the value of KMO is 0.558, which is acceptable due to the value more than 0.500, and the value of sig. in Bartlett’s test is 0.000 less than 0.05, which is significant. The result means that the related degree among indexes is high and the public factor exists, so it is suitable for doing factor analysis.

Table 3.KMO and Bartlett’s Test.

Items		Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.558
Bartlett’s Test of Sphericity	Approx. Chi-Square	130.316
	df	55
	Sig.	.000

Calculate factor loading matrix, eigenvalue and variance contribution rate. principle of factor analysis. Factor analysis is a multivariate analysis method which converts the measurable and highly correlated original variables into a few comprehensive factors (He 2004). There are two kinds of factor analysis method: type R factor analysis and type Q factor analysis.

The former concentrates on the correlation between the research variables, the later focus on the correlation between the research cases. In this paper, the type R factor analysis is used.

Table 4.Total Variance Explained.

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var.	Cumulative%	Total	% of Var.	Cumulative%	Total	% of Var.	Cumulative %
1	5.246	47.692	47.692	5.246	47.692	47.692	3.959	35.995	35.995
2	2.292	20.832	68.524	2.292	20.832	68.524	2.975	27.047	63.042
3	1.482	13.476	82.000	1.482	13.476	82.000	2.085	18.957	82.000
4	.668	6.071	88.070						
5	.519	4.721	92.791						
6	.454	4.127	96.918						
7	.146	1.329	98.247						
8	.087	.790	99.037						
9	.056	.513	99.549						
10	.033	.299	99.848						
11	.017	.152	100.000						

Table 5.Rotated Component Matrix[a].

	Component		
	1	2	3
Zscore(X_1)	0.416	-0.599	0.605
Zscore(X_2')	-0.157	0.853	-0.362
Zscore(X_3')	-0.036	0.930	-0.073
Zscore(X_4)	-0.340	0.741	0.117
Zscore(X_5)	0.771	-0.340	-0.277
Zscore(X_6)	-0.137	-0.429	0.774
Zscore(X_7)	0.913	-0.240	0.161
Zscore(X_8)	0.867	-0.320	0.271
Zscore(X_9)	-0.155	-0.093	-0.851
Zscore(X_{10})	0.812	-0.047	-0.083
Zscore(X_{11})	0.873	0.052	0.251

RESULT ANALYSIS

Name the factors. According to Table 5 above，the first main factor is influenced too much by X_5, X_7, X_8, X_{10}, X_{11}. The Per Capital GDP can reflect the development of economy; the per family income of urban residents and Per Capital customers expending determine the residents' ability of buying houses; per capital green area reflects the protection of local environment. They are all significant to attract the economic investment. The proportion of the tertiary industry reflects the development of service industry, which is important to improve the local economy. Therefore, we call it economic factor of real estate.

Variables X_2, X_3, and X_4 have big influence to second factor. It indicates that the second factor is consisted of covered housing area under construction, the housing sales areas, and growing rate of house price. This factor reflects the covered housing area, sales and house price, so we call it real estate market factor.

The third factor has big influence of completed investment and development of real estate, total population in the end of year, and per capital road areas in city. It reflects the economy, population and environment, so we call it synthetic factor.

We can almost see the whole information that we want, so we decide to use these three new factors to take place of the previous 11variables.

Calculate the score of factors. According to the Table 6 and variance contribution value, we can calculate the score of common factors. The score can reflect the degree of impact.

Calculate the synthetic score of every area：

$$F=(35.995\times F_1+27.047\times F_2+18.957\times F_3) / 82.000$$

Table 6. Synthetic Score of Every Area.

City	Fac_1	Fac_2	Fac_3	Total_Score
Shenyang	-0.1197	-0.5352	-0.2916	-0.297
Beijing	1.7870	-0.2142	1.2123	0.994
Shanghai	1.5773	-0.4898	0.7654	0.708
Hangzhou	0.4757	-0.3770	-0.3433	0.005
Guangzhou	1.9553	0.1805	-0.7955	0.734
Hefei	-0.6386	-0.8593	-1.6271	-0.940
Nanchang	-0.6362	0.5995	-1.0559	-0.326
Zhengzhou	-0.7984	0.0914	0.6204	-0.177
Wuhan	-0.2359	-0.6653	-0.9820	-0.550
Changsha	-0.2904	-0.3594	-0.5112	-0.364
Chongqing	-1.2958	-0.7956	2.3551	-0.287
Chengdu	-0.6166	-0.5041	0.2198	-0.386
Kunming	-0.6355	0.7743	-0.0490	-0.035
Xi'an	-0.4363	-0.0202	0.2085	-0.150
Lanzhou	-0.0919	3.1745	0.2743	1.070

CONCLUTIONS

The acceleration of urbanization cause the highly demand for the accommodations. The urbanization of an area and the populations of a city are the factors that decide the scale of accommodations objectively. From the Table 6, it is seen that the economic factors in eastern is higher, which indicates the highly developed economy is the significant reason for the high speed of price of house increase. The eastern of China, where the areas are near the coast, the economy and urbanization is developed faster compared to western areas in China. In eastern China, the higher speed of degradation and disperse of family leads to a stronger demand for accommodations. Shanghai and Guangzhou attracts a large quantity of migrant works, for those who have a high desire for buying or rent a house, which bring a lot of pressure for local house market. On the other hand, Beijing and Hangzhou are the important educational foundation in whole nation, many graduates hunting jobs locally, those are also the urgent demander for accommodations. In addition, someone who has the hidden income always willing to purchasing the house in Beijing, Shanghai and Guangzhou these highly developed cities as a proof of identity, therefore drive up the price.

The weak implementation of polices and the lack of investment methods make macro-control invalid and difficult to realize its effectiveness. In many places the investment on real estate occupies a large proportion of whole investment. For instance, Shanghai is 40%, and in Guangdong and Zhejiang also more than 30%.The tax on real estate and the revenue for the land transfer is the important support for local finance, some local government put much importance on achievement on their official career, they do not want to the house price drop certainly. These factors encourages the local officials to resist polices for adjust the house price and allow some property developers' illegal behaviors, which push off the house price. Moreover, the stock in China is not matured yet, the interest rate for bank is comparative low with other countries. The investment on real estate is rather stable, low risk investment channel which do not need much professional knowledge are usually welcomed.

To some degrees the variation of people's consumption notion leads to the increase of real estate demands. In the recent years, people's consumption notion has changed from residential type consumption to enjoyment type consumption, and the old thought of purchasing the residence with full payment has changed, and these changes in some way stimulate the development of real estate industry. With the improvement of people's life, people who buy houses for the second time want to purchase ones with lager size and more comfortable residential environment. Compared to first-tier cities whose habitable resources decrease (exhibited in chart 6), Nanchang, Kunming and Lanzhou score more points. These second-tier and third-tier cities with prominent culture trait and excellent residential environment are attracting more and more investors.

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Chinese International Contractors in Africa: Market Potentiality and Entry Opportunity

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Abstract

In recent years, Chinese international contractors (CICs) have been expanding their presence in the African market rapidly with the support of the Chinese government. Previously focused in traditional friendship countries such as Angola, Ethiopia, Sudan and Zambia, the CICs have rapidly established an increasing market presence in many African countries and become competitors to other overseas contractors. Taking the Nigerian market as a case study, this paper analyses the market share between CICs and contractors from other countries, the construction projects demand in African countries, the financing sources and the policies regulating the projects financing. Data used in this study are from multiple sources including literature review, statistical reports, regulations, policies and a case study of Nigeria. These findings should provide a valuable reference to evaluate the opportunities in the African market as well as to assist the decision making process for CICs who are interested in developing business in Africa.

INTRODUCTION

China overseas contracted projects started at the end of 1970s and contributed to china's foreign aid policy, becoming an important element of the country's opening-up to the outside world. Since then, China's overseas contracts have experienced phenomenal growth. From US $ 663 million in 1985, the turnover of contracted projects increased to US$ 8.379 and to 21.76 billion in 2000 and 2005 respectively. CICs have made significant progress in obtaining overseas works, evidenced by the inclusion of 46 Chinese contractors in the top 225 international contractors list of the Engineering News Record (ENR 2014) when two CICs entered for the first time the top 10 global construction list. According to the Ministry of Commerce of the People's Republic of China (MOFCOMM 2014), the turnover by China's overseas contracted projects in January-October 2014 reached US$ 107.9 billion, up 10.9% year on year; and the value of newly-signed contracts was US$ 125.93 billion, up 1.1% year on year. In October 2014, the turnover reached

US$15.616 billion, up 34.5% year on year; and the value of newly-signed contracts in October was US$ 17.09 billion, up 34.2% year on year. When 54 CICs accounted for 13.2% of the world market share in 2009 (Tulacz 2010), this percentage has grown to 15% (ENR 2014) as shown in Figure 1.

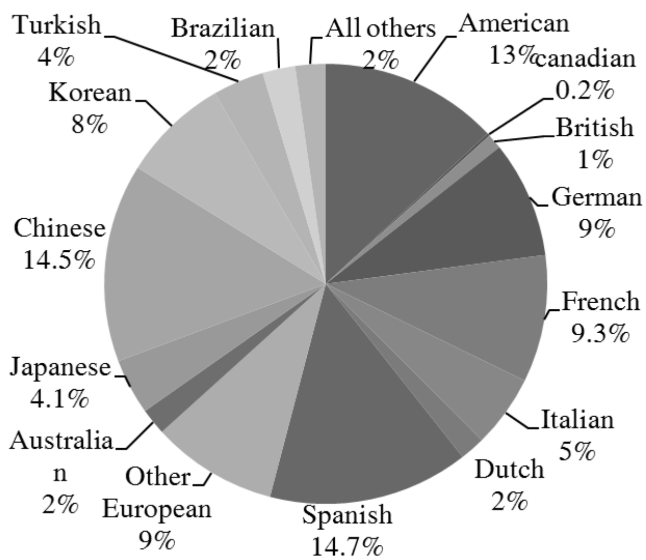

Figure 1.World market share by international contractors.

Competition against a globalized market constitutes a monumental leap for a company that has a worldwide vision to be an international firm. Though this is not a new trend, many enterprises have attempted to penetrate, seize an opportunity and establish their position in transnational projects (Tang et al. 2012). Through the implementation of its opening up policy, and particularly its long standing policy of providing aid to Africa, the Chinese government has supported and facilitated the competitiveness of the CICs which has evolved from just being labor suppliers to grow in sophistication and become present in the international market. According to a report by the China International Contractors Association (CHINCA 2014), Chinese construction companies as a group completed work worth $116.6 billion in the overseas markets in 2012, an increase of 12.7% from 2011. The recovery is mostly driven by the expansion of markets in African countries, which saw new contracts for Chinese contractors rise 39.9%, to US $64.05 billion in 2012, making Africa the largest market for CICs (see Figure 2). The biggest increase within the African markets is from Nigeria, where new project awards amounted to US $10.2 billion (Yue 2013).

According to Chen and Orr (2009), the countries with the highest number of active Chinese contractors in sub-Saharan Africa are: Angola, Nigeria, Botswana, Congo, Equatorial Guinea, Ethiopia, Ghana, South Africa and Uganda which are China's traditional friendship countries. Within those countries, Nigeria is not only the biggest African country with a high expanding market, but also currently records the highest GDP (US$523 billion) in Africa (see Figure 3).

Taking Nigeria as a representative case study of the continent, this paper analyses the entry mode as well as the opportunities for CICs in the rising African construction market. More specifically, it focuses on CICs and Nigerian projects finance sources, the policies toward projects financing, the competitiveness of CICs in this market and finally the chances for CICs to enter and dominate the Nigerian market.

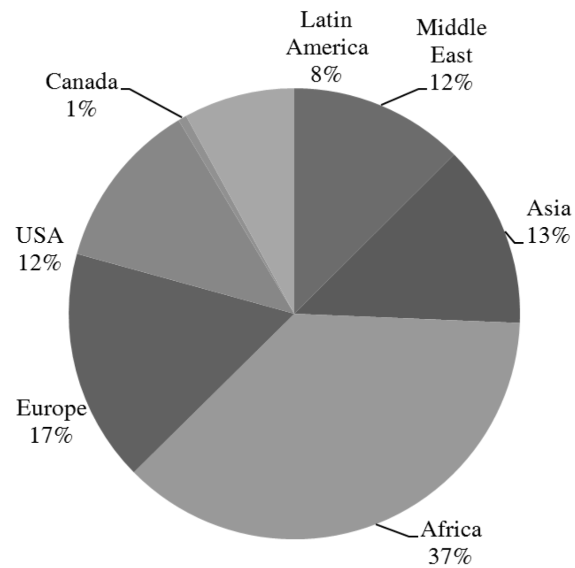

Figure 2.International revenue of CICs by regional market.

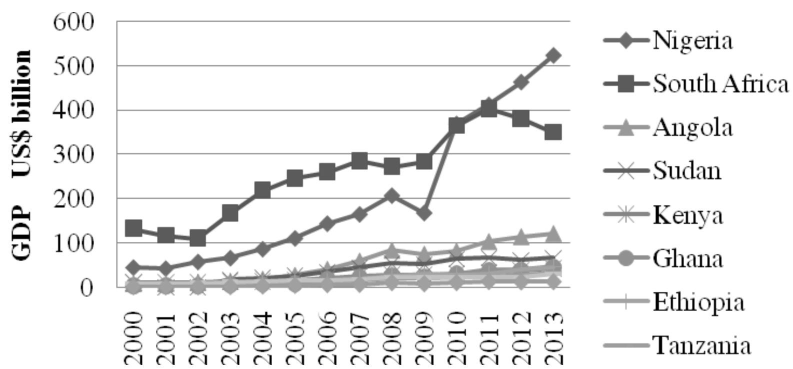

Figure 3.Top 10 GDP in Sub Saharan Africa.

RESEARCH METHODOLOGY

Due to the limitation of available literature and studies related to Chinese constructors in Nigeria, this study was conducted by collecting relevant documents from various sources such as academic literature, government portals, company profiles, online magazines and newspapers etc. Specifically, this paper analyses relevant papers on top international journals such as Journal of Construction Engineering and Management, Construction Management and Economics, Journal of Humanities and Social Science, International Journal of Business Research and Management and Journal of Environmental Science and Resource Management. The published official statistics provide useful references to analyses the competitiveness of CICs in the market share. The statistical data adopted in this study are primarily retrieved from Engineering News-Record (ENR 2014) and the World Bank. This paper also analyses reports released by authoritative organizations, such as "China News Letter" issued by China International Contractors Association (CHINCA 2014) and China Daily Africa. In addition, because policy loopholes may cause some of the projects financing problems, this paper also studies the policies and regulations issued by relevant government departments such as the Ministry of commerce of the People's Republic of China (MOFCOMM 2014) and the Federal Ministry of Industry, Trade and Investment (MITI) of the Republic of Nigeria.

CICS AND NIGERIAN PROJECTS FINANCE SOURCES

The major source of capital formation in the construction sector that can spur growth and development in Nigeria is from the public sector, with the traditional approach in the major infrastructure procurement process of funding through annual capital budgetary provision (Isa et al. 2013). According to some officials, the Nigerian government budget provides for only a small fraction of funding necessary for all its planned infrastructure projects. Large financial resources come from China, more specifically from Chinese state-owned banks while relatively followed by the World Bank and other sources. The main lender, the Export-Import Bank of China (Exim Bank), was set up expressly to finance the projects of Chinese multinational corporations expanding overseas. As will be discussed in the following sections, CICs are taking the major projects in Nigeria. In the past ten years, China's export credit agency Sino sure has offered more than US$ 113 billion in credit insurance for Chinese exports and investments (CHINCA 2014). The significant role Chinese investment played in Nigeria became clear when in January 2011 the Central Bank of Nigeria introduced the Chinese Yuan as a trading currency in the domestic foreign exchange market.

Chinese government concessional loans to finance CICs' projects are disbursed by China Exim Bank, currently one of the largest such institutions in the world. Early in May 2007, the annual meeting of the African Development Bank was held in Shanghai. Following this meeting, the Chinese State Council approved the creation of US$ 5 billion China-Africa Development Fund, to be administered by the China Development Bank. The World Bank estimates that China Exim has disbursed over US$ 12.5 billion for large-scale infrastructural projects in Sub-Saharan African alone. More than 80 percent of these in terms of value were to traditional African friendship countries such as Angola, Nigeria, Zimbabwe and Sudan where the Chinese government applies the Angola mode.

NIGERIA-CHINA MUTUAL HELP POLICY

With its large population and growing consumer demands which justifies its substantial appetite for new infrastructure, Nigeria also have enormous oil reserves; that make it a good candidate for the Angola mode. The Angola mode is increasingly being used by the MOFCOMM for countries that cannot provide adequate financial guarantees to back their loan commitments. The Angola mode is a barter arrangement whereby African nations pledge natural resource supplies in return for the provision of infrastructure from Chinese firms (Chen and Orr 2009). The Nigerian president Olusegun Obasanjo regime has established this mode called the “Oil for Infrastructure” policy. This policy towards China may best be summarized as required that Chinese and other Asian bidders that preferred oil blocs to include in their bids a commitment to provide Nigeria with major infrastructural projects (Utomi 2008). The motivational factor for this policy seems to be the growing frustration and disillusionment of the Nigerian government with its traditional Western partner’s aid. However, political risks are high in developing countries. Typically, the policies concerning the appointment of CICs can change dramatically as a result of the change or replacement of government leaders (Zhao and Li 2008). It was the case of this policy at the close of Obasanjo’s tenure when Umaru Musa Yar’Adua (deceased) took over as president of Nigeria after the 2007election. Some steps taken by the late Yar’Adua’s administration to review the policy agreements signed between the Nigerian government and Asian oil companies have almost resulted in the suspension or cancellation of these contracts according to a very senior civil service official’s participant observation. Restructuring of some of these contracts, must take account of the changed ethno-political realities of a new political leadership (Oluwole 2013). The “oil for infrastructure” policy was transmuted to “oil for cash” policy which rendered the Chinese government’s bid during Obasanjo’s second tenure in office to secure Nigerian oil assets a failure as Chinese companies only able to retain blocs for which they have fully paid. It believes as claimed by the current president Good luck Jonathan that there is fundamental mutuality and that the notion of “oil for infrastructure” is still in use by the current government. What is generally agreed however is that the relationship between Nigeria and China has become a significant feature of world politics. China’s pronounced presence in Nigeria is a reality and for stakeholders and many international affairs analysts, this could be a moment of opportunity for both sides.

MARKET ENTRY MODES ANALYSIS

When first entered Nigerian through the Chinese government aid to African countries, the increasing necessity to establish a permanent presence in overseas markets challenges the tradition of tide like market entry mode of CICs and confronts them with an important dichotomous selection between permanent entry mode and mobile entry mode. The entry modes that have been examined in international business literature include representative office (RO), branch office (BO), local agent, joint venture, acquisition, build operate transfer (BOT), licensing, sole venture, strategic alliance, franchising, counter trade, research and development (R & D), international lease, counter trade, wholly-owned subsidiary (Pan and Tse 2000). Low and Jiang (2003) found out that generally, most CIC’s are by five entry modes which are: (1) local agent; (2) representative office or liaison office; (3) subsidiaries; (4) joint-venture company and (5) branch company (solely owned). In line with Chen and Orr (2009) findings, the Chinese government adopts a long-term view of its business forays in Africa and CICs selected a permanent entry mode instead of a mobile entry mode.

Chinese contractors opt for establishing RO and branch offices BO in Nigeria. RO is used by CICs in Nigeria because it is a relatively simple way to establish a formal presence in the country and become quickly acquainted with the market. A RO can be expanded into a branch company or subsidiary. In this extent, CICs combine RO with BO or a subsidiary in the same market. Through this arrangement, the RO is independent from the BO and is organized to help the company headquarters identify potential projects in the market as can be seen in Figure 4. Other entry modes such as ventures, BOT and R & D are less used and do not yet appear in this Figure 4 (as joint ventures was put in a box with dashes) because of the Nigerian market non mature conditions. Chen et al. (2007) found that low skill and technology endowment limit Chinese Construction Firms' interest in establishing collaborative ventures with local companies. Adams (1997) pointed out that it has been noted that the Nigerian Indigenous Contractor base is incompetent and inexperienced and it prevents them of making joint ventures worthwhile. They also buttress this point when they opined that indigenous construction companies in Africa lack financial and technical capacity and do not represent a strong source of competition for international contractors. Despite the implementation of the public-private partnership (PPP), BOT is merely used by CICs in Nigeria due to the high risks. Mohammed et al. (2012) identified picking the right project; competitive financial proposal and special features of bid as three critical factors essential for the success of BOT projects in Nigeria.

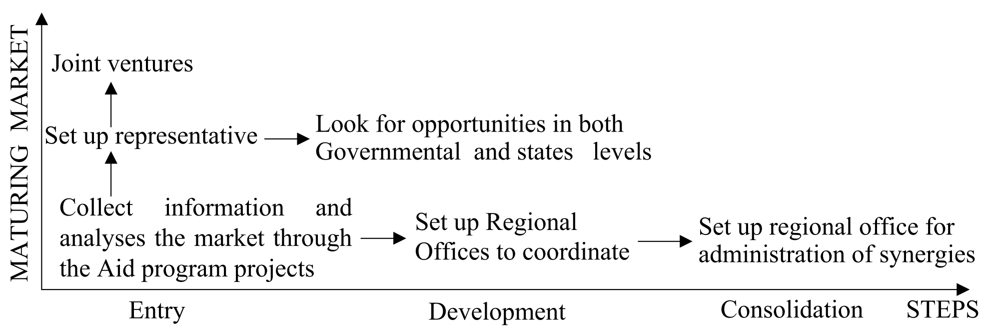

Figure 4.Permanent entry mode for CICs in Nigeria.

COMPETITIVENESS OF CICS IN NIGERIAN MARKET

CICs and indigenous contractors. Local contractors are generally seen as holding the greatest potential for increasing construction industry capacity. However, the construction industry in developing countries is dominated by foreign contractors and a few large local contractors. Adams (1997) revealed that foreign construction firms dominate major projects in most developing countries as a result of deficiencies in indigenous construction capacity. Furthermore, Ogbebor (2002) noted that 96% of the Nigerian Construction Industry is still dominated by foreign contractors on the grounds that indigenous contractors cannot be entrusted with complex project. It can then be said that CICs do not face a high competition from the Nigerian contractors. Odediran et al. (2012) found out that the Nigerian indigenous firms were medium-size firms, engaged in building construction and cannot finance projects independently prior to client financial contribution and therefore cannot compete with international contractors.

CICs and other overseas contractors. As discussed in the financing sources, one of the most important competitive advantages enjoyed by Chinese companies competing for major Nigerian contracts is namely their access to apparently inexhaustible credit facilities from China's state-owned banks. Infrastructure projects undertaken by Chinese companies are often financed by soft loans from the Chinese government, on the condition that they are carried out by Chinese companies. This is in line with the "go out" strategy driven by the Chinese government to promote the internationalization of CICs. This endows CICs with a competitive advantage that their traditional competitors do not enjoy, particularly for projects financed by Chinese government concessional loans. Chinese companies are also often perceived to be less cognizant of risk when investing in Africa compared to other foreign invested and its makes them attractive to the African governments. As pointed out by Zhao and Li (2008) and in line with Chen and Orr (2009) investigations, manpower with low cost, good skills and high degree of adaptability to work in different environments, advancement in certain technologies and lower price of construction components, are some strengths that make CICs taking the lead in the African market when it comes to bid for non Chinese financed projects.

OPPORTUNITIES FOR CICS IN NIGERIA

Construction growth in Nigeria will be the fastest of all markets, according to the 10 years Global Construction 2020 forecast from Global Construction Perspectives and Oxford Economic (2009). This study revealed that although China will overtake the US as the world's biggest construction market by 2018, the fastest growth will happen in Nigeria. Nigeria's construction industry is growing fast and is likely to grow astronomically over the next decade. Nigeria has large expanse of undeveloped land requiring road construction to link many parts of the country with other parts and construction of low cost housing to accommodate many of its city dwellers. Estimates suggest that current growth in the construction industry is greater than that of India. Indeed, the report highlighted that Nigeria's population of approximately 178.5 million is urbanizing at one of the fastest rates in the world, but construction is still around 3.2 per cent of the Gross Domestic Product. Hence it can be noted that the government objectives according to its vision for 2020 (NV2020 2010) such as creating much needed housing, improving public services, developing its tourist sector, improving transport links, creating new jobs and eradicating poverty can be linked to the construction sector. According to some reports from the government, Chinese companies have built and are currently at work on construction across Nigeria. For example early in November 2014, the China Railway Construction Corp (CRCC) awarded a US$11.97 billion rail way contract which is

China's single largest overseas contract project ever, according to CRCC.

The will of the Nigerian government to develop the private sector offers opportunities for CICs through Foreign Direct Investment (FDI). There are also significant opportunities for Chinese companies through providing subcontracting services, largely because the subcontracting sector is not developed in Nigeria as it is in developed countries. Overall, Figure 5 summarizes the opportunities of CICs in Nigeria.

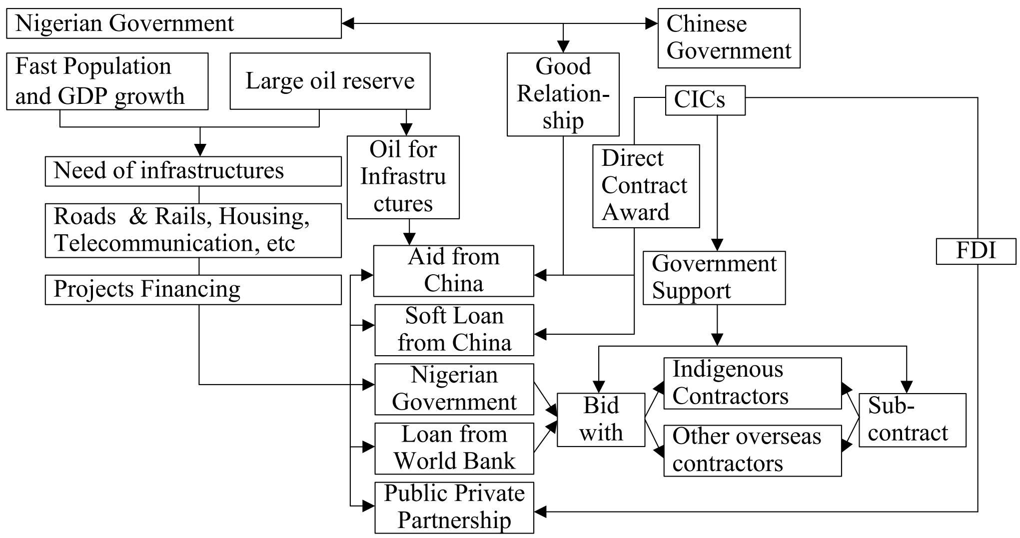

Figure 5.Opportunities for CICs in Nigeria.

CONCLUSIONS

Entering the market through the Chinese Government aid and using the oil for infrastructure policy, CICs has established a permanent entry mode and are not dependent on such policy to deepen their Nigerian market penetration. They have powerful comparative advantages, particularly concerning price, risk appetite and, as we have seen, their access to huge credit lines. In addition, they are improving their quality and service all the time, thus eroding the main remaining comparative advantage enjoyed by their Western competitors and winning the major projects as discussed above. Therefore, it seems inevitable that CICs will continue to grow their Nigerian market and African market share as well as Nigeria and other Sub-Saharan countries will continue to grow as a market for Chinese constructors.

ACKNOWLEDGEMENT

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Cost-Benefit Analysis of PPP Project Financing Based on the Government's Position

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Abstract

The PPP, which is short for Public-Private Partnership, is a kind of financing mode joints the government and private sectors together. The PPP project financial model can effectively solve the lack of funding and the financing mode selection and evaluation has become an important issue. On the basis of existing research results, this paper introduces the concept of PPP as well as leading economic efficiency into the activities of project financing. This paper proposes evaluation index of PPP project financing-the cost-effectiveness of project financing from the government's point of view. Also this paper establishes the financing cost-effectiveness model for both BOT(Build-Operate-Transfer) and BOO (Build-Own-Operate)modes which are the most two common form of PPP and then analyze the reasons for their differences.

INTRODUCTION

PPP (Public-Private Partnerships) is a kind of public project financing mode which can meet the demand for public goods and services between the government and the private sectors. PPP model has the advantage of attracting investments, making a full use of the private sectors' strength in technology and management superiority, etc. Therefore, PPP model is widely used in the construction of infrastructure and utilities projects, especially in China. For example, the Fourth line of Beijing Metro, the Olympic venue and other projects are all built under this way(Savas 2003).

Most of the existing researches concentrate on the choosing of a suitable financing mode for specific cases, but there is a lack of generic methods for selecting and comparing between different financing modes. For the government, the financing income and financing costs must be taken into account when choosing and designing the financing modes, which is called "financing cost-effectiveness." The evaluation of project financing benefit roughly consistent with the project capital in existing researches, but it is difficult to judge the effectiveness of the financing scheme itself.

This paper established the "project financing cost-effectiveness" index, use for reference from finance and cost-effective of enterprises. At the same time, this paper builds models for government to calculate project financing cost-effectiveness under the PPP project financing mode to choose a better one. Then the article selects the BOT and BOO modes which were the most two common modes in PPP to analyze the reasons for differences in financing cost-effectiveness under the same conditions. Models and methods presented in this paper can be used to select various franchising project financing mode and support financing decisions.

MODEL CONSTRUCTION OF FINANCING COST-EFFECTIVENESS OF PPP PROJECT

The definition and common type of contract of PPP. Before studying into the financing cost-effectiveness of PPP project, it is necessary to clearly define the interpretation of PPP.

Different parts of the world have specific goals and concerns about PPP with their own specific background, so the definition varies in countries. In some cases, PPP means the government will outsource its responsibilities to corporate and the government and enterprise share the risks as well as the results of public goods and services (Yang and Mu 2008). For example, in the year of 2003 the German Federal Ministry of Transport, Construction and Real Estate Department (BMVBW) issued a “Federal Report of PPP in Public House Property”, the official definition of PPP is, “PPP refers to the sharing of risk and contributing necessary resources between the public sector and the private sector while the cooperation of the two parties is under the management of contracts in long term, so they can effectively meet the needs of the public service.”

The Organization for Economic Co-operation and Development (OECD) believes that the definition of PPP was broader in Australia where The PPP is the best-matured one among all the countries in the world currently. The “National PPP Guidelines” of Australia defined that, “PPP refers to the long-term contracts between the government and the private sector. The government pays for the private sector for their behalf of the government or the aid they provided to meet the government’s responsibilities in infrastructure and related services. At the same time, the private department should be responsible for the construction of the facility and the capability through the whole lifetime of it.” In practice the PPP has produced many different types of contracts (Deng 2008). Table 1 lists some common types of PPP contracts which can be understood from the literal meaning.

Table 1.Common Type of PPP Contract.

Formal and functional privatization PPP	Real privatization PPP
(D)BOT:(Design) Build-Operate-Transfer	(D)BOO:(Design) Build-Own-Operate
(D)BOOT:(Design) Build-Own-Operate-Transfer	BDBOO: Buy-Design-Build-Own-Operate
DBFO(T): Design-Build-Finance-Operate(Transfer)	DBROO: Design-Build-Rent-Operate-Own
DBLOT: Design-Build-Lease-Transfer	

As can be seen from the table, BOT and BOO are common types of PPP contract, which both belong to the concept of PPP. However, there are a lot of studies consider that the relationship between BOT, BOO, PPP is parallel and this understanding is biased (She 2010).

The connotation and measurement of PPP project financing cost-effectiveness. Economic cost-effectiveness refers to a proportion relation of input and output in economic activity: cost-effectiveness = output / input. Putting the financing cost rate as input while rate-of-return as output, you can get:

$$\text{Financing cost effectiveness} = \frac{\text{Rate - of - Return}}{\text{Financing Cost Rate}} \tag{1}$$

When the concept of economic cost-effectiveness was introduced into project financing activities, you can get: project financing cost-effectiveness is the relationship between input and output in the project financing activities. In a rational financing activity, this relationship should exist that the amount of financing equals to the amount of investment. Therefore, this paper regards the amount of return on investment in the project within the operating period as its outputs and the financing costs of the project within the operating period as the input of its financing activities. Namely:

$$\begin{aligned} &\text{Project financing cost effectiveness} \\ &= \frac{\text{Rate-of-Return}}{\text{Financing Cost Rate}} = \frac{\dfrac{\text{amount of return on investment}}{\text{investment}}}{\dfrac{\text{amount of financing costs}}{\text{financing}}} \\ &= \frac{\text{amount of return on investment}}{\text{amount of financing costs}} \end{aligned} \tag{2}$$

Among them, the amount of return on investment is the net profit after tax and interest expenses while the amount of financing costs is the amount of the comprehensive financing cost. When the project financing efficiency factor greater than 1, the financing mode is feasible, otherwise unfeasible (Niu 2006).

From the government's perspective, the amount of return on investment of PPP projects is the profits obtained from the construction and operation of the project. The financing costs of government can be approximated as the net profit of private investors got in the project during the period of calculation. Because if the government invests projects with its own funds, this part of the profits should belong to the government. So computational model of PPP Project financing cost-effectiveness from the government's point of view is as follows:

$$P_{fce} = \frac{\text{the revenue of government}}{\text{Present value of all revenues - Initial investment}} \tag{3}$$

It can be formulated as below:

$$P_{fce} = \frac{G}{\sum_{t=1}^{n} \frac{R_t - C_t}{(1+r)^t} - L} \tag{4}$$

P_{fce} : financing cost-effectiveness of PPP project for the Government;

R_t : the income in the year t;
C_t : the costs in the year t;
n : the entire period of the project
r : expected return on investment;
L : Initial investment
G : the revenue of government.

Compared with other financial indicators, the Project financing cost-effectiveness takes the cost of financing to complete the project tasks into account. This model can be used as the evaluation and comparison of quantitative indicators under the same conditions.

THE APPLICATION OF PPP PROJECT FINANCING COST-EFFECTIVE NESS MODEL

The financing cost-effective model of BOT and BOO mode. BOT (Build-Operate-Transfer) and BOO (Building -Own-Operate) are the most common types of PPP contract. The biggest difference between the two is the calculation period. The calculation period of BOT model is the concession period of the project (Bao 2009). At the same time, the project should be forwarded to be government at the end of the concession period. The calculation period of BOO model is the entire duration of the project after completion. In addition, there is a residual value of the project which was built under BOT mode at the end of the concession period of the project when it was handed over to the government. And the residual value is determined by cash flow after the calculation period. So he financing cost-effective model of BOT and BOO mode are as follows:

$$P_{BOT} = \frac{\text{The present value of residual value of the project}}{\text{The present value of revenue in concession period - The initial investment}} \quad (5)$$

It can be formulated as below:

$$P_{BOT} = \frac{\sum_{t=m+1}^{n} \frac{NI}{(1+r)^t}}{\sum_{t=1}^{m} \frac{NI}{(1+r)^t} - L} \quad (6)$$

P_{BOT} : financing cost-effectiveness of BOT project for the government
NI : net cash flow in year t
n : the entire period of the project
m : the concession period project
r : expected return on investment;
L : Initial investment.

$$P_{BOO} = \frac{\text{The present value distributed to the government}}{\text{Present value of all revenues-Initial investment-Revenue of government}} \quad (7)$$

It can be formulated as below:

$$P_{BOO} = \frac{\sum_{t=1}^{n} \frac{NI}{(1+r)^t} * P}{\sum_{t=1}^{n} \frac{NI}{(1+r)^t} (1 - P) - L} \tag{8}$$

P_{BOO} : financing cost-effectiveness of BOO project for the government;
NI : net cash flow in year t;
n : the entire period of the project;
r : expected return on investment;
P : the proportion of return for government from private investors;
L : Initial investment.

(In practice, the way for private investors of returning of fund to the government are variable under the BOO model. Here in the model this paper select the fixed capital return of proportion for the sake of simplify the formula).

Assuming that the financing condition is the same, then it is possible to use these models to choose a more appropriate one (Bao 2014). If $P_{BOT} > P_{BOO}$, then choosing BOT mode may be a wise decision. On the contrary, the project uses BOO financing model is more appropriate.

Reasons for the differences in calculations of PPP financing cost-effectiveness. In practice the PPP has produced many different types of contracts. Even through all the contracts belong to PPP, the financing cost-effectiveness under different modes may not the same (Due to space limitations, the paper no longer give an example). Take the BOT and BOO as an example. From the connotation of PPP/BOT/BOO, it is clear that BOO mode usually applied to profit projects, BOT mode is usually applied to the non-profit or quasi-profit projects. This paper finds some reasons for this.

First, the positions impact the results. This paper analyzes questions from the perspective of government. However, if changing the position to private investors, the results may be different. For example, when the bank who invest money in the BOT project, then the residual value of the project is a outcome, not income according to the model (Lu and Zhong 2010).

Second, the computing time impacts project financing cost-effectiveness. The financing revenue of BOT project is calculated by residual value for the government and the calculation period is when the project is transferred till end. However, the financing revenue of BOO project is determined by the whole duration of the entire project as long as the government can get revenue returns from the owners of the projects.

Thirdly, the efficiency of post-operation will also affect the project financing cost-effectiveness. The private sectors runs the project by the whole duration under the BOO project, while the government takes over the project after concession period. Compared with the government, the private sectors have advantage in management, marketing and so on. So this can help to improve financing efficiency.

However, it takes a lot of costs for the government to learn about how to run the project under the BOT mode.

CONCLUSIONS

From the analysis above, it can be summarized that the use of PPP can effectively solve the shortage of funds and there are many models to choose from. From the analysis of the financing cost-effectiveness of BOT and BOO modes, the differences in financing exists in efficiency and accountability, etc.

This paper establishes calculation models of project financing cost-effectiveness for PPP project as well as compares the difference of financing benefits in BOT and BOOS modes. However, this paper only limits to economic benefits and operational efficiency projects, marginal social costs and social benefits are not involved.

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Research on Real Estate Price Bubbles through Supply Variables

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Abstract

The research on real estate bubbles can be analyzed from two perspectives: the demand and supply variables, but most researchers only consider the supply variables while ignoring the important supply factor: the land supplement. The land supply amount and the supply mode affect the real estate market. The total amount of land supply may be directly proportional to the supply changes in the real estate market; while the size of a single parcel may be in an inverse proportion to the supply changes in the real estate market. Through theoretical analysis, we learn that the main ruling part's monopoly of land markets has led to the total lack of land supply and the fact that the supply of a single parcel is too large, thus leading to real estate bubbles to a certain extent.

INTRODUCTION

The research on real estate bubbles in China can be traced back to the one conducted for Hainan province in 1992. In 2004, the rise of real estate market again led to the debate on real estate bubbles. Since the 3rd quarter of 2004, several famous economists have continuously published articles on this subject. They believe Chinese real estate bubbles have already reached to a critical level, even approaching to the edge of crash (Zhang 2004). "Bubble" was first to describe the Tulip mania happened in Holland from 1636 to 1637, the Mississippi phenomenon in Paris in the 18th century and the South Sea Bubble in London etc. All these events can be described as "bubble" according to the Palgrave Dictionary of Economics "the sudden rise of a kind/series of assets during a continuous process it gives the expectation of potential rise and therefore attracts new buyers as price rise is usually the reverse of the expectation, obvious price decline will follow with the result of finance crisis."

Yuan and Fan (2003) believe the real research on economic "bubble" should originate from the definition and analysis of rational bubbles proposed by Blanchard and Fischer (1989). According to their theory, we cannot exclude the possibility that the real estate market has bubbles. Based on this, many Chinese scholars began the research on the formation mechanism of real estate bubbles.

Zhang and Jia (2007) hold that the real estate bubble is the product of the non-stable divergence between capital price and basic value caused by the expectation of investors though multiple regression verification. Hu et al. (2006) believes the rise of Chinese real estate price is co-driven by basic economic factors and speculative components. Li and Wu (2008) also believe that "the fundamental reason of the over-heated real estate issue and the emergence of bubbles is the over-investment on housing." But the current Chinese scholars' researches on real estate bubbles are mostly based on Blanchard and Fischer's Martingale Theory (Blanchard and Fischer 1989), which are mostly focused on the speculative demand for housing. Few authors can give an in-depth study on long-held high real estate price and the formation of bubbles from the variable perspective.

Although land leverage model of Bostic et al. (2007) analyzed the real estate bubbles from the basic supply of the real estate market, i.e., land market, it has significance to the research on Chinese real estate market bubbles. However, one of the special national conditions in China is the urban land is belonged to the government monopoly. Even in such case, the government will not make decision completely based on the profit maximization logic. But land transfer might be different from that under the perfect completion. Liu and Liu (2003) from The Real Estate Research Center of Tsinghua University analyzed the price and regulation in the real estate market forms the variable perspective. They believe that "the real estate price depends on the market itself. The main indicator of the government regulation should not be the land price, but the land transfer amount." (Liu and Liu 2003). They are the first to take land transfer amount as an important indicator of the macroeconomic regulation and control. But they did not analyze the role of land transfer amount during the formation of real estate bubbles or illustrate from which perspective the regulation should be started. Therefore, analyzing the influence of land transfer amount on the formation of real estate bubbles and how to regulate the price from the land transfer perspective is valuable.

THE SUPPLY INFLUENCE ON REAL ESTATE PRICE

In a certain period of time, assume the government is the land owner and makes decision according to the framework of rational economic man's hypothesis. The land supply amount and price are denoted as Q_L and P_L, respectively. As the government is the only land owner in the current Chinese land market, i.e., the government has monopoly on land supply in the primary market. Under the monopoly state, the land owner can control the supply amount. Therefore, the price and supply amount is not determined by the interaction between the supply and demand curves.

As the government is the only land supplier, land demander and competition is not considered. Decision-making only depends on profit maximization. At this time, for rational land owners, the best land supply amount should be the point where the marginal revenue is equal to the marginal cost, i.e., MR=MC, see Figure 1.

In Figure 1, according to the law of diminishing marginal returns, the marginal revenue of land supply MR is a downward slope. However, if the monopolist increases the land supply, all the unit prices must be decreased. So the marginal revenue is always less than the price, i.e., the marginal revenue curves MR is lower than the overall demand curve D_L.

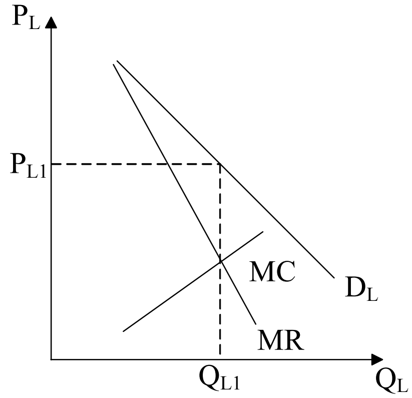

Figure 1.Land market curve.

From Figure 1, we learn that land market supply and prices are not co-determined by supply and demand. The land supply simply depends on the decision-making at the point of profit maximization. While the prices depend on the interaction between land supply and demand under the same circumstance.

During a certain period of time, assume the real estate (housing) supply D_H is consistent with the change of the overall economic development and the total social demand. The real estate supply and the real estate price are denoted as S_H and $P_{H,}$ respectively. Under perfect completion (See Figure 2), the real estate supply and price is co-determined by the interaction between the supply and demand curves. In Figure 2, the demand curve D_H intersects with the supply curve S_H at the point O, whose corresponding supply and prices are denoted by the total supply Q_{H0} and the final real estate price P_{H0}.

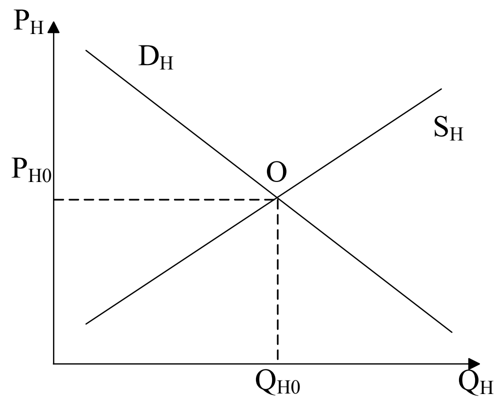

Figure 2.House market curve.

In Figure 2, as the supply and demand in the real estate market is regulated in full accordance with the competition conditions, the supply and price is co-determined by supply and demand. Now assume Q_{st}^{*} and Q_{st} are the expected the actual real estate supplies at time t, respectively. N_t is the social-economic variable, e.g., inflation or interest rates. The expected total supply of the real estate market at time meets:

$$Q_{st}^* = \alpha Q_{st} + \beta P_t + \gamma N_t + \varepsilon \tag{1}$$

ε is a random variable correction, and α, β, γ are all coefficients.

Equation (1) shows that as the overall social-ecomnic variables are changing stably, the expected real estate supply is the function of the current price. But since the real estate construction needs land, which is different from many other commodities, and the economic supply of land is the goverment monopoly supply, the current lag is formed:

$$Q_{st} = \lambda Q_{st}^* + (1-\lambda) Q_{s,t-1} \tag{2}$$

In Equation (2), λ denotes the development speed, which is a number between 0 and 1. If the current actual estate development can be achieved, $\lambda = 1$, i.e., the actual supply completely equals to the expected supply. However, if $\lambda = 0$, it means there is no new supply in the market. λ denotes the speed of acquiring land, obtaining permit, design, and construction during real estate development (Millers et al. 1999). If the government cost is not considered, λ mainly depends on the land supply conditions.

For λ, three conditions need to be considered, i.e., when the land supply is equal to, greater/less than the required land amount in the real estate market. When land transfer is excessive, i.e., the supply is greater than the demand, we can learn from the analysis in Figure 1 that land owners will definitely make adjustment to the supply according to their maximized operational profit. When the land transfer exactly satisfies the real estate market demand, $\lambda = 1$, i.e., the land market does not have any impact on the real estate market. However, as the demand increases with the total social demand and the overall economic development, the land market in recent years does not follow the appropriate speed to increase land supply. The reality is that the real estate market price has a sharp rise from 2004 to 2007. The real estate prices increase in some areas even exceed the speed of the overall economic growth. Therefore, $\lambda = 1$ does not conform to the reality. Currently, the value of λ can only satisfy that the land transfer amount is less than the total land demand of the real estate market, i.e., $0 < \lambda < 1$. The actual real estate supply is less than the expected ideal supply, see Figure 3.

Figure 3 shows the analysis after effectively binding Figures 1&2 together. In Figure 3, as the land supply depends on the point where the marginal revenue equals to the marginal cost, the total supply is Q_{L1}. The current possible real estate supply of Q_{L1} is Q_{H1}, which is less than the real estate supply Q_{H0} under perfect competition condition. In this case, P_{H2} is a rational price for real estate suppliers. But due to the special feature of the real estate itself, the supply is restricted by the land supply. And as there is no land substitute for real estate, the supply curve S_H changes to curve abc.

New supply curve abc intersects with demand curve D_H at point c. This determines that the current actual real estate price P_{H1} is higher than the actual real estate price P_{H0} under perfect competition.

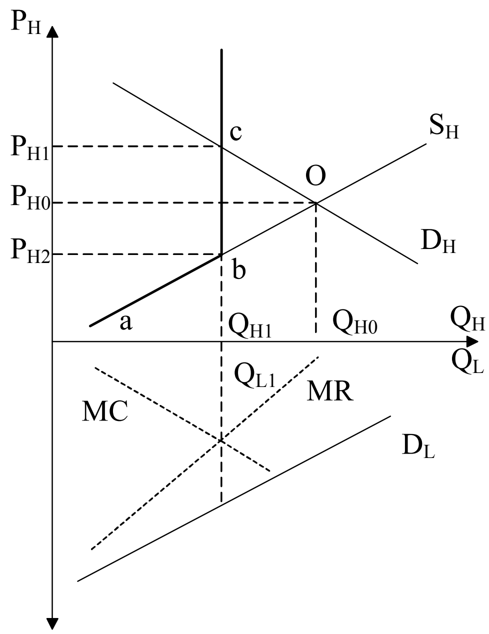

Figure 3.Combined with the land market and real estate market curve.

CONCLUSION

Land leverage theory (Bostic et al. 2007) holds that: the greater land proportion in real estate price constitution, the less likely the real estate market has bubbles. However, the special national conditions in China lie in that the supply in the primary market is completely monopolized by the government. This paper assumes the government's decision-making is accordance with the Hypothesis of "Economic Man". In reality, although the government does not fully consider profit maximization, because of its role as both land manager and owner, the decision-making is affected by serious interference of negative incentives.

When land transfer is controlled and thus influence the real estate supply, the real estate price will be definitely higher than the rational price. The current actual real estate price is still co-determined by supply and demand. Therefore, even under no speculative demand or extremely low proportion of speculative demand situation, the real estate market price remains high. Since there is no speculative demand or extremely low proportion of speculative demand, we should not blame the real estate bubbles when the price is beyond the fair value. The reasonable explanation is that the restriction of land transfer causes the high real estate price.

This paper does not come to the conclusion that real estate price and land price has causal relationships. Further research is needed to fill the gaps (e.g., Granger's causality test). The land leverage theory explains the leverage role of land price on real estate prices, but there is still no proof of causal relationships between them.

This paper attempts to study the relationships between the real estate price and the land transfer amount. It holds that although the real estate price is co-determined by demand and supply curves, the restraint of land transfer amount makes the real estate supply curve change. Therefore, it can be concluded that the land transfer amount determines the real estate price to some extent.

The real estate price change makes the supply curve will not change dramatically (due to the rigidity of the upper section of the supply curve abc in Figure 3). When shifted to the land market, the role of developer is changed from the real estate supplier to the land market demander. When the demand curve does not move or move upward slightly, as the land market supply will not change driven by maximizing profit and farmland protection policy, we can consider that the real estate market price change will not influence the land supply.

THE POLICY RECOMMENDATIONS

In the case that the current real estate price in China remains high, we can conclude from the variable perspective that it is not affirmative to believe real estate bubbles exist in a large extent. The specific measures include:

Increasing land transfer and improving the overall supply of the real estate market. When land transfer restricts real estate supply, $\lambda < 1$ in Formula (2), which causes the rational expected real estate price is lower than the actual price. Therefore we should increase the total land supply moderately under the premise of adhering to the farmland protection principals to achieve $\lambda = 1$, which satisfies the real estate market's overall land demand and pulls the price back to the rational level.

Cracking down the land-hoarding phenomenon caused by developers. When land supply fails to convert to real estate supply effectively, the increase of land transfer does not make any sense. When real estate suppliers hoard land and fail to convert land to real estate effectively, the real estate supply λ remains less than 1. In such cases, the real estate supply lagging still exists and the high real estate price issue cannot be solved. Therefore we must crack down the land-hoarding phenomenon, so that land transfers can enter into real estate market in an efficient and effective manner.

Reducing the approval procedures and enhancing the administrative efficiency. Another factor that determines the land supply speed λ is obtaining permits and construction time. Design and construction speed cannot have major change under the existing technological level. Therefore enhancing administrative efficiency has crucial impact on the real estate's immediate supply rate. When the approval and other administrative efficiency is enhanced, real estate supply rate λ increases. The actual real estate supply is close to the expected transfer and the real estate price is stabilized effectively.

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BT Operation Model Advantages in the Analysis of Park Development: Based on the Case of the Guangzhou Baiyun Airport Comprehensive Bonded Zone

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Abstract

As a way of building ownership of land and ground operation, BT operation model has a good effect in the park development to alleviate the financial pressure and invite investment. This article will focus on the Guangzhou Baiyun Airport comprehensive Bonded Zone, BT operation model in the park development of economic and social benefits were analyzed, and combined with other existing operation model, comparative analysis of park development in BT model superiority.

INTRODUCTION

Since the reform and opening up, with the great development of its industrialization and information construction, China has become the second largest economy in the world. As the urbanization advances increasingly, a great deal of infrastructure construction has become the rigid requirement of the development of national economy. It has become indispensable to construct a mass of infrastructure construction, such as development area, high-tech development district and comprehensive bonded zone. To date, some projects have applied successfully like Suzhou Industrial Park, Beijing Tianzhu comprehensive bonded zone and Shanghai Huangpu comprehensive bonded zone (Zhao 2007). However, to most of the park development in our country, the funds are from financial allocation, government loans and international financial institutions, since the vast cost and long period of capital recovery, it has become a common phenomenon of shortage of investment and funds faced by various regions in China. In order to meet people's demand for public infrastructure, to develop new project investment and financing mode is therefore imperative.

THE BASIC THEORY OF BT MODE AND ITS ADVANTAGES IN THE BONDED AREA ANALYSIS

The brief introduction of financing modes. With the need of investment construction, some innovative and applicative financing modes have applied in our country like BOT (Build-Operate-Transfer) mode, TOT (Transfer-Operate-Transfer) mode and BT (Build-Transfer) mode successfully.

BOT mode is build by project owner and has a operation for a period of time, after a demonstration effect, produces attractive to investors, and then transferred to other investor. There is an obvious different between BT financing mode and BOT financing mode, BOT financing mode has one more process: Process O (Operation) (Zhang 2006). In the park development, especially, such as the comprehensive bonded zone and industrial park projects, investors have not the righter of operation, so the BOT mode is not suitable for these projects financing, the investors in the BOT financing mode is completed within the franchise project ownership and management rights, until the project is handed over to the government free of charge.

In the TOT mode, the investors can't participate in construct; they just accept the project operation from the government directly, after the expiration they handed over to the government, namely "transfer-operate-transfer" (He 2004). This mode of operation is relatively simple, but in the park development it is not suitable for construction of bonded zone project financing, for the government has the right to operate but investors.

BT mode is originated from BOT mode, is the government use the nongovernmental funds to construct non-profit infrastructure project. From the project, investors conduct the financing and project construction, and then return to government after the project completion acceptance (Zhou 2007). The government pays the project total investment plus a reasonable return to the investors in BT mode. As a kind of financing mode, it is beneficial to attract foreign capital and folk capital investment to the construction. In recent years, our country also has many large projects successful application of this model, such as: the Caiyuanba Yangtze bridge project, Beijing metro line 10 Olympic branch line project, etc.

The characteristic of comprehensive bonded zone. The comprehensive bonded zone is approved by the state council, set up in the inland port areas where they have excellent international terms of trade and economic technology more developed, at the same time, with functions of bonded port areas under special customs supervision, and implementation of closed-end management. At present, they are the China's highest level and open, the best policy, the most complete of function. In the national open financial, trade, investment, services, transportation and other fields, they are the experimental and leader areas (Xu 2013). Bonded area is the state-owned enterprises, so in the right to run the program and regulation by the local government implementation; Secondly, the bonded zone project is extremely costly, time limit for a project is longer and have some risk to investors, so the project fund raising and management of the construction is the key to the construction of the bonded area.

The brief introduction of Guangzhou Baiyun Airport comprehensive bonded zone. The Baiyun airport comprehensive bonded zone is located in the north of Guangzhou, planned Seine scope of 7.39 square kilometers, divided into the central, southern district, north district three Seine areas. The central district is located in the northern Baiyun airport, is composed of the existing Baiyun airport center of international freight station and Guangzhou airport bonded logistics center, covering an area of 0.66 square kilometers. The southern district is located in Baiyun district Zhongluotan town, planning control area 4.53 square kilometers. North district is located in Huadu district high and new technology industry area, planning control area of 2.19 square kilometers (Yu 2010).

The Pearl river delta region has become China's most abundant region in inland eon economy, Guangzhou is an important industrial matrix of China, a comprehensive industrial manufacturing center in south China, light industry and important industry is relatively developed, is the financial center of south China at the same time, the financing capacity of the strongest cities in southern China, and it provides the BT financing mode a base forthrightly.

The advantages of BT mode analysis. As a kind of innovative mode in financing and investment, BT mode can absorb diverse capital input, and speed up the development of infrastructure construction (Liu 2012). In BT mode, it is not need the government funded directly, also not need to make a mortgage guarantee. The government at the same time, once the project completed, its ownership of project is not affected. Generally, it is very suitable mode for the project which is a non-operational in infrastructure investment and financing, mainly has the following advantages:

(1) During the all process of BT project construction, the government as a project owner, the capital they possessed does not belong to the government, it is derived from the project investors through the financing channels to obtain funds. There is about 5.5 billion yuan invested in the Guangzhou Baiyun Airport Comprehensive Bond totally. The government can pick out the best investor through the way of bidding for this huge size of funds, then investor take various channels of financing, the financing model is no specific limit, can through the way of bank loan or international financial institutions; can also be a local folk capital injection. By the BT mode of financing, the utilization rate of capital improved greatly, at the same time broaden the channels of funding sources and reducing the government's financial pressure.

(2) The Baiyun Comprehensive Bond zone covers an area of 7.39 square kilometers, and the project construction period from 2011 to 2015. In the whole project since the large scale and long period of the construction, the financing, construction and management is a big challenge to the developers. However, the BT mode, is a comprehensive investment and financing mode, it makes the construction and management are integrated and systematic, which will be conductive to reduce the project construction and management cost and shorten the construction period, thus is a advantageous to project construction smoothly and control the overall cost of project investment.

(3) The Baiyun Airport Comprehensive Bond zone is a part of a Guangzhou Airport Economic Zone, bonded processing and bonded logistics is given priority, it has the highest open level, most preferential policies and the most complete function of special open area. Due to the particularity of the bonded area, the project management and operator are conducted by the government after the completion of the project. BT mode just conforms to this need of "construction-transfer", after the completion of the project; investor will transfer the right to run the project to the Guangzhou municipal government. So that to avoid the dispute on capital and operate right between the investor and the project owner effectively.

(4) BT mode has dramatic advantages on handle the project. Generally, the project owner, investor and lenders form a team or core to handle the financing and construction in the BT mode project, so a high level of technical personnel and

management personnel is rich in reserve and abundant human resource (Wang and Li 2011). Project company is both the owners and contractors, it makes the management links reduced and the efficiency of management improved, on the other hand, because they have rich experience in site construction, management goal and direction is more clear. Besides, BT mode means low investment, high return.

(5) In the BT financing mode, the investor's funds payback period shorten and lower risks, it is conducive to attract investors, while to BOT or TOT mode, although investor has the right of project management, the payback period is long and the uncertain of market economy makes risks added (Wang 2008).

THE ANALYSIS OF RISK IN THE PROCESS OF BT MODE

According to the process of BT project construction, the risk in this mode can be divided into three stages (Ye 2010): the early stage of the project (investment), mid project (project construction) and late project (project buyback period). In the different stages of BT project construction, the risk is different and has the different features of each other. BT project risk has particularity, the investors in the project construction responsibility for all risks, while after the completion, business risk transfer to the government, and only risk capital expires. The risk has diversity and pertinence.

(1) At the early of the project, the mainly risks include: study the feasibility of the project in line with the technology and economy (Li and Liu 2013); the project budget is in line with the government's economic objective conditions and social development; whether the bidding stage in the correct procedures; estimate the project cost, financing costs, and if there is a correct evaluation of investment payback.

(2) During the construct period, amount of funds been used to pay for the construction plant and labor, the risks are increase with the inflow of own funds and loan funds, mainly displays in: the risks caused by financial market fluctuations and exchange rate changes; risks caused by the fluctuation of building materials' prices and contracting market; natural conditions of force overwhelming and some unforeseen risk.

(3) In the project buyback period, the risk mainly from the date of the contract and the funds to repurchase; the payment risks and credit risk from the project owner.

BT mode project construction, since the great engineering quantities, financing and construction is long and its all kinds of risks, the construction must be followed in the process of the basic procedures, ensure that the construction under a normative way.

THE PROPOSALS TO THE EXISTING MODE OF FINANCING

This article aim at the advantages of BT financing mode based on the project, and combination with the current background of economic development, carried on a comprehensive analysis of BT financing model. Fatherly, by the analysis of BT mode in Guangzhou Baiyun comprehensive bonded zone, demonstrates advantages in the park development of BT mode. In this paper, the above studies form the following suggestions:

(1) In the early of the construction, it's indispensable to do the market investigation and analysis of economic benefit, only when the project meet on the basis of economic and technical conditions, can they carry out project financing and

construction, otherwise cause a shortage of funds to the project, construction suspend, prolong the capital payback period, causing the waste of resources.

(2) In the infrastructure construction, the BT mode is not only an innovative way of financing, but also a kind of new way of construction management. The whole construction process is under the management of project owner and investor, on the basis of six basic steps. In order to ensure that project smoothly and reduce the risk of the project, the entire project construction process must abide by the code and relevant rules.

(3) In terms of law and policies, the government should give a vigorous support; perfect the relevant laws and regulatory system. On the policy, support the application and development of financing mode, protect the interests of the investors. Training professional talents, strengthen human resources reserve, and promote the combination of theory with practice, then form a systematic, mature and marketization theory, and at the same time continue to develop innovative, practical and economical financing, promote the sustainable development of the economic development and infrastructure construction.

CONCLUSION

Undoubtedly, BT mode in this case has been applied very good, the model focuses on “B” stage, namely BT financing and construction projects, in view of large-scale, large of investment needs and long construction period features of BT projects, Risk factors become an obstacle to the healthy operation of the model. In order to enable the smooth progress of the project, in subsequent research, investment and financing model adopted in accordance with the corresponding risk area is a direction. By dividing the risk level, choose a different financing model, making the loss is minimized, we can avoid the risk, or depending on the level of risk, combine different financing modes, select a combination of minimal risk means by which method, the risk can be shared, eliminating concentration risk. In addition, the development of BT mode in China is later, given the nature of the project, the promoters of the project are mostly government agencies, which restricted the development of BT model is largely, making the application of the model is very narrow in the future. The study, to expand the scope of the project owner is also a direction that may reputable companies can become owners, rather than government agencies.

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Research on the Marketing Planning and Design of the Yongzhou Wuxi Estate Project

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Abstract

Based on the review of the existing real estate marketing theories, this paper elaborated every link of the operation of project, according to the actual situation of Wuxi real estate project in Yongzhou. At first, the paper analyzed the marketing environment of Yongzhou Wuxi real estate project in detail, including the external environment, the internal environment, the market research and the analysis of SWOT. And then the paper sorted out the marketing strategy of Yongzhou Wuxi real estate project, based on STP strategy of product positioning, customer orientation, channel positioning, positioning of promotion and so on. At last, this paper proposed a feasible way on how to guarantee the project marketing strategy to be carried out.

Based on the research on the real project operation, this paper has obtained a large amount of data in the Qiyang market. It is believed that the research on the similar Forth Grade Cities' real estate business such as Qiyang City in the marketing practice will lead to some significant reference and guidance.

INTRODUCTION

Since 2010 Chinese government has implemented a series of policies to cool the real estate investment down and seek stable development. Implementation of these policies has significantly slowed down the increasing of house price in nationwide, even leaded to price decreasing in some areas. The housing turnover has also shrunk obviously. The survival and development of real estate enterprises have become more difficult in this severe policy and market environment. For further development, real estate developers have to focus more on marketing process to carry out and select the most suitable marketing strategy with cautious attitude to ensure the success of project.

Foreign scholars usually have not carried out a special research on marketing strategy to real estate project and most of them focused on general project planning and marketing. Marketing has separated gradually from the economics since 1960s and combined with other subjects such as social psychology, behavioral science, management as well as psychology, therefore, the marketing theory becomes more mature. At that time American scholars generalized “marketing mix” as 4P theory: Product, Price, Place as well as Promotion (McCarthy 1960), this theory has prevailed until now since it was put forward and become the classic in marketing theory. Then the scholars have also put forward STP strategy (Kotler 1967), this strategy has new breakthroughs in modern marketing strategy. While in recent years, on study of real estate project planning, foreign scholars have combined 4P and 4C theories with real estate marketing to form the most practical marketing strategy and method in real estate (William 2005).

Compared with foreign studies, domestic studies on real estate marketing strategy theory research starts lately. By using foreign relevant marketing theories for reference, some real estate marketing strategy theories and methods combined with actual status of real estate development in China have been put forward. Scholars believe that network is the propaganda media, a distribution channel for real estate marketing as well as an investigating base for market research (He 2003). Subsequently the innovative modes of real estate marketing facing “4C” in consumer-oriented have been proposed and the scholars believed that this method could better meet operation requirements of real estate developers (Jin 2004). Based on international traditional typical marketing theories such as 4C, scholars combined the actual conditions in China and summarized key points in real estate marketing (Yang et al. 2010). Finally a new theory proposed that the marketing strategy shall run through development program in real estate, not only the comprehensive scheme but including implementation feedback (Wang 2013).

In summary, real estate enterprises in China shall actively absorb foreign successful experience in innovative mode of marketing, combining basic conditions in real estate industry in China to summarize the theory system that is in accordance with marketing mode of real estate in China. Research results in domestic and abroad have played a inspiration and reference role in the research in this thesis. However, the economic system in China is different from foreign countries in certain parts, the related marketing planning in real estate paid more attention to the process and modes. As the study on project particularities was relatively weak, especially the documents on marketing strategy of real estate project were few; this has left a certain space for the study in this thesis.

MARKET INVESTIGATION AND POSITION ON YONGZHOU WUXI REAL ESTATE PROJECT

General situation of the project. Yongzhou Wuxi real estate project is developed by Yongzhou GLL Real Estate Co., Ltd. The total area is around 125Mu and the total construction area is around 280000 m^2. There are 45 buildings with various types, which include luxury properties in detached villa, semi-detached villa, townhouses villa and western-style house, the common high-rise residential in two rooms, three rooms as well as four rooms. The span of products' area range is large (99 m^2 -618 m^2).

The project is located in the south of Tao Zhu Square in Qiyang County, road network develops all around, roads around and to be linked include Fuxing Road, Wanshou Road, Zhongxing Road as well as Yinling Road. The project follows the principle of hommization in design and introduces environmental ecology concept in planing and design, which includes Toscana style gardens, central landscape belt, leisure square, and swimming pool as well as fitness places. The project is positioned as large-scale and low-density luxury residential area with 30% greening rate. The building density is lower than 35.6% and the floor area ratio is only 2.92.

Market investigation planning. (1) Real estate market investigation in Qiyang. Real estate market investigation in Qiyang adopts questionnaires, field investigation as well as comparison among the competitive projects. There are totally 6 surveyors in two groups in this investigation within 5 days. The key regions in this questionnaire are pedestrians on Tao Zhu Square, shops on main streets in old districts, government affairs halls, Jin Qiao construction materials market, schools as well as hospitals. Objects of the questionnaire are public servants and teachers with 240 pieces in total, in which 227 effective questionnaires; the effective rate reaches 95%. The competitive projects in field investigation are Binjiang Villa, Tinglan Washington, Golden Bay, the Metro City, Tianyu First City, LOHAS beauty domain, Huaxin time's platinum, which are for sale on the market or prepared for sale.

It can be concluded as follows summarizing the consumers' demand and investigation information on current situation of real estate market:

(i) The most buyers in Qiyang come from Qiyang county town and the consumer group includes mainly the government public servants, staffs in enterprises and institutions as well as teachers, privately-owned businessman, the clients from cities and towns in small percentage. There are on investors from other places;

(ii) The buyers in Qiyang are mainly in new districts, therefore, the position where Yongzhou real estate project lies is the absolute hot point, meanwhile the buildings developed are increasing, especially around the Tao Zhu Square. The competition among buildings becomes obvious fiercely;

(iii) 110-140 square meters with three rooms or four rooms for multichamber and high-rise are in the fast selling rate on real estate market in Qiyang. The high-quality buildings are few and foreign-style houses and villas belong to high selling rate products due to scarcity; The price in real estate market in Qiyang shows rise year by year, the prevailing price for houses is RMB3500/ m^2 . The average price of luxury products is around RMB6500/ m^2 and the selling price for houses with elevator is RMB3200-3500/ m^2 . The selling price for foreign-style house is above RMB6000/ m^2 and the price for villas is RMB8000/ m^2 . The overall selling price in new downtown is higher than old ones.

(2) SWOT analysis. Conducting SWOT analysis on Yongzhou Wuxi real estate project, the analysis is shown in Table 1 as follows.

Table 1.SWOT Analysis on Yongzhou Wuxi Real Estate Project.

Opportunity	Threat	Advantages	Disadvantages
(i) several road networks in future planing of region (Fuxing road, Wanshou road as well as Zhongxing road) appreciation of space is large in property; (ii) foreign-style houses and villas in the region are in temporary shortage, which provides opportunities for sales of high-level properties; (iii) projects around have been launched and part of owners have checked in, which have greatly heated the market in this region, therefore, people in Qiyang has strong recognition on those projects in this region; (iv) other projects in this region do not have a large amount of houses on the market temporarily.	(i) the government has implemented a series of policies to cool real estate investment down and seek stable development, implementation of these policies has significantly slowed down the increasing of house price in nationwide, even leaded to price decreasing in some areas. The housing turnover has also shrunk obviously; (ii) the project is in the hot point of real estate development, the future competition among developers will be much fierce; (iii) most buyers in Qiyang come from downtown and their revenues are not so high, the consumption consciousness on commercial residential buildings is weak.	(i) the project is adjacent to the administration center in Qiyang, the drive for government affairs is sufficient, which provides a large amount of potential clients for the project; (ii) the project is in the hot point of real estate development, a large amount of commercial residential buildings are concentrated in this area, which is good for project reputation popularity; (iii) the project is in the ring roads in three directions, it is directly adjacent to the future backbone road in Qiyang to the east-Zhongxing road, the traffic accessibility is good in the future.	(i) besides government affairs accessories at present, other accessories around are not perfect relatively, which has certain influences in increase of project quality; (ii) lack of image propaganda in previous stages, therefore the project popularity is not so high; (iii) repeat of Bin Jiang Villa in building planning; (iv) the project schedule lags relatively, which has adverse effect on promotion and sales afterwards.

Analysis on market positioning in Yongzhou Wuxi real estate project. For the specific positioning procedure of the real estate project, we refer to the marketing positioning procedure in marketing STP strategy proposed by the American scholar Philip Kotler. The procedure is divided into 3 steps: market segments, determination of target market as well as market positioning. We shall conduct positioning on Yongzhou Wuxi real estate project according to these three steps.

(1) Market segments. The market segments of Yongzhou Wuxi real estate project are as follows according to the principles and evidences of real estate market segments combined with previous market research:

Human factors: centered on the group aged 22-25 who have upper middle revenue and education level, staffs in enterprises and institutions as well as private owners; Geography: mainly the permanent resident population in Qiyang plus clients from towns around and migrant workers; Consumer psychology: buyers of villas foreign-style houses and villas are mainly in improved type, buyers of high-rises are mainly in high-quality lives; Consumer behaviors: mainly in the buyers of the second house and independence, few investors.

(2) Positioning of target clients. The target client types for part of Yongzhou Wuxi real estate project are as follows according to influence degree of consumers on sales:

(i) Dominant clients: mainly the permanent resident population in Qiyang, staffs in enterprises and institutions, public servants, teachers as well as returning groups and part of clients from cities and towns;

(ii) Potential clients: mainly the buyers who have the self-built houses but would like to live in residential area, unsatisfied with municipal and commercial facilities at present;

(iii) Accidental clients: buyers with sudden strong purchase desire touched by periodic promotions or on-site activities;

(iv) Commercial clients: clients from cities who purchase the shop and clients from towns around, investors in cities who purchase the shop for rent and investors from towns around.

(3) Market positioning. The positioning in level of Yongzhou real Wuxi real estate project and products are as follows through analysis on location, accessories, terrain, scale as well as present situation and considering location of the project, market competition, volume and scale, potential psychology in consumers as well as gap in the market at present:

(i) Level positioning: level positioning of the project is the high level residential area in central area in Qiyang, specifically high-level locations, high-level planning and design, high construction costs, high-level property management as well as intelligent system.

(ii) Product positioning: the marketing idea for Yongzhou Wuxi real estate project shall not limit to certain product but the whole product system and development procedure, including product types, quality, and after-sales service. Base on the concepts above, Yongzhou Wuxi project must plan living area, street business area as well as leisure & sport area in design. Luxury and different style from other projects in architecture should be prepared. In layout design, compact arrangement, high efficiency as well as comfort should also be considered. Conducting various types, combining various kinds of requirements and highlighting key requirements in proportion of apartment layout should be planned.

4P MARKETING STRATEGY DESIGN IN YONGZHOU WUXI REAL ESTATE PROJECT

Product strategy design. The project location and sight advantage are obvious and the future accessories are perfect. Therefore, previous correct positioning of target clients is the most significant and key step in the project marketing. The floor area ratio is low in this project with multi-story apartments, townhouses as well as garden houses. But which kind of the product that the client accepts shall be determined after market investigation and analysis.

We could know from analysis on market research that the private owners, public servants as well as administrators in enterprises and institutions have obvious demand to improve houses so that this part of client group has large demand on high-rises, foreign-style houses even villas in large area. Meanwhile the economic powers of young client group and client group in towns around are not sufficient and they focus on high-rise property in two rooms and three rooms. Few clients with powerful economic power also have requirements on detached villa. Therefore, product positioning of Yongzhou Wuxi real estate project shall be mainly in high-rise property, matching with foreign-style houses and villas in comprehensive and low-density living area. Meanwhile, the real estate market in Qiyang shows booming development, supplying the commercial residential building in large scale on the market. But high-level projects and exotic projects are few; this project could be positioned as “Chief Toscana-style Community in Qiyang”.

Therefore, Yongzhou Wuxi real estate project shall adopt the layout in center radiation as a whole in planning and design. The large swimming pool as the center, zoning the villas, foreign-style houses as well as high-rises set up a harmony as a whole. In space assignment the layers shall be clear, changeable and orderly with the proper scale between the public and semi-public areas, which ensures privacy and flexibility of living space at the same time. The interactive effect among spaces can be achieved.

In construction style, the bottom of building is built on stilts according to the characteristic of Italian Toscana style so that no obstacles exist on vision inside and outside the garden and the sight is not separated in visual sense. The Italian architectural elements are also introduced to the roof design of the building. By integrating all details of the project, the position of Toscana style can be shown completely. The facade of the building and color selection in the overall project are all complied with the architecture standards strictly. The beautiful outlook of facade, high level of project position and exotic outlook are displayed excellently.

In room style design, there are more than 10 wonderful room types are available. Foreign-style houses and villas are mainly in 200-300 m^2 , and also there are some others in 150 m^2 . A few of large-sized detached villas exist. Main high-rises apartment are in 3-room type in around 120 m^2 and a few of small double rooms and large 4-room types are available, which has achieved the target of combining various kinds of requirements and highlighting key demands in proportion of apartment. Besides, we have fully considered various kinds of functional requirements in waterproof, fireproof, day lighting, ventilation, separation of dry and wet, sound insulation, heat preservation, heat protection as well as kinetonema.

Price strategy design. The core for pricing target is to enhance market share and realize profit maximization. Comprehensively considering the market condition in Qiyang and competition among similar products, Yongzhou Wuxi real estate project selects relatively conservative pricing method that combines cost orientation and competition orientation. According to characteristics in market situation and referring to successful experience of other projects, the idea of “popularity flow in” is firstly introduced to increase market share rapidly, and then gradually increase price to peruse the public praise effect. Referring to prices of competitive projects, the average opening price is a little lower than that of the similar competitive projects on the Qiyang market.

After determining the basic price, we shall adopt the combination of discount pricing strategy and difference coefficient pricing strategy aiming at differences in property level, orientations, floors, areas, and sights as well as giving rate. For those clients with one-time payment, we shall give 3% of discount and 1%of discount for clients with mortgage payment. Drawing up different difference coefficients to form one price for each house and pricing on quality aiming at different property types, floors, house types as well as sights, different card thresholds and preferential strengths shall be clearly distinguished with regard to villas and foreign-styles houses RMB 50thousand for 80thousand, high rises 3 thousand for 5 thousand to realize balanced sales in respective house types.

Channel strategy design. To ensure the speed for sales and to omit intermediate links, Yongzhou Wuxi real estate project shall adopt direct channel, which could ensure strong controlling and low sales commissions. Although there shall be more investments and efforts in the channel construction, the channel construction could bring benefits that could run throughout the project. In addition, by cooperation to the consultant company, the project can shorten the time for channel construction greatly and fully take advantage of agents' sales experiences and sales resources to conduct professional operation and the channel construction can be also finished together. This could reduce the risks to maximum and the sales speed for products will be ensured. Meanwhile, through professional marketing strategy consultant companies, the project company could build better propaganda ideas so that more effective marketing methods can be adopted to increase sales price, shorten time to reduce financial costs and obtain higher sales profits.

Design of promotion strategies. (1) Design of advertising promotion. According to common cycle of real estate sales, the project shall be promoted in two phases, the specific conditions for promotion are shown in Table 2.

(2) Design of member promotion strategy. Provide Yongzhou Wuxi real estate project with the market attractiveness and competitiveness in maximum through corresponding promotion mode and overcome the homogenization tendency of sales competition among similar products. Achieve the target of fully creating advantageous opportunities and seize market share. The main methods are as follows:

(i) Promotion from members in sales office. Building a professional sales team with highly-qualified and strong technical capacity, sales members promote the products through face-to-face communication with clients. This method is to be proved to be used mostly and the most effectively in the combination of marketing and promotion of real estate.

(ii) Marketing. Establishing several sales groups and 2-3 staffs in each group, to ensure sufficient exposure rate under the condition that promotion support of company

company image, realizing high value and amount of transaction performance through leaflets distribution and visiting shops.

(iii) Experience marketing. The sales method makes clients have intuitive feelings and participation experience. This method has changed the marketing idea that only stressing in products and services. Stimulating the clients' enthusiasm to participate in the project and winning trusts and loyalty from them, the target of promotion of product sales can be achieved.

Table 2.Promotion Table of Yongzhou Wuxi Real Estate Project.

Stages	Time	Targets	Media groups
Client storage period in the first stage	Jan.2014-Mar.2014	To establish image of high-quality buildings enhance influence and attention of the project on the market, explain the product value of the project and lay the foundation of client group of the project, reserve clients for the project	Outdoor media, mainstream newspapers, messages, outdoor advertising, TV advertising
Centralized transaction period in the first stage	Apr.2014-July. 2014	Powerful sales, completely release client storage energy, promoting C1and C2 462 high-rises and part of 90 foreign-style houses and villas in the first opening, which set off sales upsurge	Mainstream newspapers, TV advertising, dispatching outside, sample rooms, messages, exhibition points
Client storage period in the second stage	Aug.2014-Feb.2015	Conduct the clearance of the first period in the second stage, due to product absorption in previous stage has been more than half and remaining source is limited, creating the atmosphere of hunger type marketing, continue to sell houses in the first period, meanwhile prepare client storage for the promotion of the second period since June.	Newspaper advertising, dispatching outside, sample rooms, messages as well as outdoor advertising
Centralized transaction period in the second stage	Mar.2015-May.2015	Realize the second sales peak	Dispatching outside, messages, newspaper advertising, sample rooms, outdoor advertising, exhibition points as well as cruise cars
Clearing the sale on period	Jan. 2014-Mar. 2014	Accomplishing overall sales of remaining buildings and achieving sales target	Messages, sample rooms as well as Internet

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CONCLUSION

By systematic and detailed market research for real estate projects, this thesis has conducted SWOT matrix analysis on Yongzhou Wuxi real estate project through systematic and detailed market research and conduct market segments and positioning on this project and finally selecting the target market. Then a marketing plan to the project was designed as the follows:

In terms of product strategy, the project is positioned to high-rise property as the main and western style building, villas integrated to low-density "Qiyang First Tuscana Style" residential zone.

In terms of pricing strategy, referring to the price of competition project, the opening price of the project is slightly lower than the price of the competitors in the current market of Qiyang. Therefore, firstly we should increase market share rapidly and then gradually raise the price to create the public praise.

In terms of channel strategy, direct marketing will be adopted firstly. Through the cooperation with the consultant company, the construction of the channel can be set up by the clients from both parties. The processional operation can be implemented by the agency's sale's experiences and resources.

In terms of promotion, outdoor media, mainstream newspapers, SMS, towns' facades advertising, TV advertising can be pushed forward. Combining with the methods of marketing sales of salesman in marketing department, sales team's marketing and customer's experience sale, the promotion can be implemented in subsequent way.

During the process of the study, the thesis has made the careful investigation and analysis in the marketing planning and design on a real estate project's operation. We hope this thesis can be a certain value for references to the project operation of the real estate enterprises.

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Acceptance and Use of LCC as a Decision Support Tool for Renovation Investments

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Abstract

This paper seek to explain why Life Cycle Costing (LCC) is used or not for renovation projects. The study is based on a theoretical explanation model called the Technology Acceptance Model (TAM). The model assumes that a number of factors determine whether and when individuals will use a particular technology. Two main components of the model are (1) Perceived usefulness, and (2) Perceived ease of use. The response rate was 32.3%. The results show that the climate in terms of the extent to which LCC is advocated and used by colleagues affects how the individual experience both usefulness and ease of use. Our study also demonstrates that the perceived usefulness, i.e. how well you feel that LCC can be used in your daily work, lays the foundation for if it is perceived as positive to use, and thus also a prerequisite for creating an intention to use and subsequently applying LCC in actual renovation projects. The study shows that the ease of use does not have the same effect.

INTRODUCTION

Construction clients face several forces steering them towards a more sustainable built environment, including EU directives, national legislation, industrial standards, policies and other requirements (Ludvig et al. 2013). For these reasons many are adopting a more long-term sustainable life-cycle perspective, increasing the interest in estimating long-term economic consequences of investment decisions, for example by using tools such as Life Cycle Costing (LCC). In addition there is an increased pressure from and need to cooperate and collaborate with a broader numbers of stakeholders than previously when this mostly could be traceable to the traditional client-contractor relationship, now including also financial stakeholders (Gluch et al. 2014).

This increased interest in LCC among practitioners and researchers can be related to the single monetary unit of LCC as a possible means to translate environmental complexities into a more familiar unit of measure for a broader audience (Gluch and Baumann 2004; Gluch et al. 2013). Interest in LCC can also be related to the ever-expanding quest of finding more sustainable alternatives to meet the significant increasing need to renovate an aging building stock (Olubodun et al. 2010; Filipsson et al. 2013; Korpi and Ala-Risku 2008; Ludvig et al. 2010). These trends have led to a revival of LCC and a large increase in publications on the topic over the decade (Goh and Sun 2015). However, a majority of research on LCC concerns tool modeling and development and surprisingly few studies pay interest into how practitioners perceive the usefulness of the tools developed. Thus, it seems the actual use of tools is taken for granted due to the actual development of models and tools.

The aim of the present paper is therefore to increase understanding of why decision makers' use LCC in construction client companies/organizations for decisions involving sustainability and energy efficiency issues. This paper is based on a questionnaire. In the questionnaire scale items measuring central concepts of the technology acceptance model (TAM) model was used. This paper highlights what explains the extent to which LCC is used. Such knowledge can be used in order to create conditions for an extended use.

THE TECHNOLOGY ACCEPTANCE MODEL (TAM)

The Technology Acceptance Model (TAM) (Davis 1989) has previously been used to explain the acceptance and use of various types of technical systems and applications. The model is an adaption of the theory of reasoned action (TRA) proposed by Ajzen and Fishbein (1980), which seek to explain and predict behaviors of people in specific situations. The model has been widely tested and used in various types of contexts, such as office tools, software tools and business application tools, and for various types of technological systems and applications, such as electronic mail, world wide web, voice mail, and production control tools (Legris et al. 2003).

TAM suggests that when users are presented with for them a new technology and/or application, a number of factors influence their decision about whether they will use it. The model assumes that a number of factors determine whether and when individuals will use a particular application. Two main components of the model are (1) Perceived usefulness - to what extent the use of a given system is perceived to improve how work is performed, and (2) Perceived ease of use - to what extent the use of a given system is perceived as easy and effort free to use. The extent to which these two factors are perceived in turn depends on external impact variables concerning the extent to which there are requirements or preferences that the new application will be used and the extent to which colleagues and others in the industry use the technology/application. Perceived usefulness and perceived ease of use are factors which in turn is assumed to influence the attitude towards usage. However, just an attitude is not sufficient to predict behavior (Ajzen and Fishbein 1980), i.e. use, it also requires an intention to use the specific technology. The degree of positive attitude towards using the technology is assumed to influence the extent to which an intention is created. In a final step this assumed intention affects the degree of actual use of a technology.

METHOD

To obtain as broad a representation of LCC use and experience as possible, a questionnaire was sent to individuals working in 99 different Swedish companies/organisations that own and/or manage properties on a long-term basis (state, municipal, and private). The individuals were chosen based on their likely involvement in decisions about building renovation and thus assumed to be in position to influence their company's long-term environmental and economic sustainability. These were specialized energy strategists, CEOs, division managers, property/facility managers, technical development managers, construction project managers, or sustainability and environmental managers, depending on their organizational structure. Data was collected in September-November 2013. The questionnaire and two reminders were sent by e-mail using the SurveyMonkey^{TM} online software. Responses were obtained from 70 respondents of a sample of 217 individuals, for a 32.3% response rate.

In order to test the TAM model the questionnaire was designed so that indicators of the TAM factors were included. Then index variables (mean values of these indicators) were created. To test to what extent the TAM model can predict the use of LCC, a number of regression analyzes of survey data was conducted. The analysis was conducted in SPSS software for statistical analysis.

RESULTS

Use of LCC in renovation projects. With its 40 year-old history it can be discussed whether LCC should be seen as a new tool for the industry or not. However, although LCC has been around for many years the increased emphasis on sustainability has led to a revival of the tool in a new context and 72% of our respondents indicate that LCC has been used or discussed within the organization only within the past 5 years.

When it comes to the number of renovation projects where LCC calculations were used as part of the decision-making basis, respondents answered across the entire scale (Table 1). 38% answered that LCC calculations are done in less than 25% of the projects. Twenty-four percent report more than 25% but less than 50%. 33% indicate that in more than 50% of projects, they have used LCC. To this question, 5% of respondents' state they do not calculate LCC in any construction project at all.

Table 1.Estimated Share of Renovation Projects Were LCC Has Been Used to Support Decisions.

Percentage of Projects	Answer %
0	5
1-25	38
26-50	24
51-75	17
76-99	12
100	4

Environmental influences - external impact variables. Individuals use different types of tools often due to an external demand. The extent of requirements or preferences for using LCC and the extent to which colleagues and others in the industry uses the LCC was investigated. As Table 2 shows, there is no external impact variable that stands out as extraordinary in terms of driving the use of LCC in a renovation context. The results however indicate that it is partly driven by external requirements and that the organization and/or management advocate the use of LCC.

There also seems to be a driving effect that other colleagues and others in the industry use LCC. There are individual variations within the results but in terms of mean value the influence from external impact variables are moderate.

Table 2.External Impact Variables that Influence Why LCC Is Used or Not. The Scale Runs from 1 (Strongly Disagree) to 6 (Strongly Agree).

Statements	Mean
The organization advocates the use of LCC	3,9
My colleagues believe that LCC is a good tool	3,8
Many within the industry use LCC	3,6
It is a requirement to use LCC	3,5
My managers think I should use LCC	3,4
Many others within the company use LCC	3,0
People that use LCC have higher status	2,1

Perceived usefulness. The respondents were asked to indicate how they feel about different statements related to the usefulness of conducting an LCC in their daily work. From the results presented in Table 3 we can see that it is perceived to be quite good conditions for the use of LCC. Lack of resources in terms of finance, time and knowledge, often highlighted as obstacles for a wider use of technology, seem not be perceived as a major problem. The actual terminology and apparatus of LCC is at least partly considered as consistent and familiar for many of the respondents. The respondents also indicate that the idea of LCC lies at least partly in line with how they normally work. LCC is also considered to be sufficiently flexible and adaptable. In addition, LCC is also perceived to make it easier to identify key information needed when making decisions on renovation of buildings and properties. The one thing that seems to be problematic in relation to LCC's usefulness is lack of clear guidelines and expertise to consult on LCC.

Table 3.Perceived Usefulness of LCC. (The Scale Ranges from 1 (Strongly Disagree) to 6 (Strongly Agree)).

Statements	Mean
Lack of cooperation between involved parties makes LCC difficult	2,6
It is too expensive to do an LCC	2,1
It takes too much time to do an LCC	2,3
I make mistakes doing an LCC	2,2
Conducting an LCC creates frustration	2,0
Use of LCC counteract with how I normally work	2,1
I have got profound guidance on how to do an LCC	3,1
There are guidelines available on how to do an LCC	2,7
We have an LCC expert I can get advice from	2,6
In respect of resources, knowledge and possibilities it is easy for me to do an LCC	3,6
I have enough knowledge to do an LCC	3,5
I have necessary resources to do an LCC calculation	3,5
I can adjust LCC so it serves the purpose I am interested in	3,4

Table 3.(Continued).

Statements	Mean
There are several different ways to conduct an LCC (flexibility)	4,2
LCC makes it easier to identify key information	3,8
I do not have to adjust my way of working to do an LCC	3,6
The terminology in LCC is consistent	3,9
The terminology in LCC is familiar to me	4,1

Ease of use. How easy it is perceived to use a certain type of tool often influences whether it is used or not. Table 4 indicates that LCC seems to be neither difficult nor easy to use. The responses align fairly well with the responses stated regarding the conditions users have to use LCC in their daily work, i.e. perceived usefulness.

Table 4.How Easy It Is to Use LCC. (The Scale Ranges from 1 (Strongly Disagree) to 6 (Strongly Agree)).

Statements	Mean
LCC differs from other investment calculus tools I have used	2,8
LCC does not look like other tools I have worked with	2,6
Using LCC is a new experience for me	2,8
It is easy to use LCC in a way I need it for	3,7
To become a skilled LCC user is easy	3,1
To learn how to use LCC is easy	3,5

Attitudes towards LCC. The results show that there seems to be a generally positive attitude about LCC (Table 5). The respondents especially agree regarding the statement that they like the actual idea of LCC and that LCC is representing something good.

Table 5.Attitudes Regarding LCC and Results of LCC Calculations. (The Scale Ranges from 1 (Strongly Disagree) to 6 (Strongly Agree)).

Statements	Mean
LCC is good in some projects but not the ones I work with	2,3
Input data for LCC calculations are unreliable	2,9
Input data for LCC calculations are missing	2,8
LCC is unusable	1,6
I like the idea of LCC	4,5
LCC is good	4,6
Calculating LCC gives me increased control	4,2
LCC is a suitable tool for doing my job	4,2
LCC contributes with relevant information	4,2
LCC provides information when I need it	4,0
LCC gives thorough information	4,0
LCC gives accurate information	3,9

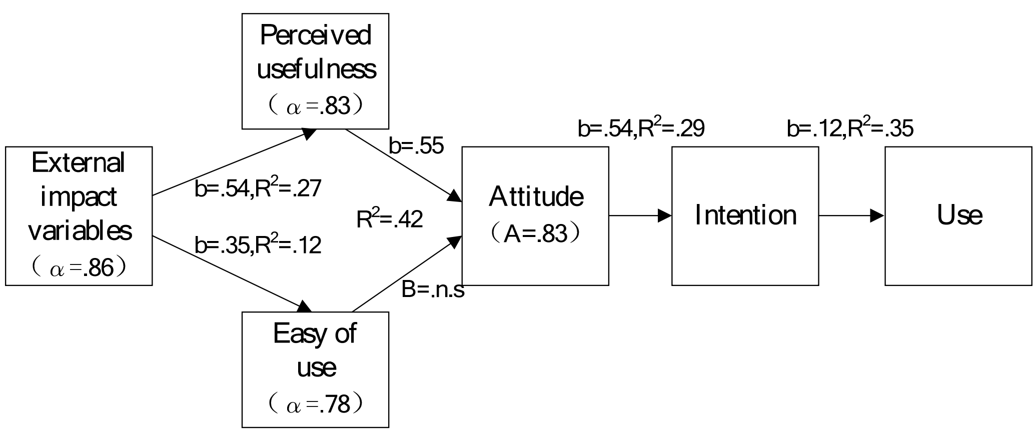
Intentions to use LCC. The results indicate that there seem to be fairly good conditions for a more widely spread use of LCC in renovation projects, both regarding the users qualifications and the LCC tool in itself. However, according to theory it is not enough with positive attitudes towards a tool there must also be clear intentions to use the tool as well. Table 6 presents results on the intention to use LCC in actual renovation projects. Here we can see a rather varying view. Twenty-seven percent of the respondents fully or highly agree regarding the claim that they will use LCC regularly in their work. Twenty-three percent state that they will not at all or scarcely use LCC in their daily work.

Table 6. Respondents' Intention to Use LCC in Their Daily Work.

I intend to use LCC in renovation projects	Answer %
Agree completely	11
Agree to an high extent	16
Agree to some extent	24
Disagree to some extent	25
Disagree to an high extent	19
Disagree completely	5

ANALYSIS

Regression analysis was used to investigate the relationship between external impact variables, usefulness, ease of use, attitudes towards LCC and the intention to use LCC. In Figure 1 the results from the regression analysis are presented. External impact variables are found to explain 27 % of the variation in perceived usefulness and 12 % of the variation in perceived ease of use.



α (Cronbach's alpha) is a measure of internal consistency among items compromising a factor. Values over .78 are considered acceptable.
R^2 (regression coefficient) is a measure of how much the variation an independent variable explains in a dependent variable.
b (beta coefficient) indicates whether an variable has a positive or negative effect on the dependent variable and the extent of this impact.

Figure 1.TAM to predict the use of LCC.

Looking at mean values, external impact variables in general are moderately influential regarding whether LCC is used or not, but in terms of the relationship between external impact variables and perceived usefulness and ease of use the analysis indicates that a higher degree of external impact the more useful and user-friendly is LCC considered to be. It can therefore be concluded that external influences have effect.

It has already been noted that there is a generally positive attitude to the use of LCC in the renovation of properties and buildings (see Table 5). In accordance with the TAM model, the relation between usability, ease of use and attitude to LCC was examined. Here it can be concluded that only perceived usefulness explains any variation in attitude towards LCC use. Thus, it seems that perceived ease of use does not affect the attitude towards usage of LCC. Attitudes towards LCC were found to explain 29% of the variation in the intention to use LCC, which in turn explain 35% of the variation in the use of the LCC. The results thus confirm the model's assumption that the higher intentions of use, the higher the degree of use.

CONCLUSIONS

The results show that TAM can be used to describe and understand factors that influence the use of LCC in renovation of buildings. From this study the following conclusions are drawn:

- Increased external impact have an effect on perceived usefulness and ease of use
- If LCC should be used for renovation of buildings it is important that the perceived usefulness of LCC is high
- The corporate climate in terms of the extent to which LCC is advocated and used by others affects how individuals experience both usefulness and ease of use.
- Perceived usefulness is a prerequisite for creating an intention to use LCC and subsequently applying LCC in the renovation of buildings.
- An experience of good conditions for conducting an LCC in form of others using LCC and available resources in terms of time, money and contribute to a positive attitude towards LCC
- Ease of use has less effect on the attitude towards the LCC and play little importance in whether LCC is used or not
- To increase the use of LCC in the renovation of buildings companies should create a culture that advocates the use of LCC - both within the organization but also through joint industry initiatives.

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Receipts in Advance and the Earned Surplus Reserves and Earnings Management of Real Estate Enterprises

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Abstract

The first part of this paper introduces the background behind advance sale system of houses in the real estate industry. Next, we discuss the information contents of receipts in advance from surplus reserves and earnings management. Among them, we adopt the receipts in advance and earnings management empirical model to analyze whether receipts in advance could be a means of earnings management. Our study found that receipts in advance can provide related information for stakeholders to predict performance. However, this kind of information probably is the results of earnings management. At last, we present recommendations in the system of advance sale and the analyzing of information as well as establishing the information system, etc.

INTRODUCTION

Since the implementing of advance sale system of houses in 1995 China, the proportion of receipt in advance shows a clear increasing tendency whether compared with the revenue that year or its total assets and total liabilities. Also it is much larger than other listed companies belong to the non-real estate industry. How does the receipt in advance with a sharp contrast to the non-real estate industry form? Dose it contain any information foreshadowing performances or making investing decisions? We try to answer these questions in both qualitative and quantitative approaches.

Later part of this arrangement is as follows: The second part reviews the relevant literature; third part of our advance sale system background and objective results; Part IV discusses the information content of prepaid accounts from surplus reserves and earnings management perspective; fifth part of the thesis conclusions and policy recommendations.

Later part of this paper is arranged as follows: Part two introduces the background and objective results of advance sale system of houses; Part three discusses the information content of prepaid accounts from the perspective of surplus reserves and earnings management; Part four gives conclusions and recommendations.

THE ADVANCE SALE SYSTEM OF HOUSES

The causes of advance sale of houses. From the perspective of economic, the advance sale of houses generates from the particularity of real estate which belongs to the special goods with high value. The real estate is a typical capital-intensive industry. The entire production process is so costly while the advance sale of houses provides an important financing channel. Not only does it can help enterprises get a considerable part of the construction funds in the construction process in order to accelerate capital returns and reduce the pressure on lending, but also greatly promotes the sale of real estate to help transfer the real estate business risk. As can be seen from the advance sale of houses, the commercial house in China is a “seller” market, with a housing shortage and soaring prices. It may form the difference between the sale price of houses and the price when it was officially completed for buyers, so the difference of prices also contributed to the active participation of buyers in the advance sale of houses.

From the institutional point of view, the real estate industry of a country plays an important role in the economic and social development. In the early stages of development of real estate market in China, the government designed the advance sale system of houses to provide a legal protection for pre-sale in order to reduce the threshold for developers so it can promote the rapid development of real estate industry.

The background of advance sale system of houses. The advance sale system of houses was produced by a Hong Kong company named Ericsson real estate in the year of 1954. According to the “Real Estate Administration Law of Urban”, the Ministry of Construction published “The Approach of Advance Sale of Urban Houses”. It regulated clearly in the scope of application for advance sale as well as the conditions when the advance sale can be used and the punishment. It is revising twice in 2001 and 2004.

The second rule of Order No. 131 published by Ministry of Construction says that: “The advance sale of houses refers to the real estate development enterprises sell the houses to bidders when the houses are under built. At the same time, the bidder pays for the deposit or housing price.” The fifth rule ruled the conditions when the advance sale can be used: “(1) the using right transfer fee of land has been delivered fully as well as obtaining using right certification of the land; (2) holding a construction planning permitting certification and construction permitting certification; (3) the total amount of fund which have already invested into the development and construction should more than 25% of the total construction investment by houses providing for sale. At the same time, the construction schedule and completion date of delivery must be identified.” The sixth rule says that without a permitting certification the company should not apply advance sale of houses.

RECEIPTS IN ADVANCE, SURPLUS RESERVES AND EARNINGS MANAGEMENT

Receipts in advance and surplus reserves. Receipts in advance happen before the transaction occurs in essence, so it is a kind of commercial credit offered by downstream business for upstream business. The actual transactions happen when the goods are issued, so the receipts in advance convert into sales revenue. That is why receipts in advance can be seen as the company's future earnings. Meanwhile, in order to protect the interests of both sides and the realization of the advance sale, "The Approach of Advance Sale of Urban Houses" rules that: "The real estate development enterprise shall sign a contract with the successful bidder in an advance sale. From the date of signing the real estate development enterprise should put it on record to the real estate management department and the land administration department of the government in 30 days." The aim of putting on record system is to strengthen the responsibilities of both parties and reduce uncertainty of advance sale of houses (Wu 2011). The essence of real estate sale is irrevocable, therefore its receipts in advance is the revenue to be achieved for the real estate business. Also it implies that surplus reserves converting into profits is only a matter of time and a question of operational efficiency (Liu and Liu 2012). According to the theory of mean reversion accounting earnings (Nissin and Penman 2001) and the establishment and release of the surplus reserves (Christensen et al. 2008; Abarbanell and Lehavy 2003), we believe that the receipts in advance as surplus reserves for real estate business has a positive effect in predicting benefits. That is to say the more surplus reserves, the higher book profit later.

Real estate companies largely transfer the main risks of selling by advance sale of houses and it is the most important part of the real estate business. So the advance sale of houses is of great significance to real estate companies. Compared to the "operating income" and "operating profit", the enterprise concerned more about the sales income provided by sales department and potential sales profit provided by budget management sector, that is to say regarding receipts in advance as the replacement of revenue and cost. Therefore, advance sale will be used as inside information to make any major decisions in invest or financing for enterprises. The advance sale of houses can not only provide important information for their own development for real estate sale of real estate, but also essential for banks and other creditors. Liu et al. (2013) proposed an index to measure surplus reserves caused by receipts in advance. They studied the relationship between receipts in advance, debt covenants and the risk of default through Logistic Regression and concluded that the formation of surplus reserves due to receipts in advance from customers increased debt covenants effective and reduce the risk of default. When creditors make decisions in whether to lend, they will judge the enterprises' repayment capacity according to the surplus reserve caused by receipts in advance. Receipts in advance play an important role for the majority of investors, especially those institutional investors with information superiority and professional strength when they make investment decisions. With the development of the securities market, the way of earning profits for investors have converted from gradually speculation, insider trading, manipulation and other abusive behavior into a legal and reasonable investment through the analysis of corporate fundamentals and earnings forecast .etc. rational decision-making. In this process, the formation of the receipts in advance of advance sale will provide additional information for investors.

Receipts in advance and earnings management. Since the emergence of the advance sale system of houses, it has been an important channel for the real estate enterprises to obtain development funds as well as capital turnover. Despite the record system reduces the uncertainty, there still exists room for earnings management. First of all, most of the projects of real estate business are developed in stage and the associated expenses, such as the manufacturing costs, administrative expenses and financial expenses are deducted in the current period, while the sales and profits do not achieved until the project completed settle down. Secondly, despite the "Real Estate Administration Law of Urban" regulates that receipts in advance sale cannot be used in other ways, but there is no corresponding supervisory measures. In practice, real estate companies may misappropriate receipts between each other and even to other sectors. At the same time most of the companies always hope to reduce tax costs through tax avoidance or smoothing their income to meet their own needs, the real estate business is no exception. Real estate companies need to pay taxes includes corporate income tax, urban land use tax, land tax, deed tax, and business tax and so on. The tax burden is so heavy that real estate companies may be tempted to delay the time of converting receipts in advance into sales income and take advantage of developing several real estates at the same time to accumulate a large amount of costs and related expenses in order to reduce the carrying amount of the profits. As a result of this arrangement, it helps the company to reduce the tax. However, it may also used to IPO; listing of additional shares and obtain an eligibility increase profits. At this time, receipts in advances have become the buffer of profits of companies to deal with requirements of investors and regulators hope.

The research studies the 85 A share listed real estate companies from 2011 to 2013 consulting the receipts in advance and earnings management empirical model raising by Zhang and Liu (2007).

$$\frac{\Delta CIA_{it}}{A_{it}} = \alpha + \beta_1 \frac{S_{it} - \Delta AR_{it}}{A_{it}} + \beta_2 \frac{CFO_{it}}{A_{it}} + \varepsilon_{it}$$

Among them, ΔCIA_{it} is the variation value of receipts in advance, $S_{it} - \Delta AR_{it}$ is the variation value of the result of operating income subtracting receivables, CFO_{it} is the operating cash flow, A_{it} is the total assets. According to the principle of accounting, we could know that $\beta_1 < 0$, $\beta_2 > 0$. ε_{it} is the receipts in advance manipulated by the company.

The empirical result of the model is shown in Table 1.

Table 1.The Empirical Result of the Model.

	B	Std. Error	Beta	t	sig
(Constant)	0.088	0.008		11.120	0.000
(S-ΔAR)/A	-0.294	0.028	-0.551	-10.396	0.000
CFO/A	0.001	0.006	0.010	0.188	0.851
Dependent Variable: ΔCISA		Adj-R^2=0.299		F=54.446	Sig=0.000

We can see the estimating results of the receipts in advance model from Table 1. The coefficient of CFO is 0.001 which matches with the hypothesis that the variation value of receipts in advance has a positive correlation with operating cash flow, but not significant. The correlation coefficient of $S_{it} - \Delta AR$ is -0.294 and it is less than zero significantly. This also matches with the hypothesis that the variation value of receipts in advance has a negative correlation with operating income adjusted in the current period. The joint significant value of F is 54.446 which indicate that they have a notable linear relation. We can determine the estimating value of earnings management on this basis. Referring to Table 2 for detailed data.

Table 2.The Estimating Value of Earnings Management under the Model.

The estimating value of earnings management	The model
Minimum	-0.2349
Maximum	0.4288
Mean	-0.0002
Std. Deviation	0.0818

We can judge from Table 2 that the mean value of the estimating value of earnings management is less than zero slightly. This result reveals that the company will carry over the receipts in advance to increase the operating income and the profit for the current period. Moreover, we can use the quarterly data to make cross-sectional model estimation. The consideration in earnings manipulation will be different in the first three quarters and the fourth quarter (Das et al. 2009). Theoretically the goodness of fit of quarterly cross-sectional model in testing earnings manipulation is better compared with the annually cross-sectional model.

Integration analysis. Through the analysis above, it can be clearly seen that receipts in advances not only can provide information for businesses, creditors and investors, but also become the "fertile soil" as surplus reserves for management. For the company itself whether publishing information is true or whitewash, it will not affect their understanding of the company. But for creditors and investors, the nature of the receipts in advances determines the correctness of its decision-making behavior to a large extent. When taking the receipts in advances of the real estate business into analysis, it is important to lag the sales income for one or two accounting period and taking receipts in advances and inventory into account.

CONCLUSIONS AND RECOMMENDATIONS

The existing literature has already made many contributions to earnings management, the field of financial condition of real estate companies. However, they did not focus on the nature of receipts in advances which formed in the advance sale in houses of the real estate business. We believe that based on the advance sale system of houses, accounting treatment and earnings mean reversion theory, the receipts in advances has a nature of surplus reserve and it will translate into sales income in the future. But on the other hand, because of the special nature of real estate sales process and accounting, receipts in advances is likely to become a means of management earnings for management layer. Apart from the above conclusion, this paper contains recommendations as below:

(1) Even through performance indicates and earnings manipulation seemingly contradictory, but both of them present in advance receivable. Therefore, when using receipts in advances, it cannot be analyzed separately and should be combined with inventory, sales as well as comparative analysis across time and examine the cycle and ratios for receipts in advances converted to sales.

(2) Improve the advance sale system of houses. Scholars express their own views on the abolition of the advance sale system and there exists no consensus. But for now, the possibility of eliminating the advance sale system of houses in short-term is not very, so what we need to do is how to improve the sale system of houses. The main risk is converted to the buyers in this system while the buyers are not in the place to protect their rights and interests. At the same time, there is lack of effective supervision of the regulatory process and earmarking funds for advance sale.

(3) The disclosure of advance sale. The advance sale system of real estate companies is significant to them and it is also vital to other interest-related parties. Therefore, the information should be disclosed in the disclosure requirements.

(4) Establish and improve the information systems to reduce information asymmetry between the two sides. For example, companies should provide information about land development, the complete schedule and the ownership as well as other relevant information to reduce transaction risk and avoid transaction trap.

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Research on the Ex-Post Evaluation of a Social Affordable Housing Project: A Case Study of Xiamen

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Abstract

The existing ex-post evaluation system of investment projects is not completely suitable for social affordable housing projects. This paper proposes the specific ex-post evaluation mechanism for social affordable housing projects based on the investigation into the projects in Xiamen. Questionnaire was used in selecting the degree of concern towards all elements of every related part of the projects. The statistical data from questionnaire were analyzed by the software SPSS and then the index system can be obtained. The concrete evaluation methods changes along with the changes in evaluation contents. Before and After Comparison has been used in the impact assessment, Logical Frame Approach in the goal assessment, Delphi in the determining of the weight, and the overall evaluation result of projects can be determined through Success Degree Method. In the last section, there is an empirical study design based on Binshui block in Jimei, Xiamen to verify the evaluation mechanism is operable. The ex-post evaluation of social affordable housing projects should focus on especially the social impact of the projects, and pay attention to the public satisfaction. As the social affordable housing are mainly organized and operated by the government, the evaluation on project management should be an important part, policy and apply-distribute-processor in particular.

INTRODUCTION

With our country launching the social affordable housing project, it has benefited many people with low income. Xiamen city takes the lead in carrying out the social affordable housing projects. Since the first social affordable housing-Wanjing apartment was started to construct in 2006, it has completed more than 20 affordable housing communities, providing many public, civil servants and introducing talents who had difficulty in housing with high-quality environment. Up to now, the first batch of social affordable housing projects in Xiamen City, have been completed for 5 years. They are facing with ex-post evaluation. The owners have already started the ex-post evaluation. However, from the practical view of it, the evaluation can't play its due role. Because content system is not perfect and the evaluation work is not in place. Therefore, establishing a set of specific ex-post evaluation content and index system aiming at social affordable housing projects is an urgent need.

DEVELOPMENT OF DOMESTIC RESEARCH ON EX-POST EVALUATION OF SOCIAL AFFORDABLE HOUSING PROJECT

Housing security system in China started late, but different provinces and cities under its own characteristics set up various rules and regulations, forming different security system to meet the housing needs of low-income groups. For example, the housing security system in Xiamen was named as the "Xiamen mode" for the unique characteristics. For these years, all sectors of the community have given various comments on affordable housing projects that were built and put into use, including the Xiamen city housing security system, and public feedback mixed. But so far there is no objective, impartial and scientific ex-post evaluation report aiming at a certain social affordable housing projects to help summarize the experience and lessons of the project and assist implementing the later project decision.

Ex-post valuation of the project has been carried out more than 20 years in our country and achieved good results in the field of urban infrastructure construction and other projects. But there is no specific ex-post evaluation of social affordable housing project. China existing "guide of ex-post evaluation of Central business investment in fixed assets project" regulates general investment projects' ex-post evaluation work. Ex-post evaluation system aiming at social affordable housing project is yet to come. The closest is the research on ex-post evaluation aiming at affordable rental housing conducted by Chongqing University scholars. But it only gives a rough contents and index evaluation system. As for the working methods and the specific implementation of ex-post evaluation of project, it does not give a clear conclusion (Hu 2011).

RESEARCH IDEAS AND METHOD

The research ideas of this paper is along with content framework system, constructing index system, selecting evaluation methods and implementing design. Research ideas and methods are summarized in the following Figure 1.

CONSTRUCTING EX-POST EVALUATION SYSTEM OF SOCIAL AFFORDABLE HOUSING PROJECT

"Guide of ex-post evaluation of investment project" divides the evaluation into technical ex-post evaluation, benefit ex-post evaluation, impact ex-post assessment, goal ex-post evaluation and sustainability evaluation. For social affordable housing, evaluation content that obviously doesn't comply with the evaluation of social affordable housing projects should be deleted. At the same time, all duplicate evaluation content should merge and particular content of social affordable housing should be added into ex-post evaluation system, finally forming evaluation index system which is suit for ex-post evaluation of social affordable housing project.

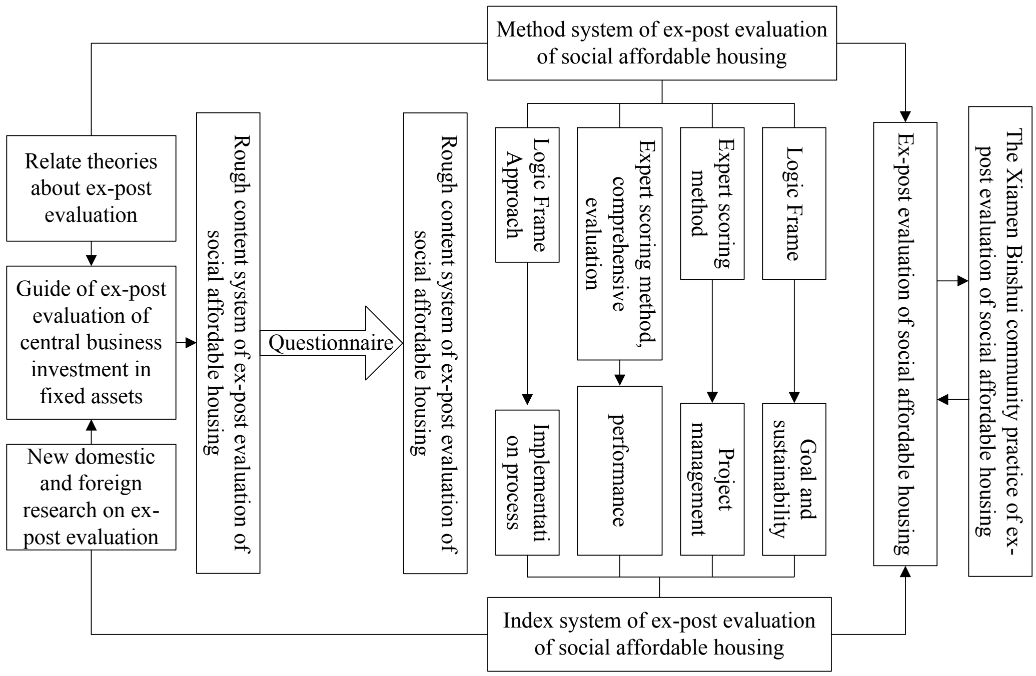

Figure 1.Theory and method system of ex-post evaluation of social affordable housing.

Content not in conformity with social affordable housing project or irrelevant. In the existing project evaluation system, basically the following four items are not in conformity with social affordable housing project or irrelevant content:

(1) In the part of residents' living conditions and quality of the social impact on project, including the impact on population and family planning. Social affordable housing projects in general will not impact on population and family planning work, they can be removed.

(2) In the part of culture education and national religion of the social impact on project, including effects on equality and the social status of women. Social affordable housing projects generally do not have an impact on equality and social status of women, they can be excluded.

(3) In the part of culture education and national religion of the social impact on project, including the impact on minority and national unity. Unless the social affordable housing in different ethnic community of evaluation shares resources, they can be excluded.

(4) In the part of culture education and national religion of the social impact on project about the content of customs and religious beliefs. In the city of Xiamen, tenants who have been living in Xiamen for a long time as the main population group of social affordable housing generally do not have similar beliefs, religions and customs, so they can be excluded.

Content should be added. According characteristics of social affordable housing and the absence of current project evaluation system, add the following two important contents:

(1) Social affordable housing projects belong to residential projects. Their direct goal is to provide residents with a complete and comfortable living conditions and environment. Therefore the degree of households' satisfaction must be added to evaluation system, classified as the evaluation of the degree of coordination of project sustainability assessment (Tian and Cui 2009).

(2) Social affordable housing projects have strict regulations and norms, and the application and allocation process must follow the "fair, justice and open" principle. Therefore the evaluation of project management regulations and procedures must be added into the evaluation system, classified as ex-post evaluation of project management.

Content should be adjusted. In the existing project evaluation system, contents that should be adjusted mainly consist of the following four contents: First, the ex-post evaluation of project implementation process contains the scope of the beneficiaries and the evaluated content of their responses. For social affordable housing project, all the households can be the biggest beneficiary and the range of beneficiaries is very clear; the reactions of beneficiaries to the project should be incorporated into households' satisfaction of project coordination content. Secondly, the ex-post evaluation of environmental impact on project contains the pollution control and protection and use of project natural resource. For social affordable housing project, these two mainly involve the problem of environmental pollutants or ecological protection. Therefore they should be incorporated into the site management section. Thirdly, the two parts of ex-post evaluation, namely development of region and community, contain the degree of public participation and community welfare. For social affordable housing programs, community survival welfare can be grouped into the project impact on the economy and society including contents of community cultural activities (Gao 2008). The content of public participation can be group into households' satisfaction. Finally, the ex-post evaluation of culture education and ethnic religion including project impact assessment of culture and education should be grouped into the section of improving quality of life.

Investigation process of ex-post evaluation content. (1) Design idea and structure of questionnaire. There are three main goals of the questionnaire. The first hopes to obtain the degree of interest in housing-related factors of affordable housing tenants. The second is to get the degree of influence made by built affordable housing on its area. The third is to obtain the degree of importance of all relevant factors of the construction process from the relevant staff. All scores are divided into five grades 5, 4, 3, 2, 1, which are very important (greatest impact), quite important (very big impact), important (large impact), modest important (modest impact), little important (little impact).

(2) Implementation and analysis of the questionnaire. There are three ways of survey to ensure the quality of the questionnaire.

(i) Network questionnaire. Network questionnaire was finished on "questionnaire star" network platform by electronic questionnaire. Questionnaire links were post on relevant forums, such as "Xiamen City" etc.) to the owners. 93

questionnaires were withdrawn by the network platform.

(ii) Electronic questionnaire. Electronic questionnaire aiming at faculty and other related staff of Xiamen University and personnel of Xiamen relevant construction unit among owners of Xiamen City Wanjing apartment and Gaolin residential area, in the form of mail ,were send to people to fill out. There were 18 electronic questionnaires taken back.

(iii) Paper questionnaire. To ensure the quantity and quality of the questionnaire, the survey had also adopted the way of issuing the paper version of questionnaire. We visited some social affordable housing community in Xiamen such as Wuyuan apartment, Gao Lin residential area, Wanjing apartment and communicated with residents. There were 10 paper questionnaires taken back.

Investigating and determining the ex-post evaluation system of social affordable housing project. Test for Independence was used for the survey, using the Chi-square test function of SPSS. All the two factors were independent. Secondly, by using the Cronbach's alpha internal consistency reliability test for questionnaire index, the overall reliability all about 0.941, and so design of the questionnaire was consistent with the requirement of reliability. Finally, it is concluded that the ex-post evaluation of social affordable housing is divided into four first level indicators, namely the implementation process, performance and impact, project management and ex-post evaluation objective and sustainability. Specific frame of index system was shown in Table 1.

SELECTION OF EVALUATION METHODS

There are several major methods of ex-post project evaluation, statistical forecast method, Logical Framework Approach (LFA), Before and After Comparison, With and Without comparison, comprehensive evaluation method and success degree evaluation method. Different methods have different qualitative and quantitative considerations and are applied in different situations.

The Ex-post evaluation of implementation process. Since the implementation process of project is one-off and cannot be copied, it is unable to form the implementation condition of Before and After Comparison and With and Without Comparison. Hence, re-post evaluation on various job contents of implementation process of project adopts the qualitative manner to evaluate whether it is successful or not. Since control work of construction period, funds, quality and safety production has expected target requirement of pre-evaluation report, Logical Framework Approach can be adopted to evaluate whether it is successful or not after making index contrastive analysis.

Ex-post evaluation of performance impact. Ex-post evaluation of Performance impact mainly includes technology, economy and impact evaluation. Here we choose the comprehensive evaluation method after being scored by experts for ex-post evaluation on the project's adopted technology (Zhou and Xu 2008). The impact on environment, economy and the society of project should be evaluated by Before and

Table 1.The Degree of Success Evaluation Matrix of Social Affordable Housing Project.

Index of evaluating project			weight index	Level of evaluation	Evaluation method
First level	Second level	Third level			
Implementation process	Project decision			B(5 points)	Logical framework approach
	Preparatory work	The quality of survey and design		A(7 points)	
		Bidding and contract management		B(5 points)	
	Implementation phase	Control of project schedule		C(3 points)	
		Control of project quality		A(7 points)	
		Control of project finance		A(7 points)	
		Construction organization and management		B(5 points)	
	Final acceptance of construction			A(7 points)	
Performance impact	Technology				Expert scoring method and comprehensive evaluation method
	Economic benefits	Finance			
		national economy			
	Influence	Environmental impact			Before and After Comparison,
		Economic impact			With and Without location Comparison
		Social impact		A(7 points)	and Comprehensive Evaluation Method
Objective and sustainability	Objective	The macro goal		B(5 points)	Logical framework approach
		The direct goal		AA(9 points)	
	Sustainability	Household satisfaction			Questionnaire
		sustainability		A(7 points)	Expert scoring method
Project management	Contract mode			A(7 points)	Expert scoring method and user interviews
	Management			B(5 points)	
	Operation procedure			A(7 points)	
Overall degree of success			B		Degree of success

After Comparison and With and Without comparison and ultimately formed comprehensive evaluation result. Before and After Comparison work mainly refers to basic information of regions before project construction and expected objective of various impacts on project pre-evaluation report. With and Without Comparison work has to select a project without security housing, but the rest factors lie in same sample regions with that of evaluated project and it also requires consistent calibres between input cost and input effect so as to guarantee that all impact effects contribute to the project itself (Zhang 1998).

Ex-post evaluation of objective and sustainability. Project objective has specific expectation and different actual situations, thus ex-post evaluation of objective adopts Logical Framework Method to analyse macro objective of project and implementation state of direct objective, to select analysis content based on pre-evaluation report and qualitatively evaluate implementation degree of stated objective of the project. Ex-post evaluation of sustainability involves tenants' satisfaction, so the use of questionnaires and expert scoring methods are combined.

Ex-post evaluation of project management. Result can be obtained through specialist judging and resident interview directing at re-post evaluation on project management, particularly relevant issues of regulations and operating procedure of security housing project. Hence, this part adopts the way of qualitative judging and corresponds to rating of success degree method. It mainly has four second-level indexes, which include project organization pattern, management, policy and regulation and information management.

The overall re-post evaluation of project. Overall re-post evaluation of social affordable housing project has to be carried out on the basis of evaluation of above-mentioned contents, which is conducive to getting quantitative evaluation result and horizontal comparison between project and project. Project total re-post evaluation adopts success degree method. The success degree of each part is confirmed by independent post evaluation work of each part, and the ultimate project success degree is confirmed by weight of each score. Complete success (AA, 9), basic success (A, 7), partial success (B, 5), no success (C, 3) and failure (D, 1).

A CASE STUDY ON BINSHUI RESIDENTIAL DISTRICT IN XIAMEN

Affordable housing project in Binshui residential district of Xiamen Jimei District was composed of affordable rental housing, affordable housing and security housing for sale, which located on the east coast of the Xinglin Bay, south of Jimei Avenue, west of connection on the highway. Project owner was residential construction office of Xiamen. The project used agent construction, whose construction-agent enterprise was Xiamen Housing Group Special Economic Zone construction company. Actual scale of total construction area was 375138.02m^2. The project total investment was about 957.2388 million Yuan. The adjustment of construction fund was dealt with by finance office. Due to incomplete information of project, in accordance with American EIA standard, assuming equal weight of each index, finally the degree of success was laid in the level of partial success. These results were accord with evaluation results of each part.

CONCLUSION

Through the analysis of the particularity of social affordable housing projects, the key point and the corresponding evaluation criteria of this kind of project can be obtained. First of all, impact evaluation is primary, social impact assessment in particular, and focuses on the degree of public participation and feedback information. Secondly, social affordable housing project is not for profit and the definition of its economic evaluation data should reflect the economic particularity of the project. Finally, the ex-post evaluation of social affordable housing project should also be concerned about the ex-post evaluation of management, especially the management regulations and ex-post evaluation of apply-distribute-processor. On the basis of theoretical study and comparing the existing ex-post evaluation system of investment project, a basic content system which is suitable for ex-post evaluation work of social affordable housing project can be constructed. Ex-post evaluation work of social affordable housing project should focus on the survey of household satisfaction and ex-post evaluation of project management in order to ensure that the construction of social affordable housing can achieve the desired effect and the housing security system can have a stable, healthy, and sustainable development.

ACKNOWLEDGMENTS

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Study on the Economic Effect of Affordable Housing on the Housing Commodity Market

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Abstract

Firstly, the mechanism that affordable housing affected demand, supply and price of housing commodity was analyzed by economic theory, then VER models were created and the effect that affordable housing affected housing demand, land supply and housing price was analyzed by the methods of impulse response function and variance decomposition. An empirical analysis was conducted using the data of Chongqing from 1995 to 2010 and concluded that affordable housing had the positive impact on housing demand, negative-positive impact on land supply, and negative impact on housing price. However from the point of contribution rate, the impact of affordable housing on housing demand, supply and price was little. Finally some suggestions were made that the government should improve construction scale of affordable housing and try to satisfy housing demand of low-income families, which would cause crowing-out effect of housing demand and price.

INTRODUCTION

In 1998 Chinese government has stopped to allocate real houses and start to allocate currency, and different families enjoy different housing supply policy and multi-level housing supply system mainly consisting of affordable housing comes into being. In several years later housing supply was too market-oriented and affordable housing supply was insufficient, which to a certain extent lead to the increasing contradiction of supply and demand in commercial housing market prominent and the high housing prices and so on, and real estate market could not develop healthily. In 2007 the government took more regards on affordable housing construction and further established and improved the urban low-rent housing system, and improved and standardized the affordable housing system, increased the shanty towns, the transformation of the old residential area (Feng 2011).

In 2010 Chinese government proposed to further promote affordable housing system and the affordable housing system and commercial housing system that met Chinese requirement gradually came into being. In March 2011 “Twelfth Five Plan” proposed focus on the development of public rental housing, which gradually became the main part of affordable housing, and built 36 million affordable houses in the next five years, and 10 million houses in 2011, 10 million units in 2012, 16 million affordable houses from 2013 to 2015, and to 20% coverage of cities and towns in the whole country (Wang2012).

As can be seen, the idea of construction of affordable housing in China has changed since 1998 and housing security system is mainly composed of public rental houses in the future. Chinese government tries to build housing supply system of both market supply and government supply, namely median-income and high-income people buy houses in the market and low-income people get houses provided by housing security system (Wu 2013; Li 2012). At present, Chinese government has established the system of low-rent housing, affordable housing, Capped-price housing, public rental housing and other affordable housing, and to some extent the system has played an active role to solve the housing problems of low-income families.

Affordable housing can satisfy the basic housing demand of low-income families and have an impact on housing commodity market. Research on the impact of construction of affordable housing on real estate market, Murray M and Malpezzi S consider the American public housing construction has alternative impact on the private housing development, so there is no increase in the total housing supply (Murray 1983; Malpezzi and Vandell 2002). Chul-In Lee considered that the investment of Korea's government in public rental housing had large crowding effect on private housing investment, and with the increase of available housing crowding-out impact was rising (Chul-In2007).

Among domestic research there are many quantitative research, Wang Xianzhu considered in practice difficulty of affordable housing come from the lack of inspiration of local government, so the short of affordable housing push more people into the commercial housing market and commodity housing price is rising. Based on practice of Hong Kong and the development and supply of Chinese affordable housing Tao Xueming considered it was hard for affordable housing to shock the commercial housing price and demand and supply in the next 3-5 years (Tao 2008). li Yong considerd that it was necessary to build the affordable housing shortly, but in the long run affordable housing should be cancelled and set up public rental housing and monetary housing allowance policy, and so low income families could solve the problems of housing (Li and Li 2005). Chen Jie built up a simple theory and analyzed the effect mechanism of affordable housing on commercial housing price, if affordable housing had restrain effect on the commercial housing price there were two conditions, firstly supply of affordable housing has not over occupied the supply of commercial housing, secondly demand of high-income groups for commodity housing will decrease (Chen and Wang 2011; Zhao et al. 2013).

Among the quantitative study, Wang Xian Zhu built a simple model of supply and demand of the housing market and analyzed the effect of construction of affordable housing on China's housing market, and the result shows that commercial housing prices will fall because affordable housing with lower price reduces the housing demand (Tao 2008).

To sum up there is not much domestic commodity market research about affordable housing, and most of the research is qualitative research, and quantitative research is about the use of a simple model to analyze the impact of the construction of affordable housing on housing price, and there is short of empirical study about the effect of affordable housing on commodity housing supply, demand and price. So

()the economic effects of affordable housing on the commodity housing by supply and demand theory was analyzed, and then by Chongqing actual data three VER models of affordable housing demand, land supply and housing prices were built up, and by impulse response and variance decomposition analysis we got a specific impact of affordable housing construction of Chongqing from 1995 to 2010 on the commodity housing market, and finally some suggestions were made.

ECONOMIC EFFECT OF AFFORDABLE HOUSING ON HOUSING COMMODITY MARKET

Definition of security housing and affordable housing. Security housing is a kind of social security housing that government provide to low-income families and has limited supply targets, construction standards, sales price or rental standards. The concept of affordable housing is a constantly changing over time and include affordable housing that are sold to specific buyers according to below-market prices, limited price housing, urban low-rent housing and public rental housing for low-income families and slum upgrading housing (Wu 2011).

Affordable housing is constructed by real estate development enterprises or financial housing units that government organizes and sold to low-income families in urban at small profit, and affordable housing is of economy and fitness (Lin 2013). Between 1998 and 2009 China's security housing are mainly composed of affordable housing; from 2010 China began to increase the scale of construction of public rental housing and public rental housing will be main part in security housing in the future. China's current housing supply system include market supply and security supply, and middle and high income families housing can be satisfied by the commodity housing market, low-income families are mainly provided by affordable housing and, of course, affordable housing and real estate market can't be completely separated, affordable housing and limited prices housing are commodity housing with security function. Therefore in this paper commodity house mainly refers to other housing except for affordable housing and limited price housing.

Economic effect analysis of affordable housing. According to Western economics theory of supply and demand, the role and impact of affordable housing on the commodity housing market is mainly reflected in housing commodity demand, supply and prices (Liang 1995), and the equilibrium price of commodity housing is formed under the action of housing demand and housing supply, and housing supply refers to housing stock providing to consumers including total supply and supply structure; housing demand refers to the ability of consumers paying housing commodity.

The basic assumptions of the economic effects analysis of affordable housing on housing commodity are as follows:

(1) The demand of commodity housing is the ability to pay demand, that is effective demand, including demand of middle-income families and above, and low-income families do not form a realistic commodity housing demand;

(2) There are two ways to satisfy the housing demand of middle-income

families: one way is by affordable housing provided by the government, second way is through housing commodity market.

(3) Housing commodity supply mainly refers to the total amount, regardless of changes in the supply structure, from the perspective of the total land; construction of affordable housing will reduce land supply of housing commodity and will reduce housing commodity supply.

(4) Other housing policy remains unchanged. Effect of affordable housing on commodity housing market actually very complex, including extrusion of affordable housing construction to the commodity housing actual demand, the effect of actual supply and psychological expectations, etc. However effect of the commodity housing prices is the most concerned. According to Western economic theory, the price is the result of the balance of supply and demand; in essence, a lot of factors affecting supply and demand relationships affect prices. For example the psychological expectations of supply and demand determine the conduct of both parties to some extent, and also affect price by supply and demand.

For middle-income families are covered in the housing security, middle-income families have a certain income and can form effective demand of commodity housing, therefore affordable housing will replace part of commodity housing and reduce the demand of housing; on the other hand, considering consumer expectations, if consumers expect housing prices fall due to the large number of building affordable housing, and they will stop buying houses in real estate market, so the current commodity housing demand will be further reduced. In terms of housing supply, in the short term due to the longer period of housing construction, housing supply will remain basically unchanged. In this case in the housing market housing supply curve is unchanged ,and lower housing demand make the demand curve move left, and new balance result in lower housing demand (Q') and lower housing prices (P'), as shown in Figure 1.

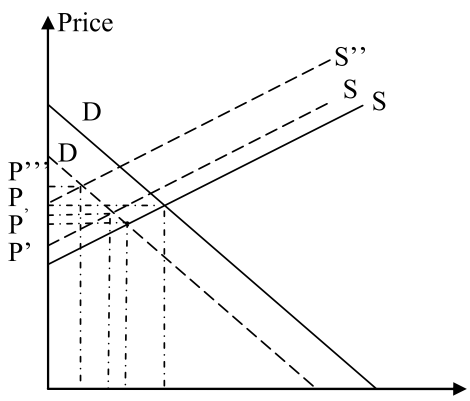

Figure 1.Affordable housing policies based on middle and low income families.

In a long run for the construction of affordable housing, reduced land supply result in lower commodity housing supply, and there are three cases about housing price change, firstly the degree of supply reduction is less than the degree of demand reduction, so housing price falls (P''); Secondly the degree of supply reduction is more than the degree of demand reduction, so housing price rises; Thirdly the degree of supply reduction is equal to the degree of demand reduction, so housing price remains unchanged (P).

For the low-income families large scale construction of affordable housing impact commodity housing market on both sides: from the aspect of housing demand the effect of affordable housing on commercial housing result in crowding out effect of commercial housing; Crowding-out effect Crowding-out effect Crowding-out effect from the aspect of land supply for affordable housing takes up a lot of land commercial housing supply is reduced too, therefore the change of commercial housing price is still uncertain.

ECONOMETRIC MODEL OF EFFECT OF AFFORDABLE HOUSING ON HOUSING COMMODITY MARKET

According to supply and demand theory the impact of affordable housing construction on the housing market is analyzed, next actual impact of affordable housing on housing market will be analyzed, namely the demand, supply and price analysis of commodity housing on effected by affordable housing.

Traditional method is based on economic theory to describe the relationship between the variables. However, economic theory is usually not sufficient to provide a dynamic link between variables, and endogenous variables can appear in both the left and the right of the equation, which makes estimation and inference more complex. Vector error correction (VEC) model is built based on the statistical nature of the data model, and VEC model commonly is used in forecasting inter-connected time series and dynamic impact of random disturbance on variables, which explain the economic impact on the economic variables.

As can be seen, VEC model is a method used to establish the relationship between unstructured variable models, which is suitable for the impact of affordable housing on commodity housing market. Firstly econometric model of multivariate time series is built, and in many econometric models variables are stationary time series, while in practice most of the economic variables are non-stationary, and for non-stationary time series we should test whether there is co-integrated relationship between the variables. If there is co-integrated relationship between multiple variables, there is a long-term stable relationship between variables, and the long-term stable relationship is maintained in the short-term dynamic process of continuous adjustment. This short-term adjustment process is dynamic error correction mechanism that can be derived by the autoregressive distributed lag model, which prevents the deviation of long-term relationships between variables from the point of the number or the scale. VEC model is a VAR model with co-integrated constraints, mostly used in non-stationary time series modeling with co-integrated relations.

Construction of VEC model. If $y_t = (y_{1t}, y_{2t}, ..., y_{kt})'$ is a one-dimensional random time series and t belongs to $= 1, 2, ..., T$, namely each $y_{it} \sim I(1)$, $i = 1, 2, ..., k$

$$\Delta y_t = \alpha\beta' y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + u_t \quad (1)$$

Among $\beta' y_{t-1} = ecm_{t-1}$ is Error correction term, which reflect Long-run equilibrium relationship between variables $\Gamma_i = -\sum_{j=i+1}^{p} A_j$. So $\Delta y_t = \alpha ecm_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + u_t$

This is vector error correction model (VEC), among which each equation is error correction model (ECM). The parameter vectors of VEC model reflect the speed of adjustment when the equilibrium relationship between the variables deviate from the long-term equilibrium, so it is also called adjustment parameter matrix, or correction parameter matrix. The coefficient vectors of differential terms $\Delta y_{t-i} (i = 1, 2, ..., p-1)$ of all explanatory variables $\Gamma_i (i = 1, 2, ..., p-1)$ reflect the impact of short-term fluctuations Δy_{t-i} of the variables on short-term changes Δy_t of variables (Gao 2006).

In order to analyze the impact of affordable housing on the housing market, in the paper we established three VEC models, namely the VEC models of housing demand, land supply and housing prices respectively, in order to determine the actual impact of affordable housing on commodity housing demand, supply and price.

After influencing factors of housing demand and supply and housing prices are compared and analyzed, three VEC model systems are as follows:

(1) Housing prices (HP), disposable income (INC), and affordable housing area (IHA) system

(2) Housing sales area (HAS), disposable income (INC), affordable housing area (IHA) system;

(3) Land acquisition area (LA), housing sales area (HAS), affordable housing area (IHA) systems.

Impulse response functions and variance decomposition. Impulse response function (IRF)is used to describe the dynamic impact of a shock of endogenous variables on other endogenous variables in VER model, when an error term changes or the VEC model suffer from some kind of shock.

The element in Line i and column j can be expressed as

$$c^{(q)}{}_{ij} = \partial y_{it+q} / \partial u_{jt}, q = 0, 1, 2, ...; t = 1, 2, ..., T \quad (2)$$

As the function of q it shows under the circumstance of other variables and early variables unchanged at the period of t the reaction of y_{it+q} to a unit shock of y_{jt} is called Impulse - response function. It can be shown with matrix as:

$$C_q = \partial y_{t+q} / \partial u_t' \quad (3)$$

The element in Line i and column j in C_q is the effect of variable i at the period of $t+q$ if variable j adds a unit and other disturbance is constant.

The element in the first row, first column of elements equals to the first period of the disturbance variables increased by one unit, other times, the impact on the value of the first variable periods of Variance decomposition is used to evaluate the importance of different structural shocks by analyzing the contribution of impact of structural shocks on each endogenous variable change (usually measured by the variance). Compared with the impulse response functions variance decomposition is a method of roughly grasping the relationship between variables, which gives the relative important information of each disturbance term affecting the VAR model.

EMPIRICAL ANALYSIS

Based on Chongqing Statistical data of related variables from 1995-2010, the impact of affordable housing on commodity housing market was analyzed, and three VER models of commodity housing demand, land supply and housing prices are built up. In order to solve the housing problem of low-income families, affordable houses began to be built from 1998; housing sales area index is chosen to characterize demand of housing, land acquisition area is chosen to characterize the supply of land, and based on 1995-2010 Chongqing Statistical Yearbook relevant variables data are get: Affordable Housing Area, AHA), Housing Price, HP), housing sales area, HSA), land acquisition area, LA), Habitat disposable income, INC), and Chongqing commodity housing market model effected by affordable housing is established.

Through the above analysis, five variables are non-stationary time series and are integrated of order one time series ($I(1)$), after co-integration tests of the three systems are tested there is co-integrated relationship in each system. So three vector error correction (VEC) models are built up and impulse response and variance decomposition analysis are done for each VEC model. Eviews 5.0 econometric software is used for calculation and analysis.

Analysis of the effect of housing prices aroused by affordable housing. After calculation, the error correction term model of housing price aroused by affordable housing is:

$$Ecmt = hpt - 0.4088inct + 0.5107ihat + 1890.224 \tag{4}$$

Calculation results of VEC model that affordable housing effect housing price are:

$$\begin{pmatrix} \vartriangle hp_t \\ \vartriangle inc_t \\ \vartriangle iha_t \end{pmatrix} = \begin{pmatrix} 308.63 \\ 744.51 \\ 50.76 \end{pmatrix} + \begin{pmatrix} -0.409 \\ -0.521 \\ -0.003 \end{pmatrix} ecm_{t-1} + \begin{pmatrix} -0.72 & 1.37 & 0.31 \\ 0.05 & -0.12 & -0.1 \\ -2.03 & 1.66 & 0.2 \end{pmatrix} \begin{pmatrix} \vartriangle hp_{t-1} \\ \vartriangle inc_{t-1} \\ \vartriangle iha_{t-1} \end{pmatrix} + e_t \tag{5}$$

Through the impulse response function analysis of The model the positive response process of housing prices caused by disposable income is get, and housing prices rise because of a positive unit impact of income (see Figure 2), and house prices fall because of a positive unit impact of affordable housing (see Figure 3), which is consistent with the theoretical analysis of the economy.

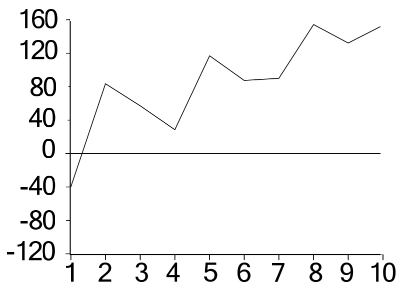

Figure 2.Impulse response functions of housing price caused by income.

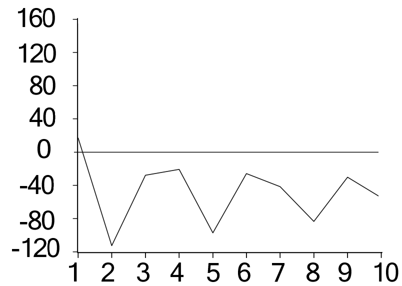

Figure 3.Impulse response function of housing price caused by affordable housing shock.

Through Further variance decomposition analysis, contribution rate of per capita disposable income and affordable housing to housing price changes are shown in Figure 4 and Figure 5, and contribution rate of income to the price continues to increase and at the tenth period reach 58%; while contribution rate of affordable housing reaches the maximum of 35% at the second period, and then declines and at the tenth period fell to 9%, which shows that the construction of affordable housing have large impact (greater than 23%)on housing prices in the short term (say 5 years), the impact gradually declines, so in terms of housing prices income is the main factor, and the construction of affordable housing can play a role, but not the major factor.

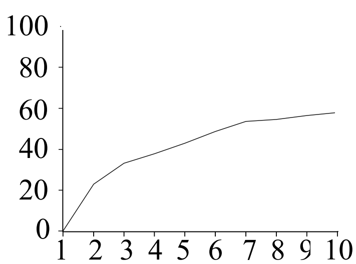

Figure 4.Contribution rate of income to housing Price.

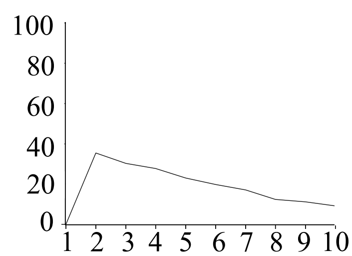

Figure 5.Contribution rate of affordable housing to housing price.

The analysis of effect of housing sale area aroused by affordable housing. After calculation, the error correction term model of housing sale area aroused by affordable housing is:

$$Ecmt = hsat - 0.3187inct - 2.4788ihat + 1726.626 \quad (6)$$

Calculation results of VEC model that affordable housing effect housing sale area are:

$$\begin{pmatrix} \vartriangle hsa_t \\ \vartriangle inc_t \\ \vartriangle iha_t \end{pmatrix} = \begin{pmatrix} 224.84 \\ 362.44 \\ 9.33 \end{pmatrix} + \begin{pmatrix} -0.669 \\ -0.98 \\ 0.038 \end{pmatrix} ecm_{t-1} + \begin{pmatrix} -0.37 & 0.2 & -1.3 \\ 1.09 & 0.28 & 0.97 \\ 0.09 & 0.02 & 0.01 \end{pmatrix} \begin{pmatrix} \vartriangle hsa_{t-1} \\ \vartriangle inc_{t-1} \\ \vartriangle iha_{t-1} \end{pmatrix} + e_t \quad (7)$$

According to the VEC model of Area of Housing Sale, respectively, per capita disposable income and affordable housing are given respectively a positive impact and impulse response of housing sales can be got as shown in Figure 6 and Figure 7. When the per capita disposable income gets a positive impact in the period housing sales area is continuously rising in the first 10 periods and at the first tenth period reaches 153, which shows that income rising has a positive role for housing sales area. When affordable housing gets a positive impact in the period housing sales area has not changed in the first period, began to improve in the second period, which shows that the construction of affordable housing also has a positive effect on housing sales area.

In the economy theoretical analysis of housing demand caused by affordable housing we conclude that the construction of affordable housing will reduce the housing demand, but through empirical analysis of Chongqing construction of affordable housing improved housing demand, the reason that empirical analysis and theoretical analysis contrary may be that housing needs of some families without houses are stimulated due to the affordable housing, or that greater housing demand is stimulated for some families of having houses, or that housing sales area does not represent the actual demand for housing and between housing sales area and housing needs there is a big difference, which may lead to housing demand rising with the construction of affordable housing.

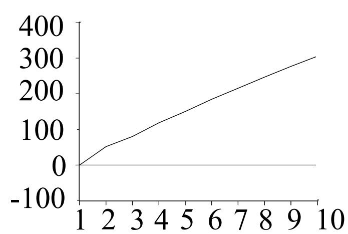

Figure 6.Impulse response function of housing sale area caused by income.

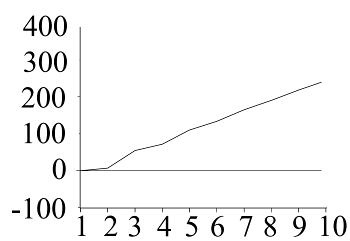

Figure 7.Impulse response function of housing sale area caused by affordable housing shock.

Variance decompositions of housing sales area caused by disposable income and affordable housing are shown in Figure 8 and Figure 9, the contribution rate of per capita disposable income is rising gradually and at the tenth period reach 50%; contribution rate of affordable housing at the first and second periods is almost zero and then gradually increased, at the tenth period reach 28%, which shows that income is an important impact on housing sales area, and disposable income is a major factor affecting housing demand, and recently increasing housing demand is closely related to China's economic development and income improvement. The affordable housing is not a major factor affecting area of housing sales.

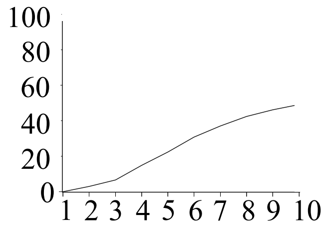

Figure 8.Contribution rate of income to housing sale area.

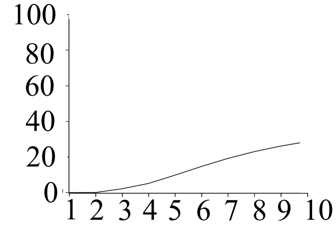

Figure 9.Contribution rate of affordable housing to housing sale area

Analysis of the effect of housing prices aroused by affordable housing. After calculation, the error correction term model of land acquisition area aroused by affordable housing is:

$$Ecmt = lat + 0.7961hsat - 5.6383ihat - 1497.002 \quad (8)$$

Calculation results of VEC model that affordable housing effect land acquisition area are:

$$\begin{pmatrix} \triangle la_t \\ \triangle hsa_t \\ \triangle iha_t \end{pmatrix} = \begin{pmatrix} 170.51 \\ 644.33 \\ -11.31 \end{pmatrix} + \begin{pmatrix} -0.02 \\ 0.48 \\ -0.01 \end{pmatrix} ecm_{t-1} + \begin{pmatrix} -0.05 & -0.3 & -2.6 \\ -0.11 & -1.3 & -1.61 \\ 0.06 & 0.1 & -0.03 \end{pmatrix} \begin{pmatrix} \triangle la_{t-1} \\ \triangle hsa_{t-1} \\ \triangle iha_{t-1} \end{pmatrix} + e_t \quad (9)$$

According to the VEC model of land acquisition area the impulse responses of land acquisition area caused by housing sales area and affordable housing are shown in Figure 10 and Figure 11. When housing sales get a positive impact in the period the area of land acquisition reduces in the period, fall to the lowest at the second period, has negative effect in the first 6 periods, begin to have positive effect at the seventh period, which shows that housing demand has first negative and then positive effect on land acquisition area. When affordable housing get a positive impact in the period, land acquisition area reduces to the minimum at the second period, then increase and get positive effect at the fourth period, which shows that land acquisition area is reduced in 2 years because of the construction of affordable housing, but in a long term it is increasing, that is, in a short term construction of affordable housing will cause the reduction of housing land area, but due to abundant land reserves, long-term housing land supply increases.

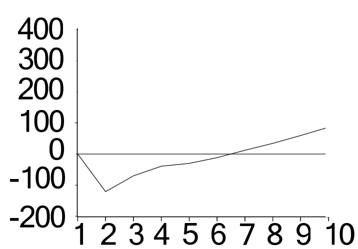

Figure 10.Impulse response function of land acquisition area caused by housing sale area.

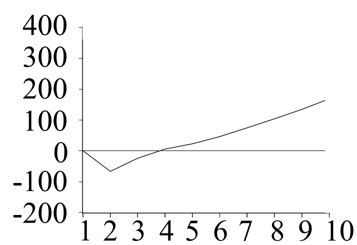

Figure 11.Impulse response function of land acquisition area caused by affordable housing shock.

The variance decompositions of land acquisition area caused by housing sales area and affordable housing are shown in Figure 12 and Figure 13, in the factors affecting area of land acquisition, contribution rate of housing sales area is 9%, contribution rate of affordable housing is only 5% in the first 7 periods, then has the growing trend, in the whole, the contribution rates of housing sales area and affordable housing to land acquisition area are both small, which shows that housing demand and affordable housing are not major factors affecting land supply.

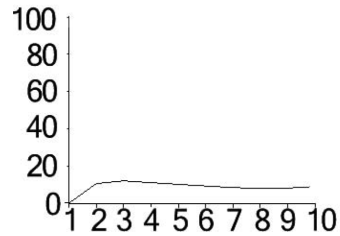

Figure 12.Contribution rate of housing sale area to land acquisition area.

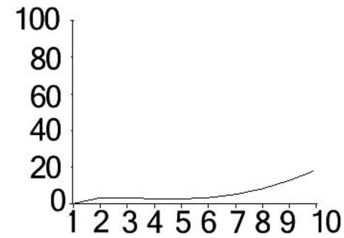

Figure 13.Contribution rate of affordable housing to land acquisition area.

CONCLUSIONS AND SUGGESTIONS.

Based on effect analysis of affordable housing on commodity housing market from 1995 to 2010 in Chongqing, affordable housing has the positive impact on housing demand, has negative-positive impact on the land supply, has negative impact on housing price. From the point of variance contribution rate, the impacts of affordable housing on the housing demand, land supply and housing prices are small. At last the following conclusions can be drawn:

Among factors effecting Chongqing housing demand, the income is a major factor, affordable housing construction does not have a “crowding out” effect on the demand of commodity housing, but stimulate housing demand, and the impact of affordable housing on housing demand is small. so it can be inferred that the impact of affordable housing is related to proportion of affordable housing, and the proportion of affordable housing accounting for housing sale area in Chongqing are shown in Figure14, from 1999 to 2010 the proportion of affordable housing sale area has gradually downward trend, in 1999 the proportion is 20.6% and is the largest, during 2005 and 2010, except for 12% in 2009, in other years the proportion are all lower than 10%, in some years only 5%. On the other hand, in Chongqing, the proportion of low-income people is 30-40 % (Huang 2011), the proportion of affordable housing supply is less than 10% and the proportion of affordable housing demand is up to 30-40 %, so affordable housing construction may have greater impact on commodity housing demand in psychology than the actual meaning. Obviously from 1999 to 2010 affordable housing construction scale in Chongqing is too small, and has not crowding out effect to commodity housing demand.

Among the factors affecting land supply of in Chongqing, the effects of housing demand and the affordable housing are both very small , and the effects of both factors of 4-7 years later are negative, and in a long run housing demand and land supply have positive effects on affordable housing. It shows that with the increase of housing demand, in 7 years land supply has decreased, which is related to government monopoly of our land market and control policies. in recent years the real estate market demand is too strong and housing prices are so high that the central government wants to adjust housing demand and housing price by restrain land supply, therefore, with the increase of housing demand, the quantity of land supply decreases. Construction of affordable housing has the negative impact on land supply in the subsequent 4 years, begin to have positive impact from the fifth year, which shows that in the short term the construction of affordable housing has a crowding out effect on land supply, but still have the positive effect during a long time, in Chongqing urban land reserves are abundant, in a long term has not reduced the amount of commodity housing land supply. However whether it is positive or negative impact the actual impact of housing demand and affordable housing on land supply are relatively small.

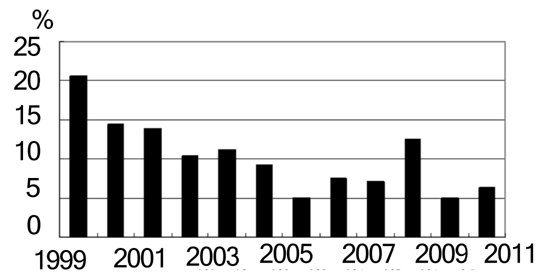

Figure 14.Proportion of housing affordable accounted for housing sales area in chong qing from 1999 to 2010.

Among the factors affecting housing prices of in Chongqing, income has a significant positive effect on housing prices, and contribution rate of the income to housing price is more than 50%, so income is a major factor to change housing price. Construction of affordable housing has the more significant negative impact on housing price, in five years the cumulative contribution rate of affordable housing is more than 20%, but in the long term is gradually decreasing, 10 years later the contribution rate is only 9%, so in the short term, construction of affordable housing has negative impact on housing price and in the long run the impact is limited.

The effect of affordable housing on housing price is related to the scale of the affordable housing, and only up to a certain scale and proportion the impact is significant. Fundamental purpose of government to build affordable housing is to satisfy the basic housing need for low-income families, to replace commodity houses and reduce high commodity housing price. Before 2010 construction of affordable housing in Chongqing is slow and there is a serious shortage of affordable housing stock, therefore, the crowding out effect to housing price is limited.

To sum up, Chongqing should increase the scale of affordable housing , including affordable housing construction , including expanding the scope of protection to meet the housing needs of low-income families , this will be the demand for goods and housing prices have a certain “crowding out “ effect . We should appreciate that Chongqing has strengthened the protection of housing construction scale and intensity in 2010, mainly in the construction of public rental, three years to be built 40 million square meters of public rental, focused on solving the housing problem “sandwich class” crowd. Chongqing municipal government decided to build a new urban housing supply system, with the original low-rent public rental housing , affordable housing , dilapidated and shantytowns housing placement , the transformation of villages resettlement housing , migrant workers protection in the form of the five apartments , a “1+5” affordable housing system , to achieve full coverage pattern of urban affordable housing . Large-scale construction of public rental housing market is bound to have a greater impact , will have a larger “crowding out” effect of commodity housing demand due Chongqing rich land reserve land occupation of public rental housing land supply of goods impact is limited , and therefore housing prices will have a significant “crowding out “ effect.

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Empirical Research on the Impact of the Financial Leverage of Listed Real Estate Companies on Enterprise Value

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Abstract

With the rapid development of Chinese economy, our country real estate industry also developed rapidly. However, the real estate cycle is closely related to the banking system. Because in the operation process of the real estate enterprise, debt level of the enterprises plays an important role. This paper uses the listed real estate companies of stock markets of Shanghai and Shenzhen in 2009-2012 as research samples to do an empirical test of the effect of financial leverage on enterprise value. The empirical results show that in Chinese listed real estate companies, short-term debt of the enterprise has a significant positive effect on the enterprise value; but the effect of the long-term debt is not obvious on the enterprise value.

INTRODUCTION

With the development of Chinese economy, the real estate industry has become a pillar industry of Chinese economy. So the healthy development of the real estate enterprises is directly related to the economic development of China. At present almost all the real estate companies bear the high debt to assets ratio. It will undoubtedly bring the certain financial risk. But at the same time, high debt to assets ratio bringing about the financial risk, also can improve the profitability of enterprises. As long as the debt is controlled in a certain range, it is advantageous for the development of enterprises. The concept of financial leverage is created. If the real estate enterprises make good use of financial leverage, they will gain more income. On the other hand, it may lead to the bankruptcy of enterprises. So, for the enterprises especially the real estate enterprises, controlling debt level will be the key to their development. And according to the length of time, debt is divided into long-term debt and short-term debt. The role they play in enterprise is different. So to control both the quantity and the ratio well will be the key to the development of enterprises. This paper attempts to explore the degree of the long-term debt and short-term debt in the form of financial leverage impact on the real estate enterprise value, in order to put forward the proposal of enterprise. And enhance our country listed real estate companies' enterprise value, to occupy a space in the international market, and survive in the process of economic globalization.

LITERATURE REVIEW

Foreign scholars have studied the impact on the enterprise value for the capital structure in the form of financial leverage early. The earliest research is MM's theory. In the first model of Modigliani and Miller (1958) thought that capital structure was not related to the enterprise value. Then the modified model of MM thought that the more enterprises' debt the greater the enterprise value, so enterprises should be 100% in debt in order to gain the maximum benefit. Later, another scholar Masulis (1983) tested the impacts of two kinds of capital structure changes on the enterprise market value. The results showed positive correlation between the level of debt and enterprise value. Harris and Raviv (1991) found that accompanied the new debt issuance, the announcement of stock repurchase, the stock price would rise. After the study of Jensen and Meckling (1976), they found that when the enterprise's debt was zero, the manager of enterprise had the lowest minimum right to dispose of the assets, so the equity capital cost was high. When the enterprise had debt, the agency cost of equity capital would be reduced; also the agency cost of debt capital would be reduced. Moderate debt ratio could make the total agency cost minimum, so Jensen and Meckling (1976) thought that there was an optimal capital structure of enterprises.

Domestic scholars for the study on this subject had a late start but also made certain achievements. Wang and Yang (2002) thought that the company size was associated with the capital structure negatively, by pointing out the affecting factors in the research of capital structure. Yan (2002) obtained through research that there was no correlation between capital structure and enterprise value of Chinese listed companies. Wang (2001), Li (2004) and other scholars had concluded that the financial leverage had a negative impact on the enterprise value through studies. Zhang (2010) had also confirmed that the constraint effect of financial leverage was existence in Chinese listed companies, and had a negative effect on the enterprise value.

Although the research that classical theory abroad and domestic recent study for the short and long term debt in the form of the financial leverage have the effects on the enterprise value has been studied deeply. But the study for the strength of comparison of long-term debt and short-term debt effect is still not clear. It is not conducive to enterprise, especially when the real estate enterprises do the choice of capital structure. This paper tries to choose the capital structure for the enterprise.

THEORETICAL ANALYSIS

Due to the existence of the fixed interest on the debt and preferred stock dividends, financial leverage can lead to variation of earnings per share of common stock is greater than the change of profit before interest and tax. Financial leverage will bring financial risk, and it is inevitable. Because private fund raising quantity is limited. When the enterprise is in the period of expansion, it is difficult to fully meet the needs of the enterprise. Debt financing is fast, flexible, borrowing funds to expand the scale of the enterprise and enhance the ability of enterprise market competition. At the same time, the enterprise can pay less tax because of the debt management. Most of enterprises will choose debt management.

The MM's theory is the earliest systematic study of the influence financial leverage has on the enterprise value. The MM's theory believed that once the enterprise had high debt ratio, it would have great enterprise value. Because of the existence of the income tax, the shareholders would get more benefits. According to the theory of the MM's theory, all the enterprises will have 100% debt ratio. However, this is not the case. The MM's theory is some of the extreme, and it ignores the possibility that the high debt ratio may lead to enterprises bankrupt. That is to say that the MM's theory only saw the benefits of financial leverage, but paid no attention to the financial risk. So the enterprises have to consider the financial leverage to bring the benefits and risks, and determine the level of debt ratio reasonably.

Liability in the form of financial leverage affects enterprise value. Capital structure is the form of financial leverage. Study on the relationship between capital structure and enterprise value was carried out in the framework of neoclassical economics firstly. In this framework, the way of enterprise financing was just on behalf of shareholders and creditors' claims on the income of the enterprise, and there was unrelated to the capital structure and corporate governance. Since twentieth Century seventy, with the development of the theory of the firm, especially the transaction cost theory, principal agent theory, property right theory had been widely used in research in the field of capital structure, and the capital structure based on the traditional theory of enterprise theory had a strong challenge. From the research achievements of scholars can be seen, the financial leverage effect on the enterprise value can be divided into three categories. Firstly, choosing the capital structure will affect the enterprise manager's effort level and behavior, thereby affecting the value of the enterprise; secondly, transmit information through the capital structure function to influence the investors' perceptions of the business situation, and affect the value of the enterprise; thirdly, capital structure affects the distribution of corporate control rights, so that affect the value of enterprise.

EMPIRICAL STUDY DESIGN OF THE IMPACT OF FINANCIAL LEVERAGE OF LISTED REAL ESTATE COMPANIIES ON ENTERPRISE VALUE

Hypothesizing. As mentioned before, the financial leverage is associated with the enterprise value. According to relevant theory and literature, this paper puts forward the following hypothesis:

H1: Debt ratio has the obvious influence on the enterprise value in the form of financial leverage.

But the debt has two forms, one is short-term debt, the other is the long-term debt. The two forms are the corporate debt financing, but there are different maturities. However the enterprises must make the decision on the selection of debt financing. So this paper puts forward the following hypothesis:

H2: Different debt has different levels of influence on enterprise value.

Since the different period of the debt has the different levels of influence on enterprise value, the influence degree of two kinds of forms is very important. So this paper puts forward the following hypothesis:

H3：The effects of short-term debt on enterprise value are more significant than long-term debt.

Variable definitions. This paper selected variables including the dependent variable (enterprise value) and the independent variable (short-term debt and long-term debt).

Select the following argument:

(1) EV. In the most of the domestic and abroad research on enterprise value, enterprise value was represented by Tobin's Q. Because Tobin's Q comprehensively reflects the enterprise value

(2) LTL. Long-term debt reflects the level of the liabilities and assets of the enterprise. So long-term debt is represented by the debt to assets ratio.

(3) STL. Liquidity ratio is on behalf of the ability of paying short-term debt .So Short-term debt is represented by the liquidity ratio.

(4) DFL. Degree of Financial Leverage.

(5) ROE. Rate of return on common stockholders' equity is a manifestation of the level of profits of the enterprise. So choose it as a control variable.

(6) ATR. Acid-test ratio reflects the ability of paying short-term debt better.

Sample selection and model design. (1) The data source. The data is more representative of the listed companies. So, in this paper, the selection of 2009-2012 in Shanghai and Shenzhen a-share listed companies were studied.

(2) Model building. Through the above analysis, there is a linear relationship between dependent variable and independent variable, and the following is model established in this paper:

$$EV = \alpha_1 LTL + \alpha_2 STL + \alpha_3 DFL + \alpha_4 ROE + \alpha_5 ATR + \varepsilon$$

THE EMPIRICAL ANALYSIS

Descriptive statistics. By collecting real estate listed company related data from 2009 to 2012, this paper analyses the distribution of debt to assets ratio, see Table 1:

Table 1.The Distribution of Debt to Assets Ratio from 2009 to 2012.

Year	More than 60%	other	Total
2009	36	24	60
2010	16	11	27
2011	44	18	62
2012	30	10	40
Total	126	63	189

By Table 1 descriptive statistics, this paper can be concluded that Chinese real estate listed companies' debt to assets ratio is high generally. In Chinese real estate listed companies, debt to assets ratio more than 60% accounted for 66.67%, while the debt to assets ratio less than 60% only accounted for 33.33%. Because debt to assets ratio is high, there is a certain financial risk in real estate enterprises. Of course, at the same time, enterprises can also use financial leverage to improve their enterprise value.

However, in the corporate debt, there are long-term debt and short-term debt, and the role they play in enterprise value is different.

Empirical results and analysis. Through the study of the real estate listed companies by SPSS, this paper gets the regression results as shown in Table 2.

Table 2.Regression Results.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Colinearity Statistics	
	B	Std.Error	Beta			Tolerance	VIF
(Constant)	5.703	1.830		3.117	.002		
LTL	0.001	0.009	0.010	0.132	.895	.882	1.133
STL	-2.685	0.828	-0.353	-3.243	.001	.429	2.333
DFL	0.033	0.131	0.018	0.250	.803	.971	1.029
ROE	-0.033	0.050	-0.048	-0.672	.502	.977	1.024
ATR	3.924	1.121	0.369	3.502	.001	.457	2.188

The liquidity ratio negatively related to the enterprise value is significant under 5% level. It suggests that short-term debt in the form of financial leverage value effects more obviously. But the debt to assets ratio's influence on enterprise value is not obvious. This may be due to the relationship between the debt to assets ratio and enterprise value is nonlinear, or the debt to assets ratio of Chinese real estate enterprises is high generally. The enterprise value is not very sensitive to that the debt to assets ratio changes and it's to say that the marginal benefit of enterprise value is very small.

Through multiple regression analysis, five characteristics of VIF values are less than 10. From the results it can be seen that the long-term debt, short-term debt, degree of financial leverage, rate of return on common stockholders' equity and acid-test ratio are no co linearity, and the regression coefficient is significant.

EMPIRICAL STUDY CONCLUSION AND POLICY SUGGESTION

Through the analysis of the theoretical and empirical research, the author draws the following conclusion: there is a significant negative correlation between liquidity ratio and enterprise value, and the enterprise is more sensitive to short-term debt, so the increase of short-term debt will bring the enterprise value a certain increment. And the Chinese real estate enterprises are not very sensitive to the long-term debt. There may be no obvious linear relation, but existing nonlinear relationship.

The debt to assets ratio of Chinese real estate enterprises is high generally; increasing the debt to assets ratio in the form of financial leverage to enhance enterprise value is difficult. Empirical research indicates that Chinese real estate enterprises can improve the short-term debt ratio instead. Chinese real estate enterprises can improve their short-term debt ratio. But over the long term, the debt to assets ratio is stable at a certain range, so that is conducive to the promotion of enterprise value, and the development of enterprises. So for a Chinese real estate enterprise, it should borrow short-term borrowing, and pay off in the short term. And ensure the stability of the debt to assets ratio in the long term. So that the enterprise can enhance its enterprise value.

This paper can provide direction for Chinese real estate enterprises in the debt management process. When a Chinese real estate enterprise wants to borrow money, it can enhance enterprise value by borrowing short-term borrowing.

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Internationalization of Construction Services: A Comparison between Emerging and Developed Economies' Construction Contracting Firms

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Abstract

Although mainstream of multinational construction firms have origin from developed countries, the relevance of construction contracting firms (CCFs) from developing countries is on the rise and becoming increasingly important, some of them becoming important global players. Scholars propose both similarities and differences in the forms of internationalization process concerning industry and geographical dispersion for multinational corporations (MNCs) from emerging and developed economies. The aim of this paper is to examine the differences and similarities in the internationalization process of construction contracting firms from emerging and developed countries. For this purpose, the case study of Pakistani construction contracting firms (CCFs) and British construction contracting firms (CCFs) was undertaken. The features examined in this study are the objectives of internationalization and the significant firm-specific and home country-specific factors that influence the internationalization of Pakistani and British CCFs. Using integrated theoretical approach, this paper employs quantitative technique. The data were collected through postal questionnaire survey and company reports. A comparative statistical analysis of the data was done. Little differences were identified between British CCFs and Pakistani CCFs in terms of their objectives for internationalization and firm-specific competitive advantages, whereas significant differences were identified in terms of home-country specific competitive advantages. The findings of this study will provide valuable implications for the internationalization of construction contracting firms from developing as well as developed economies.

INTRODUCTION

Emerging economies entry into the World Trade Organization (WTO) has sped up process of liberalization, privatization and institutional reform and pushed many construction firms from the developing as well as developed economies to go overseas to counter intense competition at domestic market (Maqsoom and Charoenngam 2014). The overseas expansion of these multinational firms plays a vital role in the present global investments landscape.

The construction industry has always contributed generously toward the progress and economic prosperity of any nation. Although mainstream of multinational construction firms have origin from developed countries, the relevance of construction firms from developing countries is on the rise and becoming increasingly important, some of them becoming important global players (UNCTAD 2006; Maqsoom et al. 2013). Very few attempts have been made in the sense of directly comparing the internationalization process of emerging countries' CCFs with the developed countries' CCFs.

The aim of this paper is to examine the differences and similarities in the internationalization process of construction service firms from emerging and developed countries. For this purpose, the case study of Pakistani construction contracting firms (CCFs) and British construction contracting firms (CCFs) was undertaken. The features examined in this study are the objectives of internationalization, the significant firm-specific competitive advantages and home country-specific competitive advantages that influence the internationalization of Pakistani and British CCFs. This study intends to contribute to the literature on the differences and similarities between internationalization of CCFs from emerging economies as well as developed economies and suggests a schema for understanding the conditions under which developed and emerging economies' CCFs grow.

LITERATURE REVIEW

The concept of internationalization has been defined differently by various scholars. Some scholars defined internationalization as a gradual and sequential process, through which firms become increasingly committed to, and involved in, international markets (Johanson and Vahlne, 1977). Calof and Beamish emphasized the adaption of firms operation to the norms and demands of international markets (Calof and Beamish 1995). Some other scholars, inspired by resource-based view, claimed that internationalization is viewed as "the process of mobilizing, accumulating, and developing resources for international activities" (Ruzzier et al. 2006). Broadly, in order to explain the complex phenomenon of internationalization, the scholars tend to support the integration of several theoretical approaches in order to get better understanding (Canabal and White 2008). The current research analyzes objectives using Entrepreneurship theory, firm-specific competitive advantages taking help from the Resource Based View and Eclectic Paradigm theory, and home country-specific competitive advantages taking help from the Eclectic Paradigm and Diamond Model. Hence, an integrated approach has been used for the current study.

The objectives for internationalization have been studied by numerous scholars. Some scholars are of the opinion that profitability is very important for firm's survival and growth and in order to gain sound profit margin the firms are encouraged to internationalize (Abdul-Aziz and Wong 2010). Another view comes from Gregorio et al. (2008) who believed that the firms internationalize to exploit abundant market opportunities available across the borders and take full advantage of the assets or resources of the host countries. Gaining international experience, expanding the business networks, to diversify the risks and to counter the domestic business cycle are some other motives of internationalization (Rundh 2007).

As far as the firm specific competitive advantages are concerned, they can be too many as reported in the literature available on this very subject. Various scholars identified that firms' unique assortment of assets (e.g., land, technological know-how brand equity, equipment, reputation) and individuals who possess skills (e.g., in managing people, marketing, communication etc.) are some firm FSCAs that enable it to internationalize (Wit and Meyer 2010). Seymour (1987) observed the British construction firms that have expanded overseas and realized that management expertise, technical knowledge and experience of foreign operations were their firm specific advantages. Some scholars proposed that the networks and relationships in the home country are the initial point for the growth of the firms in the overseas (Sharma and Blomstermo 2003). For examination of Singaporean transnational construction corporations, Cuervo and Low (2003) concluded that technology, foreign market knowledge, networks and reputation were their firm specific competitive advantages.

The literature on the home country-specific competitive assets (HSCA) reveals that internationalization of firms is driven by the environment and characteristics of home country (Wan and Hoskisson 2003). Oz (2001) realized that the internationalization of the Turkish CCFs was the result of responding to Turkish and other foreign competitors available in Turkey. Liu et al. (2005) found that there is positive correlation between the level of economic development of the home country and foreign direct investment. Political leadership and a multicultural workforce were identified as additional home country-specific variables by Abdul-Aziz and Wong (2010) in their study of international Malaysian housing developers. Rasiah et al (2010) stated that the support from the home government is a key factor which aids the international expansion of domestic firms. While according to Cuervo and Low (2003), the potential to get sufficient supply of trained work force from domestic market and financial funding available from domestic financial market were among some home country-specific competitive advantages of Singaporean transnational construction corporations.

RESEARCH METHODOLOGY

Keeping in view the research objectives mentioned above, a structured questionnaire was developed considering the factors as identified on: objectives, firm specific and home country specific competitive advantages. The questionnaire was pilot tested during November 2011 on eight executives from eight different CCFs (2 CEO and 2 General Manager of Pakistani CCFs, and 1 CEO and 3 Directors of British CCFs). The Chief Operating Officer of Construction Association of Pakistan (CAP) was also interviewed. Essential amendments were made to the questionnaire in the light of these recommendations.

The authors attempted to limit the Common Method Variance (CMV) bias by limiting the inconvenience of responding, assuring the respondents about the anonymity and confidentiality of the research so that they can answer as honestly as possible and telling them that there were no right or wrong answers. In addition, range data or ratios were asked rather than precise figures for some questions, as respondents are more comfortable to respond the questionnaire in this way.

In early 2012, the final questionnaire was mailed to the population of construction service firms from Pakistan and Britain. The Head of Administration of university and the chairman of Construction Association of Pakistan (CAP) endorsed the questionnaire by way of a cover letter, thus providing the legitimacy to the study (Sullivan and Bauerschmidt 1990). The questionnaire was sent to 150 firms in total from Pakistan and Britain. The respondents were asked to rate the variables using Likert scale (where 1 = the least important; 5 = the most important). A total of 86 responses were received. Five responses were discarded as they were incomplete. Completed questionnaire number was 46 which is a response rate of 61.3 % from Pakistani firms and 35 which is a response rate of 46.7 % from British firms. Notably, the firms which have filled questionnaire are all attributed to the construction service sector having specialization in multiple fields including Building and Civil, Petrochemical, Electrical and Mechanical.

FINDINGS AND DISCUSSION

The first phase of analysis is related to the objectives of internationalization of British and Pakistani CCFs. These objectives were taken from earlier researches on motives of internationalization. The results for objectives of internationalization are listed in Figure 1 below.

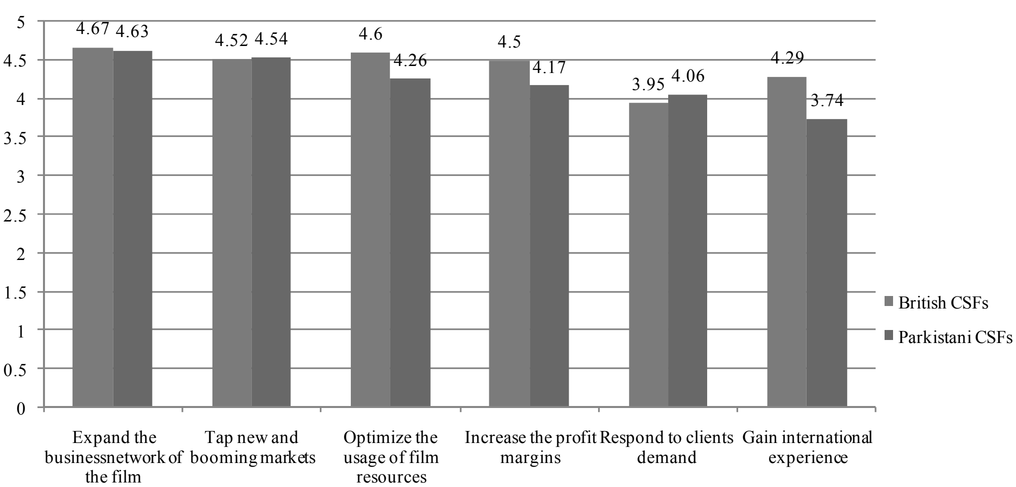

Figure 1.Objectives of internationalization.

The analysis of survey results related to the objectives of internationalization does not indicate much difference in attitudes of Pakistani and British contractors. The most important objectives of internationalization of British CCFs are expanding the business network of the firm and tap new and booming markets. These objectives influence the strategic decision of firms to maintain or enhance the positioning in the international markets. Notably, the expansion of the business network in to the new markets is seen as a powerful inducement impacting British CCFs to enter the international markets. On the other hand, Pakistani CCFs distinguish important objectives as expanding the business network of the firm and optimizing the usage of firm resources. The common important objective of internationazation of both British and Pakistani CCFs is expanding the business network of the firm. These findings are in accordance with previous research findings, stating that the expansion of the business network of the firm and possessing the skilled workforce are one of the most stimulating objectives of the firms to be involved in international activities (Maqsoom and Charoenngam 2013). The standard deviation of expansion of business network of the firm (0.490 of British CCFs and 0.526 of Pakistani CCFs) is the lowest among other internal motives, pointing out strong agreement between the respondents on its importance. On the other side hand, responding to the clients demand and gaining international experience are ranked as lowest objectives among the both groups.

The second phase of analysis is related to the firm specific competitive advantages of British and Pakistani CCFs. These factors were taken from earlier researches on competitive advantages and firm specific assets of internal firms. The respondents were asked to rate the variables using Likert scale (where 1 = the least important; 5 = the most important). The results for the firm specific competitive advantages of both groups are appended above in Figure 2.

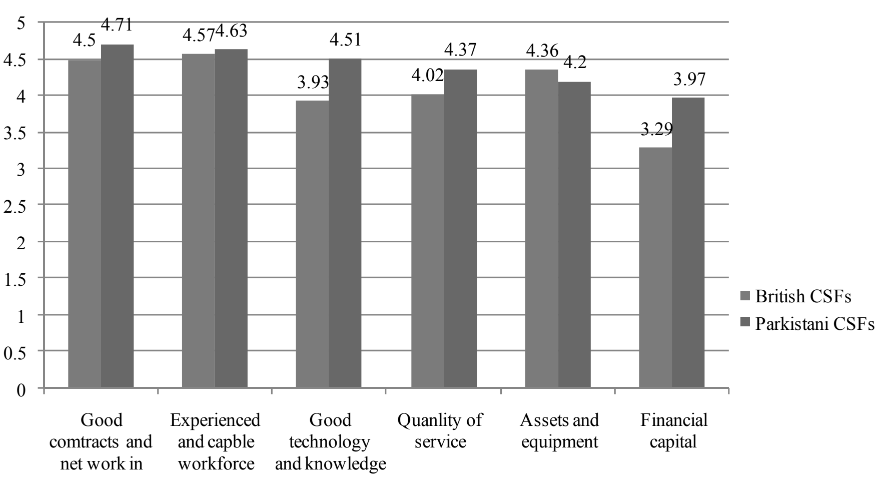

Figure 2.Firm specific competitive advantages.

The responses of British and Pakistani CCFs to the questions about firm specific competitive advantages impacting the internationalization indicate similarity in their attributes. The respondents from both groups distinguished good contacts and networks in overseas and experienced and capable workforce as the most important competitive advantages. Good contacts and networks is seen as one of the boosting factor for both British and Pakistani CCFs. Notably good networks facilitate the possibility to capture the business opportunities abroad whether it is in government or private sector. Whereas, financial capital is lowest ranked firm-specific competitive advantage for both groups. It gives a gesture that both groups don't pay much attention to the financial capital, or probably they restrict themselves from the projects involving large investments. The standard deviation of financial capital (1.043 of Pakistani CCFs) is the lowest among other variables for firm-specific competitive advantages, pointing out the difference between the respondents opinion on its importance.

The third phase of analysis is associated to the home country specific competitive advantages influencing the internationalization of British and Pakistani CCFs. These factors were taken from earlier researches on competitive advantages and competitive assets for internationalization in the perspective of home country. The respondents were asked to rate internal and external motives using Likert scale (where 1 = the least important; 5 = the most important). The results for the home country specific competitive advantages are listed above in Figure 3.

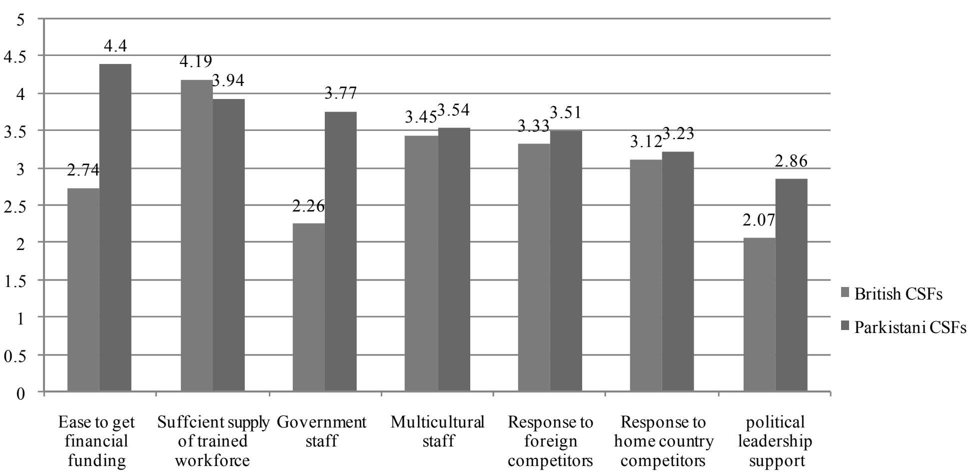

Figure 3.Home country specific competitive advantages.

The responses of British and Pakistani CCFs to the questions about home country specific competitive advantages impacting the internationalization indicate difference in their attributes. The respondents from British CCFs distinguished ease to get financial funding, sufficient supply of trained workforce and government's encouragement as three most important competitive advantages. Whereas, respondents from the Pakistani CCFs distinguished sufficient supply of trained workforce, multicultural staff and response to foreign competitors as three most important competitive advantages. Sufficient supply of trained workforce was the common most important competitive advantage for both firms, which shows that both region firms have trained skilled and unskilled workforce available at their home countries at reasonable salaries. However, political leadership support was the common least important factor for both groups. Both groups didn't have much support from their political leadership same as other countries like China and Malaysia in their foreign operations.

CONCLUSION

The aim of this paper was to investigate the differences and similarities in the internationalization process between CCFs from an emerging country in comparison to one from a developed country. The research shows that objectives of the internationalization for both country CCFs are somehow same. Expanding the business network of the firm, taping new and booming markets and optimizing the usage of firm resources are the most important objectives for both groups. Regarding the firm-specific competitive advantages, good contacts and networks in overseas was the most important variable for both countries firms. On the other hand, financial capital was least important firm-specific competitive advantage for both groups. Regarding home country-specific competitive advantages, significant differences were found between the British CCFs and Pakistani CCFs. Ease to get financial funding from the local banks and government encouragement were key competitive advantages for the British CCFs whereas multicultural staff and response to foreign competitors were main competitive advantages for Pakistani CCFs.

The findings of the study should be viewed in the limitation that only one country from the developed economies i.e. Britain and developing economies i.e. Pakistan has been taken into account and also the sample represented only one service sector i.e. construction industry. Consequently, the authors of the study call for future studies to be conducted which compare the internationalization of firms from different sectors and countries as well.

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Empirical Study on the Information Spilling Effects of Real-Estate Stocks

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Abstract

From the perspective of information spillover, an empirical study has been conducted in this paper about information spillover effect of the real estate plate in A-share secondary market on primary market's IPO latest restarted in China. Through Johansen Co-integration Tests and Granger Causality Tests, it has been concluded that a long-lasting stable relationship exists between the real estate plate stock in A-share secondary market and the IPO in primary market; furthermore, any change in real estate plate stock index would trigger a variation in IPO financing volume.

INTRODUCTION AND LITERATURE REVIEW

According to traditional economics theory, IPO of the primary market might impose information spillover effect on stocks of some boards in the secondary market (Ritter 1991). On the contrary; would stocks of any board in the secondary market hold information spillover effect on IPO of the primary market? Especially to those emerging economies including China, would the performance of real estate plate stock, a major weighting plate in the secondary market, generate such effect on the IPO? On the basis of the questions, this paper conducted an empirical study of real estate plate stock's information spillover effect on IPO which restarted recently in China.

Gao and Bai (2013) has verified that the spillover effect could date back to the Principles of Economics, published in 1890, in which Alfred Marshall presented the definition as the influence of a subject's behavior on others' benefits. Correspondingly, information spillover effect refers to that information from one market would spread to and impose effect on another relevant market (Chen 2012). Amid market economy, information dissemination and diffusion have created broad and complicated connection among markets, therefore resulted in information spillover effect. For example, the degree to which gold markets around the world are integrated has been investigated through information spillover index approach (Lucey et al. 2014). Furthermore, Taylor, Nicholas innovates by considering the forecasting performance of a popular realized volatility model in which information is incorporated from 13 international stock markets (Taylor 2015). As a typical sophisticated system susceptible to information, stock markets in emerging economies like China requires further improvement. Thus, the research of the information spillover effect in China stock market, on one hand, would push up investment & financing efficiency and optimize social resource allocation; on the other hand, matters to market supervision and risk prevention (Brooks and Henxy 2002; Van and Weder 2001; Sola et al. 2002).

Western scholars have conducted tremendous in-depth researches on the information spillover effect in stock market. Scholars in early period were mainly aimed at the effect among stock markets in different regions, including Eun and Shim (1989), Hamao et al. (1990), Koutmos and Booth (1995) who focused on major stock markets in Europe and US. Later on, studies expanded to the effect among different financial products; for example, Hotchkiss and Ronen (2002) and Underwood (2009) developed research between stock market and bond market.

However, only a few studies were conducted on information spillover effect within stock market. These literature paid attention to primary market's effect on secondary market. For instance, Braun and Larrain directed an empirical study on emerging markets which explored that the growth of stock supply resulting from IPO would impose negative effect on stock prices in secondary market. Braun and Larrain (2009) discovered that obvious spillover effect surfaced on the stocks in the same industry, scale and holding close book-to-market value with the new issued stocks as well.

Little literature has been discovered to specialize in the effect from secondary market on primary market. Still one of the researches by Hoffmann (2001) stated that the to-be-listed enterprises and most investors owned incomplete information; while prices of the companies having been listed reflected common value factors recognized by industry and indicated values of peer companies. Alti (2005) affirmed that previously listed companies demonstrated private information commonly shared by corporations in the industry and resulted in information spillover effect. Ritter (2003) insisted that eased stock pricing for their subsequent listed peers and sparked an upsurge of developing IPOs.

Chinese scholars also employed researches on this topic related with domestic stock market. Having started late but progressed rapidly, studies by Chinese scholars experienced a similar development path. The focal point firstly drew on information spillover effect among stock markets in different regions and among different financial product markets: Hu and Peng (2008) concentrated on the effect between Shanghai and Shenzhen stock markets; Liu et al. (2008) also led the research among futures markets.

Before long the focal point shifted to stocks among boards and stock groups with different market values within secondary market: Yue and Ding (2009) worked on different industries in Shanghai stock market; Qu and Zhou (2011) were occupied in stock groups with different market values. Compared with foreign researches, information spillover effect between primary and secondary markets within stock market has been neglected by Chinese scholars.

In conclusion, researches on information spillover effect of stock market at home and abroad can be categorized into two aspects: the effect between stock market and other markets as well as the effect within stock market. Currently many researches have been carried out on the effect between stock market and other markets; while those on internal stock market were not that much. The existing researches about inner stock market could be further classified into three types:

(1) Information spillover effect of primary market on secondary market;

(2) Information spillover effect of stocks among boards and stock groups with different market values within secondary market;

(3) Information spillover effect of secondary market on primary market.

Among the three types, plenty of literature focused on (1) and (2); while only a few put an eye on (3). There has emerged no literature about real estate plate stock's information spillover effect on primary market so far. Nonetheless, it has been concluded that the foundation of information spillover effect was the correlation among markets. Accordingly, the author, from the perspective of information spillover, took relevant statistics since the latest IPO restart in January 2014 as research sample and conducted research on the information spillover effect by real estate plate stock in the secondary market on primary market's IPO through the method of Co-integration and Granger Causality Test.

RESEARCH METHOD

ADF stationary tests. The stationary of financial time series means stochastic process's characteristics of time series of variables generated are not time-varying. Let Y_t ($t \in T$) be time series, if it follows that $\forall t \in T, E(y_t) = u$; $\forall t \in T, t+h \in T, Var(\varepsilon_t) = \sigma^2$, $Cov(\varepsilon_t, \varepsilon_{t+h}) = \mu_h$, then it is stationary time series.

Unit root test is the standard method of stationary tests of financial time series, where ADF stationary tests are most commonly used. Unit root is a unit root process, which causes non-stationary time series. Let $Y_t = \rho Y_{t-1} + \varepsilon_t, t \in T$, If $\rho = 1$, ε_t is stationary time series and $E(\varepsilon_t) = 0, Var(\varepsilon_t) = \sigma^2, Cov(\varepsilon_t, \varepsilon_{t+h}) = \mu_h$, $\forall t \in T, t+h \in T$, then Y_t ($t \in T$) is a unit root process.

Lagged differences of Y_t are added to the right of regression equation for controlling high periods series correlation in ADF stationary tests. Let P be lag periods, then

$$\Delta Y_t = \eta Y_{t-1} + \sum_{i=1}^{p-1} \beta_i \Delta Y_{t-1} + \varepsilon_t \quad t \in T \tag{1}$$

$$\Delta Y_t = \alpha + \eta Y_{t-1} + \sum_{i=1}^{p-1} \beta_i \Delta Y_{t-1} + \varepsilon_t \quad t \in T \tag{2}$$

$$\Delta Y_t = \alpha + \psi_t + \eta Y_{t-1} + \sum_{i=1}^{p-1} \beta_i \Delta Y_{t-1} + \varepsilon_t \quad t \in T \tag{3}$$

$\alpha \in const$, ψ_t is linear trend function, $\eta = \rho - 1$. H0: $\eta = 0$; H1: $\eta < 0$

If $|\rho| < 1$, then Y_t is stationary time series.

If $\rho = 1$, then Y_t~AR(1) non-stationary time series.

If $|\rho| > 1$, then Y_t is divergent.

If H0 is refused, then no unit root in Y_t, Y_t is stationary time series. On the contrary, it's non-stationary time series. Therefore it is indispensible to test its differences successively until refusal of H0. What is more, lagged periods P needs to be ascertained in accordance with AIC criteria.

Johansen co-integration tests. Johansen Co-integration Tests are commonly used to verify whether long-lasting stable relationship exists between time series variables. Let.

$$Y_t = \phi_1 Y_{t-1} + \cdots + \phi_1 Y_{t-p} + HX_t + \varepsilon_t, t \in T \tag{4}$$

Subtract Y_{t-1}

$$\Delta Y_t = \zeta Y_{t-1} + \sum_{i=1}^{p-1} \omega_i \Delta Y_{t-i} + HX_t + \varepsilon_t, t \in T \tag{5}$$

Where $\zeta = \sum_{i=1}^{p} \phi_i - I, \omega_i = -\sum_{j=i+1}^{p} \phi_j$, The essence of the method is to test regression coefficients between time series variables through maximum likelihood estimation to transform the Co-integration tests into matrix analysis on ζ , including Trace test and Max-Eigen test.

(1) Trace test. On eigenvalues and eigenvectors of matrix ζ , there would be r max-eigenvalues and its r co-integration vectors, while the other eigenvalues of corresponding p-r non co-integration vectors, $\lambda_i = 0, i = r+1, \cdots, p$. Hence, trace test's null hypothesis H0: $\lambda_{r+1} = 0$ and alternative hypothesis H1: $\lambda_{r+1} > 0$ ($i = r+1, \cdots, p$). Trace statistic is δ_i :

$$\delta_i = -T \sum_{i=r+1}^{p} In(1-\lambda_i), i = 0, 1, \cdots, p-1 \tag{6}$$

If δ_i is less than threshold value at a significant level, then accept H0. Namely there would be not co-integration relationship; if not, then refuseH0.Namely there would be 1 co-integration vector at least, the significance of δ_{i+1} still needs to be tested.

(2) Max-Eigenvalues Test. Max-Eigenvalues statistic ($\lambda - \max$ statistic)

$$\gamma_i = -TIn(1-\lambda_i), i = 0, 1, \cdots, p-1 \tag{7}$$

If γ_i is less than threshold value at a significant level, then accept H0. Namely there would be not co-integration relationship; if not, then refuse H0. Namely there would be 1 co-integration vector at least, the significance of γ_{i+1} still needs to be tested.

Granger causality tests. Granger Causality Tests is the further research after long-lasting correlation of data such as Co-integration Tests and so on, aiming at verifying that whether the one time series causes the other one. The core of the method is that if Y causes X, then alteration of Y would be earlier than X. Namely, there would be regression equation between the lagged variables of Y and X. If so, then Y dose Granger Cause X.

$$Y_t = \sum_{i=1}^{n} a_i X_{t-i} + \sum_{i=1}^{n} b_i Y_{t-i} + \varepsilon_t \tag{8}$$

$$X_t = \sum_{i=1}^{m} c_i Y_{t-i} + \sum_{i=1}^{n} d_i X_{t-i} + \mu_t \tag{9}$$

The conclusion of Granger Causality Tests lies in whether coefficient a_i and c_i is equal to 0 by F test.

EMPIRICAL STUDY

Sample selection. So far, A-share primary market's IPO has been restarted in China for 8 times. The latest one happened in January 2014.Financing is the main function of primary market's IPO. We sum up raw data on IPO financing volume per week from January to December 2014.The raw data need to be processed by exponential smoothing for reflecting their alteration tendency better. Consequently, we select alteration ratio of IPO financing volume per week and alteration ratio of real estate plate stock index per week (Y_t and X_t) as research sample. Both of them are non-dimensional ratio indices, and stem from reset and wind database respectively.

ADF stationary tests. Table 1 shows that Probability of X and Y are less than 0.05 significantly, as reflects no one unit root for both of alteration ratio of IPO financing volume per week and alteration ratio of real estate plate stock index per week (Y_t and X_t). Namely, Y_t and X_t are stationary time series. Moreover, Y_t~AR (0) and X_t ~ AR (0), they can be conducted directly by Co-integration Tests and Granger Causality Tests.

Table 1.Augmented Dickey-Fuller Test Statistic.

Augmented Dickey-Fuller test statistic		t-statistic	Prob.*
Null Hypothesis: X has a unit root		-6.66427	0.00000
Null Hypothesis: Y has a unit root		-6.04947	0.00000
Test critical values	1% level	-3.56267	
	5% level	-2.91878	
	10% level	-2.59729	

Johansen co-integration tests. Above results of Trace Test and Max-Eigenvalue Test indicate commonly, on co-integration relationship between Y_t and X_t, Both P (none) and P (At most 1) are less than 0.05, hence, both of H0 are refused. There are 2 co-integration relationships between Y_t and X_t at least. However, in fact, there is only one co-integration relationship between them. Therefore, a long-lasting stable relationship exists between alteration ratio of the real estate plate stock index and alteration ratio of the IPO financing volume (see Table 2 and Table 3).

Table 2.Trace Test Statistic.

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.477311	46.88844	15.494710	0.0000
At most 1 *	0.279690	15.74752	3.841466	0.0001

Table 3.Max-Eigen Test Statistic.

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.477311	31.14092	14.264600	0.0001
At most 1 *	0.279690	15.74752	3.841466	0.0001

Granger causality tests. Table 4 shows that P(X dose not Granger Cause Y) = 0.0458 < 0.05, so H0 is refused and X Granger Cause Y. Moreover, P (Y dose not Granger Cause X) = 0.1894 > 0.05, so Y dose not Granger Cause X. In conclusion, a single causality relationship exists from X to Y. That is to say, any change in real estate plate stock index would trigger a variation in IPO financing volume.

Table 4.Granger Causality Tests (X and Y).

Null Hypothesis	Obs	F-Statistic	Prob.**
X dose not Granger Cause Y	48	3.08920	0.0458
Y dose not Granger Cause X		1.73020	0.1894

CONCLUSION

Our empirical results indicate that a long-lasting stable relationship exists between the real estate plate stocks in A-share secondary market and the IPO in primary market, and a single causality relationship exists from real estate stock index to IPO financing volume. That is to say, any change in real estate plate stock index would trigger a variation in IPO financing volume. It has been verified that performance of real estate plate stock in secondary market would impose significant information spillover effect on primary market's IPO latest restarted in China.

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Development Path Exploration of China's Housing Industry from the Perspective of Market Analysis

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Abstract

In order to alleviate the shortage of energy, minerals, water, land and other resources and change the extensive and labor-intensive construction mode, housing industrialization has been promoted by the Chinese government since 1999. However, China's housing industry is still on the initial development stage and more efforts should be devoted to exploring the implementation path of housing industrialization from the macro-level. To proceed from this point, this paper is committed to investigating the industrialized housing development patterns through analyzing the intrinsic relationship between supply and demand in the industrialized housing market. Then, combined with the China's current situation, the above analytical results are extended and applied for finding out the main developmental bottlenecks and more importantly formulating our development mechanism for China's long-term housing industry by means of causal loop diagram in the end.

INTRODUCTION

The traditional cast-in-situ construction mode has been blamed as one of the main reasons for causing a great deal of energy consumption and heavy pollution during housing construction process. Thus, in order to alleviate the shortage of energy, minerals, water, land and other resources and change the extensive and labor-intensive construction mode, housing industrialization has been promoted by the Chinese government since 1999 and achieved an initial development in the past 15 years in structural reliability, quality and safety control. However, the industrialized housing market has suffered a very slow development in China due to lack of motivation on both sides of supply and demand. On the demand side, the immature technology makes the superiority of the industrialized housing fail to be fully shown. On the supply side, the incremental construction cost and transaction cost, and the lack of policy incentives inhibit the supplier's participation and more willing to take a wait-and-see attitude. Therefore, it is in urgent need to investigate the industrialized housing development patterns from the perspective of the relation between supply and demand and thereby to find out the developmental bottlenecks in China and search for improvement measures.

As the housing industry abroad started earlier, its development has been more mature and many developed countries have formed their own unique development models. Consistently, earlier studies mainly from the macro-level focused on the housing industry's path selection and development strategies (Lara and Poon 2008), while recent studies have been more committed to empirical analysis (Chiang et al. 2006). In China, numerous studies are based on the foreign experience to obtain useful advice and methods for our reference. In recent years, academics have recognized the high incremental cost as the main cause for the slow development of housing industrialization in China (Liu et al. 2008). More and more studies are from the micro-level involved in estimating the industrialized housing cost-effectiveness with financial evaluation methods by comparing industrialized and traditional houses (Liang and Gao 2006; Lv 2011). However, the above comparison results are unpersuasive and lack of credibility due to the slow domestic development and the insufficient empirical data in China.

Comparing with the foreign countries, China's housing industry is still on the initial development stage and more efforts should be devoted to exploring the implementation path of housing industrialization from the macro-level. To proceed from this point, this paper is committed to investigating the industrialized housing development patterns through analyzing the intrinsic relationship between supply and demand in the industrialized housing market. Then, combined with the China's current situation, the above analytical results are extended and applied for finding out the main developmental bottlenecks and more importantly our development mechanism for China's long-term housing industry is formulated by means of causal loop diagram in the end.

BASIC CONCEPT

The concept of industrial housing comes from the housing industrialization, which was first proposed in the 1960s by the Japanese MITI. Chinese government first mentioned the concept of housing industrialization in 1994 (Tong 2010). The housing industrialization is to organize the housing construction and management through social production. It is market-oriented and supported by building material and other light industries. Through housing industrialization, a variety of housing components and parts, finished products, and semi-finished products are produced, transported and assembled on the site. In this way, the entire housing production process from design, component and part production, sales, after-sale services and other various links is integrated into a complete production and management form. Thus, a residential house produced and built in the above mentioned manner is called industrial housing (Guan and Li 1998).

MARKET SUPPLY AND DEMAND ANALYSIS OF INDUSTRIAL HOUSING

Just like other commodities, industrial housing will also experience a process from its emergence to being accepted by the whole society. In this paper, this development process is divided into three stages: infancy stage, development stage and mature stage. In the following sections, the three stages will be analyzed one by one and the entire development course will be summarized.

Basic assumption. (1) As the industrialization technology fundamentally changes the traditional construction mode, compared with the demanders, the suppliers will be much more influenced by the difference between industrialized houses and unindustrialized ones in the housing market.

(2) As no observable exterior features exist to distinguish industrial houses from the traditional ones, they are homogeneous commodities for demanders in the housing market. Therefore, here we assume that demand is stable, that is, the housing market demand curve is not changed with the industrialization development.

(3) Assume the housing market analyzed is perfectly competitive market which includes two mutually exclusive housings, i.e. traditional house (TH) and industrial house (IH).

Market analysis of industrial housing: infancy stage. When IH just enters the housing market, no other goods but TH exists for very long time and the relation between supply and demand is stable and mature. Due to the fundamental difference for IH in construction mode, IH suppliers need to have a large initial investment in purchasing production machinery and equipments. Moreover, owing to the lack of standardized design and production capacity, economies of scale are unavailable limited to the lower yields. Therefore, on the infancy stage, the IH incremental cost is significantly high comparing with TH.

In Figure 1, the housing demand curve D indicates that the demand decreases as prices rise. S_T and S_{PC} are the supply curves for traditional houses and industrial ones, respectively. Because of the high incremental cost for IH, at the same supply amount Q_0, the supplying price of IH P_1 is much higher than that of TH P_0. Considering supply changes are consistent with marginal cost changes, in infancy the marginal cost of IH is significantly higher than that of TH, so that S_{PC} possesses the greater slope comparing with S_T in Figure 1. It means that the IH suppliers are more sensitive to price rises.

On the infancy stage, although IH possesses many advantages, its promotion suffers developmental bottleneck due to too high incremental cost compared with TH. The relationship between supply and demand for TH is still stable and there is no sufficient motivation for IH's further development.

Market analysis of industrial housing: development stage. During the infancy stage, there has been an initial development in industrialization technology and industrial housing yields. However, due to inflation and the increasing labor cost, the construction cost for traditional houses continues to increase. Benefiting from the government's active promotion and demonstration, more and more people begin to understand and accept industrial housing.

In Figure 2, according to Assumption (2), the housing demand curve D is still unchanged. However, due to the increasing construction cost, the larger slope of

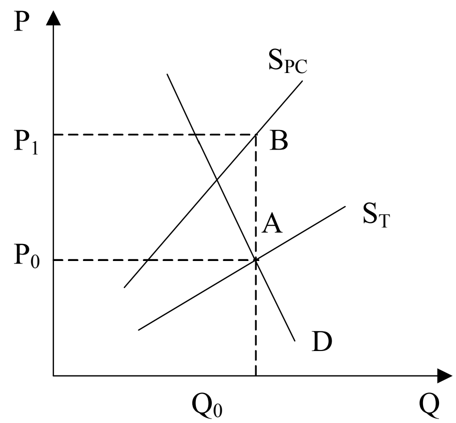

Figure 1.Relation between market supply and demand on infancy stage.

S_T is displayed as in Figure 2. Moreover, after the infancy stage, the number of IH will be continuously increased while the number of TH will inevitably be reduced based on Assumption (3). Thus, the supply curve S_T possesses the larger slope and shifts to the left on the development stage. On the other hand, owing to the gradually reduced construction cost, improved industrial housing quality and the emerging economies of scale, the supply curve S_{PC} possesses the smaller slope and shifts to the right on the development stage. Therefore, at the same supply amount Q_0, the price difference of the two houses is narrowed ($P'_0 > P_0, P'_1 < P_1$).

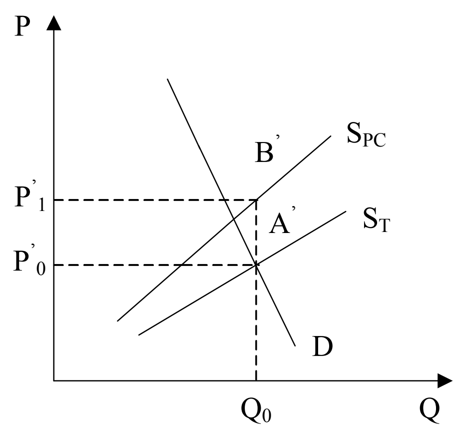

Figure 2.Relation between market supply and demand on development stage.

Therefore, during this stage, although P'_1 is still higher than P'_0, their difference is gradually narrowed and part of demanders is inclined to select IH. It means that the division of demand has occurred and the industrial housing market is gradually taking shape.

Market analysis of industrial housing: mature stage. Based upon the accumulation during the development stage, industrialization technology and economies of scale have been significantly improved. In Contrast, the construction cost of traditional houses continues to rise along with the gradually decreased demand. In this context, the mature stage starts.

In Figure 3, along with the unchanged housing demand curve D, compared with Figure 2, the supply curve S_T continues to increase and moves to the left. The slope of the supply curve S_{PC} is further reduced and moves to the right. From the development stage to the mature stage, the price of IH P''_1 is gradually moving close to the price of TH P''_0, and lower than the latter in the end at the same supply amount Q_0 as displayed in Figure 3.

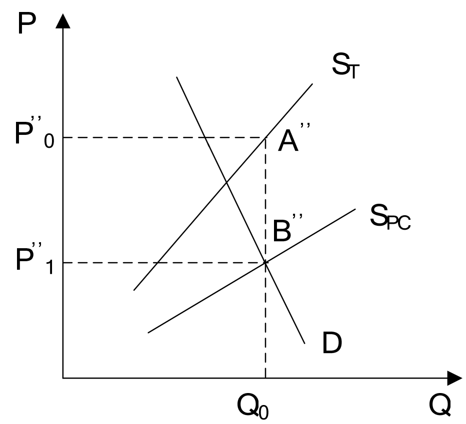

Figure 3.Relation between market supply and demand on mature stage.

During the mature stage, the industrial houses with lower price and better quality are gradually being favored by the demanders. The dual effect of increased cost and reduced demand makes the suppliers invest more in building IH but TH actively. Thus, the qualitative leap will occur and the industrial houses begin to displace traditional houses as the primary commodity on the market. Under certain extreme cases, IH will fully occupy the entire housing market and TH will be cast out of the market.

To sum up, through the whole process of the above three stages, the supply curve S_{PC} is gradually moving to the right and its slope is reduced little by little. In essence, the supply change reflects that the industrial housing, as a new commodity, experience the whole process from emergence to mature. During this process, the gradually improved technology and the reduced cost are the main active forces to push forward a fundamental change from quantitative to qualitative, along with the gradual demise of traditional houses.

PROMOTION MECHANISM DESIGN OF INDUSTRIAL HOUSING DEVELOPMENT IN CURRENT CHINA

Applying the above market analysis to China's current slow development of housing industry, we found that China's housing industry is still on the infancy stage. The relationship between supply and demand for traditional housing is still stable and there is no sufficient motivation for industrial housing's further development. Thus, during this stage, more efforts should be devoted to finding out the main developmental bottlenecks and thereby formulating long-term development mechanism for China's housing industry.

Development bottlenecks of housing industrialization in China. (1) The national standard system for industrial housing has not been issued yet so far in China. It is difficult to carry out large-scale precast production. Moreover, a detailed technical specification to guide the prefabricated assembly and construction is still in the preparation stage in China. The housing quality cannot be guaranteed.

(2) The entire housing production process includes design, component production, sales, after-sale services and in-sit assembly and construction. In China, there are still no super enterprises to perform the entire production process by alone. Also there is no multi-body coordination mechanism formed and implemented. The discrepancy in opinions from different participants has significantly increased transaction cost.

(3) The management mode is a fundamental change not only in construction methods but also in other aspects like project bidding, project valuation model, prefabricated parts production, quality control and final acceptance. A construction management mode applied to industrial housing has not been established yet. As the traditional construction management mode cannot be applied to the industrial housing production and construction.

(4) Unlike the traditional labor-intensive construction mode, the industrial housing requires professional and technical personnel at the construction site. There is a large lack of technical staff who know how to design and construction industrial houses in China.

Promotion mechanism design for industrial housing development in China. A causal loop diagram consisting of a set of nodes and edges aids in visualizing how different variables in a system are interrelated. Nodes represent the variables and edges are the links that represent a relation between two variables. A link marked positive indicates a positive relation, i.e. the two nodes change in the same direction. A link marked negative indicates a negative relation, i.e. the two nodes change in opposite directions. Closed cycles in the diagram are very important features of the CLDs. A closed cycle is either defined as a reinforcing or balancing loop. A reinforcing loop is a cycle in which the effect of a variation in any variable propagates through the loop and returns to the variable reinforcing the initial deviation. However, a balancing loop is the cycle in which the effect of a variation in any variable propagates through the loop and returns to the variable a deviation opposite to the initial. Counting the number of the negative links can determine if a causal loop is reinforcing or balancing.

The formation of an efficient industrial housing market can be described with a CLD including eight nodes and their links as shown in Figure 4. These nodes represent 8 variables, i.e. energy saving and emission reduction benefits, economic incentive intensity, other policy incentive intensity, incremental cost, industrial housing price, supply amount, demand amount and the number of housing transactions. By analyzing how these variables are interrelated in the system, 6 links among the above nodes are marked as positive and another 4 links marked as negative. The causal effect in an industrial housing market system promoted with policy incentives on the initial stage forms a positive reinforcing loop, which is essentially determined by industrial housing's positive externality of energy saving and emission reduction. Therefore, on the initial development stage, macroeconomic regulation and incentives are effective tools to stimulate the formulation of the efficient industrial housing market.

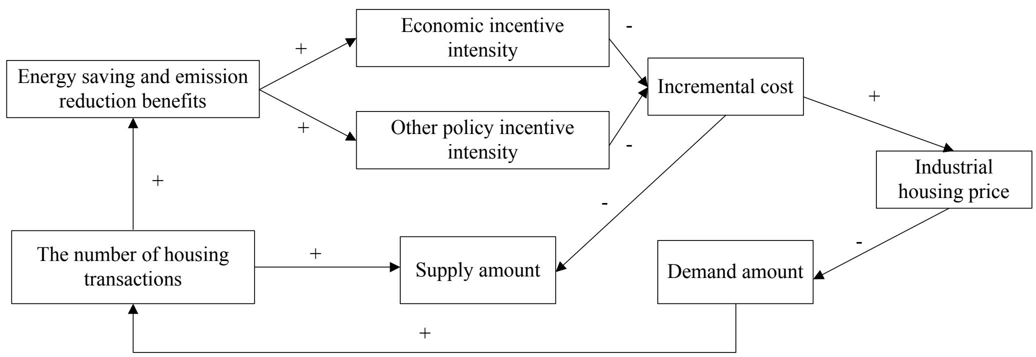

Figure 4.A causal loop diagram of the formation of industrial housing market.

Based upon the above causal loop diagram, to deal with the above four development bottlenecks, the government should start with establishing the national standards and technical specifications and positively developing leading enterprises and promote industrial chain integration. Then, relying on the government demonstration projects, multi-body coordination mechanism and project management mode are gradually established. Meanwhile, implementation of qualification exam for technical personnel in the industrial housing sector will be a usable way to improve the quality of technical personnel and strengthen the reserve forces. Basically, resorting to policy guidance and advocacy, the government should be dedicated to raising public awareness and establishing friendly industrial housing development environment.

More importantly, as industrial housing possesses a positive externality through benefiting the whole society, the government should be committed to formulate the adequate economic incentives to compensate the exorbitant incremental cost and promote large-scale construction. There are many ways to provide economic incentives, such as economic subsidies, tax relief and so on. Great efforts should be devoted to explore the most appropriate incentive offering method and its intensity by estimating the cost-effectiveness of the industrial housing in China.

CONCLUSION

Comparing with foreign countries, China's housing industry is still on the initial development stage and more efforts should be devoted to exploring the implementation path of housing industry from the macro-level. Firstly, the basic concept and the classification of the industrial houses are introduced in this paper.

Secondly, industrial housing development process is investigated through analyzing the intrinsic relationship between supply and demand in three development stages: infancy stage, development stage and mature stage. Thirdly, by applying the above market analyzing results to China's current situation, the infancy stage of China's housing industry is further confirmed and the development bottlenecks during this stage are found out. Finally, to preclude the above mentioned bottlenecks, the promotion mechanism applied to China's housing industry are analyzed and designed with a causal loop diagram. This paper is aimed at exploring the implementation path of housing industrialization from the macro-level and providing a theoretical support for the government's policy-making to ensure a sustainable long-term industrial housing development in China.

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Research on Customer Satisfaction in the Market of Pension Real Estate

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Abstract

Customer satisfaction of the products and service is an important source of competitive advantages of enterprises in the marketing of the pension real estate. First, this paper discussed the basic meaning of customer satisfaction. The customer satisfaction representative variable system based on the pension real estate market study was given, and a framework equation model was established. Then a survey of the pension real estate market customer satisfaction was designed, and the empirical analysis based on data and background of a project was conducted. The paper then discussed the intrinsic links among influencing satisfaction factors and their contributions to customer satisfaction. Finally, the marketing strategies of the pension real estate are proposed.

INTRODUCTION

With the increase of China's elderly population, the aging problem is a growing concern of the society. China has entered into an aging population era with the increase of the proportion of aging people, leading to many social problems: "empty nest" effect, disability of aging people and so on. However, government and families are insufficient to meet the huge demand for the services for the aged. So, the pension real estate, which is designed to offer services for the aged, has a huge room for development. According to the data of the national bureau of statistics in 2013, people over the age of 65 make up more than 10% of the total population with an annual 3.2 % increase rate. The demand the elderly care service is growing fast.

Pension real estate market is very different from the traditional real estate market. Technical barriers to the traditional real estate industry are relatively low, which attracts companies from other industries, giving rise to intense competition in the real estate market. The competitions among real estate exist in terms of brand, price, quality, service, location, room, and the environment. The competition mechanism can reduce the cost, meet the consumer demand and allocate the resource more reasonably by the rational development and utilization of land. Pension real estate is a kind of service as well as a product: first, the aged will enjoy the service, which is the core of the pension real estate. It's the key point which is different from the traditional real estate, covering the medical service, nursing, catering, entertainment, sports and so on. And these services required a professional organization. In summary, to win customers' satisfaction is particularly important for pension real estate companies to improve market competitiveness.

However, the development domestic service-oriented real estate remains in a preliminary stage, and the profitability of the industry is at a low level. Limited by the income of the aged, though the demand is huge, the purchasing power is limited which lead the long payback period. In addition, the policy for the elderly industry lies mainly in pension institutions and there are still many obstacles land development, health care and other area. In this context, the methods of traditional real estate are unable to satisfy the pension real estate.

Therefore, this paper attempts to use the marketing concept of customer satisfaction to study the current pension real estate market, establish a pension real estate customer satisfaction model, explore the links of different factors and contribute to the healthy development of the pension industry.

THE PENSION REAL ESTATE CUSTOMER SATISFACTION MEASUREMENT MODEL

Customer satisfaction. Oliver (1999) defined the customer satisfaction as customers' evaluations of a product or service with regard to their needs and expectations. Marketing researchers have paid more attention towards measurement of service quality to understand customer satisfaction. Both researchers and practitioners give more weight age to customer satisfaction, because, a high degree of customer satisfaction can lead to customer retention and increased market share (Yuksel and Yuksel 2002). In essence, E-retailing companies' managers need to know how to treat customers and to understand which factors (both tangible and intangible) affect customer satisfaction towards e-service quality (Hansemark and Albinsson 2004). Satisfaction is an emotional reaction to the difference between customers' expectation and what they actually receive (Geng and Chu 2012). In E-retailing, Anderson and Srinivasan (2003) describe electronic satisfaction as "the contentment of the customer with respect to his or her prior purchasing experience with a given electronic commerce firm". Prior researches have also indicated that customer satisfaction leads to customer loyalty Pont and McQuilken (2005). In addition to that, Gommans et al. (2001) proposed that e-loyalty comprises of brand value, trust and security, website and technology, and customer service. In a highly competitive e-commerce market, E-retailers need to create great service quality to target customers and over-satisfy them to retain those (Tan and Pawitra 2001).

Zeithaml et al. (1996) proposes two ways to measure customer satisfaction with the purchase behavior. First, customers are willing to recommend to others and be a positive word of mouth to behavior loyalty. Second, they are willing to pay higher price to get the product or service. This paper argues that, because of the special nature of the pension real estate products, there is a strong positive relationship between customer satisfaction and customer loyalty. The relationship between customer perception and customer satisfaction are as shown below (see Figure 1).

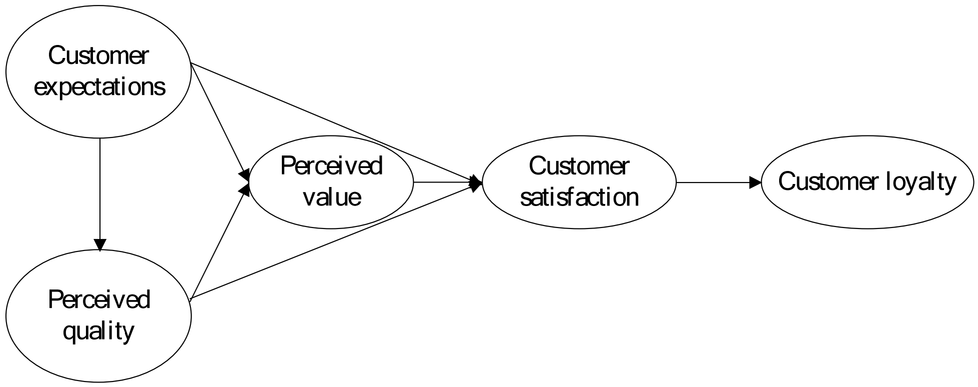

Figure 1.Customer satisfaction relational model diagram.

Characterization variables. Structural model of customer satisfaction is constructed by five variable compositions according to Ryglová and Vajčnerová (2005), which are customer expectations, perceived quality, perceived value, customer satisfaction and customer loyalty. These five variables are latent variables which cannot be measured directly. In this paper, based on the basic principles of behavioral science, combined with the actual situation in the pension real estate market, we explored the impact of customer satisfaction variables (see Table 1).

Table 1.Customer Satisfaction Model Variable System.

Latent variables	Significant variables
Customer expectations	Products, location and human environment Housing construction quality Furnishing status Architectural design and outdoor venues Medical, nursing, catering, entertainment and other ancillary services Overall expectations for developers (brand)
Perceived quality	Overall living environment Architectural design Project quality Public facilities Health care services Property management services
Perceived value	The product value Economic value Psychological value Emotional value
Customer satisfaction	Total Satisfaction The gap between expectations and realities The gap between the ideal products or services and the realities
Customer loyalty	The price increase endurance for a second purchase The possibility of recommending to others

Customer expectations include: location and human environment of products (including transportation, environment supporting such schools, hospitals and other basic support conditions for water coal electricity, environmental quality, public culture, etc.); housing construction quality; renovation status (condition level, style, etc.); architectural design and site design (public space and the environment, road network design, etc.); medical, nursing, catering, entertainment and other ancillary services (the level of quality of service); overall expectations for developers (brand).

Perceived quality (including product quality and service quality) according to Johnson et al. (2001) including: the overall living environment conditions (both natural and cultural); architectural design (public space design, interior design, physical environmental design, landscape design, etc.); project quality (architectural quality, the quality of windows and doors, the quality of water and electrical systems, etc.); public facilities (comprehensive, suitable); health care (attitudes, behavior and expertise); property management services (security, convenience, security, health, green, service attitude and quality, costs, etc.).

Perceived value, including: the product value (owner occupancy, quality, environment, full service facilities, architectural design, engineering, quality, etc.); the economic value (price, medical expenses, etc.); psychological value (buyers pay the time, energy, stamina, etc., brand reputation, quality of service); the emotional value (the degree of interaction with developers, product identity, the degree of satisfaction with the service, the degree of participation in community building).

Customer satisfaction: total satisfaction; the gap between expectations and realities on the whole; the gap between the ideal product or service and the realities.

Customer Loyalty: your endurance for the price increasing when buying again; to reduce the time of purchase, attractiveness for a lower price; the possibility of recommendation to others.

MEASUREMENT METHORDS

This research applies two methods that are qualitative and quantitative. The application of both methods is due to the problem of low customer satisfaction in the pension real estate, which is a complex problem so that to get a comprehensive discussion needs more than one research method. Quantitative method uses survey and qualitative method uses Focus Group Discussion (FGD). The sample of this research is as much as 270 respondents, consists of the aged from thirteen retired apartments in Wuhan Province. The analysis method is descriptive with SPSS and inferential with Structural Equation Modeling (SEM) using LISREL 8.54 software. Construct measurement in this research adopts previous researches. For service quality variable, the researcher adopted from Kim et al. (2007), mooring factor from Bansal et al. (2005), relationship quality from Hollensen (2003), customer satisfaction from Barnes (2001), and customer loyalty from Oliver (1999). The measurement uses Likert scale ranged from 1 to 5. Based on the pretest it is concluded that all indicators from studied construct are valid and reliable.

In the structural equation model, the path model with latent variables representing three relations which are internal relations, external relations, and the relationship between the weights. Internal relations, said the relationship between latent variables, equation describing this relationship is called structural equation;

external relations, said the relationship between the variables used to observe significant latent variables and latent variables, termed equations describing this relationship to measure the equation; the relationship between the weight estimate for the value of the latent variables. A path model is shown below (see Figure 2).

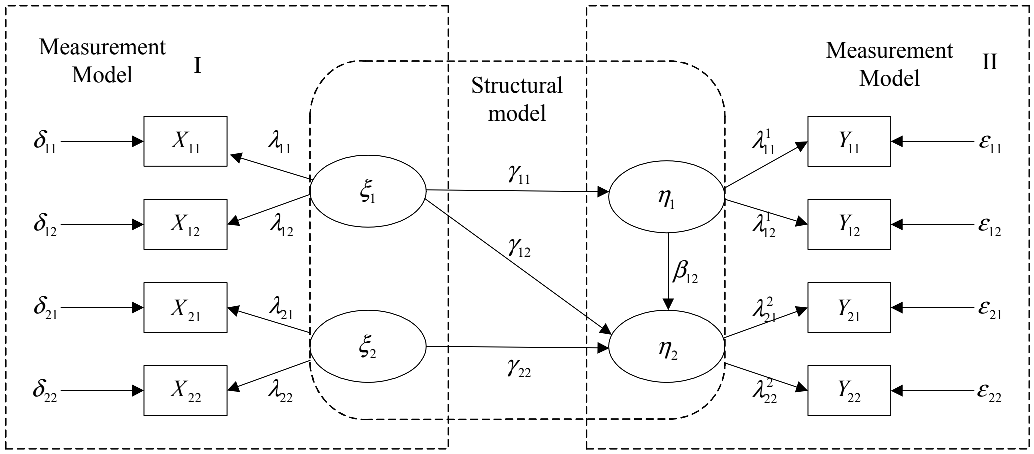

Figure 2.Structural equation modeling.

Internal relationship is described by the relationship between conceptual, empirical or theoretical significance of latent variables. The mathematical expression of the structural equation is:

$$\eta=B\eta+\Gamma\xi+\zeta \tag{1}$$

The external relationship is significant between the observed variables and latent variables latent variables. The mathematical expression of the measurement equations is:

$$Y=\Lambda_{y}\eta+\varepsilon \tag{2}$$

$$X=\Lambda_{x}\xi+\delta \tag{3}$$

MODEL ANALYSIS

In this study, a questionnaire was conducted with Likert5 grade scale, in order to evaluate investigators' options reasonably. When the option is more than 5 scales, the average person is difficult to have enough ability to identify, especially in the aged. In order to test the consistency and stability of the design of the questionnaire, we use a pre-study approach to examine the reliability of the questionnaire. Meanwhile, respondents had to communicate with those further to express and modify the wording of the questionnaire items, eventually forming a high-quality formal questionnaire (see Table 2). The results of this study provide empirical analysis.

The study also uses Cronbach's coefficient test to estimate the validity of the questionnaire. CITC index is attributed to a particular structure of a provision judge whether a variable has a good internal consistency or whether it is a good indicator. Standard reliability test screening program must be set up before they can remove this item (Lu 2002): revised total correlation coefficients (each item score and score the remaining items between correlation coefficient that CITC) of less than 0.3; delete this item to improve the overall reliability.

Table 2.Customer Satisfaction Structural Equation Model Variable System.

Latent variables	Significant variables
Customer expectations (ξ_1)	ξ_{11}: Expectations of the products and human environment
	ξ_{11}^1: Expectations of products
	ξ_{11}^2: Expectations of location
	ξ_{11}^3: Expectations of human environment
	ξ_{12}: Expectations of furnishing status
	ξ_{13}: Expectations of services
	ξ_{13}^1: Expectations of Medical
	ξ_{13}^2: Expectations of catering
	ξ_{13}^3: Expectations of entertainment
	ξ_{13}^4: Expectations of other ancillary services
	ξ_{14}: Expectations of design
	ξ_{14}^1: Expectations of Architectural design
	ξ_{14}^2: Expectations of outdoor venues
	ξ_{15}: Expectations of Overall expectations for developers (brand)
Perceived quality (ξ_2)	ξ_{21}: Living environment
	ξ_{22}: Architectural design
	ξ_{23}: Project Quality
	ξ_{24}: Public facilities
	ξ_{25}: Health care services
	ξ_{25}^4: Property Management Services
Perceived value (η_1)	η_{11}: The Product Value
	η_{12}: Economic Value
	η_{13}: Psychological value
	η_{14}: Emotional value
Customer satisfaction (η_2)	η_{21}: Total Satisfaction
	η_{22}: The gap between expectations and realities
	η_{23}: The gap between the ideal products or services and the realities
Customer loyalty (η_3)	η_{31}: The price increase endurance for a second purchase
	η_{32}: The possibility of recommending to others

70 survey questionnaires were distributed at prestage and returned 70 copies, 60 of which were valid questionnaires. Sample distribution is: male at 38%, female at 32%; age distribution mainly between 40-70. Pre-survey sample distribution is reasonable. Cronbach's coefficient is 0.9055, indicating the reliability of the questionnaire is very good. After deleted the overall reliability of the project is less than 0.3. Thus, in the final questionnaire, 21 items were adopted to measure customer satisfaction. The customer satisfaction structural equation model is shown as below (see Figure 3).

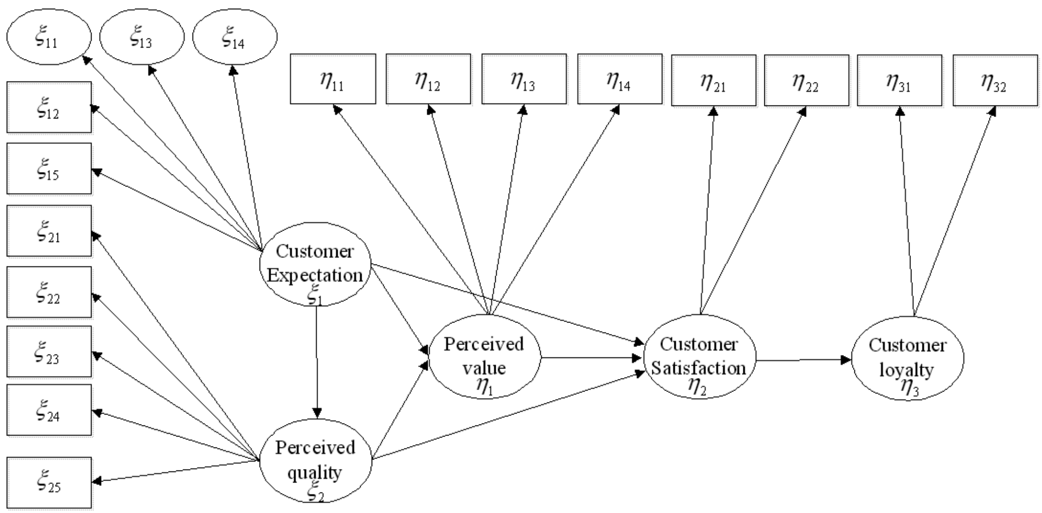

Figure 3.Customer satisfaction structural equation model.

CONCLUSION

In the customer satisfaction study, we used the structural equation methodology and achieved great success. The range of applications for the enterprise covers the macro and micro-economic level of each country. Performance of the SCSB, ACSI Customer Satisfaction Index is outstanding, accelerating the customer satisfaction research in enterprise as the basis of causal model. The study of structural equation in the customer satisfaction measurement system has become a prevailing technology method. Enterprise Implementation of measures is beneficial to achieve sustained customer satisfaction. As the core of customer satisfaction research methods, structural equation has a significant impact on customer satisfaction measurement. However, due to the limitations of the method, the data can only be based on ex-post evaluation of the current customer satisfaction, indicating a qualitative improvement. Customer Satisfaction Measurement Methods estimated for extended study in advance. Choosing an effective improvement program has become an important direction for enterprise-class customer satisfaction research.

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The Impact of Diversification Strategy on a Firm's Value in Real Estate Listed Companies: From the Perspective of Capital Investment

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Abstract

From the perspective of capital investment, this paper studies the impact path and mechanism for diversification strategy on firm value in real estate listed companies. The results show that there are two kinds of agency problems in diversified companies. One exists between shareholders and top management, and the other is between top management and department managers. Because of the problems, diversification always leads to over-investment, which makes marginal value of capital investment decrease. This conclusion not only expands the research framework of the relationship between diversification strategy and firm value in theory, but also provides new decision evidence for management and investors in practice.

INTRODUCTION

Diversification strategy is an important growth strategy, which has long-term impact on companies' development. More and more companies choose diversification strategy in China. Zhang and Gao (2010) found that the proportion of diversification companies is 75.78% from 2001 to 2008. Because of the importance and universality of diversification strategy, the issue on how diversification affects firm value has received more attention by scholars (Hong and Xiong 2006; Sukpanich and Rugman 2007).

Current studies on the impact of diversification strategy on firm value have different results. Some scholars consider that diversification strategy can increase enterprise value. Tanriverdi and Venkatraman (2005) found that diversification can bring scale economies and coordinate resource effectively. Williamson (1986) and Su (2005) found that diversification could create internal capital market and realize the optimal allocation of funds. Conversely, some scholars consider that diversification strategy can decrease enterprise value. Jensen (1986), Li and Jiang (2009) found that agency problem existed between shareholders and managers, which could lead to over-investment and reduce enterprise efficiency. Stulz (1990), Shin and Stulz (1998) found that the internal capital market in diversification companies was always ineffective and the funds were not applied to the project with positive net cash flow. Hence, though the study on the impact of diversification strategy on firm value has abundant achievements, it hasn't obtained final conclusion. The main reasons are as follows. Firstly, most studies always analyzed the direct relationship between diversification and firm value, not considering the influence path (Venkatraman 1989). Secondly, most studies didn't consider industry characteristics.

Given this, this paper studies the impact path and mechanism for diversification strategy on firm value in real estate listed companies, from the perspective of capital investment. And there are main three contributions about the paper. Firstly, the paper expands the research framework about this field. Secondly, the paper explains the source of diversification impacting on firm value fundamentally from the perspective of capital investment. Thirdly, the paper receives empirical conclusion that diversification can decrease firm value by using econometric models, which can provide decision evidence for management and investors in practice. The structure of this paper is as follows. The second part is theoretical analysis and research hypothesis. The third part is research design. The forth part is empirical analysis. The fifth part is conclusion.

THEORETICAL ANALYSIS AND HYPOTHESIS

Diversification is a development strategy that the enterprise carries on two kinds or more than two kinds of business. Therefore, diversified enterprises will have many business units, and the business unit's manager becomes a typical stakeholder with shareholders and top management together (Munoz-Bullon and Sanchez-Bueno 2012). On the basis of rational economic man, different stakeholders have different interest demands, which can lead to agency problem (Shleifer and Vishny 1989). In diversified enterprises, the agency problem can be divided into two hierarchies. The first hierarchy is agency problem between shareholders and top management, and the second one is between top management and business unit's manager (Park and Jang 2012).

Diversification strategy and capital investment. Firstly, the paper analyzes the relationship between diversification strategy and capital investment. The first hierarchy agency problem will affect the amount of capital investment. Shareholder is the enterprise's owner, who has decisive effect on enterprise's investment policy. Shareholder will determine a best investment amount (I*) to make their wealth maximization, according to current financial situation and future investment opportunity. Actually, the best investment may not be fully attained. The real investment (I) may deviate from the best one (I*). The main reason is the separation of ownership from management. Jensen (1986) considers that shareholder doesn't manage the business and top management will control companies' major events. Driven by personal benefit, the top management may make investment decision which won't help companies' development. In this case, the investment in diversified companies is an opportunistic behavior. Jensen and Meckling (1976) consider that the top management tends to seek personal benefit by diversification because it can bring profit to management. Firstly, diversification can increase management's remuneration. Liu (2009) considers that management's remuneration is always closely related to companies' scale. So management will pay more attention to the enterprise's scale not to firm value. Diversification is as an effective way to realize growth and top management may be likely to over investment. Secondly, diversification can bring rights and reputation to top management. Qin and Chen (2004) consider that high capability always matches complex organization. Compared with specialization, diversification's organization is more complex. In order to obtain more public awareness and reputation, top management tends to carry out diversification. When top management move into new field, they prefer to choose the business they are good at. So the choice and implementation of diversification always depend on management's subjective attitude. The real investment will exceed the best one. Thirdly, diversification can bring more opportunity for them to entrench interest. The main interest conflict between shareholders and management is cash payment (Meyerson 1982; Shin and Stulz 1998). The amount of paying to shareholders directly affects the rights of management controlling funds. So diversification may be as a "just reason" for management to use cash, which can increase their controllability to free cash flow.

So because that diversification can bring benefit to top management, they are apt to choose diversification strategy. And then the real investment (I) will be greater than the best one (I^*), i.e. $I > I^*$. Hence, the paper puts forward hypothesis 1:

Hypothesis 1: The higher diversification degree, the more serious over investment.

Diversification strategy, capital investment and firm value. In diversified companies, the first and second hierarchy agency problem both can affect margin capital investment value.

Firstly, the agency problem between shareholders and top management can affect the real investment amount (I). As mentioned above, because of the first hierarchy agency problem, diversification is not made by scientific decision but by the interests driving of top management. So diversification may not create synergistic effect and result in firm value decrease. At the same time, because that real investment amount exceeds the best one, the real margin capital investment value will also decrease.

Secondly, the agency problem between top management and business unit's manager can affect the real investment of every unit ($I_1/I_2 \ldots I_n$). At the basis of total investment, top management will allocate the investment to every unit, which is a game process. The internal capital market in diversified companies can guide the fund allocation under management's authority and power. Scharfstein and Stein (2000) consider that shareholders always pay attention to total investment not every unit's, and business unit's manager is only executor not decision-maker. So the top management controls the allocation of investment actually. In this situation, top management will allocate investment to realize their benefit maximizing, i.e., their expected investment allocation is $I_1^*/I_2^* \ldots I_n^*$. Actually, the real investment allocation ($I_1/I_2 \ldots I_n$) may not be the same with the top management's expectation ($I_1^*/I_2^* \ldots I_n^*$).

It is because that business unit's manager is also an economic man and they may seek benefit through rent-seeking activity in investment projects. Scharfstein and Stein (2000) found that business unit's manager may spend a lot of time on the activity irrelevant to companies' operation to increase their opportunities of joining in other companies or decrease the ability of external manager entering the existing company. For example, they may attend meetings unrelated to companies' operation or accept speeches unnecessary, which can increase their awareness. Perhaps, they set internal accounting system which is excessive opacity to hide important information, preventing successor instead of them. Without a doubt, rent-seeking activity will take business unit's manager's plenty of time and companies' operating efficiency will be adversely affected. To solve this problem, top management has two methods. One is dismissing the business unit's manager who takes rent-seeking activity, and the other is conceding to them. In general, top management always adopts the second method because that the first will lead to more cost. If top management dismisses business unit's manager, they have to hire, select and train the new managers again, which will spend much time and money. And the new managers may take rent-seeking activity either. So the loss of hiring unit's managers may be far higher than the cost of retaining them. Top management prefers to try to negotiate with the unit's manager, and satisfies their needs of investment to persuade them to give up taking rent-seeking activity. As thus, the investment allocation ($I_1^*/I_2^*\ldots I_n^*$.) top management expected will be changed. To prevent unit manager's rent-seeking, top management will give the renter more investment, i.e., $I_m > I_m^*$ (m is the business unit which is ready to rent). On the whole, the ultimate total investment (I') is greater than real investment after the first hierarchy agency problem (I), i.e., $I' > I$. It means that the over-investment is even more serious after considering the second hierarchy agency problem. And the investment efficiency, margin capital investment value and firm value will be lower, which also is called "diversification discount". Hence, the paper puts forward hypothesis 2:

Hypothesis 2: The higher diversification degree, the lower margin capital investment value.

RESEARCH DESIGN

Data sources and sample selection. The paper chooses real estate listed companies from 2009 to 2013, and filters them based on the rules as follows: (1) Reject listed companies whose index is missing. (2) Reject listed companies which were ST or PT from 2009 to 2013. At last, the paper chose 65 companies and all the data were from CSMAR, RESSET and financial reports.

Variable definition and model design. The paper uses annual stock excess return (AR) to measure firm value $AR = \prod_{t=1}^{12}(1+R_{it}) - \prod_{t=1}^{12}(1+R_{mt})$.

R_{it} means the real monthly returns of the i company in the t month. R_{mt} means the monthly returns after weighting by circulated stock value. It uses entropy method to measure diversification degree (Div) $Div = \sum p_j Ln(1/p_j)$.

p_j means the proportion of the income in *j* business unit in total income. It uses the proportion of long-term assets (fixed assets, intangible assets and other long-term assets) in total assets to measure capital investment (*Inv*). And then the paper designs empirical model.

Firstly, the paper designs over-investment measurement model. The real capital investment (*Inv*) includes two parts: the best capital investment (Inv^*) and over-investment (ΔInv). So if we can find Inv^*, we can figure out ΔInv. Based on research about Richardson (2006), Inv^* is depended on cash flows from operating activities (*Cf*, divided sum of net profit, depreciation and amortization by the difference between total assets and cash and cash equivalents), investment opportunities (*Ino*, divided market value book value), return on equity (*Roe*, divided net profit by net asset), financial leverage (*Lev*, divided total liability by total assets), companies' size (*Size*, *Ln* total asset), share ratio of the largest shareholder (*Shr*, the proportion of the largest shareholder's stock in total stock) and the year (*Year*, when it is this year, denoted by 1; or denoted by 0). As shown in equation (1) and (2):

$$\Delta Inv = Inv - Inv^* \tag{1}$$

$$Inv^* = \alpha_0 + \alpha_1 Cf + \alpha_2 Ino + \alpha_3 Roe + \alpha_4 Lev + \alpha_5 Size + \alpha_6 Shr + \sum_{r=1}^{4} \alpha_{r+6} Year + \varepsilon \tag{2}$$

Secondly, the paper designs model about relationship between diversification strategy and over-investment. The control variables contain return on equity (*Roe*), financial leverage (*Lev*), companies' size (*Size*), and the year (*Year*). As shown in equation (3):

$$\Delta Inv = \beta_0 + \beta_1 Div + \beta_2 Roe + \beta_3 Lev + \beta_4 Size + \sum_{r=1}^{4} \beta_{r+4} Year + \varepsilon \tag{3}$$

Thirdly, the paper designs model about the relationship among diversification strategy, capital investment and firm value. The control variables contain return on equity (*Roe*), financial leverage (*Lev*), share ratio of the largest shareholder (*Shr*), companies' size (*Size*), and the year (*Year*). As shown in equation (4):

$$\begin{aligned} AR = {} & \gamma_0 + \gamma_1 Div + \gamma_2 Inv + \gamma_3 Div * Inv + \gamma_4 Roe + \gamma_5 Lev \\ & + \gamma_6 Shr + \gamma_7 Size + \sum_{r=1}^{4} \gamma_{r+7} Year + \varepsilon \end{aligned} \tag{4}$$

RESEARCH DESIGN

Descriptive statistical analysis. Firstly, the paper does descriptive statistical analysis (see Table 1). From Table 1, we could find that: (1) The minimum and maximum of AR is -1.139 and 3.256, and the standard deviation is 0.717. It means that there are larger differences about the firm value among real estate listed companies in China. (2) The minimum and maximum of Div is 0 and 1.589, and the standard deviation is 0.425. It indicates that the diversification degree in companies is high and imbalance. (3) The minimum and maximum of Inv is 0.014 and 0.532. It means that there are larger differences about capital investment among companies. (4) The statistics of every control variables are all different among companies. It means that it is necessary to consider these factors. On the whole, the descriptive statistical analysis result provides much data support on the feasibility of this research.

Table 1.Descriptive Statistical Analysis.

	Mean	Min	Max	Sd.
AR	0.168	-1.139	3.256	0.717
Div	0.426	0.000	1.589	0.425
Inv	0.156	0.014	0.532	0.147
Cf	0.065	-0.318	0.621	0.067
Ino	2.338	0.529	9.827	1.422
Roe	0.127	-0.389	0.537	0.105
Lev	0.621	0.081	0.921	0.163
Shr	0.349	0.044	0.837	0.167
Size	21.680	19.520	26.170	0.933

Correlation analysis. Secondly, the paper does Pearson correlation coefficients analysis (see Table 2). From Table 2, we could find that Div has negative correlation with AR ($p < 0.01$), supporting Hypothesis 2. Capital investment has negative correlation with AR ($p < 0.05$), which means that over investment exists in the real estate listed companies generally. All the control variables all have correlation with AR ($p < 0.1$), which means it's appropriate to consider these factors. Remarkably, many independent variables have correlation, so we should avoid multicollinearity and endogenous in the next analysis.

Table 2.Pearson Correlation Coefficients Analysis.

	AR	Div	Inv	Cf	Ino	Roe	Lev	Shr	Size
AR	1.000								
Div	-0.095 ***	1.000							
Inv	-0.128 ***	0.056 **	1.000						
Cf	0.163 ***	-0.038 **	0.212 ***	1.000					
Ino	0.394 ***	0.021	0.033 *	0.325 ***	1.000				
Roe	0.221 ***	-0.046 **	-0.212 ***	0.785 ***	0.244 ***	1.000			
Lev	0.018	-0.036 *	0.040 *	-0.326 ***	-0.218 ***	-0.071 ***	1.000		
Shr	-0.055 *	-0.125 ***	0.148 ***	0.133 ***	-0.127 ***	0.119 ***	0.011	1.000	
Size	0.035 *	-0.072 **	0.193 ***	0.136 ***	-0.167 ***	0.241 ***	0.303 ***	0.314 ***	1.000

Notes: *** means $p < 0.01$, ** means $p < 0.05$, * means $p < 0.1$.

Regression analysis. Thirdly, the paper does multiple regression analysis (see Table 3). Based on the model, estimate the best capital investment (Inv*) firstly, as shown in Model (a). The result shows that Inv* has positive correlation with Cf ($p < 0.01$), and also has positive correlation with Ino ($p < 0.05$). It means that the more cash flow, the more ability to invest. And the more investment opportunities, the more likely for enterprises to invest. Next subtract Inv* from Inv and get over-investment (∆Inv).

Table 3.Regression Analysis among Diversification Degree, Capital Investment and Firm Value.

	Inv* Model (a)	∆Inv Model (b)	AR Model (c)	AR Model (d)
Constant	-0.036* (-1.73)	-0.075*** (-3.12)	-1.456* (-1.78)	-1.638** (-1.89)
Div	—	0.017*** (4.11)	-0.116*** (-3.72)	-0.092*** (-2.66)
Inv	—	—	-0.702*** (-2.53)	-0.685** (-2.14)
Inv*Div	—	—	—	-1.269*** (-2.60)
Cf	0.207*** (5.84)	—	—	—
Ino	0.005** (1.99)	—	—	—
Roe	0.020* (1.92)	0.016* (1.74)	1.560*** (8.72)	1.534*** (8.22)
Lev	0.029*** (3.53)	-0.016 (-1.55)	0.148 (1.45)	0.151 (1.55)
Shr	0.020*** (3.15)	—	-0.172** (-1.98)	-0.176** (-2.01)
Size	0.005** (2.45)	0.005*** (2.72)	0.069* (1.78)	0.085** (2.10)
Year	controlled	controlled	controlled	controlled
Vif	1.83	1.06	1.11	1.51
Adj-R^2	0.258	0.212	0.237	0.245
F value	28.36***	23.22***	21.81***	20.09***

Notes: *** means $p < 0.01$, ** means $p < 0.05$, * means $p < 0.1$.

Then take regression analysis between diversification degree and over-investment, as shown in Model (b). The result shows that Adj-R2 is significant and Vif is less than 10. So there is no multicollinearity in the model. Based on this, examine the significance of variables. The result shows that Div has positive correlation with ∆Inv ($p < 0.01$), which means that diversification strategy will result in over-investment more easily, supporting Hypothesis 1. Next take regression analysis among diversification degree, over-investment and firm value, as shown in Model (c) and (d). In Model (c), we can examine the relation between Div and AR when not considering the cross term of Div and Inv. The result shows that Adj-R2 is significant and Vif is less than 10. And Div has negative correlation with AR ($p < 0.01$), which supports "diversification discount". Then in Model (d), examine the relation between Div and AR when considering the cross term of Div and Inv. The result shows that Adj-R2 is significant and Vif is less than 10. And Div has negative correlation with AR ($p < 0.01$), which supports "diversification discount" further. Except this, Inv has negative correlation with AR ($p < 0.05$) and Div*Inv has negative correlation with AR ($p < 0.01$). It means that the increase of capital investment will result in the decrease of firm value, and diversification strategy will aggravate this decrease. So on the whole, the increase of diversification degree will result in the decrease of firm value, supporting Hypothesis 2.

To verify the above result reliable, the paper does robustness test at last. It chooses the number of business units to measure diversification degree. The result of robustness test shows that the sign and significance level of main variables don't change.

CONCLUSION

From the perspective of capital investment, this paper studies the impact path and mechanism for diversification strategy on firm value in real estate listed companies. The results show that diversification strategy has negative influence on firm value and this influence is realized by efficiency of capital investment. Compared to specialized companies, there are two kinds of agency problems in diversified companies. One exists between shareholders and top management, and the other is between top management and department managers. Because of the problems, diversification always leads to over-investment, which makes marginal value of capital investment decrease. The paper expands the research framework of the relationship between diversification strategy and firm value in theory. And it also explains the source of diversification impacting on firm value fundamentally from the perspective of capital investment, which provides new decision evidence for management and investors in practice.

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Evaluation of the Real Estate Economic Development Level in Heilongjiang Province Based on Factor and Cluster Analysis

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Abstract

The development of the real estate industry in Heilongjiang province was very fast in the last few decades, however, the development level in different regions was unbalanced, which needed policymakers' special attention when making industrial policies for the whole province. But firstly and most importantly, we need to make sure the exact development level of each city. In order to solve this problem, appropriate evaluation index of the real estate economy was constructed in this paper, and based on factor and cluster analysis, this study analyzed the 12 main cities in Heilongjiang province quantificationally and classified them into 5 categories. For each single category, analysis and evaluations were made and relevant conclusions were obtained. At the end of the paper, some comments and suggestions were offered to help improve the development of the real estate industry.

INTRODUCTION

Real estate industry is the basic and crucial industry of domestic economy and plays an irreplaceable role in stimulating regional economy growth (Wang and Chen 2014). Over the past few decades, with the explosive economic growth in our country, the real estate industry of Heilongjiang is also booming (Wu and Guo 2014). Real estate industry has played an important role in promoting the economic growth in Heilongjiang province (Zhang 2005; Chen and Shi 2005; Zhang and Tang 2013). By now, the investment in real estate is growing rapidly, the housing market system is becoming more mature, and the investment structure of real estate industry is becoming much more reasonable in Heilongjiang (Chen and Lei 2005).

However, we should also note that there are significant differences in both the level and the rate of the development of real estate economy among the 12 main cities in Heilongjiang province, which shows the province's uneven development in real estate industry. Therefore, a research on the evaluation of the real estate economic development level of Heilongjiang province is of high significance if we want to ascertain the specific developing discrepancy of real estate economy in different regions and help to make the macro-control policies to guide the development of real estate industry in Heilongjiang.

CONSTRUCTION OF THE EVALUATION INDEX SYSTEM

In order to evaluate the real estate economic development level, selecting the evaluation index is a basic premise. Different researchers select different evaluation indexes for different research purposes. Feng (2000) chose the investment of real estate industry, the real estate sales, the real estate developing cost, the condition of real estate development corporations, the output of real estate enterprises and the scale of real estate development as the indicators to evaluate the real estate economic development level. Guo (2007) shose the housing price and the investment and construction in real estate industry as the two indicators to analyze the development differences of real estate economy among different regions in Guangdong province. Some other researchers like Peng and Hu (2006), Shang and Li (2008) and Han and Wu (2011) selected other indicators in their research, which are similar to Feng's selection. When selecting the indicators, there are some principles to be followed.

Principles for the selection of the evaluation index. Before we make a comprehensive evaluation of the real estate development, a standard must be set so that the indicators we choose can synthetically reflect the development level of the real estate economy. Shang and Li (2008) concluded that the selection of the indicators should follow the following principles:

(1) The overall principle. The evaluation index system should not only reflect all aspects of the real estate development, but also should avoid overlap so that it can perfectly reflect the evaluation goals.

(2) The scientific principle. The establishment of the index system should be scientific, which means the meaning of the indexes must be specific, the structure of the indexes must be clear, and standard methods must be used to measure the indexes.

(3) Feasibility principle. The indexes selected must be comprehensive and important indicators which can reflect the real development level of the real estate industry and at the same time, the availability and reliability of the data should be considered.

Construction of the index system. According to the above-mentioned index selecting principles, combined with the research findings by predecessors, a three-grade evaluation index system is built in this paper. The specific indicators and their relationships are shown in Table 1.

EMPIRICAL ANALYSIS

Combined with the specific data, in this section, we will evaluate and analyze the real estate development level of the 12 main cities in Heilongjiang province through factor analysis and cluster analysis. SPSS 16.0 is used here and the data used in this paper comes from Heilongjiang Statistical Yearbook 2012 (HBS 2012).

Principle of factor analysis. Factor analysis is a multivariate analysis method which converts the measurable and highly correlated original variables into a few comprehensive factors (He 2004). There are two kinds of factor analysis method: type R factor analysis and type Q factor analysis. The former concentrates on the correlation between the research variables, the later focus on the correlation between the research cases. In this paper, the type R factor analysis is used.

Table 1.Evaluation Index System of Real Estate Economic Development Level.

First grade assessment indicator	Second grade assessment indicator	Third grade assessment indicator
Real estate economic development level	Investment and construction indicators	Enterprises' completed investment X_1 (100 million) Enterprises' capital source for real estate development X_2 (100 million) Floor space under construction X_3 (10000 sq.m) Floor space completed X_4 (10000 sq.m)
	Real estate sales indicators	Floor space of commercialized buildings sold X_5 (10000 sq.m) Total sale of commercialized buildings X_6 (100 million)
	Real estate development enterprise indicators	Number of enterprises for real estate development X_7 (unit) Number of employed persons for real estate development X_8 (unit) Revenue from principle business X_9 (100 million) Total profits X_{10} (100 million)

Standardization and positive management of the data. The indicators selected in this paper are all positive, so there is no need for the positive processing of the data. SPSS16.0 will normalize the data automatically to eliminate the influence of the data dimension and numerical value.

The detailed analysis process. First of all, we have to make a test to ensure that the factor analysis is suitable for this study. Just as it is shown in Table 2, the KMO and Bartlett's Test indicates that the data is suitable for this research, which means there is a strong correlation between the original variables.

Table 2.KMO and Bartlett Test.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin measure of sampling adequacy		0.720
Bartlett's test of sphericity	Approx. Chi-Square	282.087
	df	45
	Sig.	0.000

The total variance explained and the rotated component matrix are respectively shown in Table 3 and Table 4. From Table 3, three common factors are extracted according to the principle: the cumulative variance contribution is higher than 85%.We can mark them as F_1, F_2, F_3. The cumulative variance contribution of the three factors is 98.419%, very close to 100 percent, which indicates that the method we used is valid.

Table 3.Total Variance Explained.

Component	Initial eigenvalues			Rotation sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.900	89.005	89.005	4.198	41.978	41.978
2	0.621	6.206	95.210	3.438	34.378	76.356
3	0.321	3.280	98.419	2.206	22.062	98.419

Table 4.Rotated Component Matrix.

Index	Component		
	F_1	F_2	F_3
X_1	0.739	0.575	0.340
X_2	0.754	0.521	0.374
X_3	0.681	0.655	0.323
X_4	0.756	0.202	0.576
X_5	0.405	0.814	0.380
X_6	0.611	0.691	0.381
X_7	0.809	0.557	0.166
X_8	0.749	0.592	0.282
X_9	0.490	0.680	0.543
X_{10}	0.235	0.320	0.907

As shown in the rotated component matrix (Table 4), in common factor F_1,the coefficient of indicators X_1, X_2, X_3, X_4, X_7, X_8 is the biggest, so the common factor F_1 represents the investment and construction of real estate industry and the development enterprise scale. We can mark it as the factor of investment and development enterprise. The coefficient of indicators X_5, X_6, X_9 in F_2 is the biggest among the three common factors, so the common factor F_2 represents the sale of the real estate. We can mark it as factor of sale. The coefficient of indicator X_{10} in F_3 is the largest among the three, so the common factor F_3 represents the profits of the real estate development corporations. We can mark it as factor of profits.

The comprehensive evaluation process. We will calculate the comprehensive factor score of each city first, and then on the basis of the scores, we can make comprehensive evaluation. The specific calculation formula is as follows:

$$S_i = \sum_{i=1}^{3} R_i F_i$$

S_i represents the comprehensive development level of the real estate in different cities, R_i is a ratio, which equals the value of each factor's variance contribution divided by the cumulative variance contribution. F_i represents the ith common factor. In this section, i equals 1, 2, 3. According to the formula, we can calculate the score of each factor, the comprehensive score of each city, and the rank of each city, which are shown in Table 5.

Table 5.Common Factor Score, Comprehensive Score and Rank of Each City.

City	F_1		F_2		F_3		S_i	
	Score	Rate	Score	Rate	Sore	Rate	Score	Rate
Harbin	2.6975	1	1.4967	2	0.2722	4	1.7343	1
Qiqihar	0.2926	2	-0.5966	11	0.3733	3	0.0001	4
Jixi	0.0108	5	-0.4827	9	-0.6895	11	-0.3186	8
Hegang	-0.3083	9	-0.3149	5	-0.6230	10	-0.3812	11
Shuangyashan	-0.0588	6	-0.3438	6	-0.7378	12	-0.3106	7
Daqing	-0.6926	11	-0.1454	4	2.9097	1	0.3062	2
Yichun	-0.1762	7	-0.5664	10	-0.4512	8	-0.3742	10
Jiamusi	0.2925	3	-0.6909	12	0.4023	2	-0.0264	6
Qitaihe	-0.3959	10	-0.4773	8	-0.3422	7	-0.4123	12
Mudanjiang	0.2478	4	-0.1271	3	-0.3070	5	-0.0075	5
Heihe	-0.2830	8	-0.3527	7	-0.4583	9	-0.3466	9
Suihua	-1.6264	12	2.6012	1	-0.3415	6	0.1384	3

According to Table 5, Harbin, Daqing and Suihua are the top three, their scores are 1.7343, 0.3062 and 0.1384. And the scores of the three common factors of Harbin are all very high, which indicates the real estate development level in Harbin is much higher than any other cities. What's more, we can conclude that there are significant developing disparities among different cities. Therefore, in the next section, a further study will be made on the disparities of the real estate development level among the 12 different cities by cluster analysis.

The result of cluster analysis. Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters). It is a main task of exploratory data mining, and a common technique for statistical data analysis, used in many fields, including machine learning, pattern recognition, image analysis, information retrieval, and bioinformatics.

In this section, we used system clustering method by SPSS 16.0 to analyze the real estate development level of the 12 cities in Heilongjiang province, with the data adopted from the 2012 Statistical Yearbook of Heilongjiang. The result of the analysis is shown in Figure 1.

According to the result of the clustering analysis, we can divide the 12 cities into 5 categories:

(1) Harbin. As the capital of Heilongjiang province, the comprehensive score of Harbin is 1.7343, much higher than the other cities. The common factor F_1's score of Harbin is the highest, and F_2's score ranks the second. But F_3's score only ranks

the fourth. This indicates that the investment and construction scale in Harbin is large and the sale of the real estate is very good. But the profit of the real estate development corporations is not that great. So the development companies should make some change to increase the profits.

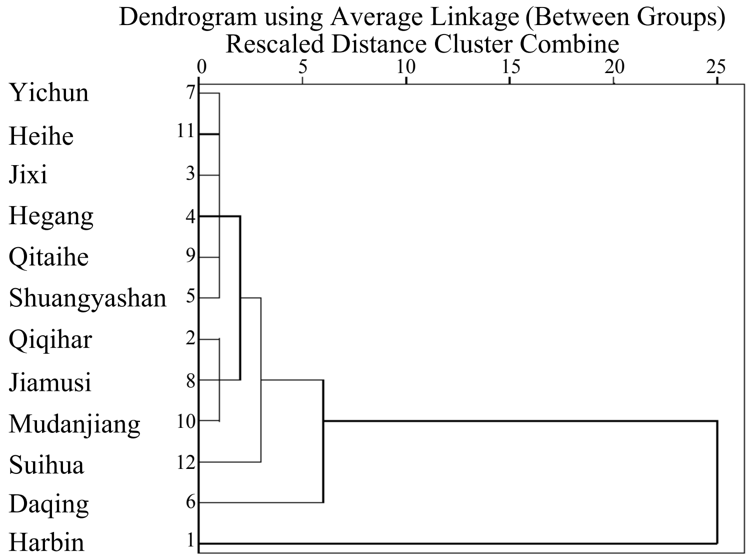

Figure 1.Cluster dendrogram.

(2) Daqing. The comprehensive score of Daqing is 0.3062, ranks the second place. Daqing is a famous industrial city, taking petroleum and petrochemical industry as its pillar industry. The industrial output of Daqing has reached the second place in northeast district and the GDP per head has reached 20000 dollars. The common factor F_3's score of Daqing is the highest, which shows the profits of the development corporations in Daqing is good. However, the other two common factors' scores are not very high; especially factor F_1's score, very low. This means that the investment and construction scale and the sale of the real estate are not ideal.

(3) Suihua. The comprehensive score of Suihua is 0.1384, ranks the third place. The common factor F_2's score of Suihua is the highest among the 12 cities, which means the sale situation of real estate in Suihua is very good, also indicates that there is a strong demand in housing market. However, the F_1's score is the lowest, indicates the investment and construction scale and the scale of the development corporations is small, which means more investment is needed.

(4) Qiqihar, Jiamusi, Mudanjiang. The comprehensive scores of these cities are high, and rank the fourth to sixth place. In general, the real estate development of these cities is good. What's more, we found that the factor F_1's score of Qiqihar, F_2's score of Mudanjiang and F3's score of Jiamusi ranks very high, which indicates that the real estate development of these cities has its own characteristic.

(5) Shuangyashan, Qitaihe, Hegang, Jixi, Heihe, Yichun. The comprehensive scores of these 6 cities are low and they are the lowest-ranked. The economic growth of these cities has been slow, the development of the real estate industry has been limited and the real estate markets are immature.

DISCUSSION AND CONCLUSIONS

With the rapid development, real estate industry has become a pillar industry in Heilongjiang's economy. However, we should notice that there are significant development differences in both the level and the rate of the real estate economy among the 12 main cities in Heilongjiang province; the development of the real estate economy is unbalanced. There are many factors which will influence the real estate development, for instance, the general economic development level of the city, different geographical locations, different industry and commercial scale, investment environment and so on, which explained the reason why the development level of the real estate in different cities in Heilongjiang province presents such a big difference.

Harbin is the capital of Heilongjiang province, plays a leading role in the economic growth. Daqing is an important and famous industrial city, its economy ranks the second place and Suihua the third, the economic development status of these three are superb. What's more, Daqing and Suihua are very close to Harbin in geographical locations, they can benefit from the economic growth of the capital city. So the real estate economic development level of these cities is high. As for the rest of the cities, because of the existence of all kinds of constrains, the real estate economic development is not that good, that's to say, the development of real estate in Heilongjiang province is unbalanced. Faced with this situation, for the part of the investors and the development corporations, different strategies should be obtained in different regions. For example, in Qiqihar, the investment and construction scale is very large; therefore the development corporations should not make blindly investment. But the sale of the real estate in Qiqihar is not good, so the development corporations could focus on the sales strategies. In Suihua, the sale of real estate is very good but the investment and construction scale is very small, so more investment is needed in this city.

As for the government, the regional differences should be considered when formulating the overall strategies, objectives and policies for the real estate industry. While developing the housing industry, government should create a housing criteria based on the different economic development level of different regions. In order to meet the needs of different social groups, the government should construct a muti-level housing supply system, which includes commercial housing, affordable housing and low-cost housing. While developing the commercial real estate, government should help attract more investment in the economically developed regions, like Daqing and Suihua, and at the same time, blindly investment should be avoided.

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An Analysis of Down Payment Constraint on Chinese Real Estate Price Fluctuations: Based on DSGE Models

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Abstract

Based on the down payment constraint of housing loans in selective tools of monetary policy, we build Dynamic Stochastic General Equilibrium (DSGE) models which contain real estate consumption. This paper studies the response of the real estate price to down payment constraint using dynamic optimization method. Our results suggest that the policy of down payment constraint increases the cost of the down payment for families when they purchase houses, leading to the reduction of real estate consumption; higher down payments constraint causes the economic negative growth. Therefore the central bank should regard the economic growth as a primary objective in the process of the implementation of monetary policy without having to make an adjustment according to the operation condition of the real estate market.

INTRODUCTION

In 1998, the housing distribution monetization marked the beginning of Chinese real estate industry comprehensive marketization and real estate price fluctuations subjecting to the forces of supply and demand on the market. In recent years, facing the phenomenon of excessive growth, the central bank generally used the way improving the down payment proportion of real estate loans to restrict housing credit scale, in turn, inhibiting housing consumption demand and controlling the housing prices.

As shown in Figure 1, according to the situation of the real estate price fluctuations on Chinese real estate market in different periods, the government public many macroeconomic policies to solve the problem of sharp fluctuations in real estate price, to promote the sound and rapid development of Chinese real estate market. In 1999, the central bank reduced down payment constraints from 0.3 to 0.2 to encourage consumers, which prompted housing loan growing at an alarming rate in 2000, when Chinese real estate industry kept developing rapidly under the policy support and played a great role in promoting the macroeconomic growth. Facing the global financial crisis in 2008, the central bank relaxed control the real estate industry, real estate prices began to rise quickly, with the promoting of moderately loose monetary policy and the 4 trillion investment plan. “Ten new countries”, published in 2010 and the monetary policy is to turn into a prudent monetary policy. The superposition effect of policy implementation appeared slowly, with the real estate regulation gradually in-depth, the government determined to control housing prices, the real estate prices began to return to a reasonable level. The 18th Central Committee approved “a decision on major issues concerning comprehensively deepening reforms”, and in terms of perfecting the tax system, forward to accelerate real estate taxes legislation and the timely reform. In 2014, the real estate prices are rising while the gains is not big, means the policy effect is obvious, and the growth rate of housing price returns to a smooth level.

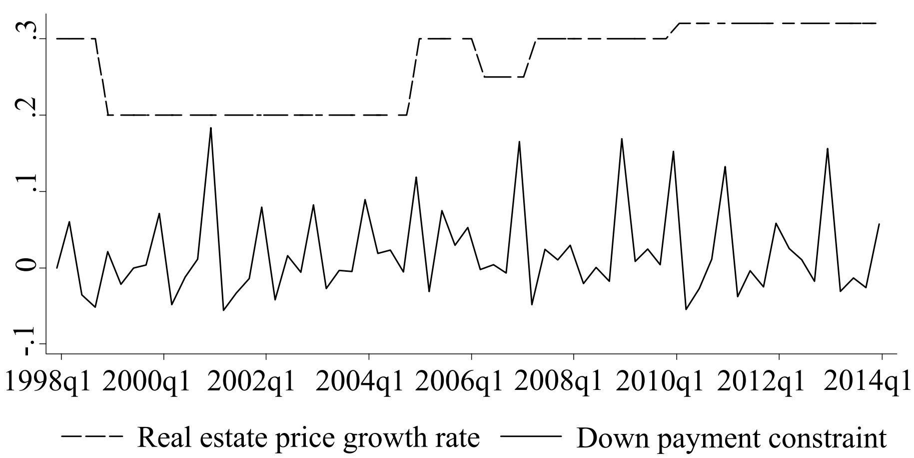

Figure 1.Down payment constraint and the real estate price growth rate.

The current domestic studies about down payment constraint mostly based on the condition of general equilibrium, without considering the dynamic factors of economy. This paper will build dynamic stochastic general equilibrium model containing housing consumption, to study the influence of the down payment constraint and other impacts on the real estate price. Using the software of MATLAB to complete impact impulse response of the process. By using the dynamic optimization method to describe behavior decisions of economic agents in uncertain environment, and we also further explore the issue of down payment constraint and the real estate price fluctuations when the optimal behavior equation is obtained in the clearing market where it meets the technical constraints, resource constraints and other conditions.

LITERATURE REVIEW

The earlier study about down payment constraint in abroad is from Stein (1995), who pioneered the first down payment effect model. Chambers et al. (2009), by establishing a general equilibrium model, found that the way of down payment constraint affect residential consumption decisions. Domestic research on down payment constraint was later. By studying the change relation between housing prices and mortgage down payment requirement, Han and Xiao (2008) came to a conclusion that mortgage down payment changes have certain effects on housing prices in short run, but the policy effect of improving mortgage down payment requirements would be reduced, because the financial institutions and consumers take the countermeasures. Guo (2011) built a model including income growth, considering the actual purchase should be divided into two parts, down payment and mortgage payments, and he found that China's real estate market bubble was mainly focused on the down payment, and these result was obtain through empirical test. Through the introduction of housing loans down payment constraint in the model, Liang (2011) found not only positive impact of payment constrain promoted the real estate prices, and also the impact would last longer; and positive impact also amplified the impulse response effect of real estate prices to the monetary policy impact and output impact.

DSGE Models first appeared in the study of real business cycle (RBC), from Kyland and Prescotta (1982). Based on the many advantages of DSGE models, central banks have set up DSGE models in their own country. Referring to the models of CMR, in combination with the practical situation of China, Liu (2008) set up an open DSGE models with" financial accelerator", using the Bayes estimation method to estimate model, and analyzed the policy. That marked the DSGE models theory was introduced into China, and had been used successfully. Since then, more and more experts and scholars devoted themselves to DSGE models consistent with the actual conditions of China, in order to solve the actual economic problems.

THEORETICAL MODELS

This article assumes that the economy consists of three departments, households, enterprise, the central bank, and introduces the impact of the real estate down payment constraint ε_t^H, the impact of technological advances in production ε_t^A, and the impact of money supply $\varepsilon_t^{\mathrm{M}}$. Learn from the models of scholars Liang (2011), and the models of Cooley and Hansen (1989) in the CIA, we finished the establishment of a closed economy of the three departments DSGE models.

Families. It is assumed that the economic agents are representative families which are homogeneous and ever-present. By providing labor to the enterprise, the families obtain the wage income, through the consumption of non-real estate products and real estate products to improve their effectiveness, each family expect by way of inter-temporal consumption to maximize their discounted utility. The total expected utility function is:

$$\max E_t \sum_{t=0}^{\infty} \beta^t U(C_t, H_t) \tag{1}$$

Where C_t is the consumption of the representative families in the t period of non-real estate, H_t for the purchase of typical family real estate area during t period. U_t for typical family total utility in period t. U_t can be expressed as:

$$U(C_t, H_t, L_t) = \frac{C_t^{1-\phi}}{1-\phi} + e^{\varepsilon_t^H} \frac{H_t^{1-\phi_H}}{1-\phi_H} - \frac{L_t^{1+\eta}}{1+\eta} \tag{2}$$

β is a representative household discount factor, $0<\beta<1$; φ, φ_H and η respectively for non-real estate consumption, real estate consumption and the labor supply elasticity; ε_t^H is the representative home down payment constraints impact, and follow first-order auto-regressive AR (1) process:

$$\varepsilon_t^H = \rho_H \varepsilon_{t-1}^H + e_t^H \tag{3}$$

e_t^H subject to independent and identically distributed with means 0 and standard deviation σ_H. For the family of the model, $C_t = \int_0^1 c_{i,t} di$, $H_t = \int_0^1 h_{i,t} di$ and $L_t = \int_0^1 l_{i,t} di$, respectively means the consumption of real estate, the real estate purchase area and the labor supply of period t.

The percent of the down payment constraints provided by the banks when the bank provides the real estate mortgage loans, represented by d_t, representative family housing loan down payment constraint can be expressed as:

$$C_t + d_t Q_t H_t \le M_{t-1} + K_{t-1} r_t \tag{4}$$

Q_t is the real estate price of period t, M_t represents the family cash for t period, which equals to personal disposable income. K_t is for rented home business capital stock, r_t is for the said enterprise need to pay to rent the rental rate of capital. Banks to provide families with real estate credit lines of $D_{t-1}Q_{t-1}H_{t-1}$. The ratio of loans is:

$$D_t = 1 - d_t \tag{5}$$

D_t is the credit proportion of families to purchase housing which bank can provide; With R_t on behalf of the family in period t loan principal and interest rates, the sum of the family in period t of real estate mortgage loan principal and interest and need to be paid for $D_{t-1}Q_{t-1}H_{t-1}R_{t-1}$, then we get the total budget constraints which the family have to face to:

$$C_t + I_t + M_t + D_{t-1}Q_{t-1}H_{t-1}R_{t-1} + d_t Q_t H_t \le W_t L_t + M_{t-1} + Q_t H_t + K_{t-1} r \tag{6}$$

Where W_t is the family salary. And I_t of period t on behalf of family enterprise investment, as follows:

$$I_t = K_t - (1-\delta) K_{t-1} \tag{7}$$

Where δ is the capital depreciation rate?

Enterprise. Because of the quantity of the family business on the market, assumption of perfect competition market, all enterprises have the same Cobb-Douglas production function, the output can be put together, and the whole economy is regarded as an aggregate production function:

$$Y_t = e^{\varepsilon_t^A} e^{\varepsilon_t^M} K_{t-1}{}^{\alpha} N_t{}^{(1-\alpha)} \tag{8}$$

N_t stands for the labor demand of the enterprise; ε_t^A stands for the impact of technology to output, which follows the first-order auto-regressive AR (1) process:

$$\varepsilon_t^A = \rho_A \varepsilon_{t-1}^A + e_t^A \tag{9}$$

e_t^A meets the independent identically distribution which means 0 standard for σ_A ; ε_t^M equals to the impact of monetary policy, and obey the first-order auto-regressive AR (1) process:

$$\varepsilon_t^M = \rho_M \varepsilon_{t-1}^M + e_t^M \tag{10}$$

e_t^M meets with mean 0 and standard deviation of σ_M independent and identically distributed. In the labor market equilibrium, the total labor supply is equal to the total demand for labor:

$$L_t = N_t \tag{11}$$

Under the Perfect competition market, when the elements market equilibrium, during the period t, the rental rate of capital r_t and W_t for the wage rate:

$$r_t = \alpha e^{\varepsilon_t^A} e^{\varepsilon_t^M} (\frac{K_{t-1}}{N_t})^{(\alpha-1)} \tag{12}$$

$$W_t = (1-\alpha) e^{\varepsilon_t^A} e^{\varepsilon_t^M} (\frac{K_{t-1}}{N_t})^{\alpha} \tag{13}$$

The budget constraints which enterprises meet during normal operation are as follows:

$$Y_t \geq W_t L_t + K_{t-1} r_t \tag{14}$$

Market clearing, the total output is equal to the sum of total consumption and total investment:

$$Y_t = C_t + Q_t H_t + K_t - (1-\delta) K_{t-1} \tag{15}$$

The central bank. Central bank money amount for M_t^a, M_t in cash held by representative households, S_t represents total deposits. The total deposits of the bank absorbed can be expressed as:

$$S_t = M_t^a - M \tag{16}$$

V_t represents the total amount of loans, what banks can provide can be expressed as:

$$V_t = W_t L_t + e^{\varepsilon_t^H} D_t Q_t H_t R \tag{17}$$

When the credit market clearing, the total amount of the deposit, which deposited on the market, are equal to the total loans that household and enterprises held.

$$M_t^a - M_t = W_t L_t + e^{\varepsilon_t^H} D_t Q_t H_t R \tag{18}$$

The above is the construction of DSGE models. By Lagrange method, utility function (2) by family, the family budget constraints (4) and (6) constitute the Lagrange function, get the equilibrium model of first-order conditions. Combining equations (8), (12) to (15), (18), finally to find the steady-state value of the model. We get the DSGE models of dynamic system contains the elements of the real estate. Impulse response is the expansion of DSGE models based on log-linearized.

DATA SOURCES AND PROCESSING

The data used in this article are based on quarterly data, sample interval from the first quarter of 1998 to the first quarter of 2014. The main economic variables used include Gross Domestic Product (GDP), the family of non-real estate consumption (C), the family of real estate consumption (H), interest rates (I) and the real estate price (Q). Data sources are from the database of CEInet. Some of these variables did not given directly, and needs to be processed to obtain. Such as quarterly real estate sales price, which is equal to the total amount of quarterly consumption divided by quarterly real estate sales area. Quarterly GDP will need numerical GDP minus the accumulative total of each month of the quarter, to get the domestic product of each quarter. Quarterly rates using weighted quarterly bank lending rates. The annual inflation rate comes from the previous year CPI index divided by the annual CPI index. Because the model is stable, the economy will eventually tend to equilibrium. But the actual data always contain a trend term; the trend will impact on the simulation model. So we need to deal with the actual data and eliminate the trend term. This paper uses the seasonally adjusted and Hodrick-Prescott method for the separation of variable trend. We get the excluding of quarter quarterly data, through this kind of get the smooth data processing.

IMPULSE RESPONSE ANALYSIS

As can be seen in Figure 2, when the down payment constraint was 0.3, in the condition of the impact of down payment constraints was 1%, the impact increased real estate prices by 1.8%, reduced the output by 0.23%, reduced real estate consumption by 6%. Real estate price and real estate consumption needed 14 period to return to the steady state level after the shock, and the output needed 12 cycles back to the steady state level after the impact. When he down payment constraint was 1.0, in the condition of the impact of down payment constraints was 1%, the impact will increase real estate prices by 7%, reduce the output by 1%, reduce the real estate consumption by 7%. Real estate price needed 14 periods to return to the steady state level after the shock, the output needed 12 cycles, and real estate consumption needed 11 cycles. When the down payment constraints were 0.1 and 0.5 respectively, the effect of monetary policy impact on real estate prices increased by 1.1% and 2.5% respectively, brought to the output to decrease by 0.6% and 0.13%respectively, and the real estate consumption reduced by 6% and %. Each variable needed about 12 to 14 cycles to recover to a steady state level after the shock.

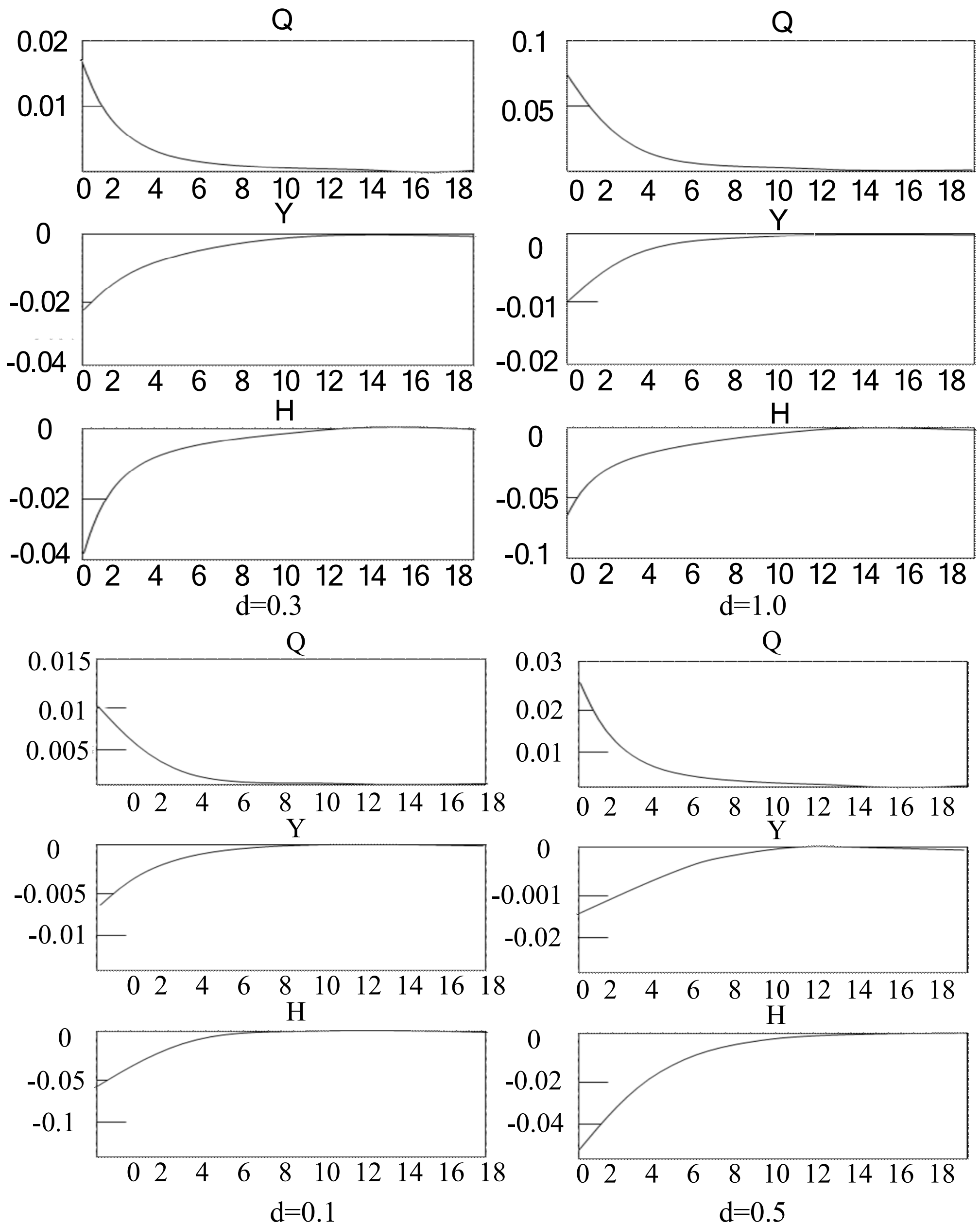

Figure 2.Down payment constraints impulse response of the real estate price, output and consumption of real estate.

Pulse results show that ,when the impact of down payment constraint was 1%, with the rising of the down payment constraint, real estate prices increased faster and faster, and it is not consistent with economic theory, and the rising house prices was with a lot of foam composition. That had to do with the study of Guo (2011), who found empirical bubble in Chinese real estate market mainly concentrated in the down payment, and as the down payment constraint increasing, the impact on output was negative, and the adverse effect was increasing. Down payment restriction policy had brought family housing consumption reducing, raised the threshold of the home loans to buy a house, and made inhibition effect on the total demand on real estate market.

CONCLUSION

The real estate consumption is applied to the consumer utility function in this paper, author construct DSGE models which contain real estate consumption. By analyzing the effect of down payment constraint on Chinese real estate prices, we get the following conclusions:

Down payment constraint can make the real estate consumption reduce. Down payment constraint is the reason to raise real estate prices, the rising part become real estate bubble, house prices too high to make the real estate market consumption demand decreases, at the same time the cost of down payment has increased, the payment is beyond the scope of families can afford, this will ultimately conduce a drop in real estate consumption.

Down payment constraint is too high to lead economic growth. As real estate prices rise, higher down payment constraint will make the family undertaking a higher housing costs, this reduce the consumption of real estate, thus resulting in a decrease of the total output. Higher down payments constraints will bring adverse impact on economic growth.

The government must fully consider its adverse influence on the economic output when they regulate and control policy. They should reduce its adverse effect on economic growth as soon as possible. Down payment constraint policy cannot be the regular monetary policy tools of stable prices; the central bank should introduce long-term monetary policy and perform the correct guidance to the expectations of people. Then we can achieve good effect of policy implementation and realize their policy objectives. Central bank should treat economic growth as a primary goal in implementing monetary policy, and it is not necessary to make an adjustment according to the operation condition of the real estate market.

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Grey Correlation Degree Analysis and Comprehensive Evaluation of the Real Estate Investment Model of Heilongjiang Province

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Abstract

In recent years, the real estate industry holds a significant position in China's economic development. The economic growth can be not only directly driven by real estate development but also provides a good platform for the development of real estate. Real estate investment has the characteristics of large contributed capital and long business cycle. Along with the increasingly obvious market segmentation in different cities, the factors needed to be considered for real estate investment decisions become more comprehensive. Generally, the factors are divided into market factors, resource supply factors, cost factors and social factors. This thesis uses grey correlation degree analysis to make an empirical analysis of Heilongjiang's real estate investment and then sort the factors from large degree to small one to filter out the main factors. Through empirical analysis, the author tests different factors and present a reasonable investment decision model.

INTRODUCTION

In the recent twenty years, both China's economy and the real estate economy have achieved a rapid growth, and the real estate market growth is higher than China's economy. The total investment of real estate has grown from 25.3 billion in 1990 to 8.6 trillion in 2013, almost 341 times as much as the former. Along with the development of the market and the increasing competition, little room is left for the market to have a rapid growth in the latter. It is known to all that investment is the first power of China's economic growth, while the real estate economy is an important part and even the predictor of the national economy (Wang 2011). What's more the real estate industry is a pillar industry of the national economy, which is mainly manifested in the following five respects (Liang et al. 2006): First it is the basis of urban construction and a necessary way to realize the process of urbanization (William 2009). Second the real estate industry provides materials for the sectors of the national economy and is also the important part of fixed assets. Third it is a prerequisite for the workforce's production and quality improvement, and also an inevitable requirement of social development and material basis to attain the goal of social production. Fourth it can promote and lead the joint development of related industries, optimize industrial structure, and improve the efficiency of the national economy (Chen 2011). Fifth, Real estate is an important source of funds for construction of the national economy. While with the implementation of the “Twelfth Five-Year Plan” of national macro-control policies on the real estate industry, the real estate market grows slowly, which makes real estate investment risk increase (Yan 2010). Therefore it becomes the key to lead an investment success of the project to know how to ensure the accuracy of the investment.

Real estate investments. Real estate investments refer to the capital owners investing their capital to the real estate industry in order to get the expected return in the future. As the real estate industry, which is highly involved in the real property and capital intensive, it has the characters of high-cost, long cycle, low liquidity and high risk. From 1978 to 2013, China’s urban resident population has increased from 170 million to 730 million, and the urbanization rate from 17.9% to 53.7 % (China Economic Net 2014), at the same time the cities from193 to 658. With the launch of China’s urbanization process, higher and more professional requirements are given to the real estate developers. Facing the new process of urbanization, China’s largest commercial housing developers Vanke disclosed a “PIE” model (China Real Estate Net 2013). In this investment model, “P” means population, “I” means infrastructure investment and “E” means the employment in this industry. There are many factors that affect the real estate investment, including the market factors, resource supply factors, cost factors and social factors. These factors have many differences in various provinces and cities, which have led to the differences in the real estate investment environment, thus it is of important practical significance to identify these factors and compare the differences between them.

Grey correlation analysis. Grey correlation analysis is not only an important part of the gray system theory, but the cornerstone of gray system analysis, modeling, forecasting, and decision-making (Xiao et al. 2010). Since professor Deng (1982) created the gray system theory, gray correlation analysis has been successfully applied to many areas of economic, social, industrial, agricultural, mining, transportation, medicine, ecology, water conservancy, aerospace, etc. It has solved many difficult problems which were inextricability in past, becoming one of the branches that are most widely used and fruitful in gray system theory (Liu and Li 2006).

The thesis studies the factors affecting the real estate investment in Heilongjiang province. Through the use of gray correlation analysis method, this thesis quantitatively analyzes the extent of the various factors and sorts them from large degree to small one to filter out the main factors. On this basis the author presents a reasonable decision model of real estate investment for Heilongjiang province.

ESTABLISHMENT OF REAL ESTATE INVESTMENT FACTORS INDEX SYSTEM IN HEILONGJIANG PROVINCE

Situation of Heilongjiang Province. Heilongjiang Province is located in the northeast of China, being the major energy industry base of our country. In terms of urban types, Heilongjiang province mainly has integrated industrial cities and resource-based cities. Its urbanization rate in 2013 was 29.6 % (Hexun Net 2014). According to the international experience on the development of urbanization, the urbanization process can generally be divided into three stages, initial stage (the urbanization rate is less than 30%), accelerated phase (the urbanization rate is between 30% and 70%), and maturity period (the urbanization rate is greater than 70%). Therefore Heilongjiang province has just stepped into the second phase of the process of urbanization, and it still has a long way to go. Besides, the province's industrialization rate was 32% in 2013. According to international standard of industrialization, the beginning of industrialization means the city's industrialization rate is from 20% to 40%, and the semi-industrial period means the rate is from 40% to 60%. When the rate is more than 60%, it means the city has arrived at the stage of industrialization. So the whole province is in the early stage of industrialization. In addition, there is a certain gap between the reasonable ratio and Heilongjiang's ratio of urbanization and industrialization, which reveals the unreasonable development range of Heilongjiang province that the urbanization has lagged far behind its industrialization. As the process of urbanization, it also brings new opportunities for the real estate market in Heilongjiang Province.

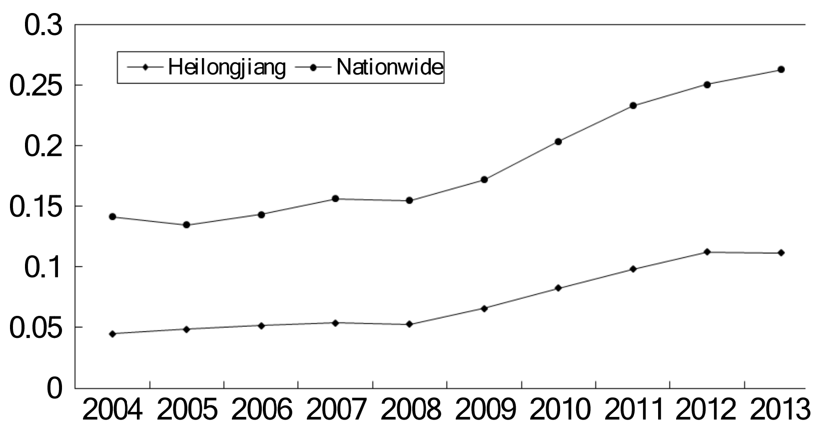

Figure 1.Ratio of real estate investment to GDP of Heilongjiang and nationwide.

For nearly a decade, the real estate investment has increased year by year, same with Heilongjiang's GDP (Wang et al. 2009). While the urbanization process will also bring new challenges to Heilongjiang's real estate market (Chen and Chen 2012). Compared with other second-tier and third-tier cities, Heilongjiang has a certain particularity in the geographical and industrial structure. As the Figure 1 shows, since 2004 to 2013, the ratio of real estate investment to GDP in Heilongjiang province has been steadily growing, consistent with the nationwide. While the ratio is much lower than the nationwide, this shows the particularity of real estate market in Heilongjiang. Therefore making a concrete analysis on the influencing factors of real estate investment will have great significance on increasing the accuracy as well as reducing the risks.

Heilongjiang's real estate investment factors index system. The previous studies have had a lot of discussions focusing on the selection of the indicators to establish the real estate investment model index system. They mainly select the indicators about economic factors without giving full consideration to the investment environment (Chen 2007). In reference to the large number of relevant documents, this paper establishes Heilongjiang's real estate investment factors index system that is composed of the consumer price index, real estate sales, GDP, construction output, total fixed asset investment, the number of public transport operators, domestic loans, the resident population and the unemployment rate as figure1 shows. Among these nine specific indicators, the consumer price index, real estate sales, and GDP reflect market conditions. The construction output, fixed asset investment and the number of the public transport operators reflect the number of resource supply situation in the province. Domestic loans reflect the cost factor. The resident population and the unemployment rate reflect the social factors.

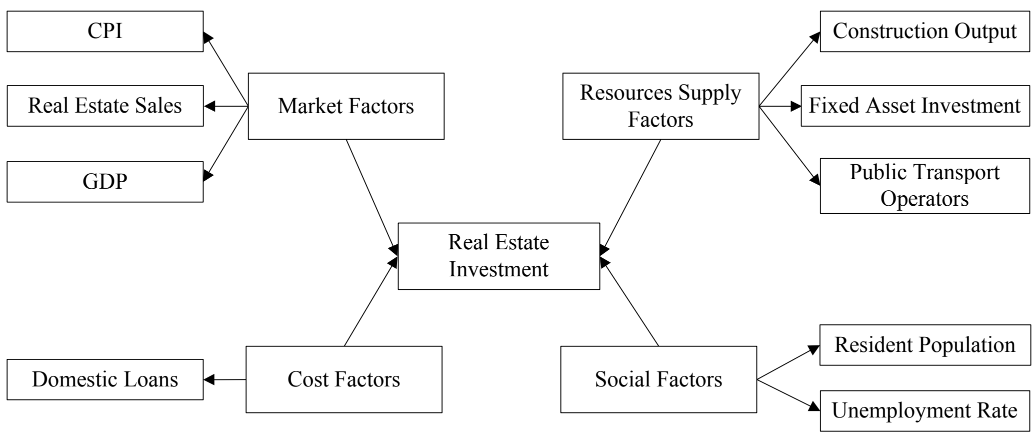

Figure 2.Real estate investment factors index system.

Market factors. The market factors include both supply and demand ones. The consumer price index reflects the consumption level of consumer goods and service items, which includes the service for real estate production. The real estate sales reflect the accumulated earnings of sales market. The market factors have a great impact on investment in real estate. In general, the higher the level of consumption, the more demand for the real estate production. And with the increase of the existing market returns, more developers will be attracted to invest here, promoting the development of the tertiary industry. Therefore, as an important part of the tertiary industry, the real estate industry will develop along with the development of gross regional domestic product.

Resources supply factors. The fixed asset investment includes the investment in infrastructure such as investments for municipal engineering, telecommunications engineering, environmental protection and other public facilities and so on. The city's public transportation is the body of the transportation structure, which is closely related to the city's operating efficiency. The construction output is the total production of the construction industry in a period of time and the production is presented in the form of value. It can reflect the scale of production, development speed and results of operations of a regional construction industry. Also it determines the resources and quality of the real estate construction industry. Therefore, these three factors are important indicators of the resource supply for real estate investment.

Cost factors. Funding is a decisive factor for real estate investment. The source and amount of funds as well as the funding guarantee are critical to the development of the projects. Generally the funds for development projects mainly come from the company's own funds, domestic loans and deposit in advance, among which the domestic loans are the primary source channels (Xiang 2013). The credit crunch makes financing constrained, which is not conducive to real estate development and investment.

Social factors. The social factors include the regional population, employment development and so on. When large numbers of people flow into the city, they offer plenty of cheap labor to the city, which greatly promotes the city's economic development (Li 2014) and makes contribution to the development of city building, commerce, food, sanitation and other industries as well as the urban residents' living. The process of population mobility is also accompanied by the changes of employment status and the industry composition, which can increase the vitality and energy of the regional economy and social development, conducive to promoting economic and social development of the region. What's more, the changes in the unemployment rate can reflect the utilization of a regional labor resource and the social stability. The higher density and lower unemployment rate of the resident population will attract real estate investment.

CALCULATION OF GREY CORRELATION OF REAL ESTATE INVESTMENT FACTORS

Dimensionless processing of the raw data. First, determine the reference sequence reflecting the system behavior features and the comparative sequence affecting the system behavior .The data array that reflects the system behavior features is called reference sequence and the ones that affect system behaviors are called comparative sequence. Then apply dimensionless method to the data. Because of the different physical meanings of each factor in the system, the dimensions of the data are not all the same, which results in the inconvenience to compare them or difficulty to obtain the correct conclusion in the comparison. It is generally required to apply the dimensionless method to the data before the gray correlation analysis. The specific method is: name the reference sequence $X_0(t)$ and the comparative sequence $X_i(t)$, t represents the year of the data, and i represents the order of the factor. And apply dimensionless method to $X_0(t)$ and $X_i(t)$ respectively, then record their absolute value at time t is:

$$\Delta_{0i}(t) = \left| X_0(t) - X_i(t) \right| (t = 1, 2, \cdots, n)$$

This thesis identifies the real estate investment in Heilongjiang province as the reference sequence, and the preliminary comparative sequences include the consumer price index, real estate sales, GDP, construction output, total fixed asset investment, the number of public transportation operators, domestic loans, the resident population, and the unemployment rate.

Calculation of grey correlation coefficients. The so-called associate degree is the degree of difference between the curve geometry in essence. Therefore, the sizes of the differences between the curves can be used as a measure of the correlation. A reference sequence X_0 has several comparative sequences such as $X_1, X_2, \cdots, X_n$. The correlation coefficient $\varsigma(X_i)$ between each comparative sequence and the reference sequence at every time is calculated by the following formula:

$$\varsigma_{0i} = \frac{\Delta\min + k\Delta\max}{\Delta_{0i}(t) + k\Delta\max}$$

Here, k is resolved coefficient, $0 < k < 1$.The minimum absolute value of difference is recorded as $\Delta\min$, and the maximum absolute value of difference is recorded as $\Delta\max$. The absolute value of the difference between each point of the comparative sequence curve X_i and each point of the reference sequence curve X_0 is recorded as $\Delta_{0i}(k)$.

After the initial transformation of the raw data and the calculation of the absolute value of each sequence, we gain the output, $\Delta\max = 6.511, \Delta\min = 0.028$, In this paper we choose $k = 0.2$.Then the data is induced into the formula to calculate the correlation coefficient between each comparative sequence and the reference sequence in each year, as shown in Table 1.

Table 1.Grey Correlation Coefficients.

Year	ς_{01}	ς_{02}	ς_{03}	ς_{04}	ς_{05}	ς_{06}	ς_{07}	ς_{08}	ς_{09}
2004	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2005	0.843	0.818	0.956	0.922	0.994	0.896	0.959	0.857	0.954
2006	0.730	0.753	0.889	0.919	0.975	0.834	0.969	0.738	0.882
2007	0.642	0.646	0.835	0.956	0.888	0.723	0.751	0.637	0.784
2008	0.568	0.745	0.828	0.987	0.737	0.640	0.779	0.565	0.727
2009	0.448	0.510	0.625	0.996	0.609	0.513	1.000	0.453	0.531
2010	0.314	0.384	0.431	0.735	0.626	0.343	0.948	0.314	0.346
2011	0.221	0.352	0.302	0.429	0.734	0.237	0.434	0.220	0.250
2012	0.178	0.385	0.238	0.343	0.782	0.189	0.285	0.178	0.193
2013	0.171	0.398	0.230	0.328	0.842	0.184	0.271	0.171	0.170

Calculation of the correlation degree. The correlation Degree is the average value of the correlation coefficients of each year.

$$\gamma_{0i} = \frac{1}{n}\sum \varsigma 0i(t)$$

γ_{0i} represents the correlation degree of X_i and X_0, and n represents the length of the sequence. After the correlation coefficients between each comparative sequence and reference sequence are obtained, we can calculate each correlation degree According to the above formula. The specific data is shown in Table 2.

Table 2.Gray Correlation Degree.

Comparative sequences	γ_{01}	γ_{02}	γ_{03}	γ_{04}	γ_{05}	γ_{06}	γ_{07}	γ_{08}	γ_{09}
Gray correlation degree	0.514	0.601	0.635	0.764	0.821	0.558	0.742	0.515	0.586
Rank	8	5	4	2	1	6	3	7	9

ANALYSIS OF THE FACTORS BASED ON THE GRAY CORRELATION DEGREE

Analysis of the fixed asset investment. Through the gray correlation analysis we find that the fixed asset investment X_5 is the most influential factor to the real estate investment in Heilongjiang province. The correlation degree is 0.821. This proves that the investors who make real estate investment decisions should be more concerned about the changes of Heilongjiang's fixed asset investment.

The fixed asset investment is the primary means of the social reproduction of fixed assets. Through the construction and purchase of fixed assets, the national economy continues to adopt advanced technology and equipment to establish new departments and further adjust the economic structure and regional distribution of productivity. Besides, it enhances the economic power and creates material conditions for the improvement of people's material and cultural life. As China's economy continues to develop, Heilongjiang's economy has made steady progress. Compared with the primary industry, the secondary and tertiary industry grows faster. But the technology content of the secondary industry in Heilongjiang is still low, remaining extensive growth, upgrading slow, affecting the improvement of industrial economic growth quality. Heilongjiang province has more backward infrastructures than other northeast, southeast provinces such as the railways, highways, urban roads, water supply and other aspects. So it is an important measure to promote the growth of the real estate brokerage in Heilongjiang province to encourage social capital to participate in the construction and operation of infrastructure.

Analysis of the construction output. As can be seen from Table 2, the correlation degree between construction output X_4 and real estate investment is 0.764, raking in the second place. The construction output is a composite indicator to reflect the construction production results, including the construction engineering production value, installation project production value, and other production value. From 2004 to 2013, construction enterprises in Heilongjiang province takes on an increasing production scale and steady growth of output led by the growth of investment in fixed assets. Compared to other more developed provinces, Heilongjiang province has a broad provincial market, especially the vast rural market. Although Heilongjiang has a lagging economy and lower per capita income, there is a huge potential market demand for construction companies and building materials. So it has the capacity to consume and absorb the industrial products and a various services in the province. If the provincial corresponding companies or products have a relatively high competitiveness, most of them can be consumed by the provincial market, forming a continuously optimizing and expanded reproduction. At the same time they can maintain great vitality to the foreign investment, science and technology.

Analysis of the domestic loans. Currently, the funding sources of Chinese real estate development enterprises mainly come from domestic loans, self-financing and other funds. While the real estate developments enterprises have lower proportion of own funds, they depend more on bank loans. Among China's real estate development funding, 55% of the funds directly comes from the banking system, according to a survey data from the national central bank and the China Banking Regulatory Commission. The other self-financing are mainly from commercial housing sales, most of which are from the mortgage loans. As can be seen from Table 2, the effects from domestic loans X_7 to real estate investment is fairly large, ranking third.

Analysis of the province's GDP. In China, the real estate industry contributes 15% directly and indirectly to GDP, promoting strongly to the development of related industries, so it is initially identified as a pillar industry of the national economy. Real estate is an industry relating to a very large number of other industries (Wang and Liu 2004). Typically the real estate industry will drive the development of more than 30 trades and 70 industries, such as construction, building materials, construction equipment, agriculture, forestry, light industry, metallurgy, machinery, appliances, furniture, finance, insurance, decoration, intermediary services and so on. Therefore, due to the strong association of real estate, its development will be able to drive the development of other industries to a certain extent so as to promote local economic development. In terms of a place, GDP indicates whether the local economic is well developed or not. On the contrary, the local economic condition is the basis for the development of real estate, affecting its progress. Between 2004 and 2013, the real estate investment makes an increasing contribution to Heilongjiang's GDP. In 2013, the contribution rate has reached 11 percent. Also, both the real estate investment and GDP have a large rise in 2009. Heilongjiang's primary industry and secondary industry occupy a relatively large proportion of the whole economy. Compared to them, although the tertiary industry develops relatively fast, but it has not become the pillar industry. It is also can be seen from the above data that the correlation degree of GDP X_3 is slightly lower, 0.635, ranking in the fourth place.

Analysis of the real estate sales. The commercial sales of real estate sales is the balanced outcome of the regional market supply and demand, which is the most direct expression of market size. Also, it is a comprehensive reflection of local economic growth, flowing population and other factors which determines the pace of urbanization new immigrants' housing demand.

With the continuous comprehensive economic development of Heilongjiang province in recent years and the improvement of housing finance policy, residents' demand for housing is increasing. Therefore, real estate sales reflect the consumption ability on their housing to some extent, and have a certain impact on real estate investments. From Table 2 we find that real estate sales X_2's correlation degree with the real estate investment is 0.601, ranking fifth.

CONCLUSIONS

In this paper, through analyzing the results of gray correlation for the factors of real estate investment in Heilongjiang province, we identify the influence of the factors and the extent of the impact. From the model results, we can get the following conclusions:

(1) The factors of real estate investment have a certain regional differences. Fixed asset investment has the largest impact on the real estate investment to Heilongjiang province and the construction output has the second one. This shows that the infrastructure in Heilongjiang province is a key factor in determining the real estate investment. Heilongjiang province has fertile land and good quality of specialty resources, but the infrastructure level is relatively backward. Therefore, construction and development of infrastructure can promote the prosperity of the real estate market.

(2) GDP and domestic loans are also important factors for real estate investment decisions. Real estate is not the dominant industry in Heilongjiang province. After the local economy contributing to the real estate largely, the real estate starts to have effect on local economy. So good economic environment and financial market environment have a guiding impact on real estate development. They can provide a good foundation for the healthy and orderly development of the real estate industry.

(3) The social factors such as the number of the resident population and the employment situation have a relatively small influence on the real estate investment. This may be because the real estate industry occupies a small proportion of Heilongjiang's regional economic, so the changes in social factors will lead to small ones to real estate industry. In addition, Heilongjiang's own geographical and resources conditions make a greater provincial demand, and other social factors cause small impact.

(4) Through a detailed analysis of relevant data in Heilongjiang province, real estate investment model of Heilongjiang province should include the total fixed asset investment, construction output, real estate sales, domestic loans, GDP and Real Estate Sales these five indicators.

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Empirical Research on the Relationships between Population Structure and Housing Price Fluctuations: Taking Beijing as an Example

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Abstract

To examine the relationships between population structure and housing price fluctuations, we construct an index system of population structure firstly, and then carry out an augmented Dickey-Fuller test and ordinary least squares regression to choose demographic variables that will be absorbed in the vector auto regressive model using data from Beijing between the year 2000 and 2011. Finally, it reveals that sex ratio, the tertiary industry employment proportion, food expenditure proportion, college and above educational level population proportion, and transferred income proportion has no effect on the fluctuations of housing price in Beijing; gross dependency ratio has the most impact, and can explain about 50% of the housing price change, family household scale and non-agricultural population proportion has less effect. It also shows that the response of housing price to gross dependency ratio and family household scale is positive at first, then turns to negative afterwards, but the response to non-agricultural population proportion is always positive.

INTRODUCTION

Since Hainan Real Estate Bubble occurred in the early 1990s, housing prices of the 35 large and medium cities in China has been rising continuously (Kuang 2010).The international financial crisis triggered by the subprime mortgage crisis caused the housing prices in many cities of China to decline in 2008, but in the first half year of 2009, housing prices started to increase rapidly again. The experience in Japan, the United States and Hong Kong has shown that housing price fluctuations is likely to bring disastrous consequences to the real estate market and macro economy. However, academia has not gained a consistent conclusion on what factors play a key role in housing price fluctuations (Xu et al. 2012). Scholars have researched a lot of factors that may influence housing price fluctuations, such as development costs, environmental factors, the level of economic development, residents' income level, government policy, financial regulation, urban population and the population structure, and consumption psychology, etc (Hao 2011). Without doubt, population structure is one of the most important factors which influence housing price fluctuations, such as immigration can lead to the spatial agglomeration of housing demand, space transference of different age groups may cause the spatial heterogeneity of housing demand, gender imbalance can also cause the change of consumption pattern and the marriage market pressure, thereby affecting the demand for housing (Wu 2011).

Population structure can be divided into three dimensions: natural structure, economic structure and social structure (Wu 2005). Among the variables of natural structure, Mankiw and Weil (1989) first explored the influence of birth rate and population size on house prices, and predicted that housing prices in America would fall twenty years later. However, Poterba (1991) used the data of Canada to examine the model developed by Mankiw and Weil (1989) and found a totally different conclusion such that rapid growth of urban population had no significant influence on housing price. Generally speaking, cities with relatively rapid population growth rate tend to have big housing price fluctuations (Kuang 2010). In big cities where population is relatively concentrated, population decline has a more significant impact on housing price than population growth (Maenning and Dust 2008). The effect of population decline is also more evident than population growth. As for economic structure, Batik concludes that job growth will enhance housing value after studying the influence of job factors on housing prices (Bartik 1991).According to a series of empirical analysis, income has a bigger impact on housing price, and income has significant positive correlations with housing price (IMFCR 2005; Vansteenkiste and Hiebert 2011; Bischoff 2012).

As for social structure, a scholar mostly focuses on population migration and agrees that population migration will increase housing demand and cause housing price and rent to rise (Akbari and Aydede 2012). Domestic situation is similar. However, Dong and Yin (2006) believes that population growth, the intensification of urbanization process and the tendency of small family scale are China’s special factors that influences China’s housing price. These factors are so distinct from foreign countries that cannot be compared.

This study attempts to analyze the interrelationships between Beijing’s Population structure and housing price fluctuations. The first is to establish a proper population structure index system and collect related data based on this index system so as to make a descriptive analysis of housing price fluctuations and population structure change. The second is to construct a math model to further study the interrelationships between population structure and housing price so as to find out the important population structure variable that influences housing price.

POPULATION STRUCTURE INDEX SYSTEM

Population structure is the division of people into different groups according to natural, social, economic and physical attributes. It falls into the basic domain of demography just as population size and population quality does. Two conditions are essential to form population structure: the first is to have two or above two components in the whole of mankind; the second is that these components must have a certain proportion in the whole. There are narrow sense and broad sense of population structure: narrow sense of population structure refers to the natural structure of population, including age structure and gender structure; broad sense of population structure includes natural and unnatural structure. Unnatural structure includes population's economic structure, such as income structure, expenditure structure and job structure, etc. It also includes population's social structure, such as marriage structure, nation structure and urban structure, etc. Some studies also incorporate regional structure, such as human migration rate, into population structure. Based on principles like objectivity, uniformity, feasibility, etc., we have drawn experiences from related research results in the field of demography and economics and then set the basic framework of population structure index system (see Table 1).

Table 1.Population Structure Index System.

First-level Index	Second-level Index	Third-level Index
Natural Structure	Age Structure (AS)	Gross dependency ratio, Children dependency ratio, Elders dependency ratio
	Gender Structure (GS)	Sex ratio
Economic Structure	Industry Structure (INS)	Employment proportion of first industry, secondary industry and tertiary industry
	Expenditure Structure (EXS)	The proportion of urban families' per capita various expenditures in consumption expenditure
	Income Structure (ICS)	The proportion of urban families' annual salary, assets, transfer earnings and business income in annual income
Social Structure	Family Structure (FS)	Average family scale, the proportion of nuclear family, stem family, joint family, etc. in all families
	Education Structure (EDS)	The proportion of primary school, middle school, high school, college or above education level population
	Urban Structure (URS)	The proportion of non-agricultural population

EMPIRICAL ANALYSIS OF POPULATION STRUCTURE AND HOUSING PRICE FLUCTUATIONS IN BEIJING

Since housing system reform in 1998, the housing market in Beijing has experienced two different periods. From the stable period (2000-2004), housing prices remain at about 4500 yuan per square meter, with a relatively low growth rate and even two consecutive years of negative growth. Immediately after 2004, the housing market in Beijing entered rapid development period (2005-) housing prices rise from 4478.4 yuan per square meter in 2004 to 14546.07 yuan per square meter in 2010. The annual growth rate between 2005 and 2011 reached 17.02%. The Olympic Games in 2008 stimulated the housing market so that the annual growth rate of housing price reached 41.18% in 2007 at peak time. However, the annual growth rate plummeted to 3.93% in 2008. In the following two years, the housing price kept on rising and reached its peak in 2010 (see Figure 1).

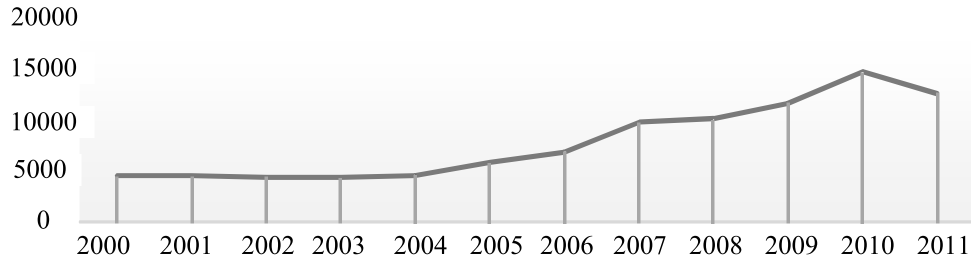

Figure 1.Adjusted housing price in Beijing, year 2000-2011 (year1999, CPI=100).

Data Resource: CEI net Industry Database.

Variable selection. For simplification and avoiding co−linearity, we choose one typical indicator for each second-level dimension to construct the regression model. The corresponding relationships are: age structure-Gross Dependence Ratio (GDR), gender structure-Sexual Ratio (SR), The industry structure-The Tertiary Industry Employment Proportion (TIEP), expenditure structure-Food Expenditure Proportion (FEP), income structure-Transferred Income Proportion (TIP), family structure (FS)-Family Household Scale (FHS), education structure-College and Above Educational Level Population Proportion (CAPP), the urban and rural structure-Nonagricultural Population Proportion (NAPP).

(1) ADF test. Variables used in a VAR model must be a smooth sequence, in order to avoid "spurious regression". In this study, we adopt the ADF unit root test with intercept, respectively on housing prices and eight other explanatory variables sequences and their first-order difference. The result is shown in Table 2.

Table 2.Outcome of ADF Test.

Variable	ADF Statistics	5% Threshold	10% Threshold	Probability
P	-0.229	-3.175	-2.729	0.907
GDR	-0.381	-3.175	-2.729	0.880
SR	-1.518	-3.175	-2.728	0.487
TIEP	-2.609	-3.212	-2.747	0.122
FEP	-2.053	-3.175	-2.728	0.263
TIP	-1.899	-3.175	-2.728	0.320
FHS	-0.147	-3.175	-2.728	0.920
CAPP	-0.768	-3.259	-2.771	0.777
NAPP	-1.493	-3.259	-2.771	0.490
D(P)	-2.924	-3.212	-2.748	0.077
D(GDR)	-4.289	-3.212	-2.747	0.010
D(SR)	-2.831	-3.212	-2.747	0.088
D(TIEP)	-5.107	-3.212	-2.747	0.003
D(FEP)	-2.137	-1.982	-1.601	0.037

Table 2.(Continued).

Variable	ADF Statistics	5% Threshold	10% Threshold	Probability
D(TIP)	-2.893	-3.212	-2.747	0.080
D(FHS)	-5.453	-3.212	-2.747	0.002
D(CAPP)	-3.691	-3.320	-2.801	0.030
D(NAPP)	-3.300	-3.175	-2.728	0.041

Looking at the results of each sequence's unit root test, we can find their ADF statistics are greater than the critical value of 10%, therefore, every sequence contains a unit root, and namely each sequence is not smooth. However, the ADF test statistics of these sequence's first order difference are less than the critical value of 10%, that's to say, these sequence's first order difference do not contain unit root, and can be seen as smooth, namely each sequence is I(1), the conditions of the VAR model are met.

(2) OLS regression. Because of the limitation of data size, we firstly use OLS regression to select explanatory variables in this study. We assume the model is:

$$P = \alpha_1 GDP + \alpha_2 SR + \alpha_3 TIEP + \alpha_4 FEP + \alpha_5 TIP + \alpha_6 FHS + \alpha_7 CAPP + \alpha_8 NAPP + \mu \quad (1)$$

where μ stands for error term, and $\alpha_1 \cdots \alpha_7$ stand for parameters to be estimated. We then use Eviews7 to run the model, and find the adjusted R-squared is 0.994, F statistics 198.55, the whole model significant at the 5% significance level. At this level, gross dependency ratio (GDR), family household scale (FHS) and non-agricultural population proportion (NAPP) will eventually come into the VAR model.

Setup and stability test of the VAR model. (1) Model setup. We use the first-order lag (1 year) of the selected variables to set the VAR model and examine the relationship between housing price and other variables. The overall log likelihood value is 65.89 and AIC and SC is 15.62 and 16.34 respectively. Result is shown in Table 3.

Table 3.Outcome of the VAR Model.

	P	GDR	FHS	NAPP
P(-1)	1.247848	-0.000676	-1.47E-05	-8.63E-05
	(0.31923)	(0.00033)	(1.4E-05)	(6.8E-05)
	[3.90898]	[-2.04477]	[-1.06059]	[-1.26970]
GDR(-1)	1128.018	-0.506004	-0.006271	-0.078828
	(406.749)	(0.42152)	(0.01771)	(0.08662)
	[2.77326]	[-1.20044]	[-0.35417]	[-0.91007]
FHS(-1)	6539.112	12.649200	-0.319765	0.726434
	(9044.95)	(9.37332)	(0.39372)	(1.92611)
	[0.72296]	[1.34949]	[-0.81217]	[0.37715]
NAPP(-1)	739.7866	0.312609	-0.050907	1.011023
	(369.223)	(0.38263)	(0.01607)	(0.07863)
	[2.00363]	[0.81700]	[-3.16749]	[12.8587]
C	-103136.8	-13.787480	7.576982	0.870634
	(53419.6)	(55.35900)	(2.32529)	(11.3757)
	[-1.93069]	[-0.24906]	[3.25851]	[0.07653]

Table 3.(Continued).

	P	GDR	FHS	NAPP
R squared	0.961958	0.906017	0.962655	0.997676
Adjusted R Squared	0.936597	0.843362	0.937759	0.996127
SSE	5374223.	5.771524	0.010183	0.243707
F Statistics	37.93053	14.460400	38.66655	644.0183
Log Likelihood	-87.65409	-12.061050	22.80889	5.344942
AIC	16.8462	3.102009	-3.237980	-0.062717
SC	17.02706	3.282870	-3.057118	0.118145
Mean of Dependent Variable	7997.627	25.518180	2.664545	75.12506
SD of Dependent Variable	3758.621	2.478115	0.165128	3.238489

The regression equation can be represented as:

$$\begin{bmatrix} P \\ GDP \\ FHS \\ NAPP \end{bmatrix} = \begin{bmatrix} -103136.8 \\ -13.787 \\ 7.576 \\ 0.871 \end{bmatrix} + \begin{bmatrix} 1.248 & 1128.018 & 6539.112 & 739.786 \\ -0.001 & -0.506 & 12.649 & 0.313 \\ -1.47E-05 & -0.006 & -0.320 & -0.051 \\ -8.63E-05 & -0.079 & 0.726 & 1.011 \end{bmatrix} \begin{bmatrix} P(-1) \\ GDP(-1) \\ FHS(-1) \\ NAPP(-1) \end{bmatrix} \quad (2)$$

Where X (-1) denotes the first-order lag of X.

As the regression result shows, the fit goodness of this model is rather good, with a value more than 0.90.For any VAR model, if the reciprocal of each root's module is less than 1, then the model is stable. Otherwise, the model is unstable and result is invalid and impulse response analysis and variance decomposition cannot be used. Here in this paper, all the reciprocals of the AR roots are within the unit circle, thus the stability condition of the VAR model is satisfied.

(2) Analysis of impulse response function. Impulse response function can be used to describe an endogenous variable's response to the impact caused by an error term. For simplification, we only analyze housing price's response to the shock of Gross Dependence Ratio, Family Household Scale, and Non-agricultural Population Proportion.

As can be seen from Figure 2, the shock of a standardized Gross Dependence Ratio results are in significant changes in the housing price. Housing prices have a positive response after the shock, and peaks at the second phase, then weaken gradually; at the end of the fourth phase, the reaction direction turns negative, and comes to the minimum point at the sixth phase; after that, reaction decreases and converges to zero slowly. This result indicates that with the increase of Gross Dependence Ratio, housing prices will increase at the early stage, and decrease after a period.

The shock of Family Household Scale is similar to that of Gross Dependence Ratio, but with a light impact. After a positive shock, housing prices responses positively first, and peaks after three phases; then the response gradually weaken, and turn to negative at the fifth period, get to the lowest point at the sixth period and gradually converge to zero.

When the shock of Non-agricultural Population Proportion occurs, housing price's response is always positive, and comes to the maximum point at the third stage, then weaken gradually. Compared with Gross Dependence Ratio and Family Household Scale, Non-agricultural Population Proportion has the smallest influence on the housing price.

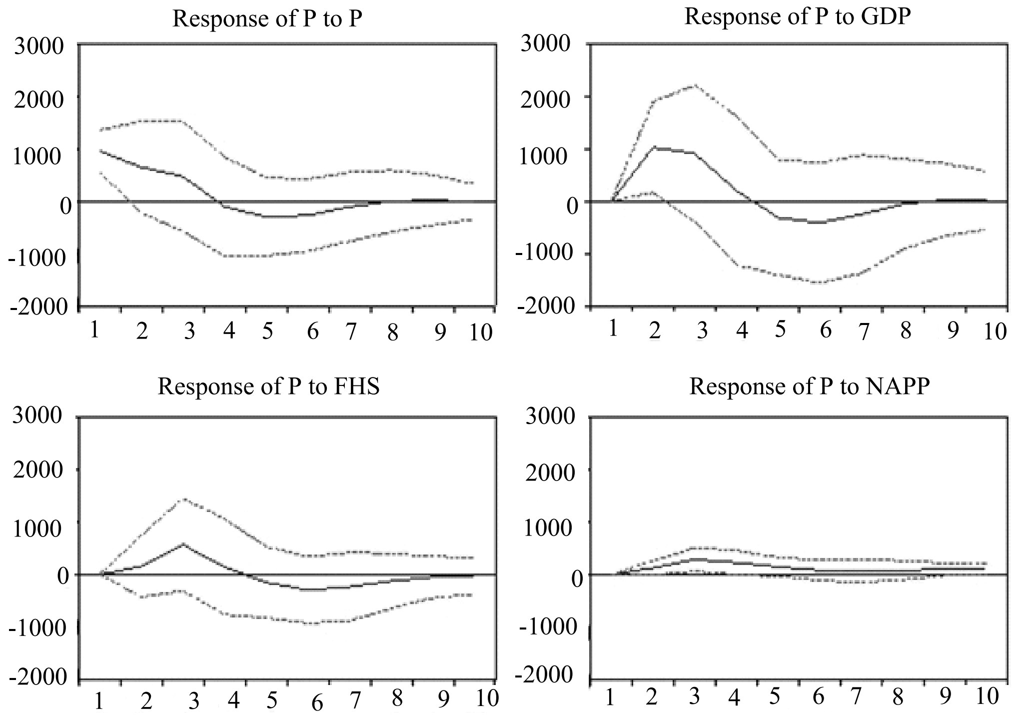

Figure 2.Housing price's response to the shock of P/GDR/FHS/NAPP.

Variance decomposition, which evaluates the importance of different structural shocks based on their impacts on endogenous variable, can also be used to study the dynamic characteristics of a VAR model. In this study, the variance analysis of housing price is shown in Figure 3. Gross Dependence Ratio can explain about 47 ~ 50% changes of housing price, and after two cycles, the contribution rate reaches maximum, while Family Household Scale contributes about 10%, and Non-agricultural Population Proportion only accounts for about 4%, having the least effect on the housing price changes. This is consistent with the analysis of impulse response.

CONCLUSION

In this paper, we mainly explore the relationships between population structures and housing price fluctuations empirically using data from Beijing. Through a series of analysis, we find that sex ratio, tertiary industry employment proportion, food expenditure proportion, college and above educational level population proportion, transfer income proportion and other structural variables have no effect on housing price fluctuations in Beijing. Among the following three structural variables, gross dependency ratio, family household scale and non-agricultural population, gross dependency ratio has the heaviest influence on housing price fluctuations. 50 percent of housing price fluctuations can be explained by gross dependency radio, whereas family household scale and non-agricultural population have a relatively small influence on housing price change. The response of housing price to gross dependency ratio and family household scale is positive at first, then turns to negative afterwards, and gradually converges to zero, but the response to non-agricultural population proportion is always positive.

The housing market has a great stake in China's economic development. Since 1998 when the government has designated residence construction development as a new economic growth point, housing price has soared and studies over the factors influencing housing price have mushroomed. Most studies study the relationships between housing price and some macroeconomic factors such as GDP, money supply, rent, credit, etc., whereas few studies focus on the relationships between population structure shift and housing price fluctuations, and these studies discuss only part of population structure such as age structure and sex ratio. This study comprehensively explores the relationships between housing price and the natural structure, economic structure and social structure of the population. According to the study results, it is essential to conduct a more specific study over the relationships between housing price and population's age structure in the future.

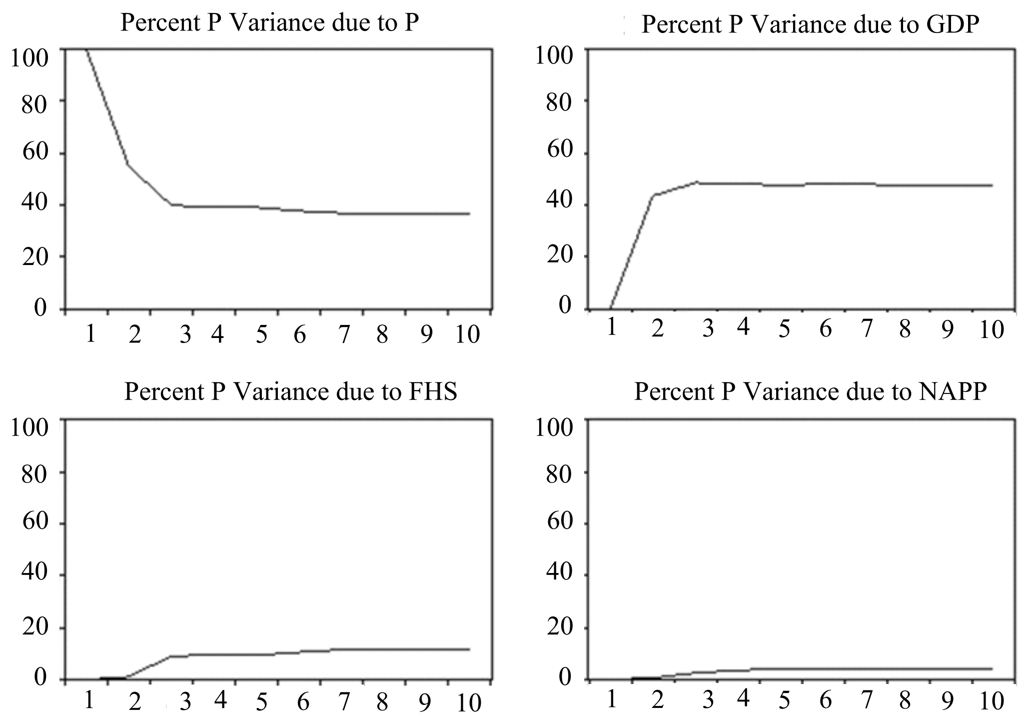

Figure 3.Outcome of variance decomposition.

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A Study on the Comparison and Selection of Agent-Construction Modes in Chinese Government Investment Projects

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Abstract

Agent-Construction mode in government investment projects is a new mechanism launched by the government investment system reform. Agent-Construction is a popular international practice, but just start to be applied in China a decade ago. The various Agent-Construction modes appeared in the past eleven years as beneficial trials. This paper analyzed the characteristics of four main Agent-Construction modes which are used nowadays. Through the comparison of advantages and disadvantages of these modes, it found the ways to choose a suitable mode in certain circumstance by the key factor analysis. Furthermore the experience and reference to promote the application of Agent-Construction have been given.

INTRADUCTION

With the government revenue increase, the scales of government investment volume and projects are getting bigger and bigger. Besides large-scale infrastructures such as roads, railways and airports, the affordable housing the government provided is going about 7 million sets each year in China (MOHURD 2014). In order to improve the effectiveness and efficiency of government investment projects, the government escaped from the traditional management mode and implemented the Agent-Construction mode since "the state council reform decision of the investment system" is issued in 2004. After eleven year practices, where are varieties of Agent-Construction modes appeared: such as Ningbo, Shenzhen, Shanghai and Beijing modes. In fact, Agent-Construction is a popular international practice: American government performed a flexible, market-based Agent-Construction system for the government to entrust part or all of public investment projects to Supervision Company. The Agent-Construction mode executed by the British government has developed through different stages, from responsibility system of public building department to "the Property Service Agency, PSA" mode. And now the British government are still searching for and establishing the new management modes, such as building contractors/consultants lists named DETR/NQS system. In

Germany the private Property federal construction co., LTD. is established for large-scale government investment project management. In a word, the practice of Agent-Construction can be comparable and reference-able worldwide.

With the diversity development of Agent-Construction modes, the related researches are also in deepening. The researcher Liu (2010) analyzed Agent-Construction based CM and EPC. Jiang's research focuses on the incentive- constraints mechanism in the Agent-Construction and its quantification (Jiang 2014). Yao and Guo (2014) researched on the dynamic game relations based on the game theory, in order to build reasonable relationships among the investor, user and construction agent. Yang's research focused on performance evaluation of construction agent organization (Yang 2015). And based on the research results both home and abroad and current practice situation in China, this article compares several main Agent-Construction modes and put forward the ways to select the suitable agent-construction mode, to improve the effectiveness and efficiency of the government investment projects (Development and Reform Commission of Beijing City 2006).

THE ANALYSIS OF THE CURRENT AGENT-CONSTRUCTION MODES

In practice, due to the different market environment, different government resources and management means, the current formation of the modes mainly have the following categories:

Shenzhen mode. (1) Mode description. In the practice of our country, the earlier agent-construction mode should be Shenzhen mode which is similar to the Hong Kong mode. The government investor entrusts the specially established inner government agents as a construction agent to build a project. Such as Shenzhen municipal government investment construction project management center was established to manage all non-profit government investment projects unified.

The concrete procedure is: after a construction task undertake, the center assigned a responsibility to a project Construction Manager who is a professional and technical person and appointed by the center. The responsibilities include: project proposal preparation, feasibility study, design and pre-tender estimation and bidding, field management and the whole process until the completion inspection and acceptance, settlement and so on. The other department in the center will give cooperation for technical proposal, the total investment control, bidding, the contract signing, and progress payment allocated, such as monitoring, assist, and service work. This management mode is shown in Figure 1.

(2) Characteristics. the mode's important characteristics is "proprietary" government, the government investment construction project management center is a inner government agency who has no investment decision-making right, and has a internal clientage relationship with government investment decision-making body who can use the means of administrative commands. Its advantages are obvious, namely the low cost for entrust, flexible operation. Principle-agent theory also thinks that the problems occurred in internal organization principal-agent is smaller than inter-organization principal-agent.

The incentive is the most important function in management. The entrusted cost is low in Shenzhen mode, but the organization cost is high. Construction project management center belongs to the government "institution" category. In reality, those who can make money without fierce competition lack the motivation to reduce costs. This is Shenzhen institutional mode problems which need to be solved.

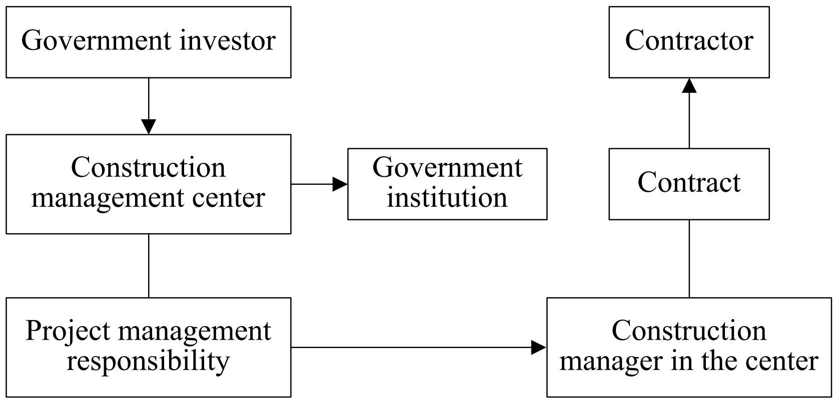

Figure 1.Shenzhen mode.

Ningbo mode. (1) Mode description. The concrete procedure is: the construction agents who are recommended by the enterprise or industry association and government departments, and reviewed by the government investment project construction qualification committee, In general, will be selected through bidding. The construction unit or client (the project user) will sign a contract with construction agent by the examination and approval of the government investor. According to the approved project proposal or approved preliminary design, the Construction agent is responsible for project construction management until the completion. The Relationships among the parties in this mode are shown in Figure 2.

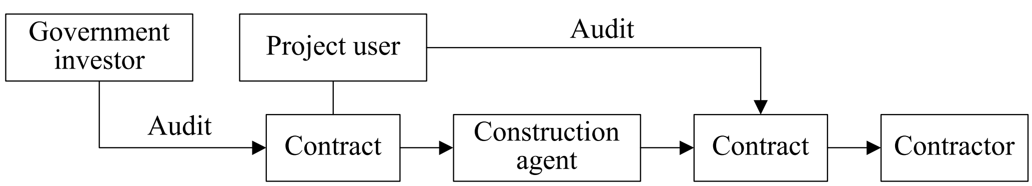

Figure 2.Ningbo mode.

(2) Characteristics. The investors (government investment departments) are not a "contract party"; the rights of Investment and funds management are handed by end user. After construction agent selected, the government investment department is virtually impossible to effectively supervise the use of investment and project construction. The end user of the project becomes the client and representative of the government investor. Its biggest characteristics and the advantages is, according to the theory of supervision and constraint; the end user must be the most loyal one to his supervisor duties. This makes, from beginning to end, the client to participate in the supervision and management with the enthusiasm and initiative.

Shanghai mode. (1) Mode description. Shanghai's procedure is: selecting some project management companies under the systems of the council, the water authority, the sanitation authority, the transportation authority for taking government investment project; the construction engineering "project legal person" is set up under the government investment department or a department is specified as a "project owner". "The project legal person" (or "project owner") will set a contract with a selected project management company that is mentioned above through bidding. This agent construction mode is shown in Figure 3.

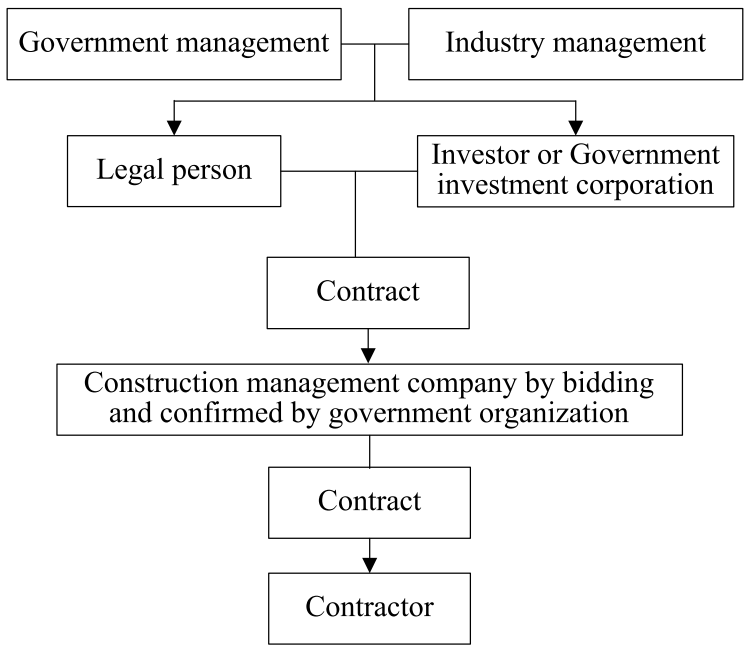

Figure 3.Shanghai mode.

(2) Characteristics. The biggest characteristic in structure of Shanghai mode is the combination of the internal entrust and the market operation, taking the low cost advantages of internal entrust and market efficiency together. Entrusted construction agent is approved by the government administrative department, although the official color is strong, the construction agent is an enterprise in the market. Through the performance of this mode the management means is improved already. The agent is also not limited to a fixed one in this limited competition environment. This results the professional management improved, and able to take more complex and large engineering projects.

The end user is not a "contract party" in this mode, the right of project investment management remains on investor ("the project legal person", "project owner"). It is difficult for end user to play the enthusiasm role. It is worth mention that "government investment corporation" as new kind agent can extend agent projects from non-business projects to the business government investment projects. This mode is different from Shenzhen mode as well as Ningbo mode, and closer to the government procurement (refers to the government and the contractor signing long-term contracts).

Beijing mode. (1) Mode description. The concrete procedure is: after the project proposal approved, the Beijing municipal government departments in charge of project examination and approval will sign the agent-construction contract with construction agent and the project user through bidding (project also can be divided into early phase and implementation phase). Mainly in the contract the rights and obligations of the trustor and construction agent are described, and matters about compensation agreed, etc. Like Beijing Huilongguan project, the Beijing municipal development and reform commission signed an entrusted construction contract with construction agent. The trustor, the user and construction agent signed the cooperation agreement to clear the rights of the three parties during project construction, namely the trustor is the decision-maker of the project, the user (only) has a right to suggestion and supervision, construction agent is in charge of the whole process of project management, etc. this mode is shown in Figure 4.

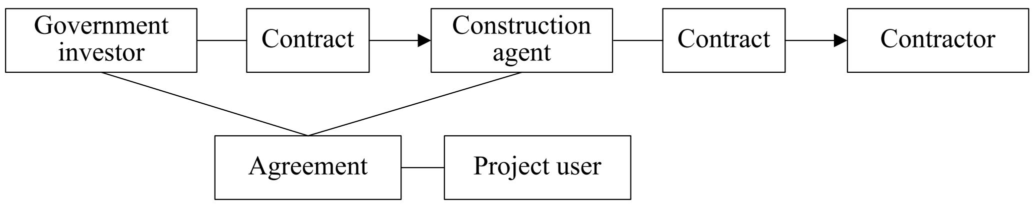

Figure 4.Beijing mode.

(2) Characteristics. In this mode the three parties can play enthusiasm role and realize the constraints among three parties and preventing corruption in public work bidding. The biggest characteristic of this mode is the government as the main project investment decision maker to participate in the market. The advantage is entrust subject clear, the investor intention can fully implemented.

THE COMPARISON AND SELECTION OF AGENT-CONSTRUCTION MODES

The comparison of agent-construction modes. It can be seen from the above mentioned practical application there are several principal-agent modes combined by different principals and different entrust methods as shown in Figure 5.

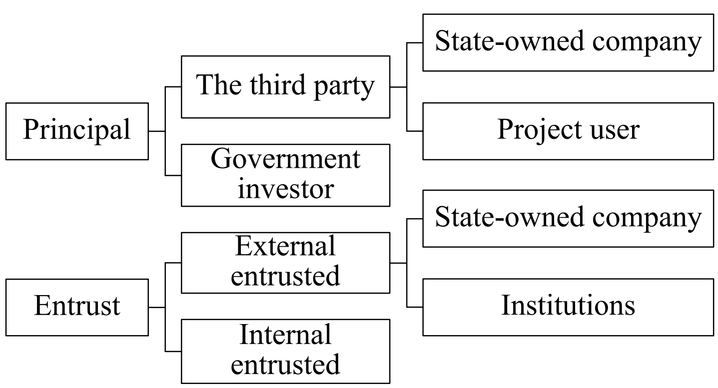

Figure 5.Entrusted agent types of agent-construction.

The government investor + external entrust → Beijing mode

Project user + external entrust → Ningbo mode

State-owned Investment Company + external entrust → Shanghai mode

The government investor + institution → Shenzhen mode

There are other combinations that can form other agent modes which have their own advantages. The comparisons of main four agent-construction modes are shown in Table 1.

Table 1.Mode Comparison.

	Enthusiasm to save money for agents	Way to choice agents	Organization costs	Operating costs	Agents binding to project	Principal intentions
Ningbo mode	Directly related to their own interests, have more motivation	Partly marketize	Not need specialized agencies, the organization cost is low	Enterprises by the management, operation cost is low	Weaker	Reflect bad
Shenzhen mode	Not directly related to their own interests, have less motivation	Internal selection	Need specialized agencies, the organization cost is high	Need experts manage, have certain operating costs	Stronger	Better reflect
Shanghai mode	More motivation	Partly marketize	To form a government professional investment company, has certain organization costs	Conducted by the company management, operation cost is low	Stronger	Better reflect
Beijing mode	Directly related to their own interests, have more motivation	High degree marketization	Not need specialized agencies, but require specialized talented person, has some organization costs	Government need special project management talent, to overcome legal obstacles, high operating costs	Weaker	Reflect good

The selection of agent-construction modes. (1) To give full play to the advantages of each mode, the different modes can be adopted according to different project and deferent situation. The new modes or the combinations can be created by gathering the advantages of each mode and it is not necessary to fixed on one mode.

(2) When investment proportion exceeded a certain amount (20%) invested by the project user, the Ningbo mode can be used. The interest of the user as one of the investor is most same as the government investor, so there is almost no moral risk.

(3) The agent as the "agent owner" represents the owner at certain extent expressed in the relevant documents at present. Whether the agent will take a risk is not the same in different municipal government agent construction systems. The problems associated with the calculation of agent service fee, what kind contract, such as whether the agent has residual claims.

(4) When government project is relative small and simple, the investment is under a certain amount, the Shenzhen mode can be used. This internal agent mode has the advantage of lowest entrust and management cost. The necessary conditions to perform this mode are to form a specialized, fixed, fewer but better senior project management team, with high level and high quality management personnel, the members can be project management experts from home and abroad. Management responsibilities mainly in the project management team are continually planning, organization, coordination and control in the whole process of the project. The operating expenses are not from project, but from the government finance. The agent behavior of the management team can be supervised by the combination team consist of the relevant government departments, Such as the Hong Kong SAR government carries on the public welfare projects mainly by the way, and the British government has generally adopted this mode.

(5) Shanghai mode can be used for more professional projects, because under this mode the construction agent is more professional engineering company.

(6) By full government investment project, the Beijing mode can be considered to use, firstly because this kind of project is limited, the government has energy for direct project management; secondly, this kind of project is particular, it is necessary for the government to take special mode different from that used in other projects.

The selection of agent-construction mode is shown in Figure 6.

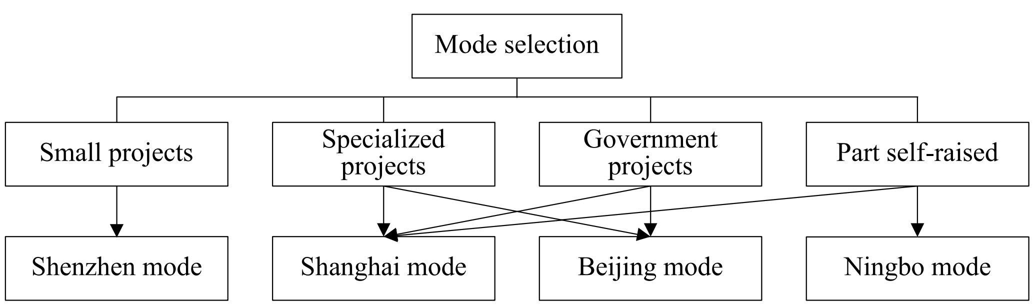

Figure 6.The selection of agent-construction mode.

CONCLUSION

Despite the many kinds of modes have been developed, the relative suitable mode can be chosen according to the specific situation, but the management innovation is the theme of development. With the development of market economy and the expansion of social division of labor and unceasing enhancement of social economic development, technical content of public project is increasing; the specialization and marketization of agent construction will be improved so as to produce new agent construction modes. As the construction agent market further opening to the whole society, it will attract many qualified professional project management company through fair competition to participate in government investment project. Fostering the subject of agent market, formulating rules and regulations, perfecting agent construction contracts, strengthening government supervision ability are the inevitable choice of deepening the reform and promotion of agent construction. Instead of the government's huge temporary management organization, the market-oriented professional project Management Company will make the project management technology, tools and ideas more professional and more advanced. Without organizing some management institutions the government can effectively prevent the expansion of staff and through the market way to transfer the risk and over cost of construction project. The government is not involved in specific economic activities that can beneficially maintain the normal market order, and can effectively prevent official from corruption. Therefore, it is the development trend of government investment project construction management system reform.

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Empirical Study on the Determinants of Internal Control Information Disclosure Quality for China's Real Estate Listed Companies

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Abstract

Based on asymmetric information theory, signaling theory and principle-agent theory, this paper investigated 276 A share real estate companies in market of Shanghai and Shenzhen Stock Exchange, which had already published the *Internal Control Self-assessment Report* in the year 2011 to 2013. The thesis established a conceptual model of the internal control information disclosure quality and observed the determinants of internal control information disclosure quality through descriptive statistics, frequency analysis, correlation analysis, multiple linear regression and robustness test in empirical study. The result shows that under other conditions in certain circumstances, profitability, the largest shareholder, board independence, the type of audit opinion, audit agency authority and company size have positive effects on internal control information disclosure quality, while ownership concentration has negative effects on the quality of internal control information disclosure.

INTRODUCTION

Economic and political environment have a great impact on China's real estate companies, which is a pillar industry of the national economy and has suffered a lot from the global financial crisis. The state has adopted a series of measures to maintain the stable development of the real estate industry. To avoid market risks and ensure the healthy development of the national economy, real estate companies must establish a sound and effective internal control system. In recent years, the internal control information disclosure have caused a widespread concern among the real estate listed companies because of a variety of domestic and foreign fraud scandals. Belonging to the significant part of modern enterprise system, the quality of internal control information disclosure has great impact on companies' internal control constructions (Udi and Jeans 2009; Beng 2009). With the promulgation and implementation of the *Internal Control Guidelines for Companies*, real estate listed companies in China are walking into the stage where they are forced to reveal internal control information. In this paper, we chose the real estate listed companies as samples and analyzed the determinants of the internal control information disclosure by empirical study and proposed appropriate measures to further improve the quality of internal control information disclosure for China's real estate companies.

THEORETICAL ANALTSIS

We analyzed asymmetric information theory, signaling theory and principle-agent theory before our empirical study.

Asymmetric information theory. Asymmetric information theory refers to the definition that different people may have different information in market economy, which can cause adverse selection and moral hazard (Karla et al. 2011). Adverse selection refers to the phenomenon that inferior products overwhelm high-quality products and result in the average decline in the quality of the goods. Moral hazard means the person engaged in economic activity maximize the effectiveness of the promotion itself and occupy the interests of others. In the stock market, listed companies should disclose prospectus, notice, regular reports, provisional notice and other information. However management sometimes may reluctant to provide real information because of the cost, trade secrets and other factors, which results in asymmetric information.

Signaling theory. Signaling theory plays an important role in solving adverse selection caused by information asymmetry (Michael 1974). As the non-financial information to reflect company management and operating conditions, internal control information provides essential message even if it has no clear measures now in China.

Principle-agent theory. When the right of property ownership and management separate and produce a new kind of economic responsibility between business owners and managers, the principle-agent relationship comes out (Santanu et al. 2012). The target of the company's owner is to maximize the interests of the shareholders. Although it has a residual claim, it's in the outside of the business operation. Business operators' goal is to maximize the pay, they have the right to operate even if they do not have a residual. Principle-agent problems arise when there are some conflicts of interests between both objectives. As the important information for company's internal control, the disclosure of internal control deficiency is significant for both principles and agents.

ASSUMPTIONS

According to the asymmetric information theory, high-quality companies have an incentive to disclose more comprehensive information to distinguish from others. Therefore, companies with stronger profitability are more likely to provide detailed information about internal control. Thus, we assumed:

H1: Profitability has positive effects on the quality of internal control information disclosure.

As a basic and important industry, real estate is relatively strongly affected by the political environment. Due to the absence of state-owned shareholders, state-owned holding companies are under much more pressure to disclosure internal control information to avoid adverse selection and moral hazard. So we supposed:

H2: The largest shareholder has positive relationship with the internal control information disclosure quality if it's state-owned.

From principle-agent theory, when the ownership is relatively centralized and the ownership concentration is high, managers can easily manipulate internal control information to conceal the true financial conditions and operating results, and the single individual shareholder lack the ability to make decisions (Xu and Lu 2014). Based on this, we made the assumption:

H3: Ownership concentration has negative effects on internal control information disclosure quality.

As the institutional arrangement to improve the level of corporate governance, setting up independent directors will help strengthen the company's monitoring functions, reduce agency costs, increase the efficiency of internal control and remedy internal control weakness to improve corporate governance structure. Therefore the higher proportion of independent directors of listed companies have, the less internal control deficiencies exist. Thus, we supposed:

H4: Board independence has positive effects on the quality of internal control information disclosure.

Audit opinion includes standard audit opinion and non-standard audit opinion. CPA states standard audit opinion only when listed companies give the fair and reliable financial statements in accordance with applicable accounting standards. Other types of opinions indicate that the CPA believes there are some problems in the company's financial statement. The auditors' opinions on the financial statements is a manifestation of the internal control information quality(Fang and Dai 2012). Based on this, we proposed:

H5: Standard unqualified audit opinion has positive relationships with the quality of internal control information disclosure.

In addition, a accounting firm with good reputations has a more professional level of business, higher standard of accounting information and more stringent internal control policies (Ye et al. 2013). If real estate listed companies hire these accounting firms, they would have a stronger professional sensitivity for the establishment and implementation of the company's internal control system, which would try to require listed companies to disclose detailed internal control information. Listed companies can hire accounting firm with high authoritative to improve the quality of internal control information disclosure. We made the assumption:

H6: Audit agency authority is positively related with internal control information disclosure quality.

MODELING

We chose internal control information disclosure quality (ICIDQ) as the dependent variable. Based on *Internal Control Guidelines for Companies*, we established a score index system as the measure of the internal control information disclosure quality. The rating indexes include the evaluation range of internal control, disclosure of internal control environment, risk assessment of internal control, internal control activities, the communication of internal control information, oversight and implementation of internal control, identification and improvement of internal control deficiency and the audit opinion on the internal control self-assessment. The weight of each index was set to 1 and we marked 1 point if it was disclosed and 0 point if it wasn't. Thus the total score could reflect the internal control information disclosure quality, which ranged between 0 and 8.

According to the theoretical analysis and research assumptions, we chose a total of six independent variables as profitability, the largest shareholder, ownership concentration, board independence, the type of audit opinion and audit agency authority:

Profitability (ROE): weighted average return on net assets; the largest shareholder (LS): 1 score if it's state-owned and 0 if not; ownership concentration (OC): the proportion of the largest shareholder, equals the ratio of the number of shares the largest three shareholders with a total share capital; board independence (PID): the proportion of independent directors, equals the ratio of the total number of independent directors and the board of directors; the type of audit opinion (AO): 1 score if standard unqualified audit opinion is issued and 0 if not; audit agency authority (AF): 1 score if top ten accounting firms are hired and 0 if not.

To avoid multicollinearity, we joined company size as the control variable for further research and analysis. Company size (LNA): equals the natural logarithm of the year-end total assets.

The multiple linear regression model was constructed as follows:

$$\mathrm{ICIDQ} = \beta_0 + \beta_1 \mathrm{ROE} + \beta_2 \mathrm{LS} + \beta_3 \mathrm{OC} + \beta_4 \mathrm{PID} + \beta_5 \mathrm{AO} + \beta_6 \mathrm{AF} + \beta_7 \mathrm{LNA} + \varepsilon \quad (1)$$

Among them, β_0 is the constant term, $\beta_i \left(i = 1, 2, \ldots, 7 \right)$ are the estimated coefficients of the independent variables and control variable, ε is the random error.

EMPIRICAL STUDY

Based on our model, we verified our null assumptions through descriptive statistics, frequency analysis, correlation analysis, multiple linear regression and robustness test.

Descriptive statistics. We collected 276 samples which met the requirements and used SPSS21.0 statistical software for the variables. The results are shown in Table 1:

Table 1.Descriptive Statistics.

	ICIDQ	ROE(%)	LS	OC(%)	PID	AO	AF	LNA
Maximum	8	30.51	1	84.95	0.57	1	1	26.89
Minimum	2	-34.28	0	16.88	0.33	0	0	21.82
Average	5.09	15.07	0.61	51.05	0.40	0.84	0.70	23.95
Standard Error	1.81	9.38	0.49	17.55	0.08	0.36	0.46	1.19

From Table 1, we can find some basic characteristics of the 276 real estate listed companies. The average score of internal control information disclosure quality was just over 5 points and from the maximum of 8 points to the minimum of 2 points, which shows the overall poor qualities and large differences between individuals in the real estate listed companies. Average profitability reached 15.07%, indicating that the overall profitability of the real estate industry was relatively high. State-owned companies accounted for 61% of the total sample of companies and the proportion of the top three shareholders' stake was approximately 51.05%. The minimum proportion of independent directors was nearly 33% and the average reached 40%, which met the requirement that independent directors of listed companies should be more than one third of the total directors. 84% of the companies were issued standard unqualified audit opinion and 70% had hired domestic top ten accounting firms. The maximum of the company size was 26.89 and the minimum was 21.82.

Frequency analysis. For the reason that the largest shareholder (LS), the type of audit opinion (AO) and audit agency authority (AF) are dummy variables that the value is 0 or 1, we did frequency analysis to improve the accuracy of descriptive statistics. The results about the largest shareholder are shown in Table 2:

Table 2.Frequency Analysis of the Largest Shareholder.

		Frequency	Effective Percentage	Cumulative Percentage
Shenzhen	0	32	50.0	50.0
Stock	1	32	50.0	100.0
Exchange	Total	64	100.0	
Shanghai	0	4	14.3	14.3
Stock	1	24	85.7	100.0
Exchange	Total	28	100.0	

From Table 2, half of the total real estate listed companies in Shenzhen Stock Exchange were State-owned and half of them were not. 24 companies in Shanghai Stock Exchange were State-owned, made up 85.7% of the 28 companies. The results about the type of audit opinion are shown in Table 3:

Table 3.Frequency Analysis of the Type of Audit Opinion.

		Frequency	Effective Percentage	Cumulative Percentage
2011	0	20	21.7	21.7
	1	72	78.3	100.0
	Total	92	100.0	
2012	0	24	26.1	26.1
	1	68	73.9	100.0
	Total	92	100.0	
2013	1	92	100.0	100.0

As can be seen from Table 3, 20 real estate listed companies in Shanghai and Shenzhen Stock Exchange were issued standard unqualified audit opinion in 2011 and 24 in the year 2012, which rose from 21.7% to 26.1%. In 2013 all of the 92 companies were issued standard unqualified audit opinion. The results about the audit agency authority are shown in Table 4:

Table 4.Frequency Analysis of the Audit Agency Authority.

		Frequency	Effective Percentage	Cumulative Percentage
2011	0	32	34.8	34.8
	1	60	65.2	100.0
	Total	92	100.0	
2012	0	28	30.4	30.4
	1	64	69.6	100.0
	Total	92	100.0	
2013	0	24	26.1	26.1
	1	68	73.9	100.0
	Total	92	100.0	

From Table 4, 60 real estate listed companies hired domestic top ten accounting firms in 2011, accounting for 65.2% of the samples. In the year 2012, the number reached 64 and the ratio continued to rise to 73.9% in 2013. From the overall situation, more than half of the companies had hired top ten accounting firms in the past three years to ensure high quality of internal control information disclosure.

Correlation analysis. We conducted a two-sided test Pearson correlation for the variables. The correlation coefficient for each variable are shown in Table 5:

Table 5.Correlation Analysis.

Variables	ICIDQ	ROE	LS	OC	PID	AO	AF	LNA
ICIDQ	1	0.10800	0.105	-0.02300	0.01300	0.449**	0.0840	0.20500
ROE	0.10800	1	-0.084	0.316**	0.08300	-0.04000	-0.0390	0.18300
LS	0.10500	-0.08400	1	-0.14100	0.19100	0.05600	0.1800	0.12100
OC	-0.02300	0.316**	-0.141	1	-0.17300	-0.04100	-0.0540	-0.19900
PID	0.01300	0.08300	0.191	-0.17300	1	0.00900	0.289*	0.393**
AO	0.449**	-0.04000	0.056	-0.04100	0.00900	1	0.2280	0.2400*
AF	0.08400	-0.03900	0.180	-0.05400	0.2890*	0.22800	1	0.2510*
LNA	0.20500	0.18300	0.121	-0.19900	0.393**	0.2400*	0.251*	1

Note: **, * represent at the 10%, 5% significance level.

From the correlation matrix, the correlation between the variables were in the same direction with the forecast. The results further validated the original hypothesis. The majority of the correlation coefficient between the variables located in the [-0.3, 0.3], indicating that the variables had good representation (Tomas and Williams 1991). Thus there was no collinearity between variables, which could be used in the regression model.

Multiple linear regression. We used regression analysis method for statistical test. The multiple linear regression results are shown in Table 6.

In collinearity diagnosis, the regression equation for each variable tolerances were greater than 0.1 and close to 1, and each VIF was less than 10 and tended to 1. The results further confirmed that there was no serious multicollinearity problem between variables and using multiple linear regression is scientific and reasonable.

Table 6.Multiple Linear Regression.

Model	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	-0.464	4.308		-0.108	0.015		
ROE	0.003	0.023	0.014	0.120	0.005	0.928	1.078
LS	0.312	0.404	0.085	0.772	0.043	0.933	1.072
OC	-0.002	0.012	-0.015	0.132	0.046	0.945	1.058
PID	0.772	2.680	0.035	-0.288	0.034	0.927	1.079
AO	2.644	0.551	0.538	4.797	0.000	0.896	1.116
AF	0.259	0.452	0.066	-0.573	0.009	0.941	1.063
LNA	0.147	0.190	0.096	0.772	0.043	0.912	1.096

Nagelkerke R Square: 0.318; F: 4.061 (Sig.=0.001)
Dependent Variable: ICDI

The model was significant at 0.01 level (Sig.=0.001), which fully illustrated that we successfully found the main determinants affecting internal control information disclosure quality. -2 Log likelihood value showed a high level of significance in our model. Nagelkerke R square value indicated that the model explained 31.8% of the overall situation, indicating that ICIDQ was affected by multiple factors.

The sign of the coefficients of the independent variables and control variables were consistent with the expected and were on the 5% or higher level of statistical significant. In short, the multiple linear regression supported our original assumptions.

Robustness test. We selected one alternative variable to test the robustness of the conclusions. Instead of AF, we choose the top four accounting firms to represent audit agency authority (AF'). The results are shown in Table 7:

Table 7.Robustness Test.

Model	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	-0.465	4.359		-0.154	0.011		
ROE	0.003	0.078	0.016	0.221	0.007	0.937	1.067
LS	0.311	0.456	0.082	0.687	0.042	0.941	1.063
OC	-0.002	0.022	-0.012	0.151	0.039	0.928	1.078
PID	0.775	2.647	0.034	-0.276	0.037	0.929	1.076
AO	2.647	0.536	0.537	4.737	0.001	0.901	1.110
AF	0.251	0.441	0.058	-0.574	0.006	0.933	1.072
LNA	0.143	0.187	0.071	0.768	0.033	0.916	1.092

Nagelkerke R Square: 0.319; F: 4.586 (Sig.=0.001)
Dependent Variable: ICIDQ

From Table 7, we found the significant level of independent variables and control variable remained stable, there was still no serious multicollinearity problem between variables and the model was significant, which further confirmed our conclusions.

CONCLUSION

We analyzed the determinants of internal control information disclosure quality for China's real estate listed companies. We found that companies with stronger profitability are more likely to disclose high-quality information about internal control. State-owned holding companies have higher internal control information disclosure quality and ownership concentration is negatively related with it. Board independence has positive effects on the quality of internal control information disclosure. Companies' internal control information disclosure quality is higher if they are issued standard unqualified audit opinions or the audit agency authority is greater. We suggest real estate listed companies define the specification and strengthen the supervision of internal control information disclosure to encourage companies to voluntarily disclose detailed and accurate internal control information.

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Construction Projects' Key Performance Indicators: A Case of the South African Construction Industry

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Abstract

Key Performance Indicators (KPIs) are one of the factors that constitute construction project success criteria which is the reason while performance measurement on construction projects are usually carried out by establishing KPIs which offer objective criteria to measure project success. An assumption is made that if a project is completed on time, within the agreed budget and set quality, also referred to as the 'golden/iron triangle', then the project is deemed successful. Evidence suggests that this is far from the truth. Hence, the construction industry needs to pay attention to critical success factors, besides the golden/iron triangle. Hence, this paper explores the most significant construction projects' KPIs in the Gauteng province of South Africa. A questionnaire survey was used to collect the data for this study as a primary source in order to establish the most significant key performance indicators for construction projects in Gauteng, South Africa. Professionals such as architects, quantity surveyors, electrical engineers, mechanical engineers, structural engineers, civil engineers, construction managers, project managers and construction project manager, were randomly selected as the target population for the survey. The secondary data was collected from a thorough review of related literature; it is through this thorough literature review that the key performance indicators for construction projects in Gauteng, South Africa, were identified which were further tested via the questionnaire survey. Findings from the questionnaire survey revealed that the most significant construction projects KPIs are: construction time, profitability, project management, material ordering, handling and management, risk management, quality assurance, client satisfaction (product), safety, time predictability (project, design, construction), productivity, client satisfaction (service). The study contributes to the body of knowledge on the subject of construction projects' key performance indicators in the Gauteng Province of South Africa.

INTRODUCTION

Projects had clearly become a central activity in most organizations and companies and they are rapidly increasing their investment resources in projects such as new product development, process improvement, or building new services (Humaidi and Said 2011). However, many studies indicated that most projects do not meet time and budget goals, or fail to satisfy customer and company expectation. Notwithstanding, other factors also contributed to the failure of projects such as weaknesses in project mission and planning, lack of project knowledge, communications breakdown, lack of resources, political issue, control issues, lack of top management support, lack of technical expertise, etc (Sauser and Eigbe 2009; Humaidi and Said 2011). Therefore the establishment of KPIs plays an important role in project delivery.

Project performance can be measured and evaluated using a large number of performance indicators that could be related to various dimensions (groups) such as time cost, quality, client satisfaction, client changes, business performance, health and safety (DETR 2000; Cheung et al. 2004; Enshassi et al. 2009). Time, cost and quality are, however, the three predominant performance evaluation dimensions in the construction industry, also known as the "iron triangle". However on the contrary Garbharran et al. (2013) states that an assumption is made that if a project is completed on time, within the agreed budget and set quality, also referred to as the 'golden/ iron triangle', then the project is deemed successful. Evidence suggests that this is far from the truth. Hence, the construction industry needs to pay attention to critical success factors, besides the golden/iron triangle (Toor and Ogunlana 2005; Garbharran et al. 2013). Ogunsanmi (2013) states that KPIs can also be referred to as Key success indicators, measuring a project's success is more than making sure it's completed. Traditionally, success is defined as the degree to which project goals and expectations are met (Elattar, 2009; Garbharran et al. 2013). It should be viewed from different perspectives of individuals and the goals related to a variety of elements, including technical, financial, education, social, and professional issues. Indeed, measuring project success is a complex task since success is intangible and can hardly be agreed upon. Such a phenomenon also exists in the construction industry where different parties are involved, including the client, the architect, the contractor, and various surveyors and engineers. Each project participant will have his or her own view of success.

Al-Tmeemy et al. (2010) and Garbharran et al. (2013) identified 13 critical success factors for building projects in Malaysia from the contractors' perspective. These criteria included: cost, time, quality, safety, achieving scope, customer satisfaction, technical specifications, functional requirements, market share, competitive advantage, reputation, revenue and profits, and benefit to stakeholder. This paper will therefore investigate the most significant construction projects' key performance indicators.

KEY PERFORMANCE INDICATORS

The construction industry KPIs were first published in 1999, and are updated annually, by the UK working group. The Headline KPIs are derived from the 5-4-7 model first put forward in the UK's Egan Report "Rethinking Construction". These improvement targets formed the basis for the national Headline KPIs in the UK, which were designed to show how improvement would be demonstrated. These KPIs are now widely used within the construction industry to measure performance and drive improvement (Swan and Kyng 2005).

Performance measurement is the process of quantifying the efficiency and effectiveness of actions. For a performance measurement system to be regarded as a useful management process, it should act as a mechanism that enables assessment to be made, provides useful information and detects problems, allowing judgment against certain predetermined criteria to be performed (Neely 2005; Basheka and Tumutegyereize 2011).

KPIs are one of the factors that constitute the project success criteria. Swan and Kyng (2005) view KPIs as the measure of a process that is critical to the success of an organisation and/or project. According to a publication by Price Waterhouse Coopers (PWC), KPIs means actors by reference to which the development, performance or position of the business of the company can be measured effectively. Thoor and Ogunlana (2010), together with Humaidi and Said (2011), suggested that KPIs are helpful to compare the actual and estimated project performance in terms of effectiveness, efficiency, and quality of workmanship and product. KPIs can be used to measure the performance of project operation and are usually used in construction projects. Moreover, performance measurement can be carried out by establishing KPIs which offer objective criteria to measure project success. The formal definition for KPIs according to Public Record Office Victoria (2010) is Key Performance Indicators (KPIs) are quantitative and qualitative measures used to review an organisation's progress against its goals. These are broken down and set as targets for achievement by departments and individuals. The achievements of these targets are reviewed at regular intervals.

Takin and Akintoye (2002), informs that the UK working groups on KPIs have identified 10 parameters for benchmarking projects in order to achieve a good performance in response to Egan's report. These parameters are also defined in the "Rethinking Construction" in the 5-6-10 model as headline KPIs and they are as follows; Construction cost, construction time, predictability cost, predictability time client satisfaction (product), client satisfaction (service), Defects, productivity, profitability, safety. Most of these indicators, such as construction cost, construction time, defects, client satisfaction with the product and service, profitability and productivity, promote result-orientated thinking, whereas predictability of design cost and time, and predictability of construction cost and time, and safety can be regarded as process-orientated thinking. (Takin and Akintoye 2002).

There are also secondary indicators, which are classified into the following categories; a) operational indicators, which bear on specific aspects of a firm's activities and enable management to identify and focus on specific areas for improvement; and b) diagnostic indicators, which provide information on why certain changes may have occurred in the headline or operational indicators and are useful in analysing areas for improvement in more detail. These secondary indicators therefore play a vital role in improving both project and organisation overall performance.

METHODOLODGY

A questionnaire survey was used to collect the data for this study as a primary source, to establish the most significant key performance indicators for construction projects in Gauteng, South Africa. Professionals such as architects, quantity surveyors, electrical engineers, mechanical engineers, structural engineers, civil engineers, construction managers, project managers and construction project manager, were selected as the target population for the survey. Questionnaires were distributed randomly to respondents in both the private and public sector. The secondary data was collected from a thorough review of related literature; it is through this thorough literature review that the key performance indicators for construction projects in Gauteng, South Africa, were identified. Using a five point Likert scale, the respondents were asked to rate the most significant construction industry KPI's, the studied factors were ranked based on the mean item score.

Mean item score. The five-point scale was transformed to mean item score (MIS) for each of the factors of causes and effects as assessed by the respondents. The indices were then used to determine the rank of each item. The ranking made it possible to cross compare the relative importance of the items as perceived by the respondents. This is the method used to analyse the collected data from the issued questionnaires in this study. Likert scaling is a bipolar scaling method, measuring either positive or negative response to a statement (Sukamolson 2005). After the questionnaire is completed, each item may be analysed separately or item responses may be summed to create a score for a group of items. Hence, Likert scales are often called summative scales.

The computation of the relative mean item score (MIS) was calculated from the total of all weighted responses and then relating it to the total responses on a particular aspect. This was based on the principle that respondents' scores on all the selected criteria, considered together, are the empirically determined indices of relative importance. The index of MIS of a particular factor is the sum of the respondents' actual scores (on the 5-point scale) given by all the respondents' as a proportion of the sum of all maximum possible scores on the 5-point scale that all the respondents could give to that criterion (Pilot and Hungler 1995). Weighting were assigned to each responses ranging from one to five for the responses of 'strongly disagree' to 'strongly agree' and 'Extremely unlikely' to 'Extremely likely'. This is expressed mathematically below. The mean item score (MIS) was calculated for each item as follows.

$$MIS = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{\sum N} \quad (1)$$

Where,

n_1 =Number of respondents for extremely unlikely or strongly disagree;

n_2 =Number of respondents for unlikely of disagree;

n_3 =Number of respondents for neutral;

n_4 =Number of respondents for likely or agree;

n_5 =Number of respondents for extremely likely or strongly agree;

N = Total number of respondents.

After mathematical computations, the criteria are then ranked in descending order of their mean item score (from the highest to the lowest).

FINDINGS AND DISCUSSIONS

From the 131 usable questionnaires, the following information was gathered; of all the respondents 61% were male and 39% were female. Relating to their qualifications, findings revealed that 1.5% of the respondents had no qualification, 6.1 % had only completed matric (grade 12), 40.5% had diplomas, while 7.6% of the respondents had B-Degrees, 7.6% had an M-Degree and lastly, only 0.8% of the respondents had a Doctorate qualification. Findings also revealed that 34.6% of the respondents were Quantity surveyors, 21.5% were project managers, 11.5% were civil engineers, 7.7% were construction project managers, 6.9% were construction managers, 5.4% were electrical engineers, 1.5% of the respondents were both structural engineers and architects and finally 4.6% were mechanical engineers and the other 4.6% had job a titles that were not identified in the study and therefore their titles fell under the heading "other". When asked about their work experience, findings showed that 54.4% of the respondents had between 2 and 5 years of work experience, 28.3 % had 6-10 years' experience, 7.2% had 11-15 years' experience, 7.1% had 16-20 years' experience and 0.8% of the respondents had 26-30 and 31-35 working experience in the construction industry.

Based on the ranking using the calculated standard devotion and mean score for the listed construction industry's Key Performance Indicators, according to the respondents the most significant performance indicators are as follows; construction time (SD=0.923; $\bar{x}$ =4.44; R=1); profitability (SD=0.842; $\bar{x}$ =4.42; R=2), Project management (SD=0.782; $\bar{x}$ =4.37; R=3), Material ordering, handling and management (SD=0.761; $\bar{x}$ =4.36; R=4), Risk management (SD=0.758; $\bar{x}$ =4.34; R=5), Quality assurance (SD=0.767; $\bar{x}$ =4.30; R=6), Client satisfaction (product) (SD=0.778; $\bar{x}$ =4.29; R=7), Safety(SD=0.872; $\bar{x}$ =4.26; R=8), Time predictability (project, design, construction) (SD=0.753; $\bar{x}$ =4.24; R=9), Productivity (SD=0.793; $\bar{x}$ =4.22; R=10), Client satisfaction (service) (SD=0.822; $\bar{x}$ =4.22; R=10), Cost predictability (project, design, construction) (SD=0.797; $\bar{x}$ =4.20; R=11), Procurement (SD=0.811; $\bar{x}$ =4.19; R=12), Construction cos(SD=0.788; $\bar{x}$ =4.18; R=13), Defects (SD=0.812; $\bar{x}$ =4.05; R=14), Human resource management (SD=0.813; $\bar{x}$ =4.00; R=15).

The UK working groups on KPIs have identified ten parameters for benchmarking projects, in order to achieve a good performance in response to the Egan's report (Takim and Akintoye 2002), however for this study, through a thorough review of literature, the researcher identified six additional parameters which were then included in the questionnaire. Findings relating to the KPIs revealed that project management, material ordering, handling and management, risk assurance and quality assurance are considered significant indicators in the South African construction industry. This indicated that the South African construction industry is dynamic in nature as the above mentioned KPIs have never been included in previous studies of this nature. Therefore due to the abovementioned reasons findings to this study were not in agreement with Koelmans, who identified Scope and quality of the project as the most influential performance indicator. Furthermore, according to the Marx and Chan and Ada cost, time and quality are the three basic and most important performance indicators in construction projects followed by others such as safety, functionality and satisfaction. Enshassie et al. is in agreement with the Marx and also states that time, cost and quality are the three predominant performance indicators for construction projects. Ogunsanmi (2013) states that KPIs can also be referred to as Key success indicators, therefore according to this notion, Al-Tmeemy et al. and Guidiene et al. findings are in disagreement with this study's' findings, their findings indicate that cost, time, quality, safety, achieving scope, customer satisfaction are the top four most significant indicators, which is in agreement with Marx and Ogunsanmi (2013), furthermore according to Al-Tmeemy et al. and Guidiene, revenue and profits, and benefit to stakeholder are the least important indicators. All as seen in Table 1.

Table 1. Construction Projects' Key Performance Indicators.

KPIs	$\bar{x}$	σX	R
Construction time	4.44	0.729	1
Profitability	4.42	0.824	2
Project management	4.37	0.782	3
Material ordering, handling and management	4.36	0.761	4
Risk management	4.34	0.758	5
Quality assurance	4.30	0.767	6
Client satisfaction (product)	4.29	0.778	7
Safety	4.26	0.872	8
Time predictability (project, design, construction)	4.24	0.753	9
Productivity	4.22	0.793	10
Client satisfaction (service)	4.22	0.822	10
Cost predictability (project, design, construction)	4.20	0.797	11
Procurement	4.19	0.811	12
Construction cost	4.18	0.788	13
Defects	4.05	0.812	14
Human resource management	4.00	0.813	15

σX = Standard deviation; $\bar{x}$ = Mean item score; R = Rank

CONCLUSION

The reviewed literature on the most significant key performance indicators revealed that, scope and quality were the most significant KPIs for construction projects, further review revealed that cost, time and quality are the three basic and most important performance indicators in construction projects followed by safety, functionality and client customer satisfaction. From the data collected, using a well-structured questionnaire, it was observed that construction time, profitability, project management, material ordering, handling and management, risk management, quality assurance, client satisfaction (product), safety, time predictability (project, design, construction), productivity, client satisfaction (service), were, according to all respondents the ten most significant key performance indicators for construction projects in Gauteng, South Africa.

However, these findings relating to the KPIs revealed that project management, material ordering, handling and management, risk assurance and quality assurance are considered significant indicators in the South African construction industry. This indicated that the South African construction industry is dynamic in nature as the above mentioned KPIs have never been included in previous studies of this nature.

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Measuring the CSR of Construction Enterprises: A Literature Review

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Abstract

Although the construction industry plays an important role in the economic development and city construction of our country, it brings about a series of social problems that construction enterprises violate legal rights and interests of their employees and some construction engineering quality problems. Construction enterprises can improve their own figures and credit, increase the efficient of finance, strengthen their oversea construction ability and advance their oversea marketing status. The article reviews and analyzes some basis thoughts and evaluation ways about the social responsibilities of construction enterprises and analyzes some existent problems in order to provide some references for the evaluation model of social enterprises responsibility in China.

INTRODUCTION

With the rapid development of China's economy, the enterprise has created for the society a lot of wealth. The continuous expanding of enterprises, however, is facing a number of challenges, involving environment, social and economic issues. These challenges affect the enterprise's image and reputation, also indirectly affecting the enterprise's financial benefits. The basic reason is that enterprises lack of corporate social responsibility (CSR). In order to make enterprises in line with international standards, the enterprise also began to pay attention to corporate social responsibility.

Construction industry as a pillar industry of our country, promote the development of the economy. But construction enterprise has many problems in the aspect of corporate social responsibility. Such as security accident, substandard buildings, noise and the default of workers' wages. Especially, more and more enterprises prepare to contact for the international projects. Therefore, construction companies are considering corporate social responsibility as a means to enhance their corporate image and to gain a competitive advantage. In conclusion, it is meaning for construction enterprise to pay attention to carry out CSR.

In this paper, we first neaten the definition of CSR. Then, we describe the research status of CSR in construction enterprise. In the end of this paper, we apply stakeholder theory to CSR in construction enterprise.

THE DEFINATION OF CSR

The definition of corporate social responsibility has always been controversial; each scholar has its own unique insights. Because there are so many other scholars proposed the definition of corporate social responsibility, so they cannot be mentioned in this paper all at once. In this paper, the author just picks up some organizations' statements. International organizations defined CSR and categorized dimensions of each definition as following Table 1.

Table 1.Defination.

Organization	Definition	Dimensions
The world business council for sustainable development	The commitment of business to contribute to sustainable economic development, working with employees, their families, the local community and society at large to improve their quality of life	Stakeholder; Social; Economic
The world business council for sustainable development	Corporate social responsibility is the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as the local community and society at large	Stakeholder Voluntariness Social; Economic
The commission of the european communities	A concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis	Voluntariness Stakeholder Communities Social Environmental; Economic
Business for social responsibility	Corporate social responsibility is achieving commercial success in ways that honor ethical values and respect people, communities and the natural environment	Voluntariness Stakeholder; Social; Environmental; Economic
Business for social responsibility	Operating a business in a manner that meets 117 Voluntariness Responsibility, 2000 or exceeds the ethical, legal, commercial Stakeholder and public expectations that society has of Economic business. Social responsibility is a guiding principle for every decision made and in every area of a business	Voluntariness; Economic; Stakeholder
Business for social responsibility	Business decision making linked to ethical values, compliance with legal requirements and respect for people, communities and the environment	Voluntariness Stakeholder Social Economic Environmental

Table 1.(Continued).

Organization	Definition	Dimensions
CSRwire	CSR is defined as the integration of business operations and values, whereby the interests of all stakeholders including investors, customers, employees and the environment are reflected in the company's policies and actions	Voluntariness stakeholder environmental economic
UK government	Corporate social responsibility recognizes that the private sector's wider commercial interests require it to manage its impact on society and the environment in the widest sense. This requires it to establish an appropriate dialogue or partnership with relevant stakeholders, be they employees, customers, investors, suppliers or communities. CSR goes beyond legal obligations, involving voluntary, private sector-led engagement, which reflects the priorities and characteristics of each business, as well as sectoral and local factors.	Voluntariness stakeholder social environmental economic
Business for social responsibility	The business operations meet or exceed social expectations of industrial and commercial institutions in the ethical, legal, commercial and public areas.	Social; Stakeholder; Economic; Voluntariness
ISO26000	The responsibility of an organization for the impacts of its decisions and activities on society and the environment, through transparent and ethical behavior.	Social; Environmental

As we can see from the Table 1, there is the World Business Council for Sustainable Development proposed different definitions and different dimensions of CSR in the same year. We can deduce that the definition of CSR cannot be given easily. Among them, CSR which was proposed by Commission of the European Communities is the most popular. The European Communities gave us 6 dimensions, including voluntariness， stakeholder ,communities, social, environmental and economic. These 6 dimensions are comprehensive for CSR.

THE RESEARCH STATUS OF CSR IN CONSTRUCTION ENTERPRISE

The basic theory of CSR is stakeholder theory which is developed by Freeman in 1984. The theory decomposed the goal of the enterprise into rights and obligations of various stakeholders, advocating the stakeholders benefit maximization. And the enterprise must be responsible for all stakeholders. Based on this theory, we not only can analyze relevant stakeholders of the construction enterprise, but also can determine the framework and contents of CSR in construction enterprise.

Construction enterprise is a pillar industry in countries; it is different from other types of enterprise. The behavior of the construction enterprise to realize the sustainable development of economy, society and environment in the future is crucial. In the case of urbanization, resource consumption and the rate of environmental pollution significantly speeding up, the effect of construction enterprise is more significant. PWC estimates the consumption of resource from construction industry accounts for about half of the total resource consumption, and the energy consumption is up to 40% of the total consumption. The whole building life cycle exists energy consumption, including the construction stage and operation stage and material production stage. In fact, the construction industry not only affects the nature, function and appearance of city, but also contributes to the formation of a community. So, the construction industry influences environment significantly.

So far, there is not a complete evaluation indicator system of CSR for construction enterprise. Common system of international standards are IS09001: 2000, IS014001: 1996, IS026000, OHSMS1800K, GRI sustainable framework. Some of CSR are focused on some specific aspects, and some evaluation is totally different from the others. There are not many papers about CSR for construction enterprise. Murray and Dainty just give the definition of CSR in construction enterprise, but they did not give the method of evaluating CSR in construction enterprise. Petrovic Lazarevic built model of CSR on the basis of construction industry in Austrilia. But Petrovic Lazarevic did not indicate the relationship between CSR and enterprise performance.

STAKEHOLDERS IN CSR AND STAKEHOLDERS IN CSR OF CONSTRUCTION ENTERPRISE

Most scholars' method of researching CSR is similar. Firstly, they find out key stakeholders of CSR. Secondly, they identify and analyze CSR performance issues. The prompt questions used in this process are: "are these CSR performance issues particularly critical for construction enterprises?" and "considering this is the significant CSR performance issue for the construction enterprises, what indicators should be designed to measure this issue?" In the end, translating the performance issues into CSR indicators to build the evaluation indicator system of CSR. Similarly, the evaluation indicator system of CSR for construction enterprise can use the 3 step method.

Stakeholder theory developed by Freeman uses primary and secondary relationships as a means to identify stakeholders (Clarkson 1995). The stakeholder analysis provides a useful input for prioritizing different stakeholders' short-term and long-term interests and subsequently making decisions (Carroll 1991). Zhao (2012) contrasted the difference of stakeholders' categories which are identified by various organizations or scholars. In his research, he believed that the stakeholders identified can be summarized into eleven broad categories: employees, customers, shareholders, creditors, suppliers and partners, environment and resources agencies, local communities, government, competitors and NGOs.

Most enterprises share some common set of stakeholders such as employees, customers, shareholders, local communities and suppliers (Clarkson 1995; Maignan and Ralston 2002). In addition, competitors may affect and be affected by the organization's behavior and business operation and therefore needs to be considered as a stakeholder (Petrovic-Lazarevic 2008). Just like the 3 step research methodology, these categories of stakeholders apply to the construction context as well.

Zhao (2012) analyzed the stakeholder group at the project level. In general, construction projects progress through the following stages: investment decision-making stage, construction preparation stage, reconnaissance and design stage, construction stage, and finally, the acceptance and maintenance stage. Then, he gave CSR performance factors relevant for construction companies. The different stage of project progress has different relevant factors. In the end of the research method, he concluded 11 indicators for clients, shareholders, customers, suppliers and partners, government, resources and environment, local community, competitors and NGOs. In the part of conclusion, Zhao had proposed a CSR indicator system that built upon existing indicator frameworks and reporting initiatives. The identification of key stakeholders provides a new way to organize the attributes of CSR. This way also offered a link between the conception of CSR and its indicators. This method of building the CSR indicator system for construction enterprise did not illustrate us the importance of each indicator, so it cannot make evaluation of CSR quantification.

Zhang and Lei (2013) first assumed six dimensions of corporate social responsibility for construction enterprise. The dimensions are stuff, community, environment, owner, sub-contractor and charities. The author built the model of CSR indicator system for construction enterprise through the questionnaire. This study used structural equation model to verify the reliability and validity of the conceptual model. This research used SPSS to analyze 100 effective samples which were obtained from stuff who engaged in construction. In the end, it got the conclusion that the dimensions of CSR for construction enterprise are stuff, community, environment, owner and sub-contractor through exploratory factor analysis. Each dimension includes its own variables. Stuff includes salary, spirit, career development, system building these four variables. Community includes convenient, volunteer and community building. Owner includes the quality of housing and the authenticity of information. Sub-contractor includes corporation and payment. This research just provided us the indication of CSR, but it cannot make evaluation of CSR quantification either.

CONCLUSIONS

Through reading articles of building the indicator system of CSR for construction enterprise. We can discover the methodology of CSR for construction enterprise is similar with the CSR for general corporate. But the indicators are different in some extent. Most of the research about CSR for construction enterprise just illustrate the indicators, they did not offer us proportion of each indicator. Without the proportion of indicators, we cannot quantify the level of CSR to perform.

In my point of view, maybe we can modeled after other CSR indicator system, just like mining industry, to establish an indicator system which is appropriate for construction industry. And using the stakeholder theory to select the evaluation index for construction enterprise. Establishing a perfect indicator system of CSR for construction enterprise is important. It can help the government to supervise construction industry and indicate the direction of enterprise development.

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Empirical Study on the Micro Network Structure of a Building Industrialization Project Based on Social Network Analysis

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Abstract

With the increasing emphasis on intellectualization and professionalization, building industrialization (BI) has become an inevitable trend of construction industry in China. However, enterprises face development barriers because of their confusion about their position, strength and weakness in the network. And managers' implementations of BI are far from satisfactory because of lacking comprehensive perspective of BI organization. To resolve these issues, an analysis of BI micro social network is established based on the social network theory in this paper. Firstly, BI project's micro social network is analyzed theoretically. Secondly, a questionnaire survey is conducted to collect authentic data and UCINET is used to quantify four network characters. The outcome of social network analysis indicates that developer is the information hinge of BI project whereas contractor and component supplier also occupy critical structural holes and play important roles in BI network. Theoretically, this study might provide a new perspective for implementer of BI to organize staff more effectively and allocate resources more rationally.

INTRODUCTION

There is a great transformation of construction mode from traditional to manufacturing and industrialized worldwide in recent years. Building industrialization (BI) is recognized as a sustainable construction method with numerous advantages, such as lower labor cost, shorter project duration, enhanced quality, higher tolerance, and reduced labor re-works onsite (Arif and Egbu 2010). China has become a manufacturing powerhouse and it is exerting a growing influence on world economy (Zhao et al. 2006). Nowadays, Chinese enterprises have increasing interest to adopt and utilize industrialized production technologies in many countries and regions. In the past twenty years, industrial organization has experienced a profound evolution; while the deepening of capital and knowledge made its organization structure appears networked and vertical integrated trend.

However, the diffusion of BI lags far behind this rapidly growing networked trend. BI has not yet to be extensively used in mainland China compared with developed countries (Goodier and Gibb 2005) while only few enterprises in China, like Vanke and Broad Group, are building BI project. Factors hinder the generalization of BI, for example, lacking of confidence and global understanding are considered as critical reasons for this phenomenon (Mao et al. 2013; Ou 2006). Specifically, enterprises haven't recognized the detailed characters of BI network structure, and they are not clear about precise self-position and hardly to seize the opportunity for development. Thus, it would be the top priority to help participants find respective structure positions accurately and to enable managers to optimize the allocation of resources and achieve high performance.

To investigate the structure of construction organization, Pryke and Pearson (2006) tried to apply social network analysis (SNA) to the management of construction industry alliance. Nevertheless, few studies have systematically examined the structure position and provide a clear direction for enterprises' development in BI project. Such knowledge gap is significant, owing to the challenges faced by Chinese house builders in delivering new homes of quality, quantity, affordability, and environmental sustainability. Drawing on qualitative and quantitative study through a series of incremental steps this study may help subsequent researchers to better study on the improvement of organization pattern for the BI project implementation.

METHODOLOGY

To better clarify the synergistic interaction of related subjects, this study adopts the method of SNA. SNA is used to describe and measure the relationships among different subjects or those tangible/intangible relationships, like information and resource (Burt et al. 1983). Nowadays, SNA is widely applied in the field of sociology, medicine, pedagogy even construction industry (Chinowsky et al. 2008). There are three general levels into which networks may fall: micro-level, meson-level and macro-level; and micro-level is applied to explore the basic role relationship in the social network of BI project. In this paper, the major tool for investigating the fabric of interpersonal relationships within groups of individuals is UCINET, which has the function of measuring index and visualizing social network's structure. The simplified logic sequence of empirical study is showed as follow (see Figure 1):

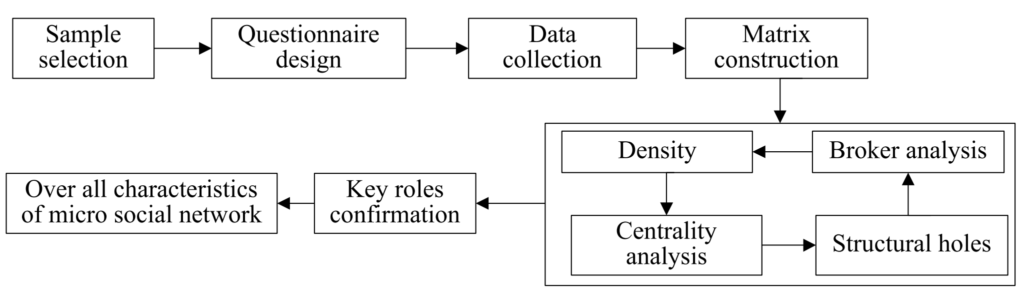

Figure 1.Simplified logic sequence of empirical study.

There are four steps for theoretical analysis to investigate different structure characteristics of BI project.

Step1: To describe overall feature of BI social network by density. A dense network can provide necessary resource of each participation and imposes great restriction on them (Wasserman 1994).

Step2: To identify network center by centrality analysis. It can be utilized to analyze the power of individuals or organizations in their social network (Freeman 1979).

Step3: Weak links in BI project will be discussed based on structural whole theory. Individuals or organizations who occupy the structural holes obtain more resources and greater competitive advantages. And the value-added behavior makes them own information advantages and control advantages.

Step4: Critical roles that stakeholders play in the network will be analyzed by Broker theory. Broker is defined as the actor who obtains information and resources from one actor and delivers those to another (Burt 2009; Gould and Fernandez 1989).

CASE STUDY

Hill City Project, located in Shenzhen (China) and sponsored by Vanke, is selected for case study. Prefabricated rate of Hill City Project is approximately 20% according to the volume calculation of building, which can be considered as the typical representative BI project in Shenzhen.

We obtained the directory of related participants and collected data in three steps: Firstly, the list of related participants is preliminarily identified based on the literature review; Secondly, items in the preliminary list will be refined and revised, then contact information of representative of each participant will be obtained by the interview of 8 developer engineers of this project; Finally, data of interactive evaluation will be collected from other participants by questionnaire survey. From November 28, 2014 to December 20, 2014, the research team has made an onsite questionnaire survey towards targets who are representative of participants. For each participant, 2 questionnaires were sent out and 58 questionnaires were collected in total, accounting for a response rate of 92%.

The specific social network that will be analyzed below is a kind of comprehensive social relationship (not a single medium), which will be measured from the flows of the material, information and captial according to the theory of industry ecology. For each medium, the strength of connection can be measured by Five-point Likert scale and scored from 1 to 5 point ("1" represents "out of touch" while "5" accounts for "tight connection"). Then, the comprehensive values of these three mediums are used to analyze the micro social network features of BI project.

Density. Through method of interview and questionnaire survey, 31 major participants are identified in this project. There are 353 ties in the network and density of it is 0.3796, meaning connections among all nodes are quite tight and it is concluded that this network have good information transmission capacity.

CENTRALITY ANALYSIS

(1) Degree Centrality: The result of degree centrality analysis is shown in Table 1:

Table 1.The Statistics of Degree Centrality.

		Degree	NrmDegree	Share
09	Developer	345.000	76.667	0.098
24	Contractor	250.000	55.556	0.071
21	Logistics Company	218.000	48.444	0.062
20	Building Component Supplier	190.000	42.222	0.054
27	Supervisor	147.000	32.667	0.042
25	Decoration Contractor	144.000	32.000	0.041
15	Cement Supplier	133.000	29.556	0.038
06	QC Department	130.000	28.889	0.037
28	Insure Company	128.000	28.444	0.036
10	Architecture Designer	127.000	28.222	0.036
26	Landscape Contractor	126.000	28.000	0.036
07	Financial Institution	119.000	26.444	0.034
16	Concrete Supplier	111.000	24.667	0.032
04	Environment Protection Agency	108.000	24.000	0.031
12	Landscape Designer	107.000	23.778	0.030
17	Decorative Material Supplier	102.000	22.667	0.029
22	Construction Machinery Supplier	99.000	22.000	0.028
11	Decoration Designer	97.000	21.556	0.028
19	Landscape Product Supplier	95.000	21.111	0.027
18	Heat Insulating Material Supplier	94.000	20.889	0.027
13	Steel Supplier	91.000	20.222	0.026
14	Wood Supplier	85.000	18.889	0.024
31	Property Management Company	80.000	17.778	0.023
30	Resident	72.000	16.000	0.020
23	Electromechanical Equipment Suppliers	63.000	14.000	0.018
29	Housing Sales Agent	61.000	13.556	0.017
08	Scientific Institution	59.000	13.111	0.017
05	Fire Department	58.000	12.889	0.016
01	Planning Department	32.000	7.111	0.009
02	Development and Reform Commission	31.000	6.889	0.009
03	Land and Resource Administration Bureau	20.000	4.444	0.006

It can be seen from Table 1, degree centralities of developer and contractor are more than twice of the average (113.613). Thus, these two nodes have greater influence and tighter connection with other nodes.

(2) Betweenness Centrality: The results of Betweenness Centrality analysis are visualized in Figure 2:

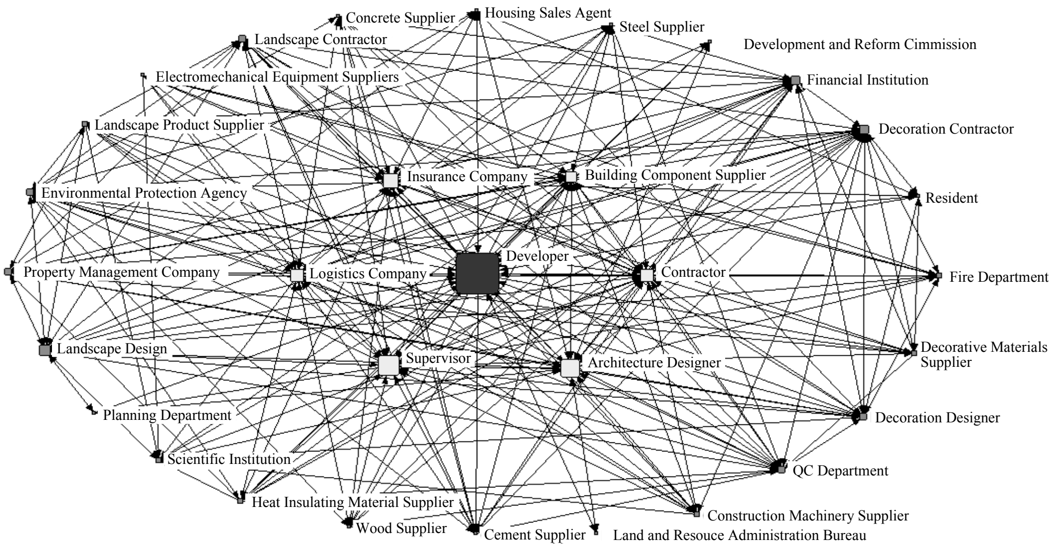

Figure 2.Visualization of Betweenness Centrality analysis.

As showed in Figure 2, seven nodes with strong information transmission capacity whose betweenness centralities are more than average: developer, architecture designer, contractor, supervisor, insurance company, logistics company and landscape contractor.

Structural holes measurement. It is quite complicated to make calculations about structural holes. This paper adopts structure holes index proposed by Burt (2009), including four indicators: effective size, efficiency, constraint and hierarchy (see Table 2).

Table 2.The Data of Structural Holes Indexes.

	EffSize	Efficie	Contra	Hierarc	Indirec
Planning Department	1.000	0.250	0.350	0.051	0.159
Development and Reform Commission	1.000	0.250	0.350	0.051	0.159
Land and Resource Administration Bureau	1.000	0.500	0.549	0.000	0.048
Environment Protection Agency	9.383	0.552	0.150	0.026	0.565
Fire Department	3.806	0.346	0.198	0.050	0.425
QC Department	8.428	0.496	0.163	0.078	0.571
Scientific Institution	9.271	0.545	0.154	0.080	0.523
Scientific Institution	6.179	0.562	0.176	0.071	0.334
Developer	17.750	0.634	0.138	0.069	0.853
Architecture Designer	11.230	0.591	0.156	0.077	0.632
Decoration Designer	6.630	0.442	0.180	0.042	0.591

Table 2.(Continued).

	EffSize	Efficie	Contra	Hierarc	Indirec
Landscape Designer	9.129	0.537	0.173	0.068	0.637
Steel Supplier	3.800	0.422	0.201	0.046	0.307
Wood Supplier	3.800	0.422	0.201	0.046	0.307
Cement Supplier	4.025	0.335	0.200	0.032	0.516
Concrete Supplier	3.735	0.374	0.209	0.040	0.407
Decorative Materials Supplier	5.529	0.503	0.181	0.053	0.364
Heat Insulating Material Supplier	5.853	0.488	0.172	0.059	0.380
Landscape Component Supplier	6.469	0.539	0.171	0.058	0.382
Building Component Supplier	10.367	0.546	0.166	0.073	0.676
Logistics Company	12.379	0.563	0.161	0.057	0.795
Construction Machinery Supplier	4.912	0.447	0.203	0.056	0.443
Electromechanical Equipment Suppliers	3.682	0.460	0.240	0.085	0.322
Contractor	12.634	0.549	0.153	0.033	0.826
Decoration Contractor	9.667	0.509	0.156	0.021	0.693
Landscape Contractor	7.677	0.452	0.165	0.024	0.644
Supervisor	13.987	0.608	0.142	0.059	0.719
Insurance Company	11.000	0.647	0.143	0.046	0.507
Housing Sales Agent	3.000	0.429	0.245	0.009	0.304
Resident	2.833	0.405	0.266	0.031	0.342
Property Management Company	7.571	0.541	0.177	0.063	0.507

The result of structural holes measurement is showed in Table 2. Developer has the maximum effective size, which indicates that it lies in the core position of the whole network, and has the freest action and minimum restriction. Additionally, insurance company has the second highest efficiency while efficiencies of architectural designer, contractor, building subassembly supplier and logistic company are also at relatively high level. Furthermore, developer has minimum constraint, and values of architecture designer, contractor, building subassembly supplier and logistic company are relatively low as well. It is indicated that these members occupy the most structural holes to become the potential opinion leaders in this network. On the contrary, land and resource administration bureau has the maximum constraint, which means land and resource administration bureau are in the edge position. Since most participants in this project have insurance business with insurance company, insurance company has the highest efficiency although it is a participant from other industry.

Broker analysis. Gould and Fernandez (1989) held the view that broker can be divided into five types according to the social role it plays: Coordinator, Consultant, Gatekeeper, Representative and Liaison. Stakeholders are classified into 8 blocks, and results of brokerage roles analysis are showed in Table 3:

Table 3. The Data of Brokerage Roles Indexes.

		Coordinate	Gatekeeper	Represent	Consultant	Liaison	Total
01	Planning Department	0	0	0	0	0	0
02	Development and Reform Commission	0	0	0	0	0	0
03	Land and Resource Administration Bureau	0	0	0	0	0	0
29	Housing Sales Agent	0	3	3	0	8	14
30	Resident	0	2	2	1	5	10
11	Decoration Designer	0	2	2	13	47	64
12	Landscape Designer	0	4	4	21	85	114
10	Architecture Designer	0	8	10	27	136	181
06	QC Department	0	0	0	1	39	40
04	Environment Protection Agency	0	0	0	38	78	116
27	Supervisor	1	4	12	39	152	208
07	Financial Institution	0	0	0	7	41	48
31	Property Management Company	0	0	0	3	48	51
05	Fire Department	0	0	0	0	16	16
08	Scientific Institution	0	0	0	1	20	21
09	Developer	1	95	10	33	195	334
17	Decorative Material Supplier	0	0	0	5	24	29
18	Heat Insulating Material Supplier	0	0	1	4	17	22
14	Wood Supplier	0	0	0	5	9	14
13	Steel Supplier	0	0	0	5	9	14
16	Concrete Supplier	0	0	0	5	9	14
15	Cement Supplier	0	2	4	5	9	20
20	Building Component Supplier	18	18	16	5	33	90

Table 3.(Continued).

		Coordinate	Gatekeeper	Represent	Consultant	Liaison	Total
19	Landscape Product Supplier	0	0	2	2	21	25
25	Decoration Contractor	0	4	4	20	119	147
26	Landscape Contractor	2	10	6	12	62	92
21	Logistics Company	0	1	7	32	79	119
28	Insure Company	1	3	9	39	107	159
24	Contractor	0	7	13	39	153	212
22	Construction Machinery Supplier	0	3	4	2	11	20
23	Electromechanical Equipment Suppliers	0	0	1	1	4	6

The data of brokerage roles analysis in Table 3 clearly show that building subassembly supplier is the Coordinator, so it plays an important role in the subgroup and has advantages of information-obtaining, especially among material suppliers. From the results of numerical analysis, it is obvious that developer plays an important role as the Gatekeeper while it has a direct effect on communication. In addition, developer has a high degree of freedom and it has the ability to manipulate the circulation of information, which is the function of Liaison. As the Representative, building subassembly supplier controls the threshold of external coordination, since it determines each material supplier in the subgroup, such as steel supplier, wood supplier, cement supplier, concrete supplier, etc. Besides, supervisor and insurance company act as Consultant in the network. Hill City is a turnkey project, so contractor has contractual relation with many participants, and it plays a critical role on communication among the subgroups (Li 2014). That's the reason why calculation result shows that contractor also act as a Liaison only behind developer.

DISCUSSION

Diagnostically, there are some innate laws of BI project's micro social network structure:

(1) From the perspective of information communication, developer is the information hinge of BI project owing to its maximum centrality, largest values of effective size as well as minimum constraint. The roles of Liaison and Gatekeeper determine that developer acts like the information window of subgroup even of the whole project network, so it has the responsibility of external communication and coordination. With large effective size and low constraint, contractor, architecture designer and building

subassembly supplier have low redundancy when they connect with other participants. Governmental department and financing institution located at the relative edge position and have weak effect of information flow in this network.

(2) From the perspective of resource control, although the developer lies in the communication center of this project, inherent features of this turnkey project determine that the contractor and component supplier control the source and whereabouts of materials to a large extent. Considering the social circumstance, architectural designer is actually the main occupant of structural holes, while it decided the usage of relevant resource at the source. In addition, the control action of indirect controller (the logistics company) cannot be ignored in BI project.

CONCLUSION

Building industrialization, an innovative mode of construction, has general characters of traditional industrial organization, as well as the unique structure due to its special production technique and process. Therefore, it is quite necessary to conduct a research and discussion of BI project's microstructure and have a clear grasp of stakeholders' structural position. This paper shows the conclusion of an interdisciplinary comprehensive study about BI project, which combats the theories and methods of industrialization and social network.

In an attempt to completely understand the function and structure position of stakeholders, SNA is applied in the theoretical analysis and calculation. This article analyzes density, centrality, structural holes and brokerage roles. The outcomes of UCINET indicate that developer is the hub of information transformation and the entrepot of production resource in the system while the sub-hubs are contractor, architecture designer and the logistics company. The findings of the case study also reflected some laws and issues of BI implementation in China from the microstructure level. In a sense, this case study may help subsequent researchers to find out critical bottleneck that influences the information circulation in BI network, then some improvement measures should be adopted to enhance the efficiency of BI projects' implementation.

The revelation we could get from this study is that the organization of BI in China is still in the transition period from conventional mode to industrialized mode, and there is still not the best organization of roles and foundation inside network organization. The aim of BI project management is to form a structurally stable community dynamically. To achieve this, all stakeholders from different social groups should play the roles of their own. And networks should be managed based on social collaboration perspective to achieve the next level of performance improvement. This study is conducted based on the case study, but BI projects in different countries and under different social background may have different characteristics.

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Correlation Analysis of Board Characteristics and Financial Restatement in Real Estate Listed Companies

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Abstract

Financial restatement is the correction for the errors of previous financial reports; it not only brings the reliability of accounting information into doubt, but also reduces the value of the company and damages the interests of investors. As the administration of the company, the board of directors is responsible for the company's financial statement.

This paper tries to use the empirical study to find out the relationships between board characteristics of real estate companies and the financial restatement. Based on Upper Echelon Theory, this paper selects Chinese real estate listed companies from 2009-2013 as study sample, measuring the board characteristic from seven aspects: board size, board sex ratio, the frequency of board meeting, the separation of ownership, shareholding proportion of board members, proportion of the financial background directors, and proportion of the independent directors. In the end, based on the research conclusion, the paper puts forward some advice to perfect the board of directors system and reduce the incidence of financial restatements.

INTRODUCTION

With the development of Chinese security market and the quality improvement of investors, the requirement of high quality financial information is also rising. As an important aspect to reflect the quality of financial information, the financial restatement is the process of listed companies to amend the previous financial errors. High quality accounting information is the basis of efficient capital markets, financial restatement shows that the company may have some problems, therefore it becomes the concern of the stakeholders' of listed companies. The development level of the real estate industry is an important indicator of the level of economic development. The real estate industry, as one of the pillars of the national economy, the frequency of financial restatements has aroused widespread concerns.

Despite the occurrence of financial restatements results from interactions among many factors, unperfected corporate governance structure is the most important reason for the financial restatement, in this way, the board of directors, as the core of corporate governance has unavoidable role in the occurrence of financial restatements. Due to the report, supplement and correction of financial reports in listed companies all need the director's approval. Therefore, the effect of board governance plays a very important influence on the quality of the company's financial information disclosure, which affects the occurrence of financial restatements.

THEORY ANALYSIS AND RESEARCH HYPOTHESIS

To some extent, the board characteristics refer to some external features, which can reflect the intrinsic properties of the board, they are the inner basis of board functions. In this paper, the board characteristics are classified into five aspects: scale characteristic, behavioral characteristic, independent characteristic, professional characteristic and the characteristic of incentive.

Scale characteristic. Characteristic of scale refers to the size of the board of directors, namely, the total number of the board of directors. At home and abroad there isn't an ideal size for the board. Some scholars believe that a large size of board of director can play the role of supervision better. On the other hand, other scholars believe that the smaller board size can be timely, flexibly and effective in problem solving and decision making. The studies of Lipton and Lorsch (1992), as well as Jensen (1993) showed that the big board is not as effective as the small ones. Liguo and Ying (2003) found that the bigger the board size, the more likely it is controlled by the insiders, which can lead to low quality of accounting information disclosure. Wen et al. (2012) found that the size and correction notice exist a little positive correlation. So the first hypothesis is as following.

H1: The board size and financial restatement have a significant positive correlation.

Behavioral characteristic. Behavioral characteristic refers to a process that the board uses the meeting mechanism to make decisions. At present most of the researches use the number of the annual meeting of the board to measure the behavioral characteristics. The frequency of the board meeting can react to a certain extent of the diligent degree of the board. The monitoring effect is not obvious if there are few meetings, but too many, it will reduce the enthusiasm of the board members to participate in the meeting, which results to the inefficient of the board meeting. The empirical study by Du and Zhou (2007) showed that the frequency of the board meeting reflects that the meeting of the board is used to solve the weak performance and discuss the countermeasures for the behavior of earnings management. Therefore, this paper holds that the board meeting is not positive; it's the remedies under emergency.

H2: The numbers of the board meetings and financial restatement have a significant positive correlation.

Independent characteristic. The independent characteristics are the basis of the objective decision-making, evaluation and supervision of the board, including the proportion of independent directors, the board leadership structure and board gender diversity.

The independent director's proportion refers to the proportion of the number of independent directors in the board. Compared to internal directors, independent directors are not subject to the controlling shareholders, thus they have an advantage in supervising the management, and can make independent judgments. The company with a high proportion of independent directors is more inclined to disclose more financial information, thus the quality of the accounting information is relatively high, and the possibility of financial restatement is smaller. Wang (2014) found that listed companies which have higher proportion of independent directors have less possibility to have financial restatements. So this paper puts forward the following hypothesis:

H3: The proportions of the independent directors and financial restatement have a significant negative correlation.

Board leadership structure is mainly refers to whether the chairman of the board and the CEO is the same person. According to principal-agent theory, the board and the CEO are in a relationship of decision-making and implementation, supervising and being supervised. If the chairman of the board and the CEO are the same person, then internal directors have the advantage position in the board of directors, so that the CEO shall enjoy the right of arbitrary in decision-making and the choice of accounting policy, this phenomenon will weaken the supervision function of the board. And the managers in order to maximize their own interests, may disclose false accounting information, therefore there is more likely to have financial restatements. The empirical results of Liu (2012) illustrated that the financial restatement is positively correlated with the separation of ownership. So this paper puts forward the following hypothesis:

H4: The joining together of chairman of the board and the CEO has a significant positive correlation with financial restatement.

Gender diversity refers to the sex ratio of the board members. Peng and Wei (2007) found that compared to female managers, male managers are more likely to show the overconfidence, thus making the wrong decision. Financial restatements are commonly believed to be the consequences of the company taking radical accounting policy. The company which has a male-dominated board, the probability of financial restatement is higher. While compared with male, female are more cautious, so female in the majority of the board has a lower probability financial restatement. In addition, Adams and Ferreira (2009) put forward that the sex ratio of dispersion can improve the efficiency of corporate governance, reducing the occurrence of financial restatements.

H5: The proportions of male members in the board and financial restatement have a significant positive correlation.

Professional characteristic. Professional feature refers to the board members of financial professional background. In this paper, we use the proportion of financial background members of the board to measure this characteristic. Financial background directors are those who had engaged in accounting or relevant teaching works, or those who graduated in accounting, financial management, auditing and relevant majors, even refer to the person who has a CPA, MBA, EMBA degree. If the board members have wealth experience and theory of finance and accounting, they can identify the financial and manage risks, and then the company can reduce the occurrence of financial restatements. The study of Wang (2014) found that the higher percentages of directors who have financial background, the less possibility of the financial restatement. So this paper puts forward the following hypothesis:

H6: The proportion of financial background members has a significant negative correlation with financial restatement.

Incentive characteristic. It refers to the incentive measures on the board. The paper mainly discusses the influence of board ownership on financial restatement. The board ownership reflects the relevance of the board and the company's future economic interests, it can incentive directors to put their own interests and the company's fate together, in order to maximize shareholders' value, to some extent it can improve the efficiency of corporate governance and then reduce the occurrence of financial restatements. The study of Hanson and Song (2000) found that the company's board of director's shareholding can effectively improve the company's internal governance mechanism. Wang (2012) found that the board holding stocks are negatively correlated with the financial restatement. So the next hypothesis is as following:

H7：The proportion of board members' ownership and financial restatement are significantly negative correlation.

THE EMPIRICAL STUDY DESIGN OF BOARD CHARACTERISTIC AND FINANCIAL RESTATEMENT

Data source and sample selection. The research object of this paper is Shanghai and Shenzhen A-shares real estate listed companies in 2009-2013.Based on the Shanghai stock exchange and Shenzhen stock exchange, this paper retrieves and sorts the real estate listed companies who had adjustment of accounting errors in the annual report notes, and who disclosed modified or supplementary announcements from January 1, 2009 to December 31, 2013 as the study sample. The information about corporate governance comes from CSMAR.

The research sample is the A-shares real estate listed companies with financial restatement in Shanghai and Shenzhen. In the acquisition of samples this paper eliminates the companies who had been delisted or ST or *ST when the announcement was published. For detailed data, see Table 1.

Table 1.The Distribution of the Financial Restatement of the Year.

Year	Financial restatements company	Non-financial restatements company	Total
2009	17	98	115
2010	14	105	118
2011	19	105	124
2012	17	112	129
2013	27	103	131
Total	94	523	617

In order to better study the relationship between board characteristics and the financial restatement, this paper selects the A-shares real estate listed companies without financial restatement in Shanghai and Shenzhen stock markets from 2009 to 2013 as paired samples. The matching criteria are as following: the paired samples and restated samples are in the same year, and the matching samples should not have financial statements during the period; the matching samples and restate samples have similar size; if the company exists one more financial restatement, every time selects the same paired company. After meeting the above criteria, there are only 79 companies, in which 11 companies in year 2009, 14 companies in 2010, 16 companies in 2011, 14 companies in 2012, and 24 companies in year 2013. Therefore, there are 158 study samples.

Variable definitions. The paper chooses the following variables:

(1) The dependent variable. This paper uses whether the company has financial restatements as the dependent variable, if the company has financial restatements, then define RESTATE = 1; otherwise, define RESTATE = 0.

(2) The independent variables. There are 7 independent variables.

The independent variable about scale characteristic: BSIZE: the board size.

The independent variable about behavioral characteristic: BAM: number of the board meeting.

The independent variable about independent characteristics: IDP: the proportion of independent directors. BLS: if the chairman and the CEO is one person, define BLS = 1, otherwise BLS = 0. BGD: the proportion of male members in the board.

The independent variable about professional characteristic: FEXP: the proportion of financial background members in the board.

The independent variable about incentive characteristic: BSTAKE: the proportion of the board members' ownership.

(3) The control variables. There are 5 control variables.

SIZE: the natural logarithm of the total assets at the end of the year.

ROE: rate of return on common stockholders' equity, net income divided by average shareholders' equity.

GROWTH: the difference of current main business income minus the main business income of the previous period, then divided by the main business income of the previous period.

LEV: asset-liability ratio, the ratio of total liabilities and assets of the final.

TRUN: asset turnover ratio, the ratio of total operating income divided by average total assets.

Model design. Through the above analysis, the following logistic model is established in this paper:

$$\begin{aligned}&\text{Logistic (Restate)} = \text{a}+\beta_1\text{BSIZE}+\beta_2\text{BAM}+\beta_3\text{IDP}+\beta_4\text{BLS}+\beta_5\text{BGD}+\beta_6\text{FEXP}\\&+\beta_7\text{BSTAKE}+\beta_8\text{SIZE}+\beta_{10}\text{GROWTH}+\beta_{11}\text{LEV}+\beta_{12}\text{TURN}+\varepsilon\end{aligned} \tag{1}$$

THE EMPIRICAL STUDY AND ANALYSIS

Sample descriptive statistical analysis. Table 2 shows the descriptive statistics of the two samples, and the mean T test results of the two samples.

Table 2.The Main Variable Descriptive Statistics and Differences Tests.

Variable	Restated samples (N=79)			Paired samples (N=79)			T test	sig
	Min	Max	Mean	Min	Max	Mean		
BSIZE	5	15	8.730	4	16	8.990	-0.792	0.431
BAM	3	24	10.860	4	23	9.590	2.168	0.033
IDP	33.33	57.143	37.907	31.250	62.500	37.520	0.419	0.676
BLS	0	1	19	0	1	9	1.815	0.073
BGD	44.44	100	85.596	25	100	83.720	0.848	0.399
FEXP	0	77.778	27.207	7.692	75	29.333	-1.022	0.310
BSTAKE	0	50.428	17.530	0	39.730	17.900	-0.031	0.976
SIZE	19.79	24.794	22.296	20.094	24.813	22.305	-0.199	0.843
ROE	-22.96	3757.586	57.292	-7.838	42.864	10.726	0.980	0.330
GROWTH	-91.67	14.880	18.943	-79.644	758.918	34.995	1.004	0.319
LEV	12.53	109.739	61.637	7.038	85.894	58.506	1.320	0.191
TURN	0.60	126.145	28.460	4.050	91.740	25.280	1.179	0.242

As is shown in the table, in the board behavioral characteristic variable, compared with paired company, the board meeting numbers (BAM) of the companies who have financial restatements are more than the non-restated companies, the difference are significant under 5% level. In the board independent characteristic variable, the restated companies are more likely to be a person holds two-title, the difference are significant under 10% level. Besides, the other variables don't have significant differences.

Correlation analysis. For further study, before the regression analyses this paper firstly analyses the Pearson correlation. Table 3 shows the significance between the variables. What can be seen from the Table 3 is as following:

The financial restatement is significant positive with the board meeting numbers, namely the more board meetings, the greater chance to have financial restatements. The result matches with the hypothesis 2.

The financial restatements is significant positive with the joining together of the board chairman and the CEO, which is matched with the hypothesis 4.

The other variables don't have significant correlation with financial restatement.

Besides, the correlation coefficients between the variables are all less than 0.8, so we can believe that there is no serious multicollinearity between the variables. Detailed analysis needs to make the regression analysis.

Table 3.Pearson Correlation Analysis.

		RESTATE	BSIZE	BAM	IDP	BLS	BGD	FEXP	BSTAKE	SIZE	ROE	GROWTH	LEV	TURN
RESTATE	Sig. (2-tailed)		.429	.054	.671	.067	.385	.312	.975	.962	.328	.317	.268	.311
BAIZE	Sig. (2-tailed)	.429		.454	.000	.211	.022	.129	.267	.750	.701	.945	.518	.369
BAM	Sig. (2-tailed)	.054	.454		.674	.029	.569	.317	.271	.143	.847	.589	.002	.573
IDP	Sig. (2-tailed)	.671	.000	.674		.354	.810	.912	.556	.299	.944	.441	.229	.024
BLS	Sig. (2-tailed)	.067	.211	.029	.354		.005	.949	.049	.497	.708	.012	.173	.613
BGD	Sig. (2-tailed)	.385	.022	.569	.810	.005		.413	.089	.297	.756	.255	.006	.691
FEXP	Sig. (2-tailed)	.312	.129	.317	.912	.949	.413		.062	.600	.830	.006	.736	.054
BSTAKE	Sig. (2-tailed)	.975	.267	.271	.556	.049	.089	.062		.188	.849	.832	.644	.001
SIZE	Sig. (2-tailed)	.962	.750	.143	.299	.497	.297	.600	.188		.386	.085	.008	.102
ROE	Sig. (2-tailed)	.328	. 701	.847	.944	.708	.756	.830	.849	.386		.994	.003	.311
GROWTH	Sig. (2-tailed)	.317	.945	.589	.441	.012	.255	.006	.832	.085	.994		.150	.192
LEV	Sig. (2-tailed)	.268	.518	.002	.229	.173	.006	.736	.644	.008	.003	.150		.715
TURN	Sig. (2-tailed)	.311	.369	.573	.024	.613	.691	.054	.001	.102	.311	.192	.715	

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Logistic regression. The regression results are shown in Table 4.

The regression analyses show that the board size and financial restatement have non-significant correlation, so hypothesis 1 fails, the possible reason is the number of board members has a best scale, neither the more the better, nor the less the better, so financial restatement and scale of the board may present a curve relationship.

Table 4.The Result of Logistic Regression.

	B	S.E.	Wald	Sig.	Exp(B)
BSIZE	-0.107	0.097	1.215	.270	0.899
BAM	0.112	0.046	5.877	.015	1.119
IDP	-0.004	0.033	0.014	.906	0.996
BLS	1.250	0.574	4.743	.029	3.491
BGD	0.018	0.014	1.599	.206	1.018
FEXP	-0.020	0.013	2.518	.113	0.980
BSTAKE	0.004	0.026	0.019	.890	1.004
SIZE	-0.118	0.156	0.572	.450	0.889
ROE	0.001	0.001	0.332	.565	1.001
GROWTH	0.001	0.001	0.701	.402	1.001
LEV	0.002	0.011	0.041	.839	1.002
TURN	0.005	0.011	0.183	.669	1.005
Constant	1.143	3.788	0.091	.763	3.135

The hypothesis 2, the number of board meeting passes the test, the significance level is 0.015, and they present a positive correlation. This is verified by the view of Jensen (1993) that the board meeting plays a role as “fire extinguisher”, that is to say the frequent board meeting is a reflection of the problems that the company faced.

The proportion of the independent directors is negatively related to the financial restatement, but not significant, so the hypothesis 3 fails the test, the reason maybe that in our country the establishment of independent directors is probably to meet the law, so the independent director doesn’t really play the role of supervision of the board of directors.

The hypothesis 4, the joining together of the board chairman and the CEO passes the test and the significance level is 0.029, they present a significant positive correlation. Because the board of directors is responsible for the supervision and management of the company, if the position of chairman and CEO hold by one, the supervision role of the board is bound to be greatly reduced.

The hypothesis 5, the relationship between the proportion of male directors and financial restatements doesn’t pass the test, but they are positively correlated. That is to say gender diversity can reduce the occurrence of financial restatement, but it only has little effect on financial restatement.

The hypothesis 6, the relationship between the proportion of finance directors and financial restatements also fails the test of significance, but they have negative correlation, namely the finance directors have certain positive effect on suppressing the occurrence of financial restatements.

The hypothesis 7, the relationship between board shareholding and financial restatement also fails the significant test, but they present a negative correlation, indicates that the board of directors’ shareholding has a certain incentive effect on the inhibition of financial restatements. As for the company with board of directors’ shareholding and the shareholding ratio are both very small, the relationship between them is not significant.

Besides, there is no significant correlation between control variables and financial restatement.

CONCLUSIONS

This paper analyzed the relationship between financial restatement and characteristics of the board in real estate listed companies. Thought the empirical study we get the conclusions as follows:

The number of board meeting has a significant positive relationship with financial restatement. So the company should maintain the proper number of board annual meeting and perfect the meeting mechanism of the board of directors. The paper suggests that the company should decide the number of board meeting according to the circumstance, and make a practicable board meeting mechanism.

The joining together of the board chairman and the CEO has a significant positive correlation with financial restatement. Therefore this paper recommends that the board leadership structure should realize the real separation of the board chairman and CEO in listed companies, and guarantee the independence of the board of directors adequately.

Besides, though the relationship between the proportion of finance directors and financial restatements fails the test of significance, they have a negative correlation. It illustrates that the finance director have certain positive effect on suppressing the occurrence of financial restatements. Therefore, the company should improve the proportion of directors with financial background. And the results of this study also illustrate that the relationship between the board shareholding and financial restatement is not significantly, but there is a reverse relation, namely compared with financial restated company, the board of directors in non-restated company has a higher shareholding proportion. Therefore we should strengthen the share incentive of the board of directors.

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Research on the Relations of Listed Real Estate Companies' Governance Structure and Social Responsibility

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ABSTRACT

With the development of social economy in China, the contradiction between the listed real estate companies' governance structure and social responsibility has become increasingly prominent, so the public call for the listed real estate companies to fulfill their social responsibility is growing. It has become a new challenge for corporate governance to effectively integrate social responsibility into the listed real estate companies' governance structure. By selecting the data of information disclosure of 110 real estate companies listing in Shenzhen and Shanghai A-share market from 2007 to 2013 as samples, from the perspective of internal governance, the relation with social responsibility is analyzed, and the suggestions which can perfect the listed real estate companies' governance structure to fulfill social responsibility effectively are put forward.

INTRODUCTION

China has made a remarkable achievement in its economy and social development, but in this process, some inevitable and ineligible problems arise, such as environmental pollution, poor quality of the products, fraud shareholders, and tax evasion. The development of enterprises cannot be separated from the environment to which it is attached; neither can the interests of stakeholders be ignored. Ad enterprises must fulfill social responsibility when pursuing profit. At present, China is practicing the socialist core values, so the social responsibility that enterprises undertake is bound to become the power of improving the comprehensive competitiveness and sustainable development.

As is revealed in the 'Corporate Social Responsibility Blue Book' which is released in 2014 by Chinese Academy of Social Sciences, the average score of the top 300 Chinese enterprises' social responsibility development index is 32.9 (full mark is 100), with an increase of 6.5 points, which is just in the initial stage, presenting the characteristics of "low start, rapid development, lower level". As a pillar industry of national economy, the real estate corporate' social responsibility development index is at the middle or lower level, and such events as the poor quality, breach of contract, and trade disputes of commercial housing are good examples of lacking social responsibility for the real estate corporate. In order to ensure the real estate industry, especially the listed real estate companies which can fulfill their social responsibilities better and maintain sound and sustainable development, it is necessary to study the influential factors of fulfilling social responsibility. Corporate governance as the core of enterprise management, of course, has become the focus of the study.

The listed real estate companies' governance structure is an important foundation for the implementation of corporate social responsibility. Only with a perfect corporate governance structure, can enterprises overcome the short-term behavior, can the rights interests of investors get guaranteed, can the interests of consumers be fully protected, and can market environment be optimized. On the contrary, with an imperfect corporate governance structure, the enterprises will pursue short-term economic interests, and be unwilling to pay social cost for enterprise's long-term development. Therefore, by integrating social responsibility into the company's internal governance structure effectively, the internal balance of the interests of all parties and constraints are formed, and the legitimate rights and interests of consumers are protected, which lays a solid foundation for the listed real estate companies to maintain sustainable development and to improve international competitiveness.

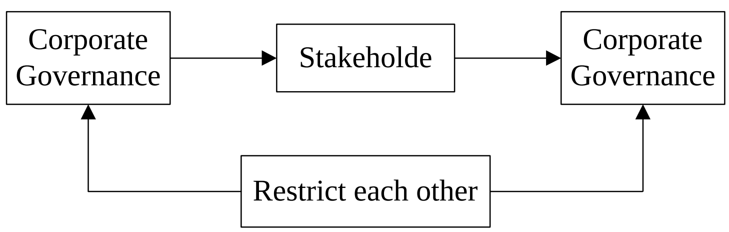

Figure 1.Diagram of corporate governance structure and social responsibility.

RESEARCH DESIGN

Research hypothesis. (1) Hypothesis 1: the number of shareholders' meeting and corporate social responsibility. The shareholders' meeting is the supreme authority of the company, at which the company's important decisions can be made and approved. If the General meeting of shareholders is held more often, shareholders have more abundant time to exchange views, thus, improving the quality of decisions related to the vital interests of the company, and the level of corporate governance (Bai et al. 2005). Therefore, the hypothesis 1 is put forward as follows: the number of meetings of shareholders is positively related to corporate social responsibility.

(2) Hypothesis 2: ownership concentration and corporate social responsibility. More concentrated ownership structure can effectively supervise the management. If the equity is over decentralized, monitoring cost will exceed the benefits which arise from supervising behavior, and the initiative to fulfill social responsibility will be reduced. On the contrary, if the equity is relatively concentrated, the competition of enterprise control rights can be enhanced, and the possibility of implementing the "tunnel" for controlling shareholders is also reduced (Xiao 2006). Therefore, the hypothesis 2 is put forward as follows: ownership concentration is positively related to corporate social responsibility.

(3) Hypothesis 3: board size and corporate social responsibility. The knowledge structure of the board and management experience of the board has an important influence on corporate development. The larger the size of board is the more different stakeholders are likely to enter the board, which can prevent big shareholders or the companies' executives from controlling the board so as to achieve the purpose of common corporate governance (Zhao 2010). Therefore, the hypothesis 3 is put forward as follows: board size is positively related to corporate social responsibility.

(4) Hypothesis 4: independent director's proportion and corporate social responsibility. Independent director's reputation, professional background and the proportion are helpful to enhance the value of the company. The implementation of the independent director system is helpful to strengthen the board balance mechanism, to prevent the interests of small investors from being infringed, to fulfill corporate social responsibility, and to give the board more consideration to the interests of stakeholders in the decision-making (Xu 2011; Sun and Guo 2014). Therefore, the hypothesis 4 is put forward as follows: independent directors' proportion is positively related to corporate social responsibility.

(5) Hypothesis 5: size of the board of supervisors and corporate social responsibility. The supervisors are elected from the general meeting of shareholders as well as the workers, whose main responsibility is to protect the interests of shareholders, supervise the board of directors and managers to perform the responsibility, and the size reflects the ability to exercise their right of supervision (Song and Li 2010). Therefore, the hypothesis 5 is put forward as follows: size of the board of supervisors is positively related to corporate social responsibility.

(6) Hypothesis 6: executives' compensation and corporate social responsibility. The better the listed companies fulfill their social responsibility, the higher their executives are paid. Executives' compensation has significantly effect on the corporate social responsibility, and executives' compensation in poor financial performance listed companies has more significantly effect on social responsibility (Liu and Han 2012; Xie 2014). Therefore, the hypothesis 6 is put forward as follows: executives' compensation is positively related to corporate social responsibility.

Sample selection. This study selects Shanghai and Shenzhen A-share listed real estate companies from 2007 to 2013 as research samples. After excluding incomplete data samples, 770 effective samples are obtained. The empirical data come from CSMAR database.

Variable definition. (1) Explained variable. The explained variable of the article is Corporate Social Responsibility (CSP). The index system of corporate social responsibility is established based on stakeholder theory, including government, employees, shareholders, creditors, suppliers, customers, and the public.

$$CSP = \sum \left(Q_i \times CSR_i \right)$$

CSP : corporate social responsibility; Q_i : representing the weight of shareholders, creditors, customers, suppliers, employees, government and the public; CSR_i : representing the rate of income contribution of shareholders, creditors, customers, suppliers, employees, government and the public. Specific index design is shown in Table 1.

Table 1.Stakeholders' Rate of Income Contribution.

Stakeholders	Symbol	Formula
Government	CSP_1	(All taxes paid - the return of taxes)/Main business income
Employees	CSP_2	Cash payments to employees and for employees/Main business income
Shareholders	CSP_3	Dividends payable/Main business income
Creditors	CSP_4	Financial expenses/Main business income
Suppliers	CSP_5	Cash paid for purchase of goods and services received/Main business income
Customers	CSP_6	Major business cost/Main business income
Public	CSP_7	Donations/Main business income

(2) The explanatory variables and control variables. The explanatory variables of this paper refer to internal corporate governance, including number of shareholders, ownership concentration, board size, proportion of independent directors, board of supervisors and executives' compensation. There are two control variables: company size and rate of return on net asset. Variables definition is shown in Table 2.

Table 2.Chart of Variable Definition.

Variable Name		Symbol	Variable Definition
Explaining variable	Number of shareholders	SHM	Annual number of shareholders' meeting
	Ownership concentration	FSD	The sum of top 5 shareholders
	Board size	BS	The number of the board of directors
	Proportion of independent directors	IDP	Number of independent directors/ Members of the board
	Board of supervisors	SNO	The number of supervisors
	Executives' compensation	FTS	Taking logarithm of the top three executives' compensation
Control variable	Company size	SIZE	Taking logarithm of total asset
	ROE	ROE	Net profit/Net asset

EMPIRICAL ANALYSIS

Descriptive statistical analysis. According to Table 3, the average value of CSP is 0.54, which indicates that Chinese listed real estate companies assume a certain amount of social responsibility, but the overall level is not high. As can be seen from Figure 2, the average value of CSP in the last seven years has a greater volatility, and the maximum value is 257.15, while the minimum value is -214.6, which explains that the condition of fulfilling social responsibility for different company is uneven.

Table 3.Descriptive Statistics.

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Y	770	-214.5793	257.1475	.544376	12.1644888
X_1	770	1.0000	14.0000	3.230000	1.8070000
X_2	770	14.3900	92.2600	50.362075	17.1991521
X_3	770	4.0000	15.0000	8.750000	1.8870000
X_4	770	.2000	.6250	.373826	.0545304
X_5	770	1.0000	9.0000	3.620000	1.0030000
X_6	770	10.8198	17.2391	14.086476	.9167250

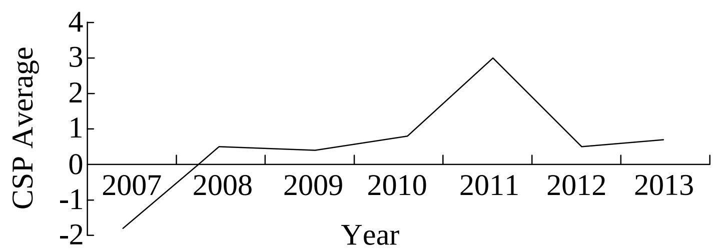

Figure 2.Variation diagram of the average value of CSP from 2007 to 2013.

From the statistical values of independent variables, the average number of shareholders' meeting held for the listed real estate companies during the year is 3.23, while Shanghai Sunshine City Group is at most 14 times, however, Wanke Group and Shenzhen Century Star is just 1 time, which indicates that shareholders' meeting of listed real estate companies is in conformity with the relevant provisions of China Company Law. In terms of ownership concentration, the average shareholding of top 5 large shareholders' is 50.36%, while the maximum value of Ningbo Silver Billion Group is 92.26%, which indicates that the ownership concentration of listed real estate companies is higher. The average value of the board size is 8.75, and the maximum of Shenzhen Century Star and Golden Group is 15; however, while the minimum of Zhong Yin Company's is 4 in 2008. Chinese Company Law rules that the number of board is 5 to 19 and all the companies have reached a quorum in the next five years. The average of the independent director's proportion is 37.38%. Xinda Real Estate Company and Shenzhen State Investment Company has a minimum of 20%, indicating that proportion of independent directors in most sample companies is in accordance with China Securities Regulatory Commission regulations 1/3, but there are also a few companies that do not live up to the standard. It is speculated that the appointment of independent directors of listed companies is just to meet the rigid requirements of regulation. As a result, the independent directors did not play their duties. The average of the board size of supervisors is 3.62, and the maximum is 9, such as Investment Real Estate, Ocean Wide Holdings Group and so on, while the minimum is 1. Chinese Company Law stipulates the number of the board of supervisors should not be less than 3, so some companies do not meet the requirements, while others exceed. The sum of the average of top three executives' compensation is 14.09, and Wanke Group has the maximum of 17.24, while Silver Investment Company has the minimum of 10.82. Although there is a certain difference among the executives' compensation of listed real estate companies, the overall level is high.

Correlation analysis. The correlation research between the index of corporate governance and corporate social responsibility is shown in Table 4. As can be seen from the results of correlation analysis, the number of shareholders' meeting (SHM), equity concentration (FSD), the board size (BS), the proportion of independent directors (IDP), executives' compensation (FTS), company size (SIZE) and ROE are positively related to the corporate social responsibility; the size of the board of supervisors (SNO) is negatively related to the corporate social responsibility. Moreover, the number of shareholders' meeting (SHM), equity concentration (FSD), executives' compensation (FTS), company size (SIZE) and ROE has a significantly positive relation with social responsibility.

Table 4.Correlations Analysis.

	CSP	SHM	FSD	BS	IDP	SNO	FTS	SIZE	ROE
CSP	1								
SHM	.123**	1							
FSD	.130**	.145**	1						
BS	.000	.018	-.108**	1					
IDP	.018	-.009	.075*	-.465**	1				
SNO	-.091*	-.067	-.002	.229**	.038	1			
FTS	.237**	.114**	.131**	.232**	-.025	.093**	1		
SIZE	.379**	.162**	.295**	.211**	.056	.069	.661**	1	
ROE	.196**	.154**	.281**	.026	-.038	-.042	.315**	.368**	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Shareholders' meeting has a significantly positive effect on the social responsibility, supporting the Hypothesis 1, which indicates the more frequently the activity of the shareholders' general meetings are held, the better the shareholders play their duties. It is helpful for company to establish a good image and perform social responsibility better. Ownership concentration and corporate social responsibility have a significantly positive relation at the level of 1%, supporting Hypothesis 2, which shows the concentration of ownership structure not only can implement effective supervision to managers and reduce the possibility of implementation of the "tunnel" behavior of shareholders, but also can improve the performance of the social responsibility. The board size and the proportion of independent directors and corporate social responsibility have positively related, but failing to pass the test of significance. Thus, the board of directors and independent directors in the internal governance do not play their important function, which may be the reason that the board of directors lacks independence or the independent director system is not perfect. The board size of supervisors has a significantly negative relation to the social responsibility, which is contrary to Hypothesis 5, which shows that the board of supervisors cannot play the role in protecting the interests of stakeholders, so the problems of the board of supervisors must be solved promptly. Executives' compensation and corporate social responsibility have a significantly positive relation at the level of 1%, supporting Hypothesis 6, which indicates the higher executives are paid, the better the incentive plays the role, making the goal of management and the company's business objectives tend to be consistent. As a result, it has positive effect on fulfilling the social responsibility, then the condition of performing social responsibility will become better and better.

In addition, the control variable: company size and ROE pass the significance test of 1% level, which shows that the bigger the company size, the stronger the ability to fulfill social responsibility.

SUGGESTIONS

As can be seen from the results mentioned above, the level of fulfilling social responsibility is uneven, the overall situation is not optimistic. The index of corporate governance is positively related to corporate social responsibility, the improvement of corporate governance will contribute to the fulfillment of corporate social responsibility. The specific suggestions are put forward as follows:

First, at the board level. Companies can expand the size of the board within a certain range and standardize the daily operation of the board of directors to improve fulfilling corporate social responsibility. The expansion of the board of directors means to enrich the decision-making information and is beneficial for companies to make judgment of their own development.

In terms of independent directors, companies should appropriately increase the proportion of independent directors and expand the source of the independent directors, especially those equipped with professional quality and ability, which can carry on the effective guidance for the enterprises to fulfill social responsibility and to implement corporate social responsibility. Firstly, companies should improve the hiring process, strictly implement the employment condition, quickly establish directors' reputation market; only in this way can the independence of the independent director ensure qualification. Secondly, companies should set up internal audit committee, strictly enforce the independent director system and ensure the independent directors make judgment independently and not affected by shareholders. Finally, companies can enrich the form of directors' remuneration, for example, promotion incentives, income incentives, stock incentives, allowances incentives and other incentives. Companies can also expand the scope of incentives, linking the interests of the independent directors with the company's operating performance in order to improve the enthusiasm of working for the company.

Second, at the board of supervisors' level. As can be seen from the empirical results, the board of supervisors scale has negative effect on corporate social responsibility, which indicates that the relevant system of the board of supervisors is not perfect, such as weak supervision and the status quo of inaction and so on. Only by changing the situation can companies fulfill social responsibility. Firstly, companies should allow the workers' representatives to enter the board of supervisors for the reason that worker understand the status of the company's business more often, which is helpful to supervise the executives. Secondly, companies can introduce external supervisors. If supervisors are armed with abundant financial knowledge, they can identify the financial risk better, which is vital for supervisory functions performed. Thirdly, companies can improve the level of supervisors' fixed compensation, and appropriately increase the supervisors' shareholding. But payment level is just one aspect influencing the enthusiasm of the supervisors, so companies can implement some additional incentives such as spiritual incentives and reputation incentives when strengthening income incentives, only by doing so can the supervisors' supervision function is performed to an extreme. Lastly, companies should not only perfect the incentive mechanism but also improve the system of the responsibility of the board of supervisors in order to maintain and strengthen the functions of the board of supervisors and their independence, guaranteeing the rights, responsibilities and benefits coordination. If there are false or major omissions in the financial statements that supervisors don't point out timely, which bring a certain loss to investors and companies, companies must investigate for economic responsibility or even legal responsibility when necessary.

Third, at the senior management level. The empirical results show that executives' payment has a significantly positive influence on corporate social responsibility. So companies can join the performance of corporate social responsibility factor into the appraisal of executives' incentive system, forming a comprehensive executive incentive mechanism, which improves the degree of executives' concern for corporate social responsibility, helping companies to fulfill corporate social responsibility better.

Perfecting management compensation structure, combining the short-term incentive and long-term incentive are effective measures to avoid the negative external effects. Companies can improve the level of compensation accordingly in order to achieve the effect of good performance of social responsibilities. But too high salary could make the executives impractical, thus, producing opposite effect. In addition to the daily wage paid, companies can also give some equity incentive. Equity Incentive gives managers the residual claim so that they can become an indirect shareholder of the company, and establish a long-term risk-sharing, benefit-sharing mechanism, thus weakening their short-term behaviors.

CONCLUSIONS

There is a kind of interactive relationship between Companies' governance and social responsibility. Good companies' governance structure contributes to effective development of companies' social responsibility activities, and the implementation of company social responsibility can improve the companies governance structure and help enterprises develop harmoniously and healthily in turn. Real estate companies can try to establish a new companies' governance mode, which should adhere to the human-oriented principle, considering the social attribute from the social value orientation. Moreover, the mode's core target is to achieve comprehensive value maximization, which includes the implementation of enterprise development of economy, society and environment factors. Only in this way can the real estate companies perform social responsibility voluntarily.

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Study on the Building Enterprise Innovation Ability Evaluation Index

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Abstract

Innovation is the strategic support to social productive forces increased and the source of enterprise progress, more and more scholars pay close attention to enterprise innovation ability. Quantitative evaluation has contributed to the understanding of the enterprise innovative behavior and providing guidance for enterprises to develop innovative strategies. In order to analyze the current situation of construction industry innovation, improve the innovation ability and promote the sustainable and healthy development of construction enterprises, this paper reviews the building enterprise innovation ability and summarizes the innovation status of construction enterprises. It adds the new technologies, construction methods and other characteristics to the enterprise innovation ability evaluation index sets existed and analysis multiple aspects such as financial, staff, technical, etc. This paper is dedicated to put forward more suitable and feasible innovation ability evaluation indexes in conformity with the construction characteristics.

INTRODUCTION

Innovation is the key factor of national progress and the inexhaustible driving force of the social progress. Innovation refers to the behavior guided by the idea different from conventional ideas and based on the existing thinking model, using existing knowledge and material in a particular environment，satisfying the social need and improving or creating new things, methods, elements, path or environment. According to Schumpeter's view of innovation theory originator, introducing a new product, referring to the new production methods and processes, opening up new markets, new sources of supply of raw materials or semi-finished products are all innovations. For enterprises, innovation is the driving force for the development of enterprises. Enterprise Innovation includes technological innovation, brand innovation, system innovation, management innovation aspects, and ideas and cultural innovation. Evaluation of a company's ability to innovate not only considers the technical aspects, but also considers the multi-faceted factor. In the enterprise, innovation plays an important role to improve product quality and product diversification, establish a corporate brand, promote the improvement in the form of business organization and management efficiency, etc. In the knowledge economy, only on the basis of changes in the market can companies remain invincible in the fierce competition through adjusting the product structure constantly, improving the technical level and innovating. In this sense, innovation is a necessary prerequisite for the survival and development, and is an inexhaustible source of corporate vitality. Construction enterprise with various elements of the enterprise also has its own unique characteristics, especially construction enterprises need majority of technology to promote the industry competition and optimize the management to deal with the complicated situation, so to local conditions, choosing a more appropriate indicator of construction enterprises innovation evaluation.

LITERATURE REVIEW

Research on innovation. Innovation refers to the technological invention or creation at first. Later significance promoted refers to the relationships of assumptions and technology, culture, business, or social aspects in the subjective effects drive of people and the new discoveries of natural science. Schumpeter in the "Introduction to Economic Development", published in 1912 first proposed the concept of innovation, that innovation refers to the factors of production and production conditions of the "new combination" into the production system (Gupta et al. 2007). In the 1960s, the rapid development of new technology revolution, Walt Rostow proposed a "take-off" six-stage theory, the technology innovation to improve the innovation dominance (Rothaermel and Andrew 2007). NSF (National Science Foundation) in 1976 stated that technological innovation is a new or improved products, processes or services into the market.

Research on enterprise innovation. Burns and Stalker (1961) first put forward the concept of enterprise-level innovation capacity. Christensen (1995) divided the technological innovation capability of enterprises into research assets, process innovation assets, product innovation and design assets. Chiesa et al. (1996) developed process-based auditing system innovation ability, from concept generation, product development, production, technology acquisition, leadership, resource supply and supply systems and tools evaluated seven process innovation capability. Hu (2001) used a collection of weights and fuzzy mathematics from management, investment capability, research and development capabilities, manufacturing capacity, marketing capabilities and the ability to evaluate six innovation capabilities. Lu and Han (2002) used the close value method from R & D capability, input capacity, organizational management, marketing capability, financial capability to build five aspects of the enterprise innovation ability evaluation system. Yam et al. (2004) proposed an audit framework of technological innovation capability; innovation capability will be divided into: learning, research and development capabilities, resource allocation capabilities, manufacturing capacity, marketing, organizational skills and strategic planning skills. Chen and Chen (2006) analyzed the shortcomings and deficiencies of technological innovation performance evaluation system currently existed, combined with innovative features and Actual technology innovation of Chinese enterprises to design a new class of enterprise technology innovation performance evaluation system. Zhang and Su (2007) constructed the network environment of the enterprise innovation ability evaluation system from the resource capacity, R & D capabilities, commercialization capabilities, technology absorption capacity, and information and innovation organizational capacity in six measuring facets.

Research on building enterprise innovation. Since the 1960s, NSF (National Science Foundation) and so began the building of technological innovation research. Tatum (1986) who is a Professor in Stanford proposed the research framework of building technology innovation mechanism, he believes that the construction of technological innovation model should include the following areas: identification of architectural innovation opportunities and incentives to create an innovative environment for the development of micro-innovation and provide the necessary impetus, proposed new construction techniques, new technology testing and refining projects across the enterprise and technology diffusion, foster construction of technological innovation organizational structure and organizational culture elements. 1963 NSF pointed out that the construction industry is a major obstacle to the discrete nature of the construction business technology innovation. Paulson believes that three discrete, owners and incentive-oriented construction industry as well as the actual value of the project's problems hindered the US transportation construction technological progress. Liu et al. (2001) thought the building enterprise innovation can refer to the national innovation system to facilitate information diffusion only in the construction business, users, mobile public R & D sector, thereby enhance technological innovation activities in the construction industry. Lin and Chen (2003) discussed the construction of innovation system, and analyzed the basic train of thought, goal and content of the building construction industry innovation system, and advanced the measures of building construction industry innovation system based on these.

BUILDING ENTERPRISE INNOVATION ABILITY EVALUATION INDEX

Ideas and methods for index. Evaluation of enterprise innovation ability should comply with the principles of objectivity, scientific, systematic, operability, easily understanding, and add unique innovative features in construction industry based on the existing relatively common recognized index. Indicators of this paper contain not only the technical aspects but also multiple angles such as management and operation to display a comprehensive innovation ability of construction enterprises. Firstly, the index of building enterprise innovation ability is based on the all kinds of enterprise. I choose the indexes through frequency analysis. This paper reference the research results (see Table1) from Luo (2011) and Zhu (2009). Through the analysis of several documents, they respectively find the highest frequency of the top five indexes. This paper integrates the indicators and chooses the general construction enterprises index and characteristic index through expert assessment to build construction enterprise evaluation index collection.

Table 1.The Top5 of Enterprise Innovation Ability Evaluation Index.

Rank	Luo (2011)	Zhu (2009)
1	R & D funding intensity	R & D expenditure intensity
2	The proportion of new product sales	Advanced production equipment
3	The proportion of R & D personnel	The proportion of new product sales
4	Business innovation strategy and planning	Patented technology and patent number
5	Advanced production equipment	The proportion of R & D personnel

Building enterprise innovation ability evaluation index summary. Innovation Index in this paper is divided into three categories which is innovation input, innovation output and innovation management, setting sub-indicators in each index. A summary of these indexes is presented in Figure1.

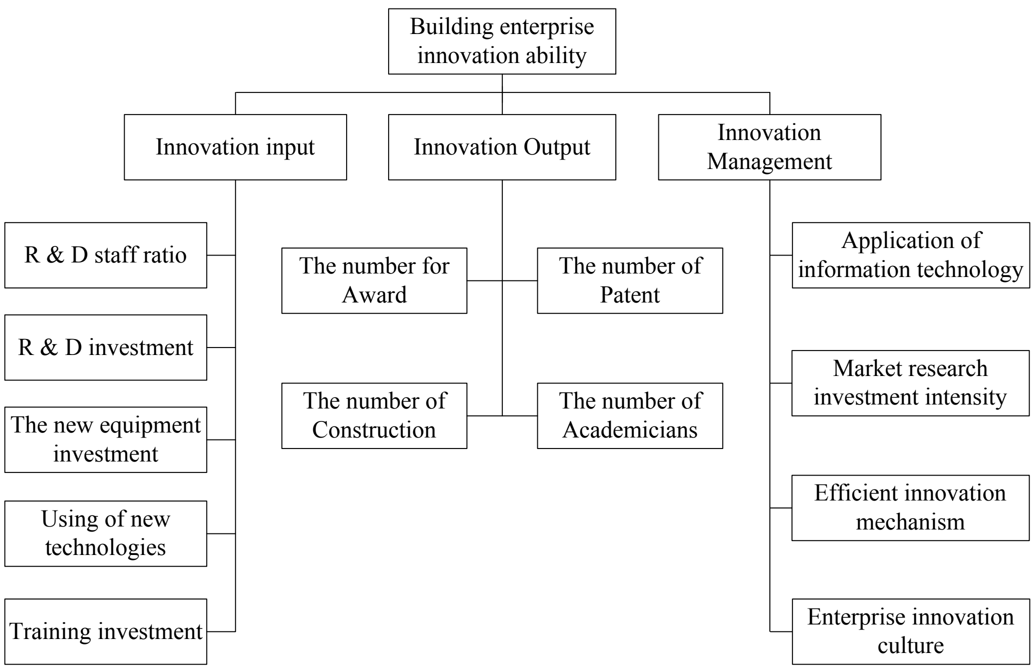

Figure 1.Summary of the innovation index for building enterprise.

(1) Innovation input. (i) R & D staff ratio. Implement innovative R & D staff is the main force for enterprises innovation, so the innovation has an important impact.

$$R\,\&\,D\ staff\ \ ratio = R\,\&\,D\ staff\ /\ all\ staff\ \ \times 100\%$$

(ii) R & D investment. This index can be quantitatively measure.

(iii) The new equipment investment. It affects the enterprises' innovation implementation capacity using high-tech equipment directly, this index is measured by invest of equipment.

(iv) Using of new technologies. There are ten new technology for building industry By the State Department of Housing and Urban-Rural Development in October 2010, including the foundation and underground space engineering technology, high performance concrete technology, reinforced and prestressed efficient technology, new formwork and scaffolding techniques, steel technology, installation engineering technology, buildings energy saving and environmental protection technology applications, building waterproof new technologies, construction process detection and control techniques, and building enterprise information management technology.

(v) Training investment. Staff training will help improve the skills of staff innovation, thus improving the overall innovation capability of enterprises.

(2) Innovation output. (i) The number of Award. This index includes the National Natural Science Award, the State Technological Invention Award and the National Science and Technology Progress Award. These awards can reflect the innovation output capacity.

(ii) The number of Construction Method. This index just consider the national and above Construction Method.

(iii) The number of Patent.

(iv) The number of Academicians.

(3) Innovation management. The indexes in this part are qualitative, so it would take score from one to five by experts. One is the worst and five is best.

(i) Application of information technology. Information technology is a main trade in current situation. Information technology can promote the innovation ability.

(ii) Market research investment intensity. The more correct positioning of marketing can make innovation more targeted.

(iii) Efficient innovation mechanism.

(iv) Enterprise innovation culture.

EVALUATION FOR INDEXES

Advantages. The evaluation system combines existing enterprise innovation ability evaluation index, and adds new technology investment and he number of construction method closely related to the construction industry and innovate the original system by adding more quantitative evaluation such as the number of award-winning, patent number and other countries prizes. Subdivided into three sections, showing innovation evaluating views orderly and briefly can not only comprehensive evaluation but also separate the various parts of the evaluation

Disadvantages. Indicators are part of innovation management qualitative evaluation, prone to large errors.

CONCLUSIONS

Under the national environment of advocating building innovation and energy conservation, the construction industry should take the “second five” plan as an opportunity to accelerate the pace of innovation in the construction industry, at the same time to carry out structural design, construction technology and technological innovation, attention to management innovation, develop more effective inter-organizational cooperation innovation model in the emerging information technology, make a breakthrough for sustainable construction and green building technology and other aspects, achieve transformation goals of construction industry, promote the sustainable development of construction by improving the sustainability of the project, and lay the foundation for sustainable human environment.

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Business Performance Evaluation for Listed Real Estate Companies Using DEA

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Abstract

Investors of Real estate listed companies is the community, so managers of those companies must conscientiously fulfill their obligations to disclose information to enable enterprises to be under the supervision and influence of shareholders, the community and other parties, thus effectively promote and improve the internal operation mechanism. How to correctly use the information to evaluate the real estate listed companies' performance scientifically and provide reference information for all stakeholders and corporate managers, is a problem that becomes more and more urgent and important in theory and reality. The purpose of this study is to construct an integrated performance evaluation method that apply to the real estate listed companies.

This study analyzes DEA's applicability in the performance evaluation of the real estate listed companies using DEA. From the application steps of DEA, the study screens the appropriate decision-making units, establishes the input and output index system, determines the DEA model. So far, the study constructs a complete set of DEA-based performance method for real estate listed companies. And in this study, 40 Chinese real estate listed companies on the Shanghai Stock Exchange or the Shenzhen Stock Exchange were selected as study subject between 2011 and 2013.We obtain the result of the evaluation, which reveals the cause why some listed companies suffer low efficiency. And it helps us find ways to solve them. Furthermore, through the comparison among evaluation, the paper analyses the tendency of the whole property development in these years.

INTRODUCTION

Real Estate is the generic terms of house property and landed estate, which is called immovable property on Economics. It includes all kinds of buildings constructed on land, all kinds of infrastructures underground, roads on the ground surface etc. According to the classification by CSRC, it could be classified as real estate development and management industry, real estate management industry and intermediary services of real estate. On next half of year 2014, Chinese real estate industry faced numerous adjustments. A series of policies are introduced aiming at real estate industry, such as house purchase quota policy, policy of exemption for purchasing, new policy for personal loan from banks, reduction of interest by Central

Bank etc. All these policies improved the real estate market at the end of the year which had been fallen back drastically at the first half of the year. Meanwhile, the existing problems of real estate itself, such as lever, tight money flow, over capacity etc. bring downward pressure to this industry to a large extent. Through the general survey of the year 2014, the real estate had been transited to development stage from rising stage and faced drastic shock.

However, it's easy to find from the statements of each real estate public enterprise that part of the enterprises was keeping favorable operation but the rest of enterprises could do nothing when facing the pressure of the downward housing prices during the differentiated year. The factors to result in the differences are from inside of enterprises, for example, reasonable resources allocation and management. This thesis is in order to verify the enterprises business performances and try to find the inefficient allocation and then adjust it and also to establish a business performance evaluation system under the help of DEA. It is of important practical significance for both investors and enterprises administrators.

Generally speaking, the gradual progresses of the enterprise business performance evaluation abroad could be attributed into 4 stages:

(1) Cost evaluation stage. In year 1891, Tayler, father of Scientific Management in US, set up the theories of scientific management. After that, the western countries had begun to have thorough and extensive researches on business performance management and performance evaluation. Most of the researches are performed by scholars from US. Harris, an accountant from US, designed the earliest standard cost system at the beginning of 19th century, which is the early form of performance evaluation. At the end of 19th and early of 20th centuries, mass production was required caused by the industrial revolution. In order to satisfy such need, more complicated cost management and financial performance measuring system were emerged at the right moment.

(2) Financial evaluation stage. In year 1917, Forbes compared the stock performance of railway industry and industrial enterprise with ROA (return on total assets). Two years later, Brown, from DuPont company of US established the DuPont financial analysis system with ROE as core. This analysis system became an important basis for enterprise financial business performance. The researcher Alexander Wall from US put forward the Wall Making System inside his thesis "Credit Barometer Research" and "Financial Statement Ratio Analysis" in year 1928. This is a comprehensive financial evaluation system which created the precedent for such kind of method and also became the milestone for comprehensive enterprise performance evaluation with financial index. In year 1950, Jackson Martindale built up the core of company management capacity assessment indicator system while marking each indicator with the form of interview. Cost and technique efficiency are concerned during cost evaluation stage but profit and economic efficiency are more concerned for financial performance indicators. Until 1980s, financial performance evaluation was nearly all the contents for enterprise performance evaluation.

(3) Comprehensive evaluation stage based on strategic thoughts and non-financial performance indicators. In year 1992, Robert·S·Kaplan & David·P·Norton published thesis on Harvard Business Review and put forward BSC for the first time to express the result caused by action taking with financial indicators and replenish

financial measurement indicators with non-financial indicators. It contains four layers: finance, clients, internal operation process, learning & creation. The British scholar Andy Neely and Anderson consulting company created performance polyhedron evaluation method together. The three sides of the polyhedron are Strategy, Process and Capacity separately. This method considered target, strategy and improvement requirements of the whole operation process from the satisfaction and contribution of the stakeholders. It's breakthrough of BSC to a certain degree.

With the development more than one hundred years, performance evaluation abroad had integrated the knowledge and thoughts from numerous subjects, such as Management, Accounting, Statistics, Economics and operational research etc.

Many scholars in China had already researched on business performance evaluation of real estate public companies. Li（2012）had made evaluation on overall performance of real estate market in China with factors analysis in his thesis "Performance Evaluation on Real Estate Market in China based on Factor Analysis". Li （2013）had made evaluation on policies of real estate market in his dissertation "Our real estate control policies Performance Evaluation". Shen（2013）had made evaluation on public companies of real estate industry with DEA and Malmquist indicators method in his thesis "Performance Evaluation on Public Companies of Real Estate Industry ". Meng （2009）had made evaluation on financial performance of real estate market in China with factors analysis in his dissertation "Chinese Real Estate Listed Companies' Financial Performance Evaluation Study". Wu（2008）had made evaluation on public companies of real estate industry all over China with Multi-level gray analysis and got the conclusion that the major reasons to affect business performance of real estate public companies were concentrated investment, small size of asset, changing on macro- economic policies and weak brand awareness etc. in her thesis "Research on Performance Evaluation of Public Companies of Real Estate Industry in China" The evaluation system in this thesis had made a clear evaluation of the enterprise business performance and suggested on adjustment based on the financial indicators of public companies.

THE SELECTION OF BUSINESS EVALUATION METHOD

It's the first step to choose proper evaluation method for performance evaluation. The so-called performance evaluation is to make comprehensive evaluation for the evaluating target through qualitative and quantitative comparing analysis with mathematical statistics, theory of operation research and specific indicators system. The major methods for business performance evaluation of public companies includes input-output method and DEA.

Input-output method. The input-output method was firstly put forward by US Economist Leontief to study the quantitative method of the relation of interdependence between the input and output of each part inside economic system(national economy, regional economy, sectoral economy, company or business economy unit). Based on the academic researches by F.Quesnay, L.Walras, and Dmitriev etc., Leontief published the thesis "Quantitative Relations of Input and

Output inside US Economy System" in year 1936 and put forward Input-Output method formally in this thesis.

The major contents of Input-Output method is to analyze comprehensively and confirm the sophisticated relations between each department of national economy and to analyze some essential issues such as industrial structures and macro-economic proportional relations. The specific method is to make checkerboard type input-output table and then establish mathematical models (The relations between each department are shown by linear equation algebra system generally) according to this table and calculate the consumption coefficient which is considered to be the method for economic analysis and prediction. It is widely applied to the proportional relation and calculation of the input and output. For the application scopes of input-output method, it could be classified into the types which is suitable for nations, regions, professionals, big size enterprises, and middle& small size enterprises separately.

DEA (Data envelopment analysis). Data Envelopment Analysis, shorted as DEA, is an different efficiency evaluation system with before based on the concept of relative efficiency developed by the famous operational researchers A.Charnes and E. Rhodes. After C2R of DEA was published in year 1978, the related theoretical innovations and further researches had made DEA a kind of important analysis evaluation tool and method for system engineering and management science to be applied widely on numerous fields.

DEA compares the relative efficiency of each Decision Making Unit with mathematical programming model to make evaluation for each Decision Making Unit (A. Charnes and Rhodes 1978). It's assumed that each Decision Making Unit, shorted as DMU, has the same performance. It's to say that each DMU has the same input and output under some point of view. The comprehensive efficiency could be analyzed and worked out with comprehensive DEA and then rank them according to efficiency of each DMU to confirm the relative highest efficient (DEA is valid) DMU and point out the degree and reasons of low efficient DMU. In this way, to feedback the administrators and the direction to improve unavailability DMU. DEA also could be used for judging if the DMU input scale is suitable and providing how to adjust the input scale of each DMU to be efficient thus to reach the purpose of guiding administration.

Compared with Input-Output method, DEA has significant advantages as bellow: (1) Only data for input and output are required, no need to establish complicated function relationship of production and input.(2)No need to preset other parameters and no need to consider production process. According to the Input-Output indicator system and data of the real estate public companies selected, business performance of real estate public companies in this thesis is with traditional CCR model and BCC model.

BASIC PRINCIPLES AND MODELS OF DEA

DEA method analyzes the modeling calculation for indicators data of input and output to get the overall efficiency of each DMU and to confirm if the DMU is efficient based on this analysis. In addition, the abundant models of DEA also could work out other indicators which are helpful to administrators on adjusting resources allocation, such as degree of returns to scale of production etc (Du 2011). According to requirements, this thesis mainly introduced BCC envelopment model used for analyzing pure technical efficiency and CCR envelopment model used for analyzing overall technical efficiency inside DEA models.

CCR envelopment model. It is assumed that there are n PCS of DMU and i is the number of input and r is the number of output of the DMU j. It's also assumed that the model satisfies the axioms of cone, convexity, minimality and unavailability.

The Production Possibility Set for DMU with CCR model is as bellow:

Based on the above formula, it could get that the function for CCR of DEA is mainly to evaluate the comprehensive efficiency for each DMU:

$$T = \left\{ (X,Y) \middle| \sum_{j\in J} X_j \lambda_j \le X, \sum_{j\in J} Y_j \lambda_j \ge Y, \lambda_j \ge 0, j \in J \right\}$$

Among them, they are slack variable. ε is Archimedes infinitesimal. The optimal solution for CCR model is θ^* When $\theta^* < 1$ DMU under CCR model is DEA unavailability. When $\theta^* = 1$ and $S^- = 0$ and $S^+ = 0$, DMU under CCR model is DEA efficient. When $\sum_{j\in J} \lambda_j < 1$, the returns to scale is decreasing. When $\sum_{j\in J} \lambda_j > 1$, he returns to scale is increasing:

$$\min\left\{\theta - \varepsilon(e^T S^- + e^T S^+)\right\}$$

$$s.t.\begin{cases} \sum_{j\in J} X_j \lambda_j + S^- - \theta X_0 = 0 \\ \sum_{j\in J} Y_j \lambda_j + S^+ + Y_0 = 0 \\ \lambda_j \ge 0, j \in J, S^- \ge 0, S^+ \ge 0 \end{cases}$$

For those DMU outside the effective leading surface, they could be changed to be efficient DEA by adjusting the input and output indicators (Generally speaking, the administrators adjust input indicators practically).

BCC envelopment model. The cone hypothesis of Production Possibility Set could be unreasonable or unpractical sometimes (It's to say that it's difficult to make sure that returns to scale benefit is stable). Thus, this hypothesis should be removed in order to make the result of business evaluation to be more close to practice. When the Production Possibility Set T could only satisfy convexity (input condition), minimality and unavailability, the scale of production could be satisfied even with BCC model:

$$\max(\mu^T Y_0 - \mu_0)$$

$$s.t.\begin{cases} \mu^T Y_j - \omega^T X_j - \mu_0 \le 0, j = 0,1,...,n \\ \omega^T X_0 = 1 \\ \mu \ge \varepsilon, \omega \ge \varepsilon \end{cases}$$

In the above formula, represents returns to scale, then returns to scale decreases gradually, then returns of scale increases gradually, then returns of scale keeps stable. This model is only used for the situation that only the technology availability of DMU need to be evaluated. The bellow dual form is also available for it:

$$\min\left\{\theta\varepsilon(e^T S^- + e^T S^+)\right\}$$

$$s.t.\begin{cases}\sum_{j\in J} X_j\lambda_j + S^- - \theta X_0 = 0\\ -\sum_{j\in J} Y_j\lambda_j + S^+ + Y_0 = 0\\ \sum_{j\in J}\lambda_j = 1\\ \lambda_j \geq 0, j\in J, S^- \geq 0, S^+ \geq 0\end{cases}$$

The calculation of business performance for real estate public companies mainly involves three kinds of efficiency indicators: Scale Efficiency (SE), Technical Efficiency (TE) and Pure Technical Efficiency (PTE). The technical efficiency under the hypothesis of Constant Return to Scale (CRS) is called Comprehensive technical efficiency. The technical efficiency under the hypothesis of Variable Return to Scale (VRS) is called Pure Technical Efficiency (PTE). The Scale Efficiency is the ratio of technical efficiency and pure technical efficiency which reflects if the production of the evaluated DMU is based on scale (Doyle and Green 1994). When scale efficiency is less than 1, it means the evaluated DMU deviates from the optimal scale. When scale efficiency is 1, it means the evaluated reaches the optimal scale. The less scores of the scale, the serious the degree of deviation is.

EMPIRICAL STUDY

The selection of DMU. The selection of DMU affects to some extent if the result of the DEA model performance evaluation is scientific and precise. DEA have bellow requirements towards DMU: Firstly, during production process, DMU should has same behavior. Secondly, In order to make the evaluation result more precise, the numbers of DMU should not be less than 2 times of the total of input and output indicators (Andersen and Petersen 1993). According to experience, the more the numbers of DMU is, the more precise the result is. In this case, we have to make sure the numbers as many as possible during DMU selection.

If year is considered as DMU of DEA for real estate input performance evaluation. There is more errors on DEA evaluation result if it is with less DMU. The numbers of real estate public companies is large. There are 146 companies only trading in Shanghai and Shenzhen exchange. Even the companies with bad management (the annual net profit is negative. As what this thesis compared is enterprise operation efficiency, the operation efficiency of enterprise with negative profit should be low than all enterprises with profit) are deducted, there are still 111 companies. Although the larger numbers the DMU is, the more precise the result is, the calculated amount is huge. After overall consideration, this thesis selected data indicators of 40 real estate public companies as models to represent each net profit level to reflect the overall real estate market. Based on the above reasons, this thesis selects each public company as DMU of DEA. Through horizontal comparison, to analyze the business performance of 40 real estate public companies. Meanwhile， in order to have a study of the change of the business performances of these companies, we selected the data from year 2011, 2012 & 2013 of these companies. All the data are from the public company annual statements from Shanghai and Shenzhen Exchange.

The establishing of Input-output indicators. When establish DEA models, the input and output indicators selection should satisfy the bellow principles:

(1) Realize the purpose of evaluation. The evaluation indicators system should serve the evaluation purpose firstly. When do business evaluations for public companies, it's annual financial indicators could be considered as input and output indicators. At the time to establish system, these indicators should be sorted out according to input and output and select financial indicators which could express the whole production process from them so as to reach the purpose to evaluate the business performance for real estate public companies, to analyze if the input of real estate industry is less or more than need and if it reached the optimized scale efficiency (Zillar and Friedman 1998). After evaluation, we could offer useful information to administrators if we need to increase input factors and how to increase input. When select input and output indicators, indicators these indicators should be controllable for administrators, such as administration expenses, net fixed assets etc. When select output indicators, these indicators should be of reference values for investment decision making. such as net profits and operating income etc.

(2) The relation between input indicators and outcome indicators. When some indicators are confirmed as input or output, they have the possibility to affect the other indicators and cause errors during model solving process as each input indicator and output indicator of DMU is not isolated but have certain degree of relations (Rowan 2013). Thus, the correlation between financial indicators which are considered to be model indicators should be paid attention to. When one indicator have more stronger correlation with the other indicators, then the input or output it presented had already been expressed by the other indicators. In this case, this indicator should not be considered as indicator of input or output anymore. Generally speaking, it will not affect the comprehensiveness of the evaluation by doing this.

Based on the above principles, this thesis selected the bellow indicators for input and output after analysis according to previous research experience (see Table 1).

Table 1.Indicators for Input & Output of Dea Model.

Indicators	Index
Input indicators	(input1) Management expenses
	(input2) Net value of fixed assets
	(input3) Employee numbers
Output indicators	(output1) Operation Income
	(output2) Net profit

(3) independent indicators with low correlations are selected for input indicators. With more stronger controllability on management, these indicators could be adjusted freely by administrators after get the result of business performance evaluation.

Operation income and net profit are important indicators on financial statements and public companies evaluation on output selection. It reflects if the operation performance is good and company capacity on operation and management. That's why it is selected as output indicator.

Data selection. 40 real estate public companies are selected as research object. The input and output indicators from year 2011 to year 2013 are brought into models to be calculated. The public companies selected are as bellow (see Table 2):

Table 2. 40 Selected Real Estate Public Companies.

Companies			
Rongfeng Holding	YunnanMetropolitan	Nanjinggaoke company	BinjiangRealEstate
Tianrun Holding	Jinfeng Investment	Rongan Property	Suning Universal
Yihua Real Estate	Lushang Property	Shenzhen Zhenye	Lujiazui
Winsan Industry	Tande	BeijingVanton	Greattown holdings
Lander Real Estate	Jiabao Industry	BeijingNorthStar Company	Jinke Property
Dongguan Winnerway	Zhejiang Guangsha	ZhongtianUrban Development	BeijingCapital
China Real Estate	Beih-Property	Zhonghong Holding	Financial Street
ChinaUnion Holdings	Black Peony	Macrolink	ChinaMerchants Property
Huaxin Holdings	Sundy Land	Yinyi	PolyRealEstate
SWUNION CONSULTANCY	TibetUrbanDevelopment and Investment	COFCOProperty	China Vanke

Result and analysis performance appraisal. The result of performance appraisal of 40 public companies in year 2013 are presented as below (see Table 3):

Table 3.Result of Performance Appraisal of 40 Public Companies in Year 2013.

DMU	Comprehensive efficiency	Pure technical efficiency	Scale efficiency	Scale efficiency status
Rongfeng Holding	0.125	0.49	0.254	irs
Tianrun Holding	0.089	1	0.089	irs
Yihua Real Estate	0.287	0.384	0.746	irs
Winsan Industry	0.208	0.391	0.533	irs
Lander Real Estate	0.494	0.531	0.931	irs
Dongguan Winnerway	0.157	0.173	0.904	irs
China Real Estate	0.224	0.299	0.749	irs
ChinaUnion Holdings	0.123	0.168	0.733	irs
Huaxin Holding	0.322	0.33	0.976	drs
SWUNION	0.123	0.139	0.888	drs
YunnanMetropolitan	0.436	0.455	0.96	irs
Jinfeng Investment	0.154	0.196	0.785	irs
Lushang Property	0.562	0.691	0.812	drs

Table 3.(Continued).

DMU	Comprehensive efficiency	Pure technical efficiency	Scale efficiency	Scale efficiency status
Tande	0.338	0.386	0.874	drs
Jiabao Industry	0.521	0.525	0.992	irs
Zhejiang Guangsha	0.213	0.224	0.948	drs
Beih-Property	1	1	1	-
Black Peony	0.288	0.35	0.823	drs
Sundy Land	0.391	0.395	0.99	irs
TibetUrbanDevelopment and Investment	0.749	1	0.749	irs
Nanjinggaoke company	0.369	0.388	0.951	drs
Rongan Property	0.788	0.793	0.994	drs
Shenzhen Zhenye	1	1	1	-
BeijingVanton	0.359	0.37	0.971	irs
BeijingNorthStar Company	0.113	0.138	0.819	drs
ZhongtianUrban Development	0.3	0.379	0.793	drs
Zhonghong Holding	0.109	0.128	0.857	irs
Macrolink	0.208	0.266	0.781	drs
Yinyi	0.175	0.213	0.823	drs
COFCOProperty	0.426	0.615	0.694	drs
BinjiangRealEstate	0.552	0.71	0.777	drs
Suning Universal	0.586	0.734	0.799	drs
Lujiazui	0.592	0.938	0.631	drs
Greattown holdings	0.269	0.279	0.964	drs
Jinke Property	0.33	0.449	0.736	drs
BeijingCapital	0.454	1	0.454	drs
Financial Street	0.655	1	0.655	drs
ChinaMerchants Property	0.754	1	0.754	drs
PolyRealEstate	0.754	1	0.754	drs
China Vanke	0.608	1	0.608	drs
Average	0.405125	0.538175	0.788775	

Three efficiency indicators including comprehensive efficiency, pure technical efficiency & scale efficiency and their scale efficiency status for 40 public companies in year 2013 are presented in the above chart. Among them, “-”represents that scale efficiency is stable, “irs”represents that returns to scale is increasing gradually, “drs”represents that returns to scale is decreasing gradually.

It could be seen from this chart that the efficiency of BEIH Property & Shenzhen Zhenye Group A two companies is 1. It belongs DEA Unavailable which means that they have need to improve on pure technical efficiency and scale efficiency.

Taking the company Tianrun Holding as example, the pure technical efficiency for this company is 1 but scale efficiency is less than 1. From practical sense, this company had already reached the efficiency on management structures and production technical, but this company is still in returns to scale increasing zone. In this case, capital and labor force input should be increased to reach scale efficiency (see Table 4).

Table 4.The Statue of The 9th DMU.

Results for firm: 9
Technical efficiency = 0.330
Scale efficiency = 0.976 (drs)
PROJECTION SUMMARY:

Variable	Original	Radial	Slack	Projected
Output1	1116827780.650	0.000	439382068.219	1556209848.869
Output2	295963392.320	0.000	0.000	295963392.320
Input1	61736911.900	-41350636.267	0.000	20386275.633
Input2	159549980.310	-106864645.463	-29593744.486	23091590.361
Input3	1689.000	-1131.272	-363.595	194.133

But the evaluation result for Huaxin Stock is just opposite with Tianrun Holding. This company is close to reach the efficiency on scale (0.976), however, the factor affect it's overall efficiency is technical efficiency. It means structural problems are existed. The bellow chart is the model to get the details of Huaxin Stock (DMU 9): The bellow information could be reached: Based on the existed input indicators of Huaxin Stock, deficiency is existed on output factors. The first output (business output) should be 439382068 more than the present data (the primary output is 1556209848 units. The bellow is the same). Redundancy are existed to some extent on input in this company: 41350636 unit's redundancy is existed for indicator 1 (management expense), 136458389 unit's redundancy is existed for indicator 2 (net fixed assets), 1494 unit's redundancy is existed for indicator3 (employee numbers).

Generally speaking, the business performance evaluation of real estate public companies presents increasing trend from year 2011 to year 2013 from the data research of real estate public companies (see Table 5). Among them, the ratio of DEA efficient companies increased by 2.5% on year 2012. But it decreased by 2% of the samples. From the ranking for the annual business performance of sample companies, there is a big difference for the year 2011, 2012 and 2013. It could be deduced that real estate industries faced the situation of transformation and realignment. Each company adjust input on self structure and means of production so as to face new requirements and challenges.

Table 5.Indicators for Input & Output of Dea Model.

Year	Comprehensive efficiency (average)	Pure technical efficiency (average)	Scale efficiency (average)	DEA effective company number	Proportion (%)
2011	0.378725	0.56835	0.699675	3	7.5
2012	0.46875	0.568925	0.838675	4	10
2013	0.405125	0.538175	0.788775	2	5

It's worth nothing that the average overall efficiency of real estate industry in China is still too low. All the evaluation had made referred to domestic public companies. There is still a long distance if it's compared with international level.

CONCLUSION

The business performances for 40 real estate public companies from year 2011 to year 2013 had been evaluated and analyzed with DEA inside this thesis. The result showed that the overall efficiency for 40 real estate public companies during 3 years changed obviously. DEA efficient public companies increased to 4 companies in year 2012 based on 3 companies of year 2011, but it decreased to 2 companies in till year 2013. Also, there are seldom companies keeps efficient constantly during all 3 years. This stated that the real estate industry faced transformation and adjustment in recent years. Through the calculation of annual efficiency indicators and specific production situations of each company, we found that input redundancy and insufficient output are the major reasons to lead public companies inefficient. Public companies could further be optimized by improving their pure technical efficiency to avoid waste on input.

From the overall situation of real estate industry, we could see that rare companies could reach efficient on DEA and companies polarization is obvious. Many companies with low efficiency is deceasing during the 3 years' development, but some companies with more higher overall efficiency is increasing persistently with the adjustment of resources allocation. Considered the present situation of financing difficulties, over capacities and increasing on bad debt of real estate companies, if the companies still enlarge on scale, the company efficiency will be affected or even be weeded out by market. The data for specific situation of DMU also expressed that redundancy on net fixed assets are existed commonly in public companies. It also verified the situation of over capacity. The top challenge for real estate public companies even the whole real estate industry is to change the company operation model of extensive and capital intensive.

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Gray Correlation Analysis on the Tax Cost and Core Competence of Real Estate Enterprises

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Abstract

Due to the severe competition and saturation of real estate market, vicious price competition reappears between the real estate enterprises in second and third-tier cities, which contribute to the unsustainable development of real estate enterprises. Therefore, reducing the construction cost, especially the tax cost, will certainly enhance an enterprise's core competence. Based on the panel data of Chinese real estate tax and house price during 2002~2012, the influence of different types of real estate tax on the house price can be quantified to find out the correlation by the gray correlation analysis. According to the relational degree, some suggestions will be offered to prevent and control the possible tax risks caused by the increased tax costs of corresponding taxes. And on this basis, some possible solutions can be designed to avoid tax reasonably and achieve the goal of tax saving.

INTRODUCTION

The real estate registration has drawn wide attention among the public because it may cause the sale of massive second-hand houses in a short time, which will definitely add huge pressure on the Chinese property market facing slower demand for houses and will intensify price competition, especially among the less economically important cities. And the real estate enterprises has been listed into the special inspection for 13 consecutive years since 2002 (Liu and An 2012). The punishment of the taxation authority will not only bring massively economic loss and increase tax cost, but also lead to a forfeiture of enterprises' credibility and even incur barriers to the financing activities. Compared with cutting residential prices, reducing the project cost, especially the tax cost, can be a smarter call for a property company. Therefore, this paper will use the panel data of China' real estate tax and housing price to figure out the relational degree by the help of grey correlation analysis method. Moreover, corresponding conclusions on tax risks involved in different types of real estate tax can be generalized according to the sort of relational degree. At the same time, there is going to be some advice served as the way of prevention and risks controlling, which can hopefully deepen the understanding of tax risk, assist enterprises in taxation management, lowering tax cost and reinforcing the core competence of enterprises (Liu 2014).

THE THEORY OF THE GRAY CORRELATION ANALYSIS

The gray correlation analysis is an active research area of gray system theory (Liu et al. 2013), which overcomes weakness of the regression analysis that only can analyze linear and few factors. Besides, it can analyze nonlinear and dynamic factors. Therefore, the gray correlation analysis is more commonly used.

The basic principle. The gray correlation analysis describes an internal system's fuzzy relations (Ma and Wu 2014). The relational degree which can be figured out by the gray correlation analysis reflects relationship among all factors of a system. And according to the order of relational degree, the size of the factors which affect the relationship can be obtained, and it is the optimization approach of solving problems (Deng 1991; Liu et al. 2010).

Calculation process. (1) The selection of the original data. The burden of taxes per square metre and house price during 2002-2012 are used as samples. And housing prices (X_j) are defined as reference sequence; the burden of taxes per square metre ($\underline{X}_{ij}$) is defined as compare sequence. The model of original data is shown in Table 1.

Table 1.The Burden of Taxes per Square Metre and House Price.

Indicators	2002	2003	…	2011	2012
House price (X_j)	X_{02}	X_{03}	…	X_{11}	X_{12}
Enterprise income tax (X_{0j})	X_{002}	X_{003}	…	X_{011}	X_{012}
Individual income tax (X_{1j})	X_{102}	X_{103}	…	X_{111}	X_{112}
City maintenance development tax (X_{2j})	X_{202}	X_{203}	…	X_{211}	X_{212}
Stamp tax (X_{3j})	X_{302}	X_{303}	…	X_{311}	X_{312}
Land use tax (X_{4j})	X_{402}	X_{403}	…	X_{411}	X_{412}
Land value-added tax (X_{5j})	X_{502}	X_{503}	…	X_{511}	X_{512}
Business tax (X_{6j})	X_{602}	X_{603}	…	X_{611}	X_{612}
Cultivated land occupancy tax (X_{7j})	X_{702}	X_{703}	…	X_{711}	X_{712}
Deed tax (X_{8j})	X_{802}	X_{803}	…	X_{811}	X_{812}
House property tax (X_{9j})	X_{902}	X_{903}	…	X_{911}	X_{912}

(2) The application of dimensionless method. Due to many differences in time, with the methods of data processing, or of the dimensions, these selected factors will be differences, which cannot be compared directly; otherwise the results will produce the error. In order to remove or restrain those negative factors, the dimensionless method should be applied to the data. The normalized data can be used to get results directly.

The methods of the data formalization are: the formula (1) is applied to the data of Table 1, getting the C matrix (2), as follows:

$$C_{ij} = \frac{X_{ij} - \min X}{\max X - \min X} \quad C_{ij} \in [0,1] \tag{1}$$

$$C_{ij} = \begin{bmatrix} C_{02} & C_{03} & \cdots & C_{11} & C_{12} \\ C_{002} & C_{003} & \cdots & C_{011} & C_{012} \\ C_{102} & C_{103} & \cdots & C_{111} & C_{112} \\ \vdots & \vdots & \cdots & \vdots & \vdots \\ C_{802} & C_{803} & \cdots & C_{811} & C_{812} \\ C_{902} & C_{903} & \cdots & C_{911} & C_{912} \end{bmatrix} \tag{2}$$

C_{ij} is non-dimensional data, it is calculated by formula (1) and the table 1. In formula (1), $\min X$ are minimun values of X, and $\max X$ are maximun values of X.

(3) Gray correlation coefficients. Δ_{ij} is calculated by equation (2) and formula (3).

$$\Delta_{ij} = |C_{ij} - C_j| \tag{3}$$

ξ_{ij} represents the gray correlation coefficient between the burden of taxes per square meter and house price during 2002-2012. ξ_{ij} is calculated by formula (4).

$$\xi_{ij} = \frac{\Delta \min + \rho \Delta \max}{\Delta ij + \rho \Delta \max} \tag{4}$$

In formula (4), $\Delta \min$ is minimun values of Δ_{ij}, and $\Delta \max$ is maximun values of Δ_{ij}. and $\rho \in [0,1]$, the value of ρ is 0.5 generally.

(4) Calculation and ranking of the gray relational degree. The gray correlation coefficients are more than one, which reflect the gray relational degree between reference sequences and compare sequence in different time. In order to centralize information and perform a comparison, R_i represents the average of ξ_{ij}, which need to be calculated by formula (5), as follows:

$$R_i = \frac{1}{N} \sum \xi_{ij} \tag{5}$$

R_i is the gray relational degree. According to the size of R_i, the R_i can be sorted.

THE EMPIRICAL ANALYSIS

Collection and processing of the original data. The following data (see Table 2) shows the burden of taxes per square meter and house price during 2002-2012.

The calculation process. (1) The Application of Dimensionless Method and Range Sequence. The non-dimensional data can be obtained by formula (1), thus getting range sequence. The following data (see Table 3) shows range values (Δ_{ij}).

(2) Gray Correlation Coefficient. The following data (see Table 4) shows the

gray correlation coefficient.

(3) The Gray Relational Degree. The Gray Relational Degree is sorted as follows: (see Table 5)

Table 2.The Burden of Taxes per Square Meter and House Price.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
X	2092	2197	2608	2937	3119	3645	3576	4459	4725	4993	5430
X_0	48.2	56.7	94.3	93.0	111.0	136.7	190.0	127.8	173.3	202.0	205.0
X_1	8.3	9.9	10.7	9.9	11.0	13.8	20.9	20.3	24.4	29.2	27.1
X_2	7.7	8.5	10.2	8.6	10.1	11.2	14.1	13.5	16.5	21.3	23.2
X_3	1.5	1.8	2.3	1.9	2.2	3.1	5.2	4.0	5.8	6.5	6.5
X_4	28.7	27.2	27.8	24.8	28.6	49.8	123.8	97.2	95.8	111.8	138.4
X_5	7.7	11.1	19.6	25.3	37.4	52.1	81.5	75.9	122.0	188.6	244.3
X_6	154.9	183.1	213.5	179.7	207.6	231.5	260.6	250.0	295.3	328.3	350.5
X_7	21.4	26.7	31.4	25.6	27.7	23.9	47.7	66.8	84.8	98.3	145.6
X_8	89.2	106.2	141.3	132.5	140.3	155.9	198.2	183.1	235.3	252.9	258.2
X_9	21.9	13.7	11.8	14.9	13.4	8.7	14.6	15.3	9.1	19.5	24.5

Note: X_9 = The total house property tax / [0.5*(Last year's total sales area + This year's total sales area)]; X_i (I = 0, 1,…, 8) = The total different types of real estate tax / This year's total sales area)

Source: The China Statistical Yearbook (2003-2013), the China Tax Yearbook (2003-2013), the National Bureau of Statistics Web Site. Minx = 1.5; maxX = 5430

Table 3.Range Sequence.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Δ_0	0.376	0.394	0.463	0.524	0.554	0.646	0.624	0.798	0.838	0.883	0.963
Δ_1	0.384	0.403	0.478	0.539	0.573	0.669	0.655	0.818	0.866	0.914	0.995
Δ_2	0.384	0.403	0.479	0.539	0.573	0.669	0.656	0.819	0.867	0.916	0.996
Δ_3	0.385	0.404	0.480	0.541	0.574	0.671	0.658	0.821	0.869	0.919	0.999
Δ_4	0.380	0.400	0.475	0.536	0.569	0.662	0.636	0.803	0.853	0.899	0.975
Δ_5	0.384	0.403	0.477	0.536	0.568	0.662	0.644	0.807	0.848	0.885	0.955
Δ_6	0.357	0.371	0.441	0.508	0.536	0.629	0.611	0.775	0.816	0.859	0.936
Δ_7	0.381	0.400	0.475	0.536	0.569	0.667	0.650	0.809	0.855	0.902	0.973
Δ_8	0.369	0.385	0.454	0.517	0.549	0.643	0.622	0.788	0.827	0.873	0.953
Δ_9	0.381	0.402	0.478	0.538	0.572	0.670	0.656	0.819	0.869	0.916	0.996

Analysis. The conclusions can be drawn that the order of the gray relational degree is $X_6>X_8>X_0>X_5>X_4>X_7>X_9>X_1>X_2>X_3$. According to the ranking, it is easily to be seen that the corresponding relationship between the tax cost and house prices, and business tax is the most closely related to the house price, followed by deed tax, enterprise income tax and other taxes. Knowing about the corresponding the tax risk, simultaneously to avoid it, can reduce the tax cost efficiently, thus strengthening the real estate enterprises' competiveness. The following shows the risk of different taxes in the relational degree's descending order.

Table 4.Gray Correlation Coefficient.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
X_0	0.978	0.958	0.890	0.837	0.813	0.747	0.762	0.660	0.640	0.620	0.586
X_1	0.969	0.949	0.876	0.824	0.799	0.733	0.742	0.650	0.627	0.606	0.573
X_2	0.969	0.949	0.876	0.824	0.799	0.733	0.741	0.650	0.626	0.605	0.573
X_3	0.968	0.947	0.874	0.823	0.798	0.732	0.740	0.649	0.626	0.604	0.571
X_4	0.974	0.952	0.878	0.827	0.801	0.737	0.754	0.657	0.633	0.612	0.581
X_5	0.969	0.949	0.877	0.827	0.802	0.737	0.749	0.655	0.636	0.619	0.589
X_6	1.000	0.984	0.910	0.850	0.827	0.759	0.771	0.672	0.651	0.630	0.597
X_7	0.972	0.952	0.879	0.827	0.801	0.734	0.745	0.654	0.632	0.611	0.581
X_8	0.986	0.968	0.898	0.843	0.817	0.750	0.763	0.665	0.646	0.624	0.590
X_9	0.972	0.950	0.876	0.825	0.799	0.732	0.741	0.650	0.626	0.605	0.573

Table 5.The Sort of The Gray Relational Degree.

Indicators	The Gray Relational Degree	Ranking
Enterprise income tax (X_{0j})	0.771821	3
Individual income tax (X_{1j})	0.758891	8
City maintenance development tax (X_{2j})	0.758521	9
Stamp tax (X_{3j})	0.757429	10
Land use tax (X_{4j})	0.764275	5
Land value-added tax (X_{5j})	0.764458	4
Business tax (X_{6j})	0.786431	1
Cultivated land occupancy tax (X_{7j})	0.762682	6
Deed tax (X_{8j})	0.777173	2
House property tax (X_{9j})	0.758957	7

(1) Business Tax. Business tax is most in all taxes, which is increasing year by year. The risks of business tax are mainly reflected in the following aspects.

(i) The deposit, liquidated damages, sincerity gold and so on, these parts have not paid business tax in accordance with Chinese tax law.

(ii) The real estate enterprises have not handled tax declaration according to the date in the installment contract.

(iii) Revenue from garage, basement and attic sales, which has been separated invoices, has not been recognized as the revenue in time.

(iv) The behavior regarded as the sales has not been handled tax declaration.

(v) The commercial housing is sold to related parties below the market price. And the relevant business tax has not been paid accurately.

(2) Deed Tax. The risks of deed tax are mainly reflected in the following aspects.

(i) The real estate enterprises pay the cost of the premises' attached facilities by instilments. And the deed tax has not been paid based on total price.

(ii) The part which enjoys exemptions of the land transfer fund has not been paid deed tax according to the tax laws.

(iii) The revenue of deemed sales, such as payment of debt with real estate or the exchange of houses in kind, has not been paid deed tax, thus violating the tax law.

(iv) The land-use right obtained by bidding is transferred directly, which has not been handled the registration of property rights. And the land-use right has not been paid deed tax in accordance with Chinese tax law.

(3) Enterprise Income Tax. The risks of enterprise income tax are mainly reflected in the following aspects.

(i) When the development of real estate products has been completed, the real estate enterprises have not made the final settlement in time according to the tax law.

(ii) The enterprises exaggerate their construction cost, such as making much more compensation for demolition or charging the cost outlays in advance.

(iii) Other revenue, like receiving liquidated damages, has not been recognized as enterprise's income to pay enterprise income tax.

(4) Land Value-added Tax. The risks of land value-added tax are mainly reflected in the following aspects.

(i) Cooperative-Housing which has been finished is transferred to sale, and its land value-added tax has not been paid in time.

(ii) When the real estate fits conditions of liquidation, the land value-added tax has not been paid in time.

(iii) The real estate is transferred again after the completion of the liquidation. The enterprises have not paid the land value-added tax according to tax law.

(iv) The commercial housing and ordinary housing have not been calculated out the land value-added tax by the different tax rates separately.

(5) Land Use Tax. The risks of land use tax are mainly reflected in the following aspects.

(i) The real estate enterprises have not paid land use tax at the right time.

(ii) The real estate enterprises have not adjusted the tax standard after changing land grade timely.

(iii) The idled land or unsold homes' land have not been paid land use tax.

(6) Cultivated Land Occupancy Tax. Cultivated land occupancy tax is involved in the link of land obtained, and its risks are mainly reflected in the following aspects.

(i) The cultivated land that used to enjoy tax's exemptions has not been handled tax declaration after land-use change.

(ii) The real estate enterprises have not adjusted the tax standard timely when the tax standard no longer applies to present tax amounts.

(7) House Property Tax. The risks of house property tax are mainly reflected in the following aspects.

(i) The enterprises have not distinguished underground buildings' purposes, using lower the taxable value deliberately to pay less house property tax.

(ii) The value which doesn't be listed alone, such as supporting facilities or buildings' auxiliary equipment, has not been incorporated into original value of the property to pay house property tax.

(iii) When commercial housings have been lent or rented out, or been used for enterprises themselves before they are sold, the enterprises have not paid house property tax.

(8) Individual Income Tax. The risks of individual income tax are mainly reflected in the following aspects.

(i) The real estate enterprises give away gifts to the customer for sales promotion campaigns. Enterprises have no withholding individual income tax.

(ii) Sales commission has not been incorporated into the salary income of salesman to withhold individual income tax.

(iii) The enterprises sell houses to clerks below the construction cost or purchase price. And the part of the price adjustment has not been paid individual income tax.

(9) City Maintenance Development Tax. The risks of city maintenance development tax are mainly reflected in the following aspects.

(i) City maintenance development tax is based on consumption tax, business tax and value-added tax. When the three taxes enjoy tax rebating, enterprises forget to request tax rebate, thus causing the risk of extra tax.

(ii) The real estate enterprises have not considered regional differences to select the right tax rate for city maintenance development tax.

(10) Stamp Tax. Stamp tax runs through the whole business process of real estate basically. It takes up little proportion in all taxes, but its risk should not be neglected. And its risks are mainly reflected in the following aspects.

(i) Making decals has finished, but writing off has not been finished. Above behaviors cause tax risk.

(ii) Confusing contracts' types causes enterprises do not pay enough stamp tax.

SUGGESTIONS

Due to the severe competition and diverse environments, house price are always changing. Instead of passively accepting house price fluctuation, the real estate enterprises should enhance core competence. The following some possible solutions can be designed to avoid tax reasonably and achieve the goal of tax saving.

The rational use of tax shield effect. It is the key for the real estate enterprises' development to solve the difficult problem of financing. The ways of raising real estate enterprises' fund mainly can be divided into the debt fund raising and the rights fund raise fund raising. A reasonable capital structure and the asset-liability ratio are important for enterprises to reach the financial leverage and bring tax avoidance. The interest on a loan can be deducted before reporting tax to achieve the goal of making a narrow tax base. Therefore, the real estate enterprises can save a part of enterprise income tax.

The efficient use of critical point. The ordinary standard houses have a tax privilege' critical point of a 20% the added value about land value-added tax. When the real estate enterprises build the ordinary standard houses to sell, the appreciation forehead has not exceeded the 20% of deduction. Land value-added tax can be exempted from the above situation. In order to reduce the tax burden, the real estate enterprises can take some measures to lower the critical value, for example, they can reduce house price or increase amount of money of project. But the amount of tax saving must be compared with the diminishing profits, when the former is larger, this tax planning can be used to achieve the goal of tax saving efficiently.

The profitable selection of the construction mode. The mode of construction has three methods, including the agent construction mode, the self-built mode and the cooperative construction mode. The income of the real estate enterprises belongs to labor remuneration income in the agent construction mode, which should be paid business tax. But the part of income does not have to be paid land value-added tax, because it does not be involved in the real estate ownership transferred. In the cooperative construction mode, if houses are divided to use for themselves after completing buildings, the real estate enterprises can be exempted from land value-added tax. So it reduces the burden of tax.

CONCLUSIONS

All kinds of problems, such as the extensive inventory, a slow pace inventory adjustment, macro-control policies and so on, have caused the plight of the real estate enterprises. After the comprehensively understanding the relational degree between different types of real estate tax and house price, the real estate enterprises can manage the tax risks more effectively. At the same time, enterprises can save the extra administration cost of tax to achieve the goal of comparative cost-effectiveness. The expropriation of real estate taxes is the focus of the tax authorities. So when the real estate enterprises face inspection of the tax authority, it is necessary to take actions to control of standard operating procedures and management to reduce the tax risk. Meanwhile the real estate enterprises can make tax plans to reduce tax cost, increase long-term profit, enhance the core competence, and finally contribute to maximizing the value of enterprises.

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Research on the Dynamic Investment Efficiency of Listed Real Estate Enterprises in China

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Abstract

This paper has made valid evaluation of dynamic investment efficiency of 41 listed real estate companies between 2009 and 2013 using DEA-Malmqusit index. The result shows the current investment situation of listed real estate companies of our country is that the investment efficiency of companies is quite different and that the internal dynamic investment efficiency is unsteady and has relatively low efficiency. Positive research shows that dynamic investment efficiency of real estate companies is greatly influenced by technological change; listed real estate companies should formulate reasonable investment mode and management strategy according to their investment scale; improve the investment efficiency for the purpose of effectively promoting technological change so as to realize long-term development.

INTRODUCTION

The real estate industry is the leading industry for national economics which has all-important status in the modern economy life. It hold enormous power over stimulate economic growth, promote all-round social progress, improve land development program and improve the livelihood of the people. It is not only related to urban construction, but also became one of the most principal factors which can promote macroeconomic growth. As the industry progress dominant power, the real estate enterprise should enhance corporate value and meet the market demand in the increasingly competitive environment. The most direct performance of enterprise value manifests as enterprise's investment behavior, and the enterprise investment efficiency is the core philosophy embodiment of measuring enterprise value optimization. In this article, investment efficiency refers to the number of enterprise investment activity result which reflects the proportional relation of investment outcomes and investment expenses. The inefficient investment is in serious trouble in Chinese listed company. It is widely believed that excessive investment behavior is one of the important causes of ineffective investment (Tang and Ma 2007).

In the real estate market, as the enterprise representative of measuring industry comprehensive strength, the investment efficiency of the listed real estate companies related to the enterprise survival and sustainable development, and also affected the industry development trend of the future. At the same time, the real estate enterprise investment is a dynamic operation process and it need to weigh the efficient varying condition in the process of measuring the company's investment efficiency. The micro enterprise investment efficiency also was measured from the perspective of total factor productivity and was believed that the enterprise investment behavior equal to the production behavior of enterprise value (Qin et al. 2009). In view of this, the paper evaluated the dynamic investment efficiency of real estate listed companies in China through constructing DEA-Malmqusit from the perspective of total factor productivity.

DYNAMIC INVESTMENT EFFICIENCY EVALUATION MODEL OF LISTED REAL ESTATE COMPANY

The data envelopment analysis which is based on mathematical programming is suitable for analysis of input and output efficiency in the situation of multiple input and multiple output (Liu and Sun 2006). DEA (Data Envelopment Analysis) was proposed by A.Charnes, W.W.Cooper and E.Rhodes in 1978, which is a relatively effective efficiency evaluation method to evaluate the decision-making unit. The evaluation research of total factor productivity was begun from Malmquist index which is aiming at analysis the efficiency change in different period. The DEA calculation of different period could produce different location frontier production function. It could lead to the situation which a decision-making unit is not in all efficient frontiers and the DEA efficiency value of this period is below the previous calculation period, but the absolute efficiency is significantly higher than last period. DEA-Malmquist index can effectively make up for the defect of DEA model measurement and evaluate the dynamic operation process of enterprise management. Similarly, it can give a further analysis on dynamic investment efficiency condition of the enterprise. Therefore, the article chose DEA-Malmquist index method to evaluate the dynamic investment efficiency of real estate enterprise.

CONSTRUCTION OF INDEX SYSTEM AND SELECTION OF DATA SOURCES

The construction of input and output index system. When using DEA analyzes real estate enterprise investment efficiency, the input and output index should be selected objectively so that achieving the goal of efficiency evaluation. This article adopted Cobb-Douglas product function's definition of input and output and formed input and output index system. For the input and output indexes which were selected in this paper, the further explanation is as follow, listed in Table 1. It is sorted out as follow:

Sample selection and data sources. The article selected A share listed real estate enterprises of Shanghai and Shenzhen stock exchanges, about 132 listed real estate enterprises were found through retrieved real estate industry in net ease financial network stock plates. The initial samples should be screened in order to ensure the efficiency and rationality, and then 41 valid samples which the time series from 2009 to 2013 were screened. The data sources of this paper are come from annual report data of listed real estate enterprises in net ease financial network stock plates and CSMAR financial database.

Table 1.Explanation of Input and Output Indicators.

		Variable Description	Variables Source
Input Indicators	Long-term equity investments	Adopt long-term equity investments as variables	Wang and Yang (2010)
	Fixed assets	Adopt fixed assets as variables	Xu (2010)
	Intangible asset	Adopt intangible asset as variables	Yao et al. (2011)
	Operating cost	Adopt operating cost as variables	Fu (2010)
	Human input	Adopt cash paid to employees as variables	Xu (2010)
Output Indicators	Operating Income	Adopt operating income as variables	Wang and Yang (2010)
	Total Profit	Adopt pre-tax profit as variables	Yuan and Gao (2009)

EMPIRICAL ANALYSIS OF LISTED REAL ESTATE ENTERPRISE DYNAMIC INVESTMENT EFFICIENCY

According to the input oriented DEA-Malmquist index model and the input-output data of 41 listed real estate companies. The calculation of investment Malmquist production index from 2009 to 2013 reflected the changes of investment efficiency among these evaluated companies. The concrete analysis results are shown in Table 2.

Table 2.2009-2013 Investment Efficiency Malmquist Indicators of Listed Real Estate Companies.

Company Name	EFFCH	TECHCH	PECH	SECH	TFPCH
Zhejiang Guangsha	1.005	0.974	0.963	1.044	0.979
Lushang Property	0.984	0.843	1.000	0.984	0.830
Lujiazui	1.000	0.780	1.000	1.000	0.780
Meidu Holding	1.115	0.967	1.078	1.034	1.078
New Huangpu	0.998	1.253	1.000	0.998	1.251
Qixia Construction	0.956	1.001	0.952	1.005	0.957
Suzhou New District Hi-tech Industrial Company	1.004	0.967	0.995	1.009	0.971

Table 2.(Continued).

Company Name	EFFCH	TECHCH	PECH	SECH	TFPCH
ShangHai ShiMao	0.971	0.926	0.992	0.979	0.899
Xinhu Zhongbao	1.037	0.921	0.993	1.045	0.955
CAC Group	0.985	0.999	0.991	0.993	0.983
Songdu Shares	1.049	0.977	1.025	1.024	1.025
Sunshine City	1.000	0.975	1.000	1.000	0.975
Phoenix Shares	1.000	0.710	1.000	1.000	0.710
First Shares	1.030	0.974	1.051	0.981	1.003
Vantone Real Estate	0.990	1.026	1.013	0.977	1.016
Huaxia Xingfu	1.099	0.953	1.000	1.099	1.047
Beijing Urban Construction	0.994	0.976	1.003	0.991	0.970
Catic Real Estate	1.018	0.987	1.024	0.994	1.004
Oceanwide Holding	0.997	0.966	1.003	0.994	0.963
Huayuan Property	1.014	0.957	1.010	1.004	0.970
Cinda Real Estate	0.979	0.990	0.987	0.993	0.969
Bright China Group	0.917	0.995	0.997	0.920	0.912
Rhein Property	1.021	0.870	1.007	1.014	0.888
Million City Investment	0.948	0.994	0.953	0.994	0.942
East Lake High-tech	1.111	0.951	1.064	1.044	1.057
Fuxing Shares	1.038	0.991	1.038	1.001	1.029
Shenshenfang A	1.076	0.973	1.070	1.006	1.047
Jinke Shares	1.182	0.768	0.964	1.226	0.908
Poly Real Estate	1.000	0.915	1.000	1.000	0.915
Vanke A	1.022	0.978	1.000	1.022	1.000
China Merchants Property	0.989	0.699	1.000	0.989	0.691
Gemdale Group	0.985	0.860	1.000	0.985	0.847
Pearl Industrial Development Company	1.043	1.059	1.004	1.039	1.105
Yatai Industrial Development Company	1.305	0.939	1.000	1.305	1.225
Chongqing Development	0.985	0.955	1.025	0.962	0.941
Rise Sun Real Estate Development	1.000	0.913	1.000	1.000	0.913
Financial Street	1.055	0.982	1.008	1.047	1.037
Guangyu Development	1.000	1.635	1.000	1.000	1.635
Zhongfang Real Estate	0.978	0.922	1.000	0.978	0.902
Rongan Property	1.000	0.708	1.000	1.000	0.708
Huafa Industrial Shares	0.966	0.751	0.968	0.998	0.725
Industry Avarage	1.019	0.940	1.004	1.015	0.958

NOTE: TFPCH: Total factor productivity; EFFCH: Technical efficiency indicator; TECHCH: Technical change; PECH: Pure efficiency change; SECH: Scale efficiency change; FPCH = EFFCH×TECHCH, EFFCH = PECH×SECH.

Different company investment TFP indicators and situation analysis. (1) Analysis of total factor productivity. From the year of 2009 to 2013, the average investment efficiency of Chinese listed real estate companies is still far lower than optimal state (TFP = 1). TFP indicator is 0.958, decreasing by 4.2% on average over the past five years. On account of the varied investment and management conditions and the difference of capital operation scale and technique using status, the difference of the efficiency among the evaluated enterprises are obviously. Among them, the highest TFP productivity index is Guangyu Development (TFP = 1.635) and the lowest one is China Merchants Property（TFP = 0.691）. Through comparison and analysis of the two companies productivity decomposing index, the productivity differences is mainly caused by technical change indicator. The TECHCH of China Merchants Property is 0.699 and Guangyu Development is 1.635, the gap between them is close to 1, it means that the effective use of technical change can directly affect the investment efficiency of enterprise to some extent. From the perspective of industry average, the technical efficiency indicator of real estate enterprise is 1.019 and the average rate of climb is 1.9%. It shows that the real estate enterprise have promoted enterprise internal management and investment management and enhanced investment capital and technique using efficiency for five consecutive years. But the mean value of technical change indicator is only 0.940, decreasing by 6% on average. Because the difference of management system and operating scale, the ability of promoting technology innovation and putting into use also exist differences. There are only five enterprises which the technical change indicator is greater than 1in five years. It is obviously less than half of sample size. The weakness of technical change directly pulls down the investment productivity index. Therefore promoting the technical change indicator of internal industry, pulling investment efficiency and promoting industry steady development should be taken into primary consideration.

(2) Analysis of technological efficiency index. Between 2009 and 2013, the average value of technological efficiency of listed real estate companies is 1.019, increasing by 1.9 % on average. Technological efficiency index can be further decomposed into pure efficiency index and scale efficiency index. Pure efficiency index is the efficiency measure that real estate companies make to investment conditions of corporate investment by current resources and technological methods; scale efficiency index shows the scale amount measure that real estate companies make to investment elements condition. It can be seen from Figure 2 that companies whose pure efficiency index is below 1 should further promote management level and strengthen technological investment, such as Zhejiang Guangsha, Xixia Construction, Suzhou High-tech and Xinhu Zhongbao etc. Companies whose scale efficiency index is below 1 should improve the scale condition of investment element so as to further improve the total efficiency of investment, such as Lushang Property, New Huangpu, Beijing Capital Development Co., Ltd, and Beijing Vantone Real Estate Co., Ltd etc. When pure efficiency index and scale efficiency index are below 1, enterprises should make effective adjustment of its production and technology level and management ability; meanwhile, they should control the scale usage of

these investment elements and constantly improve investment competitiveness, such as Shanghai Shimao Co., Ltd., Thaihot Group Co., Ltd, China Real Estate Co., Ltd. and Jilin Guanghua Holding Group Co., Ltd.

(3) Analysis of technological change. The average value of technological change between 2009 and 2013 is 0.940; through analysis of Table 2, it can be seen that one important factor that influences TEP index of corporate investment is the technological change of real estate companies. A new technology or new management idea may be more effective than purely promoting current management level and production technology. Technology change can directly promote investment efficiency of real estate companies. In these five years, investment TEP index of listed companies have not reached the optimum state, which is only 0.958, greatly affected by technological change. Through comparison between sample companies, it can also be seen that the differences of technological changes are apparent. Therefore, each real estate company should positively inspect external environment and their conditions, strengthen innovation of investment and profit-making mode, promote innovation of production and management technology and make effective control and risk control of investment scale so as to promote efficiency of technological change and increase investment efficiency of real estate companies.

Analysis of company investment TFP indicators of different annual category. From the perspective of annual category, analyze investment efficiency change of sample companies between 2009 and 2013, in which dynamic change tendency of investment efficiency of each year can be found. Detail is shown in Figure 1 and Table 3.

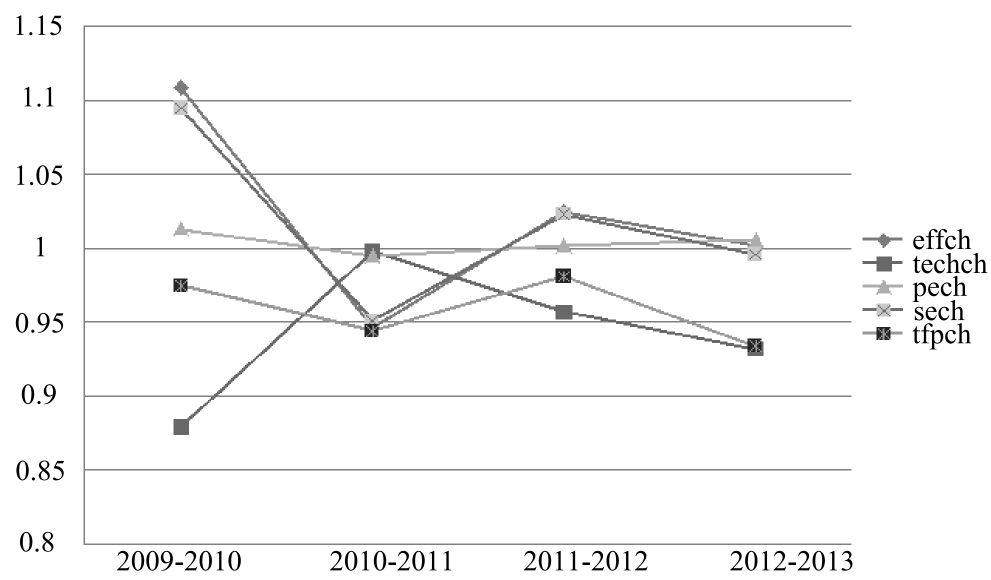

Figure 1.Malmquist index trend chart of real estate state enterprises.

Seen from each year, although the total factor productivity of four annul company investment does not reach the optimum state, all below 1, yet productivity still fluctuates among the years. TEP index is relatively high from 2009 to 2010 and 2011 to 2012, reaching 0.975 and 0.981 respectively; TEP index has reduced from 2010 to 2011 and 2012 to 2013, reaching 0.944 and 0.934 respectively, which shows that there is apparent fluctuation of investment efficiency in listed real estate companies in the four years and its investment condition is not very steady.

Table 3.Annual Investment Productivity Changes from 2009 to 2013.

Year	Effch	Techch	Pech	Sech	Tfpch
2009-2010	1.109	0.879	1.013	1.095	0.975
2010-2011	0.946	0.998	0.995	0.951	0.944
2011-2012	1.025	0.957	1.002	1.023	0.981
2012-2013	1.002	0.932	1.006	0.996	0.934
Mean value	1.019	0.940	1.004	1.015	0.958

Scale efficiency is above 1 from 2009 to 2010, 2011 to 2012 and 2012 to 2013, which makes some contributions to increase of total factor productivity. However, total factor productivity from 2012 to 2013 is 0.934, the lowest in the four years. The main reason is due to the low technology change index; although real estate companies have increased scale efficiency and promoted management level and production technology, yet the reduction of technological change still lowers the total investment efficiency.

It can be seen that TEP index of real estate company investment has positive correlation with technological change index. Real Estate companies can promote investment efficiency through promoting scales, improving internal management, strengthening organizing and managing ability and promoting technology. But with the constant development of the industry and the constant change of environments, only by improving technological innovation and realizing total innovation of real state production technology and management idea can the investment efficiency of real estate companies be improved.

CONCLUSION

This paper has made valid evaluation of dynamic investment efficiency of 41 listed real estate companies between 2009 and 2013 using DEA-Malmqusit index. The conclusions are as follows:

The market amount of capital invested in real estate industry of our country is increasing year by year; however, efficiency of external investment of listed real estate companies is insufficient. The average investment dynamic efficiency between 2009 and 2013 is 0.958; it drops 4.5% on average between the five years, which shows that the external market investment is popular and investment efficiency difference of each enterprise is apparent. The reason of insufficient dynamic investment efficiency may be that in recent years, our country has increased control of real estate market and credit grades also tighten real estate investment; real estate companies adopt different investment mode because of company scale, cash flow situation, volume period of project development and corporate management, which caused the situation that the dynamic investment efficiency is relatively low and unsteady.

It has evaluated dynamic investment efficiency of listed real state from the perspective of all-details productivity in terms of corporate category and time sequence; dynamic efficiency of corporate investment is affected by technological efficiency index and technological change, in which technological change index is the key to further promote dynamic investment efficiency of real state enterprises. Therefore listed real estate companies should formulate reasonable investment mode and management strategy according to their investment scale; improve the investment efficiency for the purpose of effectively promoting technological change so as to realize long-term development.

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The Relationship between Executive Compensation and the Performance of Listed Real Estate Corporations

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Abstract

As the real estate industry becomes a pillar industry of China, its executive compensation has received widespread attention. To study the relationship between executive compensation and the performance of real estate corporations, this paper reviewed the studies of national and foreign scholars, and proposed three hypotheses around this issue. This paper selected the financial data of 122 listed real estate corporations, in Shanghai and Shenzhen Stock Exchange A-share markets, from the year 2011 to 2013, and did the regression analysis by STATA. The research suggested that executive cash compensation had a positive correlation with corporate performance, but there was no significant correlation between the proportion of executive shareholding and corporate performance. Neither did the research suggest that there is any interval effect in proportion of executive shareholding and corporate performance. In view of the above, this paper proposed some corresponding recommendations to improve executive compensation incentive mechanism of listed real estate corporations.

INTRODUCTION

With the rapid development of China's market economy, executive salary incentive mechanism of listed corporation becomes a hot issue, which is caused by the separation of ownership and operation. The asymmetry of information between the principal and the agent leads to adverse selection and moral hazard. It has aroused widespread concern that how to satisfy the executive's own interests and maximize the value of corporation at the same time. The key to solve this problem lies in designing reasonable and effective salary incentive mechanism. Compared with the other industries, there is a wider gap of compensation in real estate industry. Therefore, this paper analyzes the relationship between executive compensation and the performance of listed real estate corporations, and provides suggestions for designing reasonable and effective salary incentive mechanism in real estate industry.

LITERATURE REVIEW

Taussig and Barker (1925) firstly hypothesized that executive compensation was likely to affect corporate performance. Through the study they found that there was a weak relationship between executive compensation and corporate performance. Jensen and Meckling (1976) firstly proposed the agency cost theory. The theory suggested that the agency cost should be reduced as the managerial ownership increased. The targets of the principal and the agent should become uniform with increasing of managerial ownership. Murphy (1985) collected data of 73 listed manufacturing companies from 1964 to 1981, and chose sales revenue and shareholder returns to represent corporate performance. The empirical study indicated that there was a significant positive correlation between the proportion of executive shareholding and corporate performance. Matthews (2006) used accounting income and market performance to represent corporate performance respectively for analysis. This conclusion showed that accounting income correlated significantly with executive compensation. Giorgio and Arman (2008) found that there was a strong correlation between executive compensation and corporate performance, by using panel data of American 'New Economy' firms from 1996 to 2002. Sigler (2011) selected the data of 280 companies listed on the New York Stock Exchange from 2006 to 2009. This study concluded that return on equity was significantly and positively correlated with executive compensation.

Wei (2000) took 813 A-share listed corporations as samples to make analysis. His research indicated that the average annual cash compensation of executive was low, and the compensation structure was irrational. There was no significantly correlation between executive annual cash compensation and corporate performance. Yang et al. (2007) took 963 corporations which were listed in Shenzhen Stock Exchange A-share markets before the year 2003 as samples. Using panel data from 2000 to 2002, this paper studied the impact of corporate governance on corporate performance. The result indicated that the executive compensation had no significant effect on corporate performance. Li and Liang (2010) selected all corporations from Shanghai and Shenzhen Stock Exchange A-share markets as samples. Their study didn't find any strong relationship between corporate governance and executive compensation. The reason was considered to be the low shareholding ratio. Gao and Dai (2011) made analysis on corporate performance and executive compensation according to different corporate types. In private corporations, there wasn't any strong correlation between corporate performance and executive compensation. However, in state-owned corporation, there was a strongly positive correlation between them. Liu and Wan (2013) analyzed the relationship between executive compensation and corporation performance in different corporate ownership structure. Their study arrived at a conclusion that in private listed corporate, when the executive shareholding increased, the effect of executive compensation on corporate performance would increase, but state-owned listed corporation was contrast.

By reviewing relative literature about the relationship between executive compensation and corporate performance, we can find that as different factors are considered, there is no general agreement about this question. There are still some limitations in current researches, since there are few studies about this question according to specific industries. The real estate industry as a pillar industry of China is gradually concerned by community, especially its corporate governance. Therefore, this paper will study the real estate corporations specifically, to find the relationship between executive compensation and corporate performance.

HYPOTHESIS

Hypothesis 1. There is a positive correlation between executive cash compensation and corporate performance.

According to principal agent theory (Jensen and Meckling 1976), the principal should sign compensation-performance contract with the agent in order to reduce the moral risk which caused by the asymmetry of information. Executive compensation is based on corporate performance according to compensation performance contract. This contract pushes the executives to improve the efficiency and the achievements of their corporations. As a result, this paper assumes that there is a significantly positive correlation between executive cash compensation and corporate performance.

Hypothesis 2. There is a positive correlation between proportion of executive shareholding and corporate performance.

According to agency cost theory (Jensen and Meckling 1976), the agent is likely to be risk-averse, and the principal tends to be risk-neutral. If the agent holds the stocks, equivalent to residual claims, the interests of the agent and the principal's will be aligned. It motivates the agent more effectively producing value for the corporation. Due to the effect of residual claims, the more stocks the agents hold, the better the corporate performance. Therefore, this paper puts forward the hypothesis that there is a significantly positive correlation between proportion of executive shareholding and corporate performance.

Hypothesis 3. There is interval effect in proportion of executive shareholding and corporate performance.

The more corporate stock executives hold, the more tightly their interests are linked to the corporate performance. So we suppose that when the executives hold big chunks of their corporate stock, there will be a more obvious correlation between proportion of executive shareholding and corporate performance. So this paper puts forward the hypothesis that there is interval effect in proportion of executive shareholding and corporate performance.

SAMPLE AND MODEL

Sample selection. This paper chooses all the listed real estate corporations from Shanghai and Shenzhen Stock Exchange A-share markets from 2011 to 2013 as the research samples. The data for this research come from GSMAR database, RESSET database. Data analysis is performed by STATA and EXCEL software. The principles of selecting sample are set as follows:

(1) Excluding Special Treatment (ST) listed corporations.

(2) Excluding the corporations of which data is incomplete.

Eventually we select 122 corporations as samples based on the conditions above.

Variable selection. (1) Dependent variables. This paper studies the relationship between executive compensation and corporate performance, so the corporate performance is regarded as independent variables. There are three evaluation methods of corporate performance, including Tobin's Q value, economic value added (EVA), and finance index method. Different evaluation methods have different influences on empirical results. Tobin's Q and EVA both rely on efficient stock markets. However, considering the weak effectiveness of Chinese stock markets, these two evaluation methods both have a few limitations. Finance index method, by contrast, has wide application scope. We chose return on equity (ROE), the most frequently used finance index in former researches, to value the corporate performance.

(2) Independent variables. In a broad sense, executive compensation includes cash compensation and stock compensation. This paper considers annual total compensation (AC) of top three paid executives as the value of cash compensation. We use the natural logarithm of AC to eliminate the heterogeneity. In addition, the proportion of executive shareholding (ESP) represents stock compensation.

(3) Control variables. Since corporate performance is affected by various factors, this paper includes the corporate size, ownership concentration, liabilities degree, proportion of independent directors, and regional economic situation as control variables in the model (see Table 1).

Table 1.Variable Definition.

Variable nature	Variable name	Variable abbreviations	Variable definitions
Dependent variables	Return on equity	ROE	Net profit / Average Equity
Independent variables	The proportion of executive shareholding	ESP	Corporate shares held by executives / The corporate total share capital
	Annual total cash compensation	LNAC	Natural logarithm of annual total compensation of top3 paid executives
Control variables	Corporate size	SIZE	Natural logarithm of the corporate total assets
	Ownership concentration	OC	Corporate shares held by the first largest shareholder / The corporate total share capital
	Liabilities degree	ALR	Assets-liability ratio
	Proportion of independent directors	ID	Independent directors/All directors
	Regional economic situation	GDP	Natural logarithm of the per capita GDP in the location

Model design. According to the hypothesis previous, we employ the following regression models to investigate the effects of executive compensation on corporate performance.

$$\begin{cases} ROE_{it} = a_i + b_1 ESP_{it} + b_3 SIZE_{it} + b_4 OC_{it} + b_5 ALR_{it} + b_6 ID_{it} + b_7 GDP_{it} + u_{it} \\ i = 1, 2......122; t = 2011, 2012, 2013 \end{cases} \quad (1)$$

$$\begin{cases} ROE_{it} = a_i + b_1 LNAC_{it} + b_2 SIZE_{it} + b_3 OC_{it} + b_4 ALR_{it} + b_5 ID_{it} + b_6 GDP_{it} + u_{it} \\ i = 1, 2......122; t = 2011, 2012, 2013 \end{cases} \quad (2)$$

ROE_{it} represents the value of ROE in cross-section i at time t, and ESP_{it} represents the value of ESP in cross-section i at time t, and so on. a_i represents the constant term, and u_{it} represents random disturbance.

DESCRIPTIVE STATISTICS ANALYSIS

Table 2 presents the descriptive statistics for corporate performance and executive compensation. The minimum value of return on equity (ROE) is -26.51%, the maximum value reached 111.68%, and the mean value is 10.04%. The listed real estate corporations have strong profitability. The minimum value of the proportion of executive shareholding (ESP) is 0, the maximum value is 56.61%, and the mean value is 2.16%. The minimum value of top3 paid executives annual total compensation (AC) is 0.196 million yuan, the maximum value is 38 million yuan, and the mean value is 3.121 million yuan. It indicates the significant differences among the 122 corporations. See Figure 1, there are 86 corporations of which top3 paid executives' annual total compensation is between 1 million to 5 million yuan, about 70% of the total corporation. Only 5 corporations have more than 10 million yuan compensation, about 4% of total.

Table 2.Descriptive Statistics Analysis of Parts of Variable.

Variable	Minimum	Maximum	Mean	Standard deviation
ROE	-26.51%	111.68%	10.04%	10.22%
ESP	0.00%	56.61%	2.16%	8.68%
AC	196,000	38,000,000	3,121,038	3,642,336

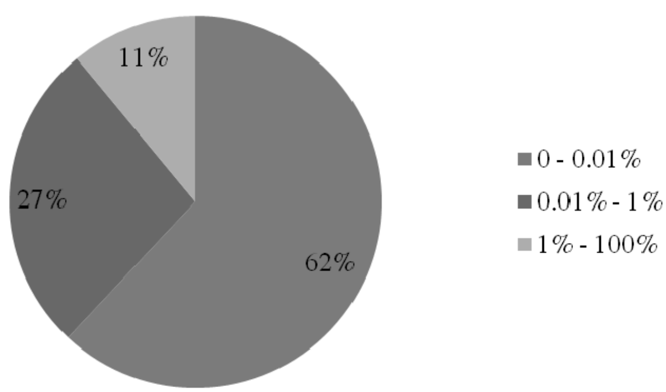

Figure 1.Total cash compensation of top3 paid executives.

See Figure 2, there are 76 corporations' executive shareholding's proportions below 0.01%, about 62% of the total corporations. Only 13 corporations' executive shareholding proportions are above 1%, about 11% of total. These data suggest that the phenomenon of executive shareholding isn't widespread in the listed real estate industry.

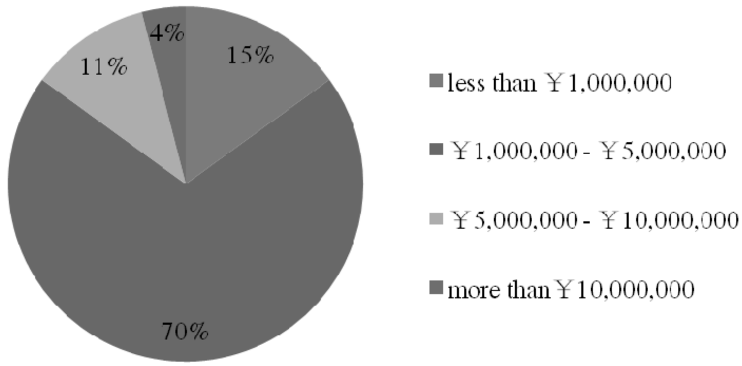

Figure 2.The proportion of executive shareholding.

REGRESSION ANALYSIS

Regression test on model (1). See Table 3, Model (1) was approved by significance test (F = 5.01, Sig. = 0.000). All the factors passed the significance test except ID (t = -1.330, Sig. = 0.186). As LNAC passed T test (t = 2.280, Sig. = 0.023) obviously, there was a significant correlation between ROE and LNAC, that was, the corporate performance was positively relevant to the executive cash compensation. Annual salary compensation as a short-term incentive can stimulate the executive a lot of effort effectively. So it proved that the hypothesis 1 was tenable.

Table 3.Regression Results of Model (1).

Variables	Unstandardized coefficients	Standardized coefficients	t	Sig.
Constant	-0.089	0.512	-0.170	0.862
LNAC	0.038	0.017	2.280	0.023
SIZE	0.130	0.020	6.350	0.000
OC	0.387	0.101	3.850	0.000
ALR	-0.482	0.059	-8.170	0.000
ID	0.212	0.160	1.330	0.186
GDP	-0.292	0.059	-4.980	0.000
Model	R^2=0.3094	F=5.01	Sig.=0.000	

Regression test on model (2). See Table 4, Model (2) was approved by significance test (F = 5.06, Sig. = 0.000). All the factors passed the significance test except ESP (t = -1.320, Sig. = 0.188) and ID (t = 1.380, Sig. = 0.168). According to the result, there was no obvious correlation between ROE and ESP. In other words, the performance was not relevant to the proportion of executive shareholding. As an important method to long-term incentive, the executive shareholding was more concerned by theory field. However, the result indicated that the executive shareholding doesn't appear to motivate executives enough. So hypothesis 2 didn't really stand up to the regression test.

Table 4.Regression Results of Model 2 ESP∈[0, 100%).

Variables	Unstandardized coefficients	Standardized coefficients	t	Sig.
Constant	-0.185	0.517	-0.360	0.721
ESP	-0.231	0.175	-1.320	0.188
SIZE	0.134	0.021	6.520	0.000
OC	0.417	0.102	4.080	0.000
ALR	-0.477	0.059	-8.020	0.000
ID	0.223	0.161	1.380	0.168
GDP	-0.244	0.055	-4.400	0.000
Model	R^2=0.2995	F=5.06	Sig.=0.000	

To confirm hypothesis 3, Table 5, Table 6 and Table 7showed the regression results of Model (2) when the proportion of executive shareholding (ESP) was in different range. In Table5, the proportion of executive shareholding (ESP) was from 0 to 0.01% (not including 0.01%), and there were 288 samples in this regression test. The result showed no obvious correlation between ESP and ROE.

Table 5.Regression Results of Model (2) ESP∈[0, 0.01%].

Variables	Unstandardized coefficients	Standardized coefficients	t	Sig.
Constant	0.610	0.575	1.06	0.290
ESP	2.668	3.978	0.67	0.503
SIZE	0.031	0.025	1.22	0.223
OC	0.382	0.116	3.28	0.001
ALR	-0.141	0.076	-1.86	0.064
ID	0.156	0.193	0.81	0.419
GDP	-0.121	0.058	-2.11	0.036
Model	R^2=0.1159	F=4.45	Sig.=0.000	

In Table 6, the proportion of executive shareholding (ESP) was from 0.01% to 1% (not including 1%), and there were 99 samples in this regression test. The result was that ESP (t = 0.31, Sig. = 0.755) didn't passed the significance test.

Table 6.Regression Results of Model (2) ESP∈[0.01%, 1%).

Variables	Unstandardized coefficients	Standardized coefficients	t	Sig.
Constant	-0.302	1.231	-0.25	0.807
ESP	1.704	5.444	0.31	0.755
SIZE	0.224	0.048	4.72	0.000
OC	0.313	0.448	0.70	0.488
ALR	-0.726	0.115	-6.29	0.000
ID	0.324	0.290	1.12	0.269
GDP	-0.405	0.138	-2.93	0.005
Model	R^2=0.5756	F=7.64	Sig.=0.000	

In Table 7, the proportion of executive shareholding (ESP) was from 1% to 100%, and there were only 39 samples in this regression test. The result was that ESP (t = -1.56, Sig. = 0.135) didn't passed the significance test.

Table 7.Regression Results of Model (2) ESP∈[1%, 100%].

Variables	Unstandardized coefficients	Standardized coefficients	t	Sig.
Constant	1.229	1.239	0.99	0.333
ESP	-0.239	0.154	-1.56	0.135
SIZE	-0.131	0.088	-1.49	0.153
OC	0.714	0.196	3.64	0.002
ALR	0.036	0.308	0.12	0.907
ID	0.866	0.562	1.54	0.139
GDP	0.125	0.196	0.64	0.532
Model	R^2=0.5183	F=3.43	Sig.=0.0073	

Based on the analyzed results of Table 5, Table 6 and Table 7, we arrived at a conclusion that there was no indication of interval effect in proportion of executive shareholding and corporate performance. In other words, the hypothesis 3 was invalid. Meanwhile at the same time, we could find that there were only 39 samples (13 corporations, from the year 2011 to 2013), of which ESP was greater than or equal to 1%. It was obvious that executive stock-holding was not very general in the listed real estate corporations

CONCLUSIONS

Through the use of panel data of 122 listed real estate corporations from 2011 to 2013, the paper concludes that when the listed real estate corporation performance is represented by ROE, there is a significant and positive correlation between executive cash compensation and corporation performance. It proves that the hypothesis1 is tenable. Annual salary compensation as a short-term incentive system can stimulate the executives' enthusiasm and efforts, and it is conducive to improving the corporation performance. However, neither hypothesis 2 nor hypothesis 3 is substantiated. There is no significant correlation or interval effect between proportion of executive shareholding and corporation performance. Although executive stock option has strong incentive effects in theory, it can hardly arrive at the expected incentive purpose. The reason could be that the proportion of executive shareholding in the listed real estate corporations is too low to get the interests together between the shareholders and executives.

RECOMMENDATIONS

Based on the conclusions above, there are some recommendations as follows. Because the current proportion of executive shareholding in the listed real estate corporations is low, the interests of shareholders and executives can't get together substantially. In all corporations we take as samples, only 27 of them have more than

0.1% proportion of executive shareholding. Even 43 corporations' executives have no stock of their own corporations. If the proportion of executive shareholding reaches a reasonable level, it may provide more incentive on executives. Besides, during analysis, we find that the executives' pay gaps in the listed real estate corporations are high, and the maximum is more than 10 times as the minimum. If the executives feel underpaid, they may lose enthusiasm for their work. As lacking of interests, rent-seeking behavior may be produced in the process of searching for personal interests. "Grey Income" will increase the administrative cost and especially damage for the corporation. Therefore, it is necessary to balance the executive cash compensation in the listed real estate corporations.

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Research on the Safety Performance Mechanism of Construction Companies

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Abstract

There is a sign that the way of advancing the safety management system to improve the security is facing with the further developing difficult. As Chinese construction industry is still labor-intensive, the “person” is a special as well as key factor in the whole process. In this paper, scales about safety culture, safety motivation and safety performance are established on survey data analysis. The structure model of safety performance is created by combining the safety performance model with self-determination theory, and the relationship between the three dimensions of safety culture is verified by using path analysis. The results showed that the three dimensions of safety culture are significantly related; Safety motivation plays a fully mediating role between safety culture and safety performance behavior; the relationship between the self safety motivation and safety performance behavior is closer than control safety motivation. The empirical result also provides some policy implication for improving the construction safety performance.

INTRODUCTION

With the rapid development of construction in China, the high accident mortality rate in this industry is gaining more attention (Xie 2003). Effective measures to improve the level of safety performance of the construction site must be taken. However, it is difficult to improve the development of safety performance by improving the safety management system (Reason 2000). Haslam’s research shows that 70% of accidents involving human factors. And the safety motivation of people has a great impact on safety performance (Haslam et al. 2005). The intervention of safety motivation plays a significant role in increasing security and reducing accidents (Ford and Tetrick 2008). Staff’s behavior is largely affected by the company. Plus, the construction and organization of the safety culture also have great influence on safety motivation, consequently, affecting the safety performance. The paper first analyzes how the safety cultures and safety motivation affect the safety performance, and then builds up the safety performance model, discusses main human factors which affect the safety performance, finally brings forth some suggestions from the perspective of the motivation of self-determination theory.

EMPIRICAL ANALYSIS OF FACTOR OF SAFETY PERFORMANCE

Overview of surveyed employees. This research totally hands out 300 questionnaires. After excluding unrecovered and invalid questionnaire, we get 238 valid questionnaires, which could meet the requirements of the model. The result reflects that the majority of the sampling companies are male. Most of the laborers have worked for 5 years. The paper intends to investigate safety behaviors of relevant employees directly related to construction behaviors, therefore the selected objects are most frontier workers with a part of managers and supervisors. The selected laborers are most from the sub unit with education background lower than junior school.

Exploratory factor analysis. By using SPSS20.0, the paper performs the analysis using principal components analysis and varimax rotation. Generally, consistency of factors should be greater than 0.7. In this paper; value of KMO is 0.898, which could meet the requirement of factor analysis.

Factor analysis output results are shown as below: First factor is Material cultures, 5 questions in total, of which the percent variance is12.989%. Second factor is Institutional cultures, 4 questions in total, of which the percent variance is9.585%. Third factor is safety participation, of which the percent variance is9.085%. Fourth factor is spontaneous safety motivation, 5 questions in total, of which the percent variance is8.7%. Fifth factor is safety compliance, 4 questions in all, of which the percent variance is8.676%. Sixth factor is controlled safety motivation, 4 questions in total, of which the percent variance is6.754%. Seventh factor is Ideational cultures, 4 questions in all, of which the percent variance is6.224%.

Scale's reliability test. Cronbach's alpha is generally considered acceptable between 0.6 and 0.8; If Cronbach's $\alpha < 0.60$, we should consider designing the scale again. If CITC is greater than 0.3 and Cronbach's α if Item Deleted doesn't increase significantly, the measurement index for reliability measure corresponding factor is acceptable (Wu 2003; Cuieford 1965).

By using SPSS 20.0, we find that all the indexes of reliability are close to or more than 0.70, which indicates that these scales have good internal consistency.

As value of CITC in every item is all greater than 0.3, and Cronbach's α if Item Deleted all smaller than its Cronbach's α, we could think these questionnaires have good inner consistency.

Validity test. For construct-related validity, the paper, by using AMOS18.0 and adopting the structure equation model when testing the model, and discuss whether the factor measuring model of the scale accords with the data collected and whether the indicator variables can be regard as measured variables of factor construct effectively by confirmatory factor analysis. During the process of testing the theoretical model, two basic assumptions should be followed (Wu 2003): Measurement of indicators in the measurement model of the measurement error term path coefficient slated for 1 (It can also be changed to define the error variance is equal to 1); The path coefficient in measurement model must have an index variable slated for 1 (Result T is not displayed), Thus we establish the initial measurement model, as is shown in Figure 1:

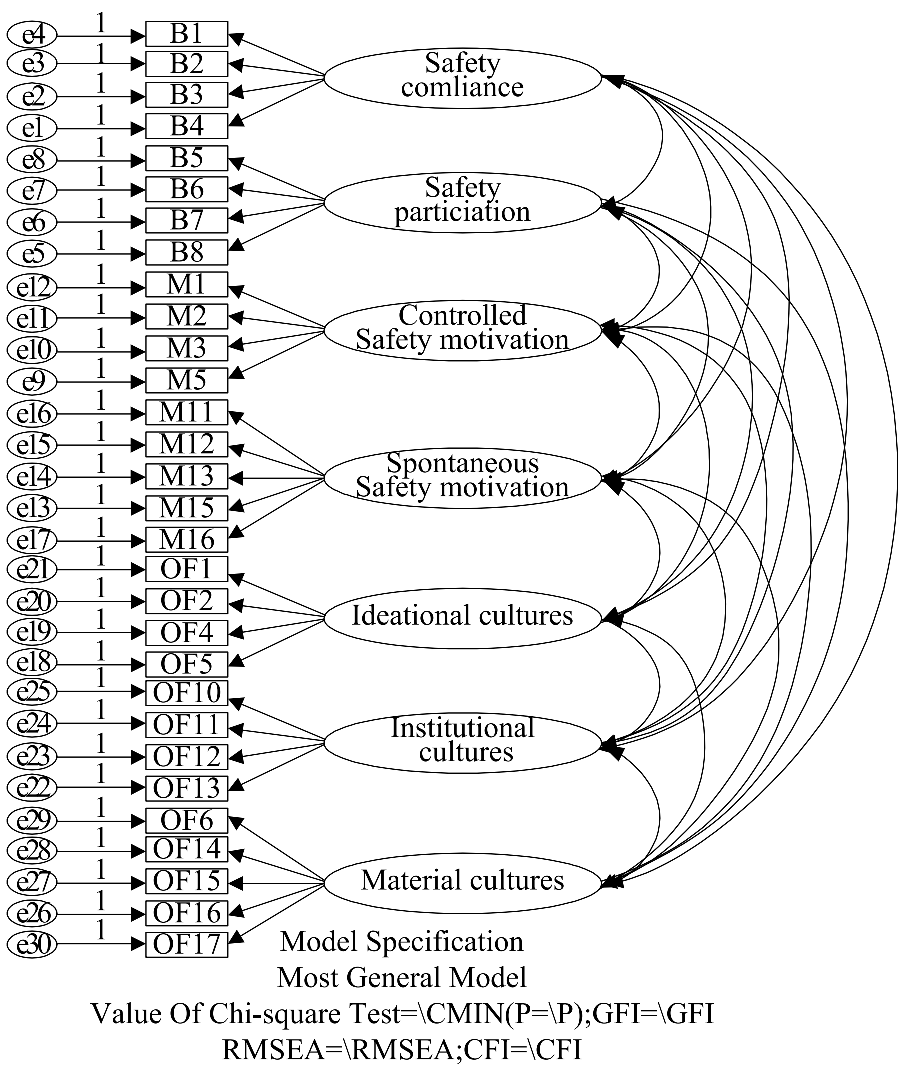


Figure 1.Initial measure model.

Fit of model can reflect the consistency. Donald and Canter (1994) indicated that we could consider three aspects: basic adaptation indicators, overall fit index, and inner model structure fit index.

(1) Preliminary fit criteria. Bogozzi and Yi (1998) proposed the following guidelines about preliminary fit criteria: Factor loadings between latent variable and its measurement index values prefer 0.50 to 0.95; there cannot be negative

value variances; criteriaized coefficients cannot exceeding of very close to 1.0; cannot exist great criteria error.

The analysis demonstrates that factor loadings are between 0.411 and 0.857. Furthermore, all correlation is significant at the 0.001 level; there is no negative error variance in evaluate and all criteria errors are small, which could show that overall fit of this model is good; indicator variables can effectively reflect the constructs traits that need measuring.

(2) Overall model fit. According to Structural Equation Modeling Theory (Schumacker and Lomax 1996), test of overall model fit is to check external quality of model, which can be divided into three categories: absolute fit measures, comparative measures and parsimonious fit measures. With reference to a recognized criterion, in this study, the indexes are: x^2/df, RMSEA, GFI, AGFI, CFI, NFI, IFI, PGFI and PNFI. The paper adopts maximum likelihood method to conduct the confirmatory factors analysis.

The result shows that most of the fit index can meet the requirements; and effect of overall model fit very well. Almost all the adaption index could meet acceptable criteria of this model. We could get the conclusion that the model could tally with the data well.

(3) Fit of internal structure of model. Bogozzi and Yi (1998) give suggestions of three commonly used indexes on rule of fit of internal structure of model. They are shown as follows: Individual item reliability should over 0.5, composition reliability should over 0.6, and the estimated value of all parametric statistics should achieve significant level. The results are shown in Table 1.

Table 1.The Summary Table of the Inner Quality Testament of the Confirmatory Factors Analysis.

Evaluation Project	Criterion	Model adaptation judgment
The estimated value of all parametric statistics achieve significant level	$\lvert t \rvert > 1.96$	Yes
Individual item reliability over 0.5	$R^2 > 0.50$	Yes
composition reliability over 0.6	$P_v > 0.60$	$P_v = 0.927$, yes

SET UP MODEL OF SAFETY PERFORMANCE

Correlation analysis. Through analyzing the data bilaterally about their correlation to test the relationship between these variables by SPSS20.0, we could conclude that there are significant correlations between variables in the questionnaire, which meet the demands of structural equation model.

The conclusions we get from the correlation analysis are shown as follows:

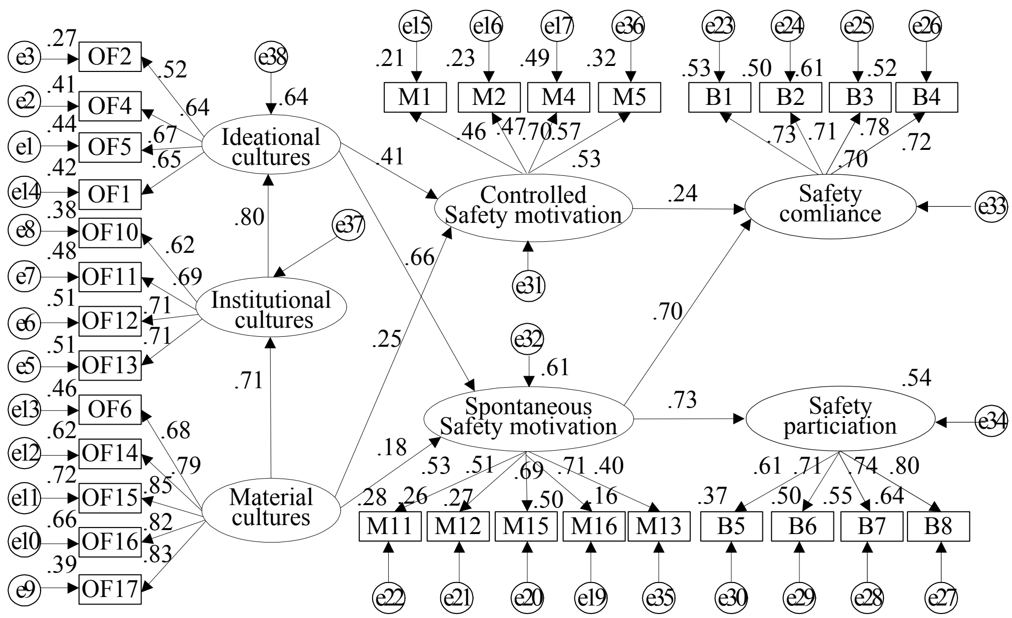
(1) For organizational factors, Ideational cultures get the lowest score, which imply that managers don't give production safety enough attention. However, contrary to Ideational culture, institutional cultures get a high score for the reason that the laws and regulations promulgated by China matter the constraints to construction enterprise security.

(2) The score of spontaneous safety motivation (3.86) is higher than that of

the controlled safety motivation (3.393). Although workers seemingly can get strong security, in fact, they give up aside by safety behaviors because of objective reasons.

(3) The score of Safety compliance (4.118) is higher than the score of Safety participation (3.134), which demonstrates that managers pay inadequate attention to Safety participation, and employees also have low enthusiasm on joining in safety managing voluntarily.

Testing structure model. After ensuring the measurement model is credible, this concept model is established, as Figure 2 shows:



Standardized estimates
Default Model
Value Of Chi-square Test=620.667(P=.000);GFI=858
RMSEA=.049;AGFI=.832;CFI=.918

Figure 2.Safety performance concept model.

The testing result of the indicators in this model result and criteria or thresholds adaptation is shown as Table 2.

Table 2.Overall Fit of Confirmatory Factor Analysis.

Statistics	Criteria or the critical value	Observations	Model adaptation judgment
x^2 / df	1~3	1.579	Yes
Value of RMSEA	<0.08 (<0.05 is better)	0.049	Yes
Value of GFI	≧0.85	0.858	Yes
Value of AGFI	≧0.85	0.832	Yes
Value of NFI	>0.90	0.808	No
Value of IFI	>0.90	0.920	Yes

Table 2.(Continued).

Statistics	Criteria or the critical value	Observations	Model adaptation judgment
Value of CFI	>0.90	0.918	Yes
Value of PGFI	>0.50	0.725	Yes
Value of PNFI	>0.50	0.730	Yes

Using Maximum Likelihood Estimation to evaluate path coefficient between these factors, we could get results as Table 3 shows.

Table 3.Coefficient of Path.

Final fix index of model			Non-standardized estimates	Standardized estimates	S.E.	C.R.	P
Institutional cultures	<--	Material cultures	0.797	0.712	0.108	7.348	***
Ideational cultures	<--	Institutional cultures	0.743	0.803	0.097	7.689	***
Spontaneous safety motivation	<--	Ideational cultures	0.697	0.662	0.126	5.521	***
Controlled safety motivation	<--	Ideational cultures	0.280	0.406	0.090	3.089	0.002
Controlled safety motivation	<--	Material cultures	0.176	0.247	0.085	2.079	0.038
Spontaneous safety motivation	<--	Material cultures	0.196	0.180	0.099	1.979	0.048
Safety compliance	<--	Controlled safety motivation	0.422	0.241	0.157	2.683	0.007
Safety compliance	<--	Spontaneous safety motivation	0.802	0.700	0.117	6.854	***
Safety participation	<--	Spontaneous safety motivation	1.138	0.734	0.134	8.495	***

CONCLUSIONS AND SUGGESTIONS

Conclusions. We get the following conclusions through analyzing the data we get from documents and Semi-structured interviews among 8 construction sites in Anhui, Shenzhen and Hubei by SPSS20.0 and AMOS18.0.

(1) Ideational cultures have a positive influence on Spontaneous safety motivation and Controlled safety motivation, especially spontaneous safety motivation;

(2) Material cultures have positively influence on controlled safety motivation and spontaneous safety motivation;

(3) Institutional cultures have indirect influence on controlled safety motivation and spontaneous safety motivation through Material cultures;

(4) As a decisive factor of safety performance, safety motivation can influence the workers' safety complying behaviors directly. Controlled safety motivation does not have significant influence on safety participation; spontaneous safety motivation has greater influence on safety participating behaviors than safety complying behaviors;

(5) Safety compliance does not have significant influence on safety behaviors;

(6) The three dimensions of safety culture correlate significantly, which is in accordance with the three factors of organizational culture from the inside to the outside;

(7) According to the paper, while organizational culture is improving, the inner needs of safety of individuals needs enhancing, at the same time, feeling the pressure from the outside, the individuals' safety motivation are stimulated to generate safety behaviors.

Suggestions. The research shows that in order to improve the safety performance, construction companies should not only adopt some external measures to restrain employees' behaviors, but also enhance the sense of value of safety and stimulate their spontaneous safety motivation. Therefore, based on the paper, we make the following recommendations:

(1) Schedule more safety education and training to enhance safety awareness. As most companies' safety trainings are always fall into formalism instead of enhancing the employees' safety awareness and stimulate their safety motivation, we recommend that from now trainings should be diversified, along with needs analysis conducted before safety trainings. Meanwhile the purpose of safety trainings should be enhancing the safety motivation instead of a mere formality.

(2) Pay more attention to humane care. Frontline employees of construction companies often suffer from heavy work, excessive pressure and the shortage of psychological education; therefore it is easy for them to generate the sense of exhaustion. Moreover, these employees may want to work with less time and effort, as a result, they may adopt insecure behaviors. Therefore, senior managers and supervisors should have the responsibility and obligation to care for them, conduct psychological counseling, improve frontline employees' value of safety, listen to views and opinions of employees about safety and working and allocate work to employees according to reality to reduce the burden appropriately.

(3) Let the employees participate in safety management. Companies should actively encourage employees to participate in safety management, let them be in charge of some safety activities and listen to their opinions about safety standards when drawing up safety management regulations.

(4) Employ human resource policies. First of all, safety tendencies should be taken into consideration when recruiting new employees.

Secondly, perform safety exams regularly. Companies can adopt modernized IT systematized safety examining system, conduct safety evaluation to employees irregularly, and establish a data base of safety assessment. Meanwhile, companies should conduct individualized targeted education trainings against those employees with tendencies to insecure behaviors to enhance safety awareness.

Finally, combine safety performance and working performance with salaries and take appropriate rewarding actions to stimulate employees' motivation to induce them to act safely.

Establishing a safety-oriented performance management system contributes to cultivating a favorable safety culture and enhancing the employees' controlled safety motivation to improve safety performance and lower the frequency of accidents.

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Empirical Research on Executive Incentives and the Corporate Performances of Chinese Listed Real Estate Companies

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Abstract

With the deepening of economic globalization, the impact of executive incentive on corporate performance attracts more and more attention. In this paper, based on the data of Chinese listed real estate companies in recent years, the study highlights the correlations between executive incentive and corporate performance by empirical research methods. To quantify the executive incentive, the ratio of managerial ownership and the sum of senior managers' annual payment are selected. According to the results of regression analysis and robustness test, the conclusion can be drawn that corporate performance is positively related to executive incentive. Meanwhile, the study shows that equity incentives in Chinese listed real estate companies are not perfectly functional. Finally, there are several specific suggestions about executive incentive for Chinese real estate companies.

INTRODUCTION

The real estate industry is the mainstay of economy in China. Its healthy development is not only helpful to improve people's living standards, but also beneficial for the development of the economy. Listed real estate companies are regarded as the leading enterprises in this industry; to improve their corporate performances is beneficial for the rapid development of the industry.

Senior managers compose a distinct and important group in a company. Because their decisions impact on the corporate performance, executive incentive is an important way to improve the corporate performance. Therefore, study on the relevance between executive incentive and corporate performance of listed real estate companies in China has become one of the most important issues.

This paper explores the correlation between executive incentive and corporate performance of Chinese listed real estate companies by empirical method, which aims to find how executive incentive influences corporate performance so as to provide proper recommendations.

LITERATURE REVIEW

Theoretical study on executive incentive and corporate performance originated in western countries: Murphy (1985) made a research about 71 companies selecting shareholder return and executive pay as the indicators. The research revealed that positive correlation between executive incentive and corporate performance was significant. Kaplan (1994) selected CEO pay as the index of executive incentive and showed that CEO pay and corporate performance were positively correlated. Mehran (1995) extracted more than 150 companies to explore the relationship between the structure of manager compensation and corporate performance. The result showed that corporate performance and the rate of equity incentive were positively correlated. Martin and Graham (1995) made a sensitivity analysis based on data of 532 senior managers from 100 English companies and concluded that executive equity incentive and corporate performance showed a positive correlation. Michel (2005) made an empirical analysis of relationship of manager incentive and corporate performance. The result supported conclusions above. However, some other studies showed that there was no correlation between the two. Jensen and Murphy (1990) selected executive pay as the indicator of executive incentive and made a research based on data of about 7000 senior managers in American companies from 1969 to 1983. They came to the conclusion that executive pay was not sensitive to corporate performance.

And many domestic scholars made the researches about this topic from different angles: Yu and Gu (2002) chose the rate of return on common stockholders' equity (ROE) as the indicator, the result showed that corporate performance and the ratio of managerial ownership were positively correlated，but not significant. Sun and Zhao (2006) selected market value and book value to evaluate corporate performance, the research indicated the positive linear correlation between executive compensation and corporate performance. Xue and Han (2007) used a sample of 1416 companies listed on Shanghai and Shenzhen Stock Exchanges to explore the correlation between the two from two aspects: compensation incentive and equity incentive. The result showed that it was not equity incentive but compensation incentive that influenced the corporate performance. Besides, the correlation was positive. Zhang (2014) also made a research from the two aspects using a sample of all companies listed on Shanghai and Shenzhen Stock Exchanges from 2009 to 2011 with available data. The result showed that compensation incentive was significantly and positively correlated with corporate performance, while the correlation between equity inventive and corporate performance was not significant. In addition, other studies showed different results. Li (2000) defined executive as general manager and chairman of the board and chose the ratio of managerial ownership and the sum of senior managers' annual payment to measure executive incentive. The research came to the conclusion that the sum of senior managers' annual payment and corporate performance were not related. Besides, equity incentive was not efficient. Wei (2000) made an empirical research on executive incentive and corporate performance to conclude that the senior managers' annual payment was positively but not significantly correlated with corporate performance.

As for the study about real estate industry, Coughlan and Schmidt (1985) and Davis and Shelor (1995) studied the relationship between executive incentive and corporate performance based on data of the real estate industry in the United States. They concluded that the correlation was significant.

In summary, according to review, although the study on executive incentive and corporate performance is mature, research about the relationship between the two in real estate industry is limited. Only in recent years, have Chinese experts begun to focus on the issue. Based on the data of listed real estate companies, this paper starts from the perspective of quantitative analysis, in order to explore the relationship between executive incentive and corporate performance in real estate industry.

EMPIRICIAL STUDY DESIGN

Hypothesis. Because compensation incentive and equity incentive are major aspects of executive incentive, the study put forward hypotheses as follows.

(1) based on incentive theory, whether the design of executive pay is reasonable influences the diligence degree that executive works. According to agency theory, if the managers and owners get asymmetry information, the managers and owners would sign contracts about payment to encourage the managers to work hard. Therefore, we make Hypothesis 1 as follow:

Hypothesis 1: Executive pay and corporate performance show a positive correlation.

(2) Information asymmetry results in problem of moral risk, the executives would strive for more leisure time according to the information they get or harm the interests of owners. When there are no shares for them, executives would avoid riskier but higher-yielding projects and turn to projects with lower income but less risk. While holding shares, executives would invest in higher-yielding projects so as to improve their welfare. To solve the problems above, it is necessary to choose equity incentive executives to motivate the executives to work hard. Therefore, we make Hypothesis 2 as follow:

Hypothesis 2: Equity pay and corporate performance show a positive correlation.

Data sources and sample. There are total 793 samples in Shanghai and Shenzhen stock market from January 1st, 2007 to December 31st, 2013. All the data are acquired from RESSET Database. All statistics are processed by SPSS Statistics 19.0.

Variable selection. In this paper, variables are selected as follows.

(1) The dependent variable. Earnings-per-share (EPS) is an important indicator to measure the value of equity investments. It is often used as a basis for investment. This indicator reflects the profitability of the company and the long-term corporate performance. Rate of return on common stockholders' equity (ROE) also reflects the profitability. It is reliable to measure short-term corporate performance. Therefore, ROE and EPS are selected as dependent variables.

(2) The independent variable. Because compensation incentive and equity incentive are major aspects of executive incentive, the sum of senior managers' annual payment (AC) and the ratio of managerial ownership (MSR) are selected to measure compensation incentive and equity incentive respectively.

(3) The control variable. The study should control other variables, which can also cause changes in the dependent variable, in order to clarify the causal

relationship between experiments. Based on previous research experience, this paper chooses the size of the company assets (SIZE), debt to assets ratio (DAR), and total assets turnover as control variables (DAT).

The interpretations of variable selection are shown in Table 1.

Table 1.Defined Variables.

	Name	Meaning
Dependent variable	ROE	Net Profit/ Average net assets
	EPS	Net profit after tax/ Capital stock
Independent variable	AC	Natural logarithm of the sum of senior managers' annual payment
	MSR	The ratio of managerial ownership
Control variable	SIZE	Natural logarithm of total assets
	DAR	Total liabilities/ total assets
	DAT	Net business income/the average of total assets

Model specification. Based on the hypotheses, this paper constructs mathematical models and makes linear regression analyses to test hypotheses. The models are listed as follows:

$$ROE = \alpha_0 + \alpha_1 AC + \alpha_2 MSR + \alpha_3 SIZE + \alpha_4 DAR + \alpha_5 DAT + \varepsilon \quad (1)$$

$$EPS = \beta_0 + \beta_1 AC + \beta_2 MSR + \beta_3 SIZE + \beta_4 DAR + \beta_5 DAT + \varepsilon \quad (2)$$

EMPIRICAL ANALYSIS

Descriptive statistics. As can be seen from Table 2, the maximum of ROE is 125.50%, and the minimum of ROE is -135.70%. The maximum of EPS is 244.70%, and the minimum of EPS is -143.64%. These indicate that the differences among corporate performance in Chinese listed real estate companies are large. The data of the sum of senior managers' annual payment (AC) and the ratio of managerial ownership (MSR) vary among different companies, showing that executive incentives in different real estate companies are uneven.

Table 2.Descriptive Statistics.

	N	Min	Max	Mean	Standard deviation
ROE	793	-1.357000	1.255042	0.09819126	0.137494008
EPS	793	-1.436400	2.447000	0.34677907	0.372802576
AC	793	10.068060	14.979494	12.46875399	0.830903083
MSR	793	0.000000	0.518756	0.01661206	0.066437030
SIZE	793	18.594071	26.895395	22.35139363	1.352603234
DAR	793	0.014459	0.966965	0.60057325	0.176993682
DAT	793	0.001400	1.330300	0.29965372	0.195251004

Linear regression analysis. SPSS Statistics 19.0 processes the data on linear regression analysis; the results are listed as follows (see Table 3, Table 4 and Table 5):

Table 3.Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.319	0.102	0.096	0.130703690
2	0.594	0.352	0.348	0.300994464

Table 4.Analysis of Variance.

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.528	5	0.306	17.886	0.000
	Residual	13.445	787	0.017		
	Total	14.972	792			
2	Regression	38.773	5	7.755	85.594	0.000
	Residual	71.300	787	0.091		
	Total	110.074	792			

Table 5.Coefficients.

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.501	0.089		-5.598	0.000
	AC	0.016	0.007	0.098	2.183	0.029
	MSR	0.183	0.071	0.089	2.594	0.010
	SIZE	0.014	0.005	0.141	2.737	0.006
	DAR	0.073	0.032	0.094	2.294	0.022
	DAT	0.102	0.024	0.145	4.219	0.000
2	(Constant)	-3.675	0.206		-17.833	0.000
	AC	0.108	0.017	0.241	6.316	0.000
	MSR	0.198	0.163	0.035	1.216	0.224
	SIZE	0.118	0.012	0.427	9.790	0.000
	DAR	-0.122	0.073	-0.058	-1.669	0.096
	DAT	0.374	0.056	0.196	6.721	0.000

The values of Adjusted R Square are 0.102 and 0.352. The interpretation abilities of the model are weak. However, based on econometric theory, when the number of samples is greater than 30, the fitness can be low. So the judgment about the fitness of the model also refers to the significance of the F test. Table 4 shows that the values of Sig. are both 0.000 (far less than 0.05) and the values of F are also cogent which indicate the models are effective. In Table 5, the values of Sig. indicate that the sum of senior managers' annual payment (AC) is positively related to corporate performance, but the ratio of managerial ownership (MSR) is not significantly but positively related to corporate performance. Besides, result of robustness test which chooses ratio of income as a percentage of sales (ROS) as the indicator of corporate performance is similar to the results above.

CONCLUSION AND SUGGESTIONS

According to the results above, it is concluded that executive pay and corporate performance in listed real estate companies show a significantly positive correlation; equity pay and corporate performance in listed real estate companies show a positive but not significant correlation. In summary, corporate performance is positively related to executive incentive. So the paper puts forward the following suggestions:

(1) Compensation incentives in listed real estate companies are efficient. The companies should continue to improve the pay system so as to encourage executives to work hard for better corporate performance.

(2) It is a problem that there are shortages of long-term incentive like equity executive, which results in the excessive pursuit of short-term interests. To promote the development of listed real estate companies, establishing and promotion of long-term system are necessary.

(3) Improve the supervision mechanism about executive incentive to provide a fine environment for the development of executive incentive so that corporate performance of real estate companies can be improved and the development would be more balanced.

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An Exploratory Study of the Causes of Failure in Construction Small Businesses: A Case of the Johannesburg Construction Industry, South Africa

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Abstract

The objective of this study is to explore the causes of small businesses failure within the Johannesburg construction industry, a metropolitan municipality in the Gauteng province of South Africa. The data for the study was collected through a structured questionnaire survey distributed to a sample of 30 owners of small and medium construction companies in Gauteng. The research respondents were construction professionals who work in SMEs. The survey results shown that the major causes of small business failure can be divided into two aspects, which are external and internal. The internal factor revealed from the study include- lack of financial managerial ability and general administration of the business. The study findings revealed the urgent areas that small construction businesses need to be supported in order for them to be sustainable which in order guarantee job security for construction professionals who are employed in these companies; thus contributing to the macroeconomic indicators of the economy.

INTRODUCTION

In the past, the South African government did not give enough support to the small business sector. Big business typically received more support than SMEs. However, this scenario has changed since 1990. Some of the businesses that were started in the early 1990s are no longer in existence. There are also those businesses that are not growing beyond the survivalist stage. The high failure rate can be partially attributed to the lack of support that the small and medium enterprises (SMEs) experience. The government has since initiated small business support measures aimed at developing and promoting the SMEs (Bowler and Dawood 1996). The National Strategy for the Development and Promotion of Small Business in South Africa White Paper was published in 1995. This initiative was followed by the National Small

Business Act of 1996. Dickey (1994) reports that small businesses fail because more often than not cash flow is not properly managed. The point is made that when a business starts or expands; more money needs to be invested for a while and gives the business owner very little in return. The argument regarding the failing of small businesses is that small businesses will most likely employ poor financial information, respond badly to change and may well over trade as well as allow their gearing to rise to levels that convert normal business hazards into constant threats.

Small and medium-sized businesses form an integral part of the South African economy and therefore this industry is mostly influenced by various factors which are basically externally and internally. Many researchers have discovered that major factors or causes of failures in these SMEs are categorised in four groups which are top managerial skills, financial management, and skills shortage, loss of an important personnel or employee incompetence and the market environment. Ladzani and Van Vuuren (2002) believes that a considerable number of small businesses fail just before many of them start to operate. This is caused by lack of preparedness and failing to accurately estimate the cost of starting and running one's own business. Ladzani and Van Vuuren (2002) emphasise that training alone may not be the only solution that can help small businesses succeed, but that constraints such as the lack of financial resources, lack of access to markets, lack of support services, and low literacy levels should also be addressed. Therefore, the aim of the present study is to synchronize the existing body of knowledge on the subject of SMEs in the understanding of small business failure; and to identifying the remedies of the major causes of failure in SMEs as this has attracted much attention over the years to researchers and research bodies (corporate or government).

RESEARCH METHODOLOGY

This research is mainly a literature review of what has been found in previous years on the failures of SMEs. The study was conducted with reference to existing theoretical literature, published and unpublished literatures. The study was derived from passed studies on SMEs, with the specific aim of identifying the remedies of the major causes of failure in the SMEs as this has attracted much attention over the years to researchers and research bodies (corporate or government).

HISTORY AND DEFINATION OF BUSINESS FAILURE

Small business is considered primarily because any activity must start from stages of infancy: man grows from a child; huge empires and civilizations are built from small groups of people; elementary ideas and notions germinate into intricate and complex thought processes; modern giant industries of today were small business of yesterday. In any appraisal of the conditions prerequisite to the growth and survival of a system of private enterprise, the role of small enterprise is a strategic factor. It is natural, in thinking of South African industry, to be impressed with large scale operations; but these corporate giants did not start full grown, nor can they stand alone. Large-scale industries are fed by and feed thousands of smaller suppliers and customers that link the chain from raw materials to consumers.

Business failure can be defined as the inability of a firm to pay its obligations when they are due or considered as a firm's inability to exist due to loss of capital or insufficient return on investments. It mostly appears in a critical situation as a consequence of a sharp decline in sales, as a result of recession, the loss of an important customer, shortage of resources for instance; raw materials, shortages of management, and others. The researchers suggest that a business should not be categorized as "successful" unless it is sustained over a period of time. Being profitable in one year that leads to bankruptcy the next is not a correct definition of a successful business, it must have at least survived three years and still have the vision of continuing to exist in the foreseeable future. However, if a business cannot survive at least three years in the construction industry, it does not matter if it had a fruitful first year or not but if it cannot even pay its debts or loans and end up bankrupt, it is not successful but unsuccessful which results to business failure. Therefore a business should have goals and a plan on how to achieve those goals, it must know the main aim of the business and business must be for right reasons (Berryman 1982).

SMES OWNERS AND ENTREPRENEURS

Management can exert no control over exogenous problems that manifest themselves in the economic, political, technological and international spheres. The most noticeable problems influencing SME success in this environment are the state of the economy, compliance with legislation, resource scarcity, crime and corruption and rapidly changing technology. The entrepreneurs in the previously disadvantaged townships, for example, experienced problems with understanding the impact of technological development and the state of the economy on the success of their business (Brink and Cant 2003). In typical or economic theory, the entrepreneur can be viewed as someone who co-ordinates different factors of production, but the important difference is that this role is viewed as a non-important one. The entrepreneur becomes combined with the capitalist employer, the owner-manager, who has the wealth to enable production to take place, but otherwise does not retain any special attributes. However, Deakins and Freel (1999), reported that the entrepreneur, if recognized at all, is a pure risk-taker, the reward being the ability to appropriate profits.

They also mention that the idea that the entrepreneur has a significant role in economic development has been developed by writers outside mainstream economic thinking. Their contributions now have an important place, but it is only relatively recently that the importance of these contributions has been recognized. Since the attention has become more focused on the importance of the SME sector for the economic development and job creation, so greater attention has also been directed at theories of entrepreneurship. In the Key Contributions of Economic Writers on the Role of the Entrepreneur, that an entrepreneur has to have the ability to spot an opportunity and also be innovative and bold enough to take risks in the construction business.

MAJOR CAUSES OF FAILURE

The Technological Capabilities Theory popularised by Lall (2001) argues that smallness is dangerous just like in the animal kingdom where younger and smaller animals are easy prey for predators. The theory postulates that small firms do not easily access funds from financial institutions because they lack collateral and hence lending to them is viewed as highly risky. This means that the only plausible way that SMEs can raise capital is through self-financing, but since their initial capital is small and their sales value is also small against very high operating costs, they are caught in a vicious circle of smallness which is hard to break out of and may result in eventual collapse of SMEs.

Kivrak and Arslan (2008) examined the critical factors causing the failure of construction companies through a survey conducted among 40 small to medium-sized Turkish construction companies. A lack of business experience and country's economic conditions were found to be the most influential factors to company failure. A scrutiny of the sub-factors related to the lack of business experience confirms that difficulties with cash flow and poor relationship with the client drove the contractors' failure. In addition, preparing an accurate and realistic bid proposal with the profit margin being carefully determined is highly critical (Arslan et al. 2006). However, due to high competition, companies are usually forced to reduce their profit in order to win the bid and this would increase the default risk substantially. Kangari (1988) found that more than half of business failures in construction were due to unrealistic profit margin.

Many researchers have discovered many different major causes of failure but those causes revolve around four important factors, which are top managerial skills, financial management, skills shortage, loss of important personnel or employee incompetence and the market environment. These factors are basically external and internal causes, and they are as follows.

External causes. Market environment. Competition: According to Thwala and Phaladi (2009), there are a large numbers of small contractors or businesses entering at the lower end; this sector has become extremely competitive, thereby making it difficult for new entrants to keep a sustainable workflow. This inability to sustain workflow impacts on their ability to achieve sustainable employment and economic empowerment (Construction Industry Development Board 2006). Hence, for a company to withstand the effects of competition, before it chooses a location it should conduct a market research on their competitors and customers in order for it to understand its customers and the demand.

Internal causes. According to Schaefer (2006), the following are the internal causes.

(1) Financial managerial ability.

- Lack of finances,
- Insufficient capital,
- Poor estimating and job costing,
- Debt.

Thwala and Phaladi (2009), concord with Schaefer (2006) because they reported that lack of effective financial management during the early stages of a business is a major cause of business failure for small and medium sized contractors. If a business does not have a good book keeping, it is planning to fail because without book-keeping the business end up losing track of their daily transactions and cannot account for their expenses and profits at the end of the month. Moreover, according to Schaufelberger (2008) also mentioned that most external problems are caused by internal problems that are neglected, and they are as follows:

- Strategic planning Issues
- Lack of comprehensive business plan

Components may include:

- Description of the business, vision, goals, and keys to success
- Work force needs
- Potential problems and solutions
- Financial: capital equipment and supply list, balance sheet, income statement and cash flow analysis, sales and expense forecast
- Analysis of competition
- Marketing, advertising and promotional activities
- Budgeting and managing company growth

In addition, most bankers request a business plan if you are seeking to secure addition capital for your company." Schaefer's components as they follow will help companies define goals in order to succeed and have a clear vision.

- Diversifying into unfamiliar types of projects
- Lack of managerial maturity

The following components below are under lack of managerial maturity.

- Strategic implementation/Control issues
- Increase in project size
- Poor cost-estimating skills
- Lack of equipment control
- Poor internal communications
- Financial management issues
- Poor use of accounting systems
- Excessive debt

Schaefer (2006) states "A common fatal mistake for many failed businesses is having insufficient operating funds. Business owners underestimate how much money is needed and they are forced to close before they even have had a fair chance to succeed. They also may have an unrealistic expectation of incoming revenues from sales. It is imperative to ascertain how much money your business will require; not only the costs of starting, but the costs of staying in business. It is important to take into consideration that many businesses take a year or two to get going. This means you will need enough funds to cover all costs until sales can eventually pay for these costs." Borrowing funds from financial institutions in order to be in business is good, but when the debt goes high it drains the business income and causes the capital resources of the business or company not to grow or even decline. Thus the business leaders or the company should pay attention to the cost of borrowing.

(2) Lack of planning or managerial skills. Owners tend to manage their businesses themselves as a measure of reducing operational costs. Poor record keeping is also a cause for start-up business failure. In most cases, this is not only due to the low priority attached by new and fresh entrepreneurs, but also a lack of basic business management skills. Some owners employ family members simply because of bond relations. In some cases, these have turned out to be undisciplined and ineffectual, a

factor that has led to eventual and sometimes rapid failure of businesses. Managers, who are unable to employ competent workers, deal with tendering properly, and contract documentation, mentoring, lack of entrepreneurial skills; conduct a proper training for its employees also end up with a business that is bankrupt.

(3) Not taking risks as a company and not being innovative. If a business does not engage in new things or even become part of new project or fear challenges, which can be a hindrance for it to grow and become successful because growth in the construction industry is part of success.

FACTORS THAT CAN BE IMPLEMENTED TO REMEDY THE MAJOR CAUSES OF FAILURE IN THE SMES

The following factors can help to remedy failures in small and medium enterprises when implemented.

The government intervention, leadership training and skills training workshops. The South African construction industry will continue to provide jobs for historically Disadvantaged Individuals (HDI) but without such an intervention, small and medium sized contractors will remain unsustainable and their performance satisfaction. In order to address problems and challenges faced by small businesses or contractors in South Africa, it is critical for the government to review policies with regard to Contractor Development Programmes (CDP) to ensure that the government contributes to the success of small contractors in South Africa. The research had established that there is not one critical success factor that can make small contractors to be successful but a combination of factors. In the North West Province case study it was found that some factors were critical and some were less critical. The authors recommend that the following factors to be considered as key to the success of small contractors in the North West Province. (Thwala and Phaladi 2009).

Business skills. Location of business premises is very important. Set specific targets for your business, carry out market research, employ qualified personnel and put them in position according to their skills. Know and understand existing skills needed and attend refresher courses on business management skills. (Thwala and Phaladi 2009).

Management skills. Thwala and Mofokeng (2012) discuss management factors and started by stating that experience in any kind of management is very important and it plays a vital role in making sure that a business fails or succeeds. Poor management was suggested as one of the main causes of failure of small enterprises. The lack of experience was seen as a cause for managers making bad business decisions within the construction industry. Thwala and Mofokeng (2012) continued on by saying that, financial mismanagement and management incompetence was among the attributes that lead to construction failures. Financial management should be emphasized as well as networking with other people with similar businesses and keeping records of workers to help in evaluation of the performance (Thwala and Phaladi 2009). However, recommends the following remedies in order to produce a successful business.

Access to capital. One of the remedies is to join with others that have similar businesses, negotiate favorable credit purchases from the supplier, source affordable loans from financial institutions and negotiate advance payments from the clients.

Good record keeping. Financial records should be prioritized and a record of books of accounts on a daily, weekly, monthly and annual basis should be established.

Well managed cash flow. Prepare cash flow forecasts and budgets and prepare a cost-benefit analysis. Lease equipment and other financial assets to improve your cash flow, negotiate outstanding loans through payment procedures and scale down operational costs.

Family/domestic situation. Separate business activities and family obligations and look for alternatives sources of income to cater for the family's basic needs. With the above mentioned, during 2001, skills development was clearly stated as a national priority. Twenty-five Sector Education and Training Authorities (SETAs), covering all aspects of economic activity, are now entering their fifth year of existence. All SETAs are expected to make specific contributions to the National Skills Development Strategy. Specific projects initiated by different SETAs include training domestic workers, training people to work in national parks, and enhancing the skills of micro-lenders (Lazarus, 2005). Hence this stated SETA will assist in development of SMEs by training employees and employers.

LESSON LEARNT FROM LITERATURE REVIEW

Lesson learnt from the study reveal that:

- Government should review policies with regard to Contractor Development Programmes (CDP) to ensure that the government contributes to the success of small contractors.
- Poor management is one of the main causes of failure of small or any enterprises.
- Good record keeping is one of the vital remedy to a company.
- Access to capital and constant entrepreneurship training is very influential when coming to turning a failing construction company to a success.
- Well managed cash flow is the most important remedy to a construction company, because if contractors manage their cash flow well, many SMEs will remain successful and be in existence for more than 5 years without being bankrupt and the company will remain in business.
- Recruiting new professionals is another remedies that can help failing companies to become successful.

CONCLUSION AND RECOMMENDATION

A business should have goals and a plan on how to achieve those goals, it must know the main aim of the business and must be for the right reasons. The most noticeable problems influencing SME success in this environment are the state of the economy, compliance with legislation, resource scarcity, crime and corruption and rapidly changing technology. Many researchers have discovered many different major causes of failure but those causes revolve around four important factors, which are top managerial skills, financial management, skills shortage, loss of important personnel or employee incompetence and the market environment. These factors are basically external and internal causes; thus, these findings relate with the literature from other researchers like Thwala and Phaladi (2009), who recommended that good record keeping, access to capital, family domestic situation, entrepreneurship training and recruiting young professionals as remedies in order to produce a successful business.

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Correlation of Corporate Income Tax and Debt Financing: An Analysis for the Real Estate Industry

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Abstract

The real estate industry is characterized by high investment and high fund demand. As a result, a reasonable capital structure is very important to it. Based on the analysis of current research about the corporate income tax and debt financing at home and abroad, combined with the amended Modigliani-Miller, trade-off and pecking order theories, this paper selects the real estate company data from 2009 to 2013 as research samples and analyzes the correlation between the corporate income tax burden and debt financing through empirical study. Moreover, the correlation between no-debt tax shield and debt financing is studied at the same time. This study aims to help the real estate industry ensure its reasonable proportion of financing and optimize its capital structure.

INTRODUCTION

In the past 20 years, the real estate market in China has developed rapidly, contributing a lot to the growth of economy. As an industry which has high capital requirement, the real estate companies need reasonable capital structures. In China, almost all companies are required by law to pay the corporate income tax and therefore their interests are cut by the payment. However, the interest of debt financing can be deducted from the taxable income before taxing and as a result, improve the enterprises' value. It can be concluded that debt financing can decrease the loss of interests which is caused by the corporate income tax. This effect is called as debt tax shield. So, research about the correlation of corporate income tax and debt financing is very important for companies to choose the reasonable capital structure. This research collects the concerning data from 2009-2013, with the attempt to analyze the correlation of corporate income tax and debt financing and the correlation of no-debt tax shield and debt financing in the real estate industry through empirical study. This paper aims to help the industry ensure its reasonable proportion of financing and optimize its capital structure.

LITERATURE REVIEW

For several years, much research work has been done abroad on the correlation of corporate income tax and debt financing. Modigliani and Miller (1958) point out that under the perfect market assumptions, and also assuming no taxes, the companies get the same marginal income through debt financing and equity financing, which means that the capital structure doesn't affect the value of company. The amended MM theory found that with the consideration of tax, the value of the company will increase as the proportion of debt increases. When the ratio is 100%, the company gets its maximum value. Obviously, the amended MM theory ignores the disadvantage of debt financing. Because of this, Robichek and Myers (1966) find the trade-off theory. The theory points out that besides the value of tax saving, debt financing also has the cost of financial crisis and agency. The best capital structure is determined by the balance between the advantages and disadvantages of debt financing. Myers and Majluf (1984) points out the pecking order theory which argues that the reasonable financing order for companies is internal financing, debt financing and equity financing. Besides these theories, Deangelo and Masulis (1980), Bardley (1984) and Mackie-Mason (1990) propose and validate the alternative hypothesis one after another. This theory argues that companies prefer to use debt tax shield and no-debt tax shield at the same time. If a company has enough no-debt tax shields, it will not choose debt financing.

In China, there are few concerning researches. What's more, some study shows different conclusion with those abroad. For example, Song (2001) states that the impact of taxation on capital structure appears in the form of parabola instead of linear. Cao (2010) points out that the impact of the corporate income tax on capital structure is not significant. The conclusions show the difference between China and developed countries.

EMPIRICAL STUDY DESIGN OF CORPORATE INCOME TAX AND DEBT FINANCING

Hypothesizing. According to the law, the interest of debt financing can be deducted from the taxable income before taxing. What's more, the amended MM theory also states that the higher tax rate a company bears, the lower debt financing cost it gets and as a result, it will have strong motivation to choose debt financing. Based on it, assuming the income tax paid by the company is constant and defining the effective tax rate as the ratio of tax expense and pre-tax profit, this paper puts forward the first hypothesis:

H1: the level of debt financing and the company's effective tax rate is positively correlated.

No-debt tax shield is defined as other expense which can be deducted from the taxable income before taxing, such as depreciation of fixed assets and amortization of intangible assets. It can be abbreviated as NDTS. If a company has enough no-debt tax shields, then it will decrease the tax benefit of debt financing, and the company may therefore tend to reduce the proportion of debt financing. And according to the alternative hypothesis, if a company has enough no-debt tax shields, it will not choose debt financing. Based on this, the paper puts forward the second hypothesis:

H2: the level of debt financing and NDTS is negatively correlated.

Study sample. This paper selected all of the listed companies in the real estate industry from 2009 to 2013 as the initial study sample, which can show the conditions after tax reform which was push forward in 2008. In order to increase the accuracy and validity of the research, the study removes the companies whose disclosed information is non-standard or incomplete. This study also removes the companies which are particularly transferred or specially treated as well as those whose effective tax rate is negative. In the end, the study sample turns out to be 582 sets. Data in this research is collected from CSMAR and the analysis software is SPSS 16.0.

Variable definitions. This paper chooses asset-liability ratio as the dependent variable which is abbreviated as DEBT. The indicator reflects the ratio between the debt and assets. The indicator is also commonly used to measure the level of debt financing. In the selection of the independent variables, the study uses the effective tax rate to measure the corporate income tax burden. Compared with the other indicators, the effective tax rate which is abbreviated as ETR can accurately reflect the tax burden of almost all the different companies. What's more, the data is relatively simple and complete. In addition, this research uses the sum of depreciation of fixed assets and amortization of intangible assets to measure the no-debt tax shield.

In the selection of the control variables, this paper refers to the researches of some scholars such as He (2009), Liang (2011) and Liu (2012). Due to there are a great number of concerning researches and the factors are mainly generalized as company size, profitability, bankruptcy risk and growth, as a result, this paper chooses these four indicators as the control variables. In order to complete the empirical analysis, the study chooses SIZE, ROE, Z-SCORE and GROWTH to measure these variables. Description of each variable is shown in Table 1.

Table 1.Variable Definitions.

Type	Name	Note
Dependent variable	DEBT	DEBT = total liabilities/total assets × 100%
Independent variables	ETR	ETR = income tax expense/profit before tax × 100%
	NDTS	NDTS = (depreciation of fixed assets + amortization of intangible assets)/total assets
Control variables	SIZE	SIZE = ln (total assets)
	ROE	ROE = profit after tax/owners' equity
	Z-SCORE	Z-SCORE = (3.3 × EBIT + main business income + 1.4 × retained earnings + 1.2 × working capital)/total assets
	GROWTH	GROWTH is measured by revenue growth.

Model design. The purpose of this research is to analyze the correlation of the corporate income tax and debt financing of the real estate listed companies from 2009 to 2013. According to the above analysis, the paper constructs the regression model as follows to examine how corporate income tax affects debt financing. What's more, in order to examine the correlation more effectively, this research designs a model which only contains the control variables and compares the significance and goodness of fit of these two models. In order to be clearer, this study notes the model which only contains the control variables as model 1 and which contains the independent variables as model 2. The two models are expressed as follows:

MODEL 1:

$$DEBT = \beta_0 + \beta_1 SIZE + \beta_2 ROE + \beta_3 Z\text{-SCORE} + \beta_4 GROWTH + \varepsilon$$

MODEL 2:

$$DEBT = \beta_0 + \beta_1 SIZE + \beta_2 ROE + \beta_3 Z\text{-SCORE} + \beta_4 GROWTH + \beta_5 ETR + \beta_6 NDTS + \varepsilon$$

All the variables are explained in Table 1. According to the first hypothesis, the level of debt financing and the company's effective tax rate is positively correlated. So the expected symbol of ETR coefficient is positive. According to the second hypothesis, the level of debt financing and NDTS is negatively correlated. So the expected symbol of NDTS coefficient is negative.

THE EMPIRICAL ANALYSIS

The goodness of fit for the model. According to the sample data, this paper uses SPSS 16.0 to complete the multivariate regression analysis. The results are shown in Table 2.

Table 2.Comparison of the Goodness of Fit for the Model.

Model	R Square	F	df1	df2	Sig.
Model 1	0.379	87.789	4	576	0.000
Model 2	0.445	76.488	6	574	0.000

Table 2 shows that the F value of model 1 is 87.789 which only contains the dependent and control variables, and the significant probability of it is 0. So the result is significant at the 5% level, which shows that these control variables have strong explanatory power to debt financing. What's more, according to the table, the R^2 of model 1 is 0.379, which means the explanatory degree of model 1 on the dependent variable is about 37.9%.

The table also shows the regression result of model 2 which contains the independent variables. According to the table, the F value of model 2 is 76.488 and the significant probability is 0. It is also significant at the 5% level. This shows that adding the independent variables is meaningful. What's more, the R^2 of model 2 is 0.445. It means the explanatory degree of model 2 on the dependent variable is 44.5%, which is 6.6% bigger than model 1. The result shows that taking the tax variables into consideration, the explanatory power of the model has increased by 6.6%. In other words, the goodness of fit for the model increases and the explanatory power also becomes stronger when the tax variables are included in the model. The result is consistent with the expected one.

Descriptive statistics. By collecting concerning data from 2009 to 2013, this paper analyzes the distribution of each variables and the result is shown in Table 3.

Table 3.Descriptive Statistics.

Variable	N	Minimum	Maximum	Mean	Std. Deviation
DEBT	581	0.016520	0.925847	0.625096659	0.165614224
SIZE	581	1.9073E1	2.68953E1	22.619123470	1.317262943
ROE	581	-9.7899E0	1.177896	0.112230950	0.432854617
Z-SCORE	581	-1.5845E0	2.396168	1.021067038	0.441320088
GROWTH	581	-1.3575E0	1.17633E4	40.524058830	5.05366085E2
ETR	581	0.002560	3.72724E1	0.357406735	1.594557862
NDTS	581	0.000084	0.038991	0.004245734	0.005759944

The table shows that the minimum value of the asset-liability ratio is 1.65% and the maximum is 92.56%. The average of which is 62.51%. In general, the ratio of companies in China is about 40%. Compared with this, the real estate industry has a relatively high asset-liability ratio, which is consistent with its characteristics of high capital requirements and long payback period. The data of ETR shows that the average effective tax rate of the industry is 35.74%, higher than the statutory tax rate which is 25%. The result is consistent with the fact that the real estate companies bear a relatively more strict taxation. According to these two indicators, we can speculate that the high asset-liability ratio of real estate industry maybe associated with its high ETR. Because when the ETR is high, the companies will lose relatively large interests, and as a result, they tend to choose debt financing for its tax-shield effect.

Empirical results and analysis. By using SPSS 16.0, this paper gets the regression results as shown in Table 4. According to the table, the coefficient of ETR is 0.002, and the symbol of which is consistent with the expected one. But in the T-test, the t value of ETR is 0.588 and the corresponding significance is 0.556, which does not pass the test. The result shows that the correlation of ETR and debt financing is not significant. However, the coefficient of ETR is positive and is consistent with the expected one, which means that ETR and debt financing is positively correlated. The higher ETR a company bears, the higher level of debt financing it will choose which is consistent with the amended MM theory.

Table 4.Coefficients.

Model	B	t	Sig.
(Constant)	-0.757	-7.655	0.000
SIZE	0.065	15.399	0.000
ROE	0.003	0.273	0.005
Z-SCORE	-0.059	-4.947	0.000
GROWTH	-1.253E-6	-0.122	0.903
ETR	0.002	0.588	0.556
NDTS	-8.014	-8.166	0.000

Table 4 also shows that the coefficient of NDTS is -8.014, and the symbol of which is consistent with the expected one. What's more, according to the T-test, the t value is -8.166 and the significance is 0, passing the test. The result shows that NDTS and debt financing is negatively correlated. If a company has enough NDTS, it may choose relatively low level of debt financing. So both hypothesis 1 and 2 pass the empirical test, but hypothesis 1 is not significant. And the reason may be connected with the trade-off theory and China's specific national conditions.

In addition, the regression results of the control variables can also be seen in the table. SIZE, Z-SCORE and ROE have passed T-test and all of them are significant at the 5% level. This means that there is a significant correlation between the company size, profitability, bankruptcy risk and debt financing. Among them, company size and debt financing is positively correlated, indicating that the larger the company is, the higher level of debt financing it will choose. Profitability and debt financing is also positively correlated, which means that if a company has strong profitability, it will probably choose the high level of debt financing. Bankruptcy risk and debt financing is negatively correlated , indicating that the lower bankruptcy risk a company has, the higher level of debt financing it will choose. However, the t value of GROWTH is -1.122 and the significance is 0.903, which does not pass the test. The result means that there is no significant linear relationship between the growth and debt financing.

Multicollinearity test. In order to ensure the reliability of the research, this paper makes the multicollinearity test and the result is shown in Table 5. Through multiple regression analysis, the tolerance of the 6 variables is all more than 0.1 and the VIF value is all less than 1.3. It can be seen from the results that there is no serious multicollinearity among SIZE, ROE, Z-SCORE, GROWTH, ETR and NDTS.

Table 5.Tolerance and Variance Inflation Factor of Variables.

Model	SIZE	ROE	Z-SCORE	GROWTH	ETR	NDTS
Tolerance	0.852	0.979	0.942	0.98	0.985	0.830
VIF	1.174	1.021	1.061	1.02	1.015	1.204

CONCLUSION

Tax has the effect of encouraging companies to choose debt financing. Through the empirical study in this paper, the corporate income tax has a certain impact on debt financing. It can been seen from the model comparison that the goodness of fit of model 2 which contains the independent variables is better than model 1 which only contains control variables. In the further regression analysis, the research finds that there is a positive but not significant correlation between the ETR and debt financing and there is a significantly negative correlation between NDTS and debt financing. According to the study, it can be seen that there is a correlation between the corporate income tax and debt financing. Tax plays a certain role in promoting the company to determine a reasonable capital structure.

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A Model for Assessing Embodied Energy and GHG Emissions in Infrastructure Projects

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INTRODUCTION

Construction and operation of buildings and infrastructure is a main contributor to emissions of Greenhouse Gases (GHG) in Sweden. The embodied energy of construction, meaning all the energy that is used until the completion of the construction project (see Figure 1), cause roughly 10 million tones of CO_2 equivalent emissions each year which equals to the emissions from all cars in Sweden (IVA 2014). About 6 million tones of CO_2 equivalent emissions are attributed to the embodied energy of roads, railroads and other civil works while the remaining 4 million tones are attributed to the embodied energy of buildings (IVA 2014). Although reducing energy use and associated GHG-emissions in road and railroad construction is prioritized by the Swedish Transport Administration (Trafikverket 2012), the GHG-emissions from such construction projects have increased in recent years (Boverket 2014). Many of the existing efforts to reduce energy use and associated GHG-emissions focus on individual phases of the life cycle and don't take into consideration the effects at other stages during the whole life cycle of a project (Boverket 2011). A crucial step in the assessment of energy use and associated GHG-emissions is to clarify and categorize the different phases of a life cycle. Figure 1 shows a proposed categorization of life cycles phases and use of energy based on previous research (Davies et al. 2014). Buildings' main use of energy happens during its operational phase from e.g. heating, lighting and use of electrical appliances

(Sartori and Hestnes 2007). In infrastructure projects such as road construction the embodied energy is roughly equal to the operational energy for roads with lighting, or in fact considerably higher if the road lacks lighting (Stripple 2001).

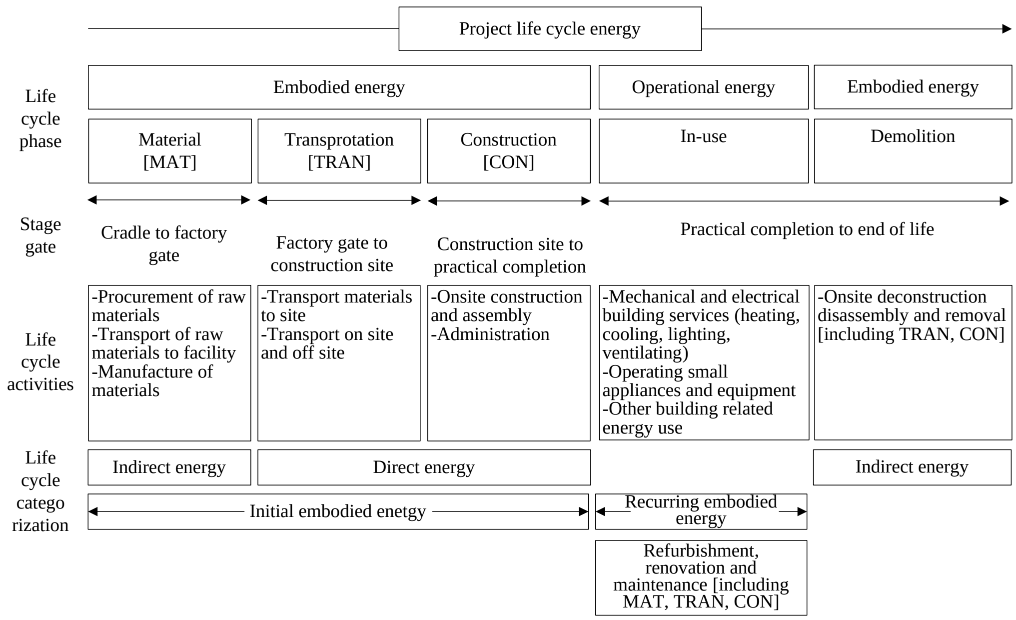

Figure 1.Life cycle phases and energy use in construction projects.

This study presents a model for estimating the GHG emissions of CO_2 and CO_2 equivalents resulting from the use of energy in infrastructure projects. The model covers the first three life cycle phases associated with the embodied energy shown in Figure 1, the material, the transportation and the construction phase. A simple database is designed to store relevant data for the estimation of embodied energy and GHG emissions of infrastructure projects.

PROPOSED EMBODIED ENERGY model

The proposed model is aimed at quantification of the embodied energy and associated GHG emissions in infrastructure projects, as shown in Figure 2. The model is based on previous work on life cycle phases and use of energy (Davies et al. 2014) and the Discrete Event Simulation and Building Information Modeling framework by Lu and Olofsson (2014).

A main feature in the model is the implementation of a database with energy- and GHG emission data. The energy source can be in terms of electricity or fossil fuels measured in megajoules (MJ). The GHG emissions are accounted for in terms of global warming potential (GWP) and is measured in CO_2 equivalents. In the proposed model this concept is used for material and component productions were the data are acquired from EPDs (Environmental Product Declarations). For transportation and on-site construction the model only accounts for GHG emissions in terms of CO_2.

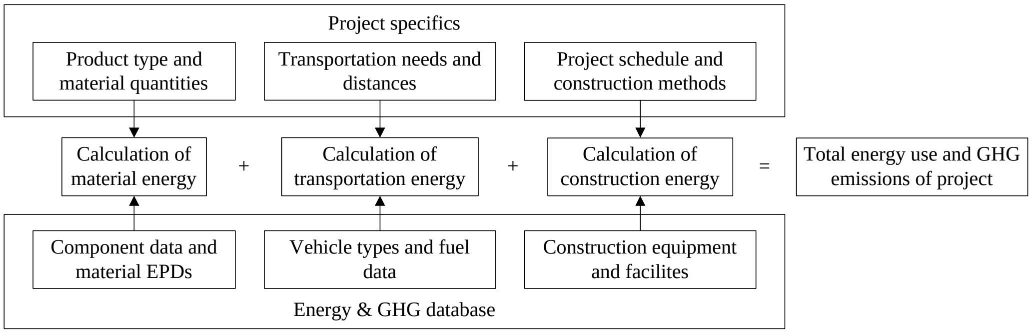

Figure 2.The proposed model.

The benefit of utilizing a database for non-project-specific data about off-site production and transportation of materials and components is that additional data when available can be added for the quantifications of upstream life-cycle analysis (LCA) in infrastructure projects. The data in the database is mainly acquired from EPDs and can easily be changed or complemented if other materials or components are to be used. The on-site part of the database includes energy-and GWP data of transportation vehicles, construction equipment and on-site facilities. The project specifics are data from the specific project, such as quantities, project location, construction methods and detailed schedules. By combining the project specifics and the associated parts of the database, the upstream energy- and GWP calculations of the project can be automated.

DEMONSTRATION

The usefulness of the proposed model is evaluated on the construction and assembly of a superstructure of a prefabricated bridge. The evaluated bridge “Montagebro” is shown in Figure 3 and is described in more detail in Larsson et al. (2014) and Larsson et al. (2015). In Larsson et al. (2015) a schedule and detailed productivity data for different activities involved in the construction of the superstructure is presented. The database is composed of energy data from EPDs and suppliers of the bridge superstructure materials and components.

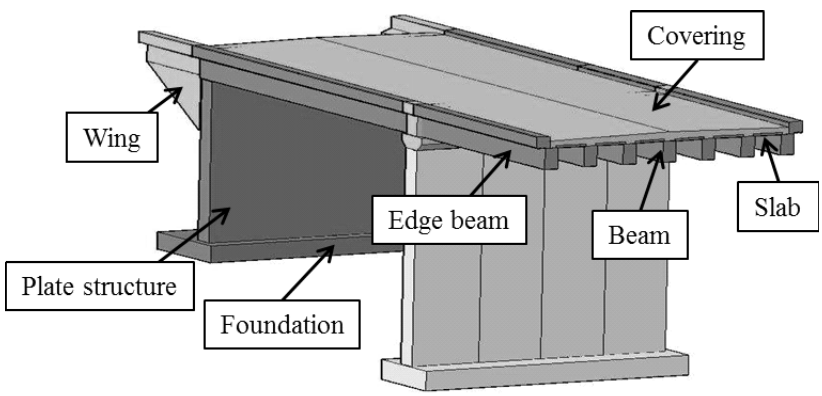

Figure 3.The “Montagebro” bridge used in the demonstration.

Materials, components, transportation and equipment. The demonstrated bridge superstructure is 18 by 8 meters. The construction of the superstructure starts with mounting a total of 9 prefabricated beams onto the substructure. The beams in each side, the so called edge beams, are larger than the 7 in the middle. Onto the beam structure 48 prefabricated plates are mounted to cover the gaps between the beams and create a level surface to construct the surface. Next a structure of reinforcement is assembled on the plates and then finally the reinforcement is covered with a layer of concrete. The material quantities are summarized in Table 1.

Table 1.Material Quantities of the Superstructure of the Bridge.

Material	Quantity	Unit
Beams	7.0	pcs
Edge beams	2.0	pcs
Plates	48.0	pcs
Concrete	35.1	m^3
Reinforcement	5.4	tones

The construction processes on-site requires a mobile crane and a concrete pump. The workers need two units, one with a kitchen and one with shower and dressing room possibilities. The energy use of this equipment and facilities is shown in Table 2.

Table 2.The Energy Use of the on-site Equipment and Facilities.

Equipment or unit type	Energy use	Unit
Mobile crane	26.8	L/h
Concrete pump	29.2	L/h
Workers unit	50.4	MJ/d

The construction of the superstructure takes a total of 16 days in which the mobile crane is used for 64.5 hours and the concrete pump for 1.7 hours. In this demonstration the location for the prefabricated bridge and the transportation distances from suppliers are based on a hypothetical case. The transportation distances used in the demonstration are listed in the next table, see Table 3.

Table 3.Assumed Transportation Distances from Suppliers to Construction Site.

Supplier	Distance (km)
Prefab factory	100
Concrete	50
Reinforcement	50
Workers units	50

Prefabricated components. The prefabricated concrete components are produced in a factory from concrete and reinforcement. Each type of component in the bridge superstructure has a GWP datasheet listing the emissions from cradle to factory gate including the extraction and manufacturing of input materials, transportation to the factory and the energy used at the factory for producing the components. The energy use is an assumption based on the components GWP. Table 4 shows a summary of each component's GWP and energy use.

Table 4.Energy Use Per Prefabricated Component from Cradle to Factory Gate.

Component	GWP (CO_2 eq.)	Energy use (MJ)	Unit
Edge beam	1234	30603	pcs
Beam	1029	25528	pcs
Plate	29	720	pcs

Building materials. The building materials/components used in the superstructure of the bridge beside the prefabricated components is concrete and reinforcement. The GWP and energy use during extraction, transportation, and manufacturing are based on the materials EPDs from cradle to factory gate, see Table 5.

Table 5.GWP and Energy Use of Building Materials from Cradle to Factory Gate.

Material	GWP (CO_2 eq.)	Energy use (MJ)	Unit	Source
Concrete	188	1495	m^3	EPD-Norge
Reinforcement	785	11556	tone	UK CARES

Transport. The building materials, prefabricated components and on-site facilities need to be transported to the construction site. For each type of transport, the fuel consumption and load capacity is needed. The load capacity is described for each functional unit of the particular goods transported. The fuel consumption data is based on average values for trucks fully loaded half the distance and unloaded the other half of the total distance. The assumed diesel consumption of the transported goods to the construction site is listed in Table 6.

Table 6.Diesel Consumption for Transportation of Materials, Components and Facilities.

Transported goods	Quantity	Unit	Diesel /km
Edge beams	1	pcs	0.52
Beams	2	pcs	0.52
Plates	48	pcs	0.40
Concrete	4	m^3	0.40
Reinforcement	10	tonnes	0.45
Workers units	1	pcs	0.45

Database design. A simple energy and GWP database is designed and populated with the data in the previously mentioned tables. The *Resource* table is populated with construction equipment and on-site facilities. Both prefabricated components and building materials are summarized in the *Material* table. The *Truck* table is populated with the transport information. These tables form the general energy and GWP database. The remaining tables in Figure 4 are input tables for project specific data. The *Task* table summarizes the total electricity and fuel use in the cradle to construction gate analysis of the bridge superstructure. The ER-diagram of the Energy & GHG and Project specifics databases are shown in Figure 4 below.

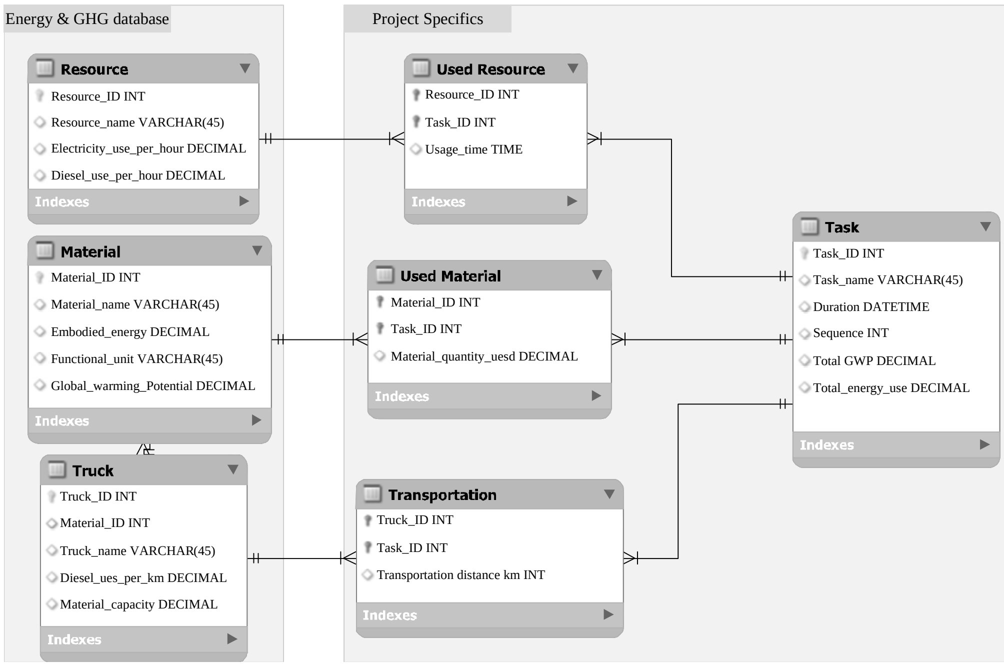

Figure 4.ER-diagram of the energy-and GWP database.

Tasks in the database need to be delimited from other tasks in a rational way on order to keep data gathering and input simple. In this demonstration the construction of the bridge is seen as one task, thereby resource use during the project is summarized in advance.

Results. The energy use (embodied energy) and associated CO_2 equivalent emissions of the cradle to construction gate analysis of the bridge superstructure are presented in Table 7.

Table 7.Energy Use CO_2 eq. Emissions of Each Category in the Demonstration.

Category	Energy use (MJ)	CO_2 eq. emissions (kg)
Material	389365	21902
Transportation	42948	3165
Construction	65311	4695

Each category's contribution to total CO_2 emissions and energy use of the project's embodied energy can be seen in Figure 5.

The CO_2 emissions for 1 liter of combusted diesel is 2.64 kg (Orovwode et al. 2014). The Swedish energy mix is used for electricity which accounts for 0.0056 kg CO_2 emissions for each MJ of used electricity (Svensk 2014). As shown in Figure 5, material production is the main user of energy with 78% of the total embodied energy. Material production also and has the highest emissions of CO_2, however, due to differences in the energy sources used the CO_2 equivalent emissions don't fully reflect the energy use.

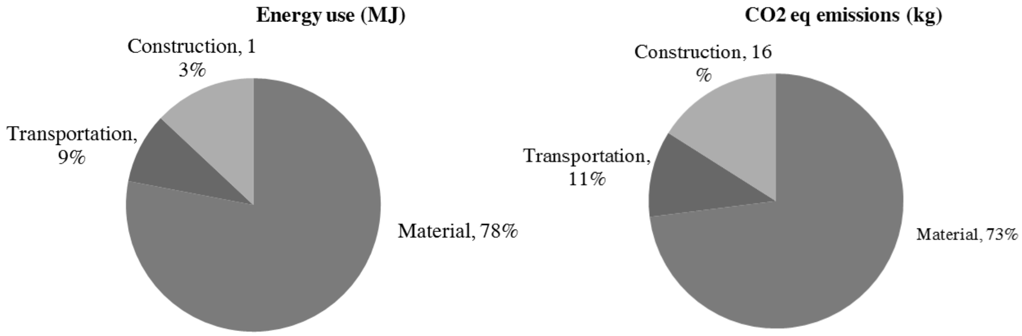

Figure 5.CO_2 emissions and energy use of each category.

DISCUSSION AND CONCLUSIONS

The demonstration shows that implementation of the proposed model to estimate an embodied energy and GHG emission is a relatively straightforward task. By storing energy- and GHG data attributed to materials, transportation and construction processes in a database the data can be used in other projects and new data can be added to expand the scope of the database. This type of model is probably more useful in constructions projects that use more standardized components and construction methods since data in the database can be reused in new projects.

Expanding the model to include the entire life cycle requires more extensive gathering of input data. Part of the required input data can be found in EPDs, but maintenance and operation data might be harder to acquire depending on the types of activities required in these phases. One barrier for the application of the proposed model is the gathering of reliable and relevant data in the database. EPDs are still rare and not commonly defined by suppliers of material and components. One might therefore be forced to use EPDs from other suppliers, which was the case in this study. Also, the conversion between energy use and GHG emissions need to be adapted if suppliers from other countries are selected. Future research should focus on the data acquisition for the database and how the data can be made more reliable so that it's applicable in more general settings than previously discussed.

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Transport Noise and Residential Property Markets

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Abstract

With the increased need for transport options and the pressures for residential housing requirements, more residential property sectors are becoming subject to transport noise. Increasing road, railway and aircraft noise is affecting a greater number of residents in major cities and towns. Previous Hedonic Price Model studies have shown a link between transport noise and residential property prices but these studies are often contradicted by buyer and seller behavior in these markets.

This paper will review a range of residential property research studies focusing on aircraft transport orientated noise and in the next stage of this research project will compare these studies to the anecdotal results from print and electronic media on the same issue.

These results will show if there is a long term relationship between house prices in these locations and transport noise or if these negative value drivers are offset by other positive locational factors such as distance to employment, location to schools and services, and the location to recreational facilities.

INTRODUCTION

Although not a significantly researched issue in Australia, there has been a continuing debate on the potential negative and positive impact of airport development and subsequent aircraft noise on residential property markets both adjoining airports and those under designated aircraft approach and take off flight paths.

With the increase in demand for additional residential housing in cities with increasing population growth, existing airport precincts are facing greater constraints with respect to noise levels, while balancing the air travel requirements of a growing population base. This is particularly the case for older established airports in major residential cities where the need for increased residential accommodation has resulted in new urban areas being developed close to airports that were once considered remote from the residential population of the city. In addition, expanded airport infrastructure resulting in new flight paths, added aircraft movements and aircraft movements over a greater number of areas have also been an issue facing residential property owners and airport operators.

Residential property studies have highlighted factors that are considered to be both advantageous and detrimental to residential property values and in isolation have been found to increase or decrease property values at a single point in time. Studies on residential property stigma, such as flooding, visual pollution, traffic noise, crime and socio-economics status, have shown results ranging from an immediate but not long-term impact to a continuing impact. In most cases the impact of the stigma is once only with all other future transactions of such affected properties being based on full disclosure of the negative market issues.

The analysis of these studies will be presented in chronological order to show the development of both the study results and methodologies over time. Following a review of relevant studies during the defined periods overall conclusions are drawn.

AIRCRAFT AND TRANSPORT NOISE STUDIES

Prior to the early 1970s there was very little research carried out with respect to the impact of aircraft noise on residential property adjacent to an airport or under designated flight paths for aircraft landings and take-off. Research on this topic was limited during this time due to a number of factors, including:

(1) Limited residential development and population close to airports;

(2) Reduced aircraft movements in comparison to current levels;

(3) Different aircraft types and size pre 1970 compared to later time periods;

(4) Limited data availability and statistical modeling tools to enable a study of these issues to be undertaken.

A common theme with all of the studies undertaken during this time is that they were all based on limited time periods and the actual data points were relatively small. The studies did not necessarily explain the housing market drivers that could have been influencing the markets at the time of the sales or data collection period. The models based on actual sales and sale listing data showed a lower discount for houses affected by aircraft noise compared to the models based on census block and census tract data (see Table 1).

The Gautrin (1975) study was based on two suburbs adjoining Heathrow airport. This study also focused on not only aircraft noise but also the accessibility of these two locations to the airport and the London CBD. The rationale for this approach was that the savings on the cost of transport could outweigh the noise impact for a range of house buyers. The results from this study actually showed a premium for houses in Cranford despite being adjacent to the airport due to the emphasis that buyers placed on a superior transport location

The majority of studies on aircraft noise and housing markets during the 1980s through to 1999 were again based on Hedonic Price Models (HPM). Studies undertaken by O'Byrne et al. (1985) based their analysis on the previous work by Nelson (1980). Results from this comparison showed an increase in the impact of aircraft noise from 1970 to 1980 for the same locations. However, the results were qualified by the fact that the databases compared were not identical for the two time periods and changes in the residential property markets over that time span of 10 years were not taken into consideration.

Table 1.Aircraft Noise and Property Value Studies 1969 to 1994.

Author	Year	Study Airport	Method	Result
Emerson	1972	Minneapolis	HPM	9.8% reduction MNL
Palk	1972	New York	HPM	2.09% reduction MNL
Dygert	1973	San Francisco	HPM	Noise depreciation indexes 0.5% to 0.7%
Price	1974	Boston	HPM	At MNL rents decrease by $8.33/$100 per monthly rent
Gautrin	1975	London Heathrow	Modified Mohring model	Noise discount is offset by accessibility premium
De Vany	1976	Dallas	HPM	24% discount at MNL
McDougall	1976	Los Angeles	HPM	Increased noise levels decrease price
Maser et al	1977	Rochester, US	HPM	11% to 16% discount at MNL
Mieszkowski & Saper	1978	Toronto	HPM	House price discounts at MNL 7.8%
McMillan et al	1978	Edmonton	HPM	7% reduction between houses at NEF 20 and NEF 35
Nelson	1978	Washington DC	HPM	Noise depreciation index 1.1%
Abelson	1979	Sydney, Australia	HPM	8 to 10% reduction at MNL
Pennington et al	1990	Manchester	HPM	6% reduction
Frankel	1991	Chicago	Survey	16 to 25% reduction MNL
Collins and Evans	1994	Manchester	Artificial Neural Network	12% maximum reduction
Levesque	1994	Winnipeg	HPM	1.3% for each decibel above EPNL 75

Source: Nelson 1980

A study of Manchester Airport by Pennington et al. (1990), considered that aircraft noise had limited impact of house prices in affected locations. They considered that other factors needed to be considered when assessing potential aircraft noise on property prices.

The study by Frankel (1991) was based on a survey of real estate agents and valuers covering 35 suburbs of Chicago (O'Hare airport) subject to various levels of aircraft noise. This study found that most buyers were aware of the level of noise when purchasing the property and only 9% of vendors reported placing their home on the market because of aircraft noise (across all noise level sectors).

However, their survey did indicate that there was generally a buyer concern for noise and over 55% of buyers used the existence of aircraft noise in this market as a bargaining point in their negotiations rather than a reason not to purchase.

The model indicated that detached houses with the highest noise level locations were 12% (projected) lower in value than non-affected houses. For semi-detached houses in the highest noise zones the price difference was stated to be 7.48% (projected) and a maximum of 6.2% (projected) for leasehold flats.

Collins and Evans (1994) used the same data as Pennington et al. (1990) to analyze the impact of aircraft noise on the two locations adjoining Manchester airport.

The findings by Levesque (1994) raise some important issues with respect to how the public and home owners view the impact of aircraft noise. Levesque was interested in the Bullen et al. (1986) study of Australian airports that showed the impact of noise should be considered with respect to the number of aircraft movements and the variability in aircraft noise.

Actual distance from the airport was considered by Kaufman and Espey (1997) in their study of airport noise at Reno-Sparks airport. Like previous HPM studies they found that for every one decibel increase (above 60 Ldn) there was a 0.29% decrease in property values.

Tomkins et al. (1998) based their study on Manchester airport and focused on the issues of accessibility to airports in relation to industry and employment and the impact of airport related noise. The inclusion of distance to the airport in their model has provided some new insights into the issue of aircraft noise. The study found that there was an 11.8% premium for houses in close proximity to the airport with lower aircraft noise (Leq 60) compared to similar noise affected houses further away from the airport.

Three of the studies (Burns 2001; Theebe 2004; McMillen 2004) undertaken during 2000 to 2005 focused on the impact that aircraft noise on the value of affected residential properties. All of these studies were based on HPM analysis. The social cost of aircraft noise was the topic of the study for Morrell & Lu and van Praag and Baarsma with van Praag and Baarsma adopting a novel methodology of using a happiness survey to identify the variables in the HPM study.

The broader impact of transport noise pollution (road, rail and air) on property values in the western part of The Netherlands was considered by Theebe (2004). This study involved a HPM study of over 160 000 sale transactions to determine the impact of transport noise. The study found that traffic noise had an impact on property value. It was found that noise levels below 55dB did not impact property value but traffic noise above 65dB appeared to result in a reduction in value, with a maximum reduction of approximately 12%.

The number of airport and aircraft noise research studies increased over the 2006 to 2014 period.

Hui et al. (2007) found that in a high density residential property market such as Hong Kong, noise of any kind had less impact on property prices than the actual location of the property relative to transport. This shows that the impact of noise factors is only one of many factors that buyers take into consideration when they purchase a residential property.

The issue of highway noise was addressed by Kim et al. (2007) who found that highway noise in Seoul, South Korea had a negative impact on residential property prices, with a 1% increase in highway noise resulting in a 1.3% decrease in land prices. These figures are actually higher than the majority of aircraft noise studies (see Table 2) (Lazic and Golaszewski 2006; Mieszkowski and Saper 1978; Schipper 1996; Schipper et al. 1998).

Table 2.Aircraft Noise and Property Value Studies 1995 to 2006.

Author	Year	Study Airport	Method	Result
Schipper	1996	Various locations	Meta Analysis	Results from studies are basically consistent
Kaufman and Espey	1997	Reno-Sparks	HPM	Noise levels impact on house prices, distance is also important
Schipper et al	1998	Various locations	Meta Analysis	The results from one study cannot be applied directly to other locations
Tomkins et al	1998	Manchester, UK	HPM	Distance to the airport can actually add a premium to house prices
Little V Dept Natural Resource QLD	1999	Brisbane Australia	Court decision	Other factors impact price
Burns	2004	Adelaide	HPM	1995: decrease in values where a significant ANEC
Theebe	2004	Amsterdam	HPM	Sound below 55dB does not harm property value
McMillen	2004	Chicago	HPM	Houses affected by severe noise are 9.5% lower
Baranzini & Ramirez	2005	Geneva	HPM	Impact of noise on rents in Geneva. Rent is more impacted in public sector owned apartments
Lazie & Golaszewski	2006	Various	Literature review	Commonly used methodologies HPM, CVS, Meta-analysis

Source: Author

Road noise and railway noise are also factors that affect residential property prices and these should also be considered whenever residential property markets are analyzed to determine the impact of aircraft noise. Brandt and Maennig (2011) determined that in areas of Hamburg, unit prices were affected by locations being subject to aircraft noise, rail noise and road noise. In locations with aircraft noise in excess of 70db, the reduction in house prices was 9.1%, with reductions for rail noise being slightly less than 9.1% and prices for units in close proximity to busy roads were 5% lower.

CONCLUSIONS

A common factor with over 90% of studies undertaken is that they are based on econometric modeling using Hedonic Price Models. In the majority of these studies the data used has been mainly census data in the US and sales data in the UK, Asia and Australia, and the time period for the analysis has been single time periods 12 months or less. Generally these studies lack longitudinal depth with very limited examples of studies over a longer time period or based on two individual time periods.

The studies have generally been based on the difference in price for property at 55dB level affectation from aircraft noise to similar properties at the 65-70dB levels. The NDI figures have ranged from a low of 0.10 to 1.80 per increase in 1dB. Two major studies also reported that variation in aircraft noise was more of an issue compared to the number of aircraft movements. Several studies also pointed out those older studies were influenced by aircraft types that were far noisier than the current generation of new planes, and that the reduced noise will benefit areas that were impacted prior to the new planes coming into operation.

A common limitation listed by all researchers was that the models adopted cannot account for all factors that drive a particular property market. A further issue that is raised in these studies, but not actually tested in any of the models, is the fact that individuals have different levels of tolerance to noise and that people really adverse to high levels of noise will not purchase residential property in high noise locations. Home owners in this category are only affected by aircraft noise when an airport is expanded, aircraft operations increase or flight paths change.

Any discount of affected properties can only occur once in the property lifecycle, not each time the property is bought and sold. There comes a point in any property cycle subject to stigma of any kind, where the asking and selling price are just market prices, with the market already factoring in any negative factors.

Even minor factors such as the name of the street can have a negative impact of residential property prices. Market analysis has shown that a derogatory street name can decrease house prices in that street and these issues are not a variable considered in HPM.

NEXT RESEARCH STEPS

This is the first stage of a multi stage research project. The next stage will investigate the perceptions of the public to aircraft noise based on a review of electronic and print media articles and comments on this issue. This will then be followed up by an extensive analysis of the Brisbane residential property sectors that are impacted by high, moderate and minimal aircraft noise. The study period will be from 1988 to 2013 and will cover over 40 Brisbane suburbs and in excess of 200,000 sales transactions.

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A Study on the Equilibrium of Chinese Urban Infrastructure Construction Investment Based on the Gini Coefficient

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Abstract

The equilibrium of urban infrastructure construction investment is significant for the equilibrium of regional economy development and social stability. This paper quantitatively analyzes the equilibrium of urban infrastructure construction Investment by the method of Gini coefficient. First of all, this paper selects Chinese urban infrastructure construction investment index through the literature research. Then, this paper draws the Lorenz curve and calculates the population and GDP Gini coefficient of Chinese urban infrastructure construction investment. The results show that, on the whole, Chinese urban infrastructure construction investment is in a state of "comparative equilibrium" at present. From 2004 to 2013, Chinese urban infrastructure construction investment based on population develops toward a more balanced direction. The equilibrium of urban infrastructure construction investment based on GDP nearly remains unchanged. China gives more and more attention to the equilibrium of Chinese urban infrastructure construction investment based on population.

INTRODUCTION

Urban infrastructure is some specific service facilities to provide power, transportation, post and telecommunication, water supply and drainage, and environmental protection, etc, for production and living. It is the basis of the survival and development of a city (Tang 2010). The equilibrium of urban infrastructure construction investment is significant for the equilibrium of regional economy development and social stability. At present, the research about infrastructure is mainly focused on the development level of infrastructure, the efficiency of infrastructure investment, and the evaluation of infrastructure construction and economy coordinated development. There is little research about the equilibrium of infrastructure construction. Dong (2010) studied the equilibrium allocation of urban and rural infrastructure of Shanghai by utilizing the method of comparative analysis and empirical analysis. Zhang and Wang (2012) measured the regional inequality level of Chinese rural infrastructure construction investment through establishing the imbalance index. Ding (2013) qualitatively analyzed the equilibrium allocation of education infrastructure in Qingdao, Shandong province.

Based on this, this paper applies Gini coefficient concept to calculating the equilibrium of urban infrastructure construction investment. The Gini coefficient is a kind of generalized analysis tool. It can be used not only in the income distribution problem, but also in all kinds of distribution equilibrium analysis. Li and Xie (2008) studied Chinese education equality through the Gini coefficient. Groves and Denman (2009) analyzed seasonal variation of environmental radon gas trough the Gini coefficient. He and Fan (2010) studied the distribution equilibrium of highway network through the Gini coefficient.

This paper quantitatively analyzes the equilibrium of Chinese urban infrastructure construction investment from both horizontal and vertical views, through establishing the Gini coefficient of Chinese urban infrastructure construction investment from six dimensions. It puts forward a new research method to study the equilibrium of Chinese urban infrastructure construction investment. Besides, it can provide reference and theoretical basis for the national's decision-making from macro level.

SELECTION OF CHINESE URBAN INFRASTRUCTURE CONSTRUCTION INVESTMENT INDEX

As countries national conditions are different, the concept of urban infrastructure has no unified explanation in the world. "Infrastructure" was presented by a study about the ability of the north Atlantic treaty organization to wage and cope with a war on a country in 1950s. Webster's dictionary defines "infrastructure" as, infrastructure is a system composed of base, service training, facilities, etc, such as used for military action. From this, it indicates that the understanding of infrastructure was confined to the category of military infrastructure at that time.

As a public product, the definition of infrastructure is constantly changing with the society's progress. Its connotation is continuously enriched. According to the world development report in 1994, whose theme is providing infrastructure for development, the infrastructure investment is divided into physical infrastructure investment and social infrastructure investment (Gramlich 1994). The physical infrastructure is divided into transportation, communication, energy supply, etc. The social infrastructure is divided into education, social insurance and welfare, culture and sports, scientific research and public management, and other facilities.

At present, the infrastructure has no unified concept. The urban infrastructure investment index has no unified standard. In order to establish scientific and reasonable Chinese urban infrastructure construction investment index, based on the literature review of the related researches, this paper makes the summary to the main related researches by the following four dimensions, as Table 1 shows:

Table 1.Literature Analysis of Urban Infrastructure.

Time	Author	Research Type	Index
2004	Cai and Zhang	Level of urban infrastructure development	Transportation. Public Facilities. Water supply and drainage. Environment

Table 1.(Continued).

Time	Author	Research Type	Index
2005	Wang	Urban infrastructure investment index	Transportation. Communication. Water and sewage treatment. Waste disposal. Production and supply of electric power, heat Power, gas. Public facilities.
2006	Li and Xia	Level of urban infrastructure development	Traffic and transportation. Energy supply. Communication. Health and environment. Water supply and drainage
2008	Zhu and Liu	Urban infrastructure performance evaluation	Water supply and drainage. Traffic and transportation. Energy supply. Environment. Post. Disaster prevention
2010	Shi and Lei	Urban infrastructure investment index	Road. Water supply and drainage. Health and environment. Energy supply. Traffic
2011	Huang and Huang	Level of urban infrastructure development	Environment. Transportation. Post. Water supply and drainage. Energy supply
2012	Wang	Scale of urban infrastructure development	Traffic. Energy supply. Post and telecommunication. Environment. Water supply and drainage
2014	Yan	Level of urban infrastructure development	Road and traffic. Water supply and drainage. Energy supply. Post and telecommunication. Environment.

According to the review of the main literature above, in consideration of the statistical data, this paper selects six types of Chinese urban infrastructure construction investment indexes, as shown in Table 2.

Table 2.Chinese Urban Infrastructure Construction Investment Index.

Type	index
Energy supply	Production and supply of electric power, heat Power, gas and water
Transport, storage and post	Traffic transport storage and post
Water, environment and public facilities	Management of water conservancy, environment and public facilities
Education	Education
Health and social work	Health and social work
Culture sports and entertainment	Culture sports and entertainment

CONCEPT OF THE GINI COEFFICIENT OF CHINESE URBAN INFRASTRUCTURE CONSTRUCTION INVESTMENT

The principles and methods of Gini coefficient. At beginning of the 20th century, In order to measure inequality degree of social distribution of income, Gini coefficient was proposed by Gini, Italian economist, based on the Lorenz curve, as shown in Figure 1.

The abscissa measures the cumulative percentage of population and the ordinate measures the cumulative percentage of income. The Gini coefficient is equal to the ratio of the area surrounded by the perfect equality line and the Lorenz curve and the area of the right triangle below the perfect equality line. In other words, G=A/(A+B), 0＜G＜1. The more fair income distribution, the Lorenz curve radian is smaller, and the Gini coefficient is smaller. Conversely, the more unfair income distribution, the Lorenz curve radian is bigger, and the Gini coefficient is bigger. Table 3 shows the Gini coefficient criterion of United Nations. Usually, 0.4 is the international warning line.

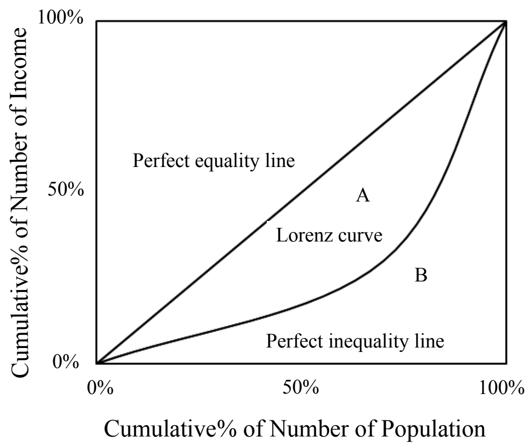

Figure 1.The Lorenz curve and the Gini coefficient.

Table 3.The Gini Coefficient Criterion of United Nations.

Range	G＜0.2	0.2≤G＜0.3	0.3≤G＜0.4	0.4≤G＜0.5	G＞0.5
Evaluation result	Absolute fairness	Comparative fairness	Relative fairness	Unfairness	Very unfairness

Because the Lorenz curve is not a smooth curve, therefore, there are lots of formulas to select to calculate the Gini coefficient. This paper refers to the formula below to calculate the Gini coefficient based on the related literature (Zhang, 2007).

$$G = 2\left[\sum_{i=1}^{n}\left(y_i \sum_{i=1}^{n} x_i\right)\right] - \sum_{i=1}^{n} x_i y_i - 1 \tag{1}$$

In the above formula, G stands for the Gini coefficient. xi is the ratio of urban population (or GDP) of regional area and urban population (or GDP) of China. yi is the ratio of urban infrastructure construction investment of regional area and urban infrastructure construction investment of China. n=31 (China has 34 administrative areas and this paper doesn't include Hong Kong, Macao and Formosa).

The Gini coefficient of Chinese urban infrastructure construction investment. Urban infrastructure construction investment is closely related to urban population, the regional economic development level and the regional area. The former two play a leading role among the three factors. Although the western region is broad, urban infrastructure construction develops slowly compared with the east. Therefore, this paper measures the equilibrium of Chinese urban infrastructure construction investment by urban population and GDP. Based on the two points of view, the equilibrium of urban infrastructure investment can be divided into the population Gini coefficient of urban infrastructure investment and the GDP Gini coefficient of urban infrastructure investment.

THE ANALYSIS OF THE EQUILIBRIUM OF CHINESE URBAN INFRASTRUCTURE CONSTRUCTION INVESTMENT

Drawing of the Lorenz curve. All the data of this paper come from the Chinese Statistic Almanac. Through the abscissa measures the cumulative percentage of urban population (or GDP) and the ordinate measures the cumulative percentage of Chinese urban infrastructure construction investment, the Lorenz curves of 2013 are drawn from the perspective of urban population and GDP, as shown in Figure 2 and Figure 3.

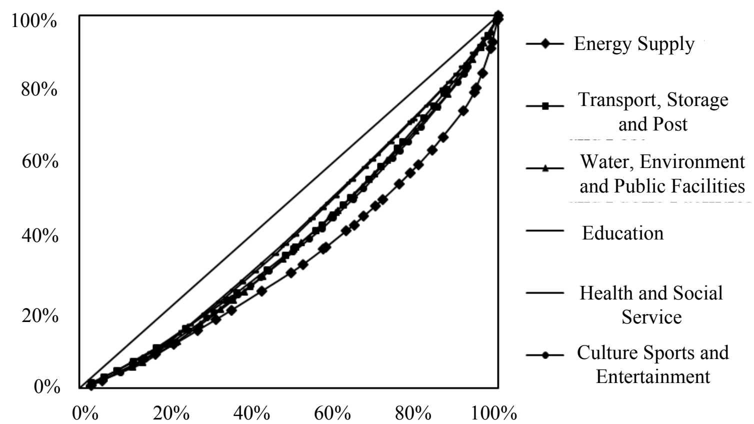

Figure 2.The population Lorenz curve of Chinese urban infrastructure construction investment of 2013.

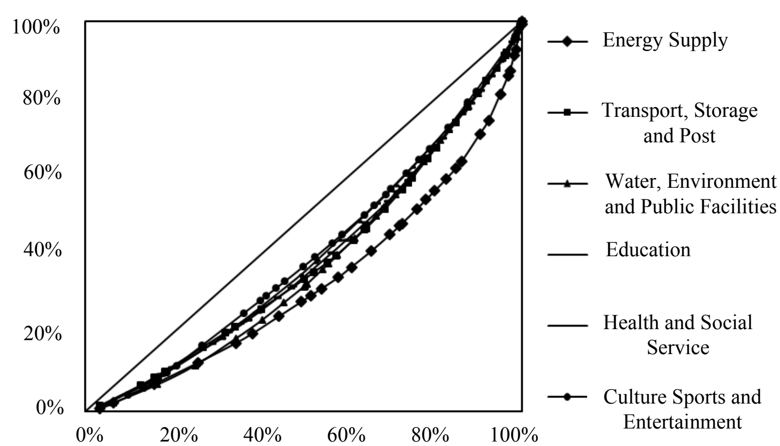

Figure 3.The GDP Lorenz curve of Chinese urban infrastructure construction investment of 2013.

The calculation of the Gini coefficient. This paper selects 2004, 2007, 2010 and 2013 as the representative year. According to the statistical data and formula (1), this paper calculates the population Gini coefficient of Chinese urban infrastructure construction investment and the GDP Gini coefficient of Chinese urban infrastructure construction investment, as shown in Table 4.

Table 4.The Calculation Results of the Gini Coefficient of Chinese Urban Infrastructure Construction Investment.

Year	Energy Supply		Transport, Storage and Post		Water, Environment and Public Facilities		Education		Health and Social Service		Culture Sports and Entertainment	
	Pop	GDP	Pop	GDP	Pop	GDP	Pop	GDP	Pop	GDP	Pop	GDP
2004	0.28	0.29	0.25	0.20	0.32	0.23	0.25	0.12	0.25	0.23	0.37	0.19
2007	0.26	0.33	0.23	0.24	0.18	0.24	0.17	0.20	0.18	0.19	0.24	0.27
2010	0.30	0.36	0.21	0.25	0.18	0.24	0.24	0.31	0.16	0.24	0.24	0.24
2013	0.30	0.35	0.19	0.22	0.20	0.25	0.15	0.22	0.16	0.20	0.21	0.19

The analysis of the equilibrium of Chinese urban infrastructure construction investment. From the Lorenz curve of Chinese urban infrastructure construction investment of 2013, we can see that the Lorenz curve of urban energy supply infrastructure investment has the longest distance to the perfect equality line based on the population and GDP. The population and GDP Gini coefficient of energy supply infrastructure investment are 0.3 and 0.35 respectively. It is in a state of "relative equilibrium" and close to the international warning line. It is mainly related that Chinese northwest region is broad and its resources is rich. 1.37% of urban population and 1.33% of GDP occupied 6.27% of urban energy supply infrastructure construction investment in Xinjiang. 1.99% of urban population and 2.67% of GDP occupied 6.64% of urban energy supply infrastructure construction investment in Inner Mongolia. There is little difference between The Lorenz curve of Transportation storage and post, water environment and public facilities, education, health and social work, culture sports and entertainment. The Gini coefficient of them is between 0.15 and 0.25. They are in a state of "absolute equilibrium" and "comparative equilibrium". The population Gini coefficient of urban education infrastructure construction investment is smallest. It's 0.15. It is related that China gives more and more attention to the western education in recent years. According to the data from 2004 to 2013, the average growth rate of urban education infrastructure investment is 10% in eastern China. It is 14% in central China and 18% in western china. On the whole, Chinese urban infrastructure construction investment is in a state of "comparative equilibrium".

According to the data in Table 3, this paper maps the tendency chart of the population and GDP Gini coefficient of Chinese urban infrastructure construction investment, as shown in Figure 4 and Figure 5.

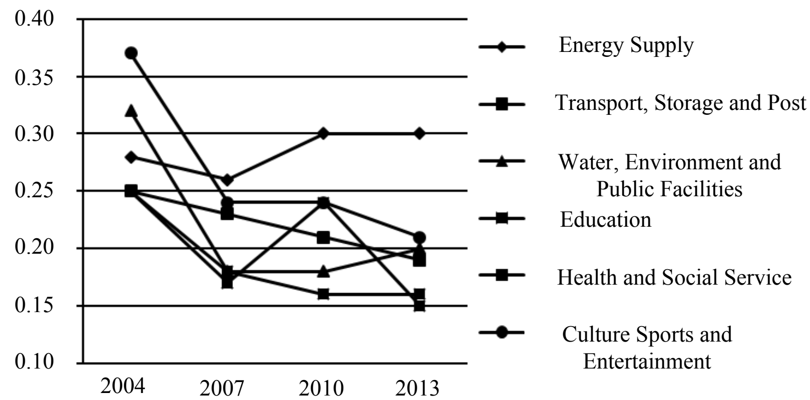

Figure 4.The tendency chart of the population Gini coefficient of Chinese urban infrastructure construction investment.

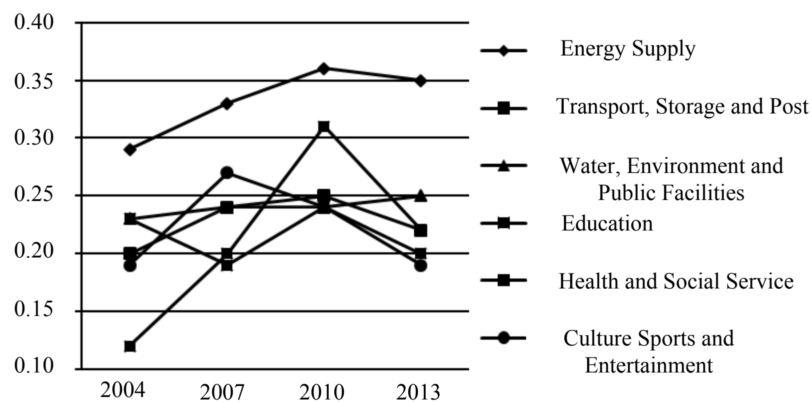

Figure 5.The tendency chart of the GDP Gini coefficient of Chinese urban infrastructure construction investment.

From Figure 4, it indicates that the population Gini coefficient of Chinese urban infrastructure construction investment is in a downward trend as a whole. Chinese urban infrastructure construction investment based on population develops toward a more balanced direction. The gap is shrinking. From figure 5, it indicates that the GDP Gini coefficient of urban education and energy supply infrastructure construction investment is in a slight upward trend. The others are largely unchanged. On the whole, the equilibrium of Chinese urban infrastructure construction investment based on GDP nearly remains unchanged.

By contrasting Figure 4 and Figure 5, the population Gini coefficient is generally larger than the GDP Gini coefficient in 2004, but the GDP Gini coefficient is generally larger than the population Gini coefficient in 2013. It indicates that China gives more and more attention to the equilibrium of urban infrastructure construction investment based on population, instead of only considering the demand of economic development in recent years.

CONCLUSION

This paper proposes the method of Gini coefficient to measure the equilibrium of Chinese urban infrastructure construction investment. Based on population and GDP, through establishing the Gini coefficient of Chinese urban infrastructure construction investment from six dimensions, this paper quantitatively analyzes the equilibrium of Chinese urban infrastructure construction investment from both horizontal and vertical views. The results show that, at present, Chinese urban infrastructure construction investment is in a state of "comparative equilibrium" as a whole. Urban energy supply infrastructure construction investment is in a state of "relative equilibrium" and close to the international warning line. From 2004 to 2013, Chinese urban infrastructure construction investment based on population develops toward a more balanced direction. The equilibrium of urban infrastructure construction investment based on GDP nearly remains unchanged. China gives more and more attention to the equilibrium of Chinese urban infrastructure construction investment based on population.

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Estimation on the Cumulative Amount of Rural Infrastructure Investment in Henan Province Based on the PIM Method: 2000-2012

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Abstract

Doing estimation of cumulative amount of rural infrastructure investment is the premise to research into internal reason for rural economic growth. Perpetual inventory method (PIM) is a proper and scientific theory to measure the cumulative amount of capital. Firstly, this article handles and analyzes the economic depreciation rate, initial cumulative amount of capital, investment in successive years and price index of investment. Then, it estimates cumulative amount of Henan rural infrastructure investment at the end of years from 2000 to 2012. Lastly, it discusses the measurement data and puts forward to the focus of further research. The results show describing the contribution degree of rural fixed assets in the economy development.

INTRODUCTION

Henan province has a large number of farmers; it invests a little in rural area; and the problem of urban-rural dual structure is distinct. All the above shows that the "three rural issues" is also the hardest problem to solve the rise of central plains (Lin 2001). All the above researches show that in the upsurge of new rural construction, the academic circles did large amounts of research on the rural infrastructure (Ju and Pang 2005; Jiang 2008), functional mechanism (Li 2002) and finance problems (Liu 2010). Meanwhile they put forwards lots of counter measures to settle problems about the development and finance of rural infrastructure. But present studies pay little attention to rural infrastructure investment economic performance.

As an important role in the economy development of infrastructure, scholars has realized that it is necessary to analyze the amount of capital investment more carefully to explore the inner driving force of economy development (Solow 1957). For several reasons, it is rare that research on cumulative amount of capital investing in our country's rural infrastructure (Xiao and Hao 2005; Wang et al. 2007; Xu et al. 2008). In this paper, it tries to capital calculation of rural infrastructure of Henan province since 1990 to supply comprehensive and precise data for sequel research on the foundation of production function and estimation of investment efficiency.

In such real environment and historic setting, this article quantitatively estimates capital stock of rural infrastructure, including the three parts: (1) introduces the main thought of PIM; (2) discusses and chooses the four angles of PIM in rural infrastructure investment; (3) analyzes the measurement's trend, at the same time, points out the focus in the future research. In the condition of limited new rural construction capital, it has very important practical significance to ascertain investment order of every kind of infrastructure's according to its contribution.

In this paper, it tries to capital calculation of rural infrastructure of Henan province since 2000 to 2012 to supply comprehensive and precise data for sequel research on the foundation of production function and estimation of investment efficiency.

MAIN THOUGHT AND MEASURING PROCESS OF PIM

In this article, standing on the shoulders of giants, we choose the PIM method to measure the amount of capital investment. It's main thought and measuring process as follows.

Main thought. As previously stated, PIM is set up by Goldsmith in 1951 (Goldsmith 1951). The essential of this method is adjust and convert capital flow of different time year by year and accumulate them into same significant capital calculation. According to the change of efficiency during Life Circle (L), there are three assumed patterns for capital change to relative efficiency series: the "one-horse-shay" method, the straight-line method and the depreciation-reducing balance method. The paper uses the third one, namely:

$$K(t) = I(t) + (1-\delta)K(t-1) \tag{1}$$

Here, $K(t)$-terminal capital stock; $I(t)$-investment of time t; δ-economic depreciation rate; $K(t\text{-}1)$-prior capital stock.

In model (1), relative capital efficiency depends on material enlistmentage. Generally speaking, assume the relative efficiency decreases with enlistmentage (non-increasing), replacement demand is determined by the efficiency loss of onhand capital goods and practical physical decommission. As each capital goods will retire or scrap, its relative efficiency is 0. For each capital goods, d(τ) is the efficiency of enlistmentage τ relative to new capital goods, in which its relative efficiency is 1, that is, d(0) = 1. The above thought can be described as follow:

$$\begin{cases} d(\tau) - d(\tau-1) \le 0 \quad (\tau = 1,\ 2\cdots) \\ \lim\limits_{\tau\to\infty} d(\tau) = 0 \end{cases} \tag{2}$$

Non-negative sequence {d(τ)} describes relative efficiency of capital goods with different enlistentage.

As the efficiency of capital goods decreases with the time goes on, we must reset production ability to keep efficiency of capital goods.

$$m(\tau) = d(\tau-1) - d(\tau) = -\left[d(\tau) - d(\tau-1)\right](\tau = 1,\ 2\cdots L) \tag{3}$$

As the relative of capital goods is non-increasing, $m(\tau) \ge 0(\tau = 1,\ 2,\ \cdots)$. And all the depreciation rate sums up to 1, namely,

$$\sum_{\tau=1}^{\infty} m(\tau) = -\sum_{\tau=1}^{\infty} \left[d(\tau) - d(\tau - 1) \right] = d(0) = 1 \tag{4}$$

In the model, the discharge rate and the replacement demand are two important items.

The discharge rate $\delta(\tau)$ is the depreciation ratio at time τ after the initial investment, which can be calculated though the depreciation sequence:

$$\delta(\tau) = m(1)\delta(\tau - 1) + m(2)\delta(\tau - 2) + \cdots + m(\tau)\delta(0)(\tau = 1,\ 2\cdots) \tag{5}$$

The definition of replacement demand $R(t)$ is the investment level to maintain production ability of capital stock, which can be expressed by previous investment and depreciation rate:

$$R(t) = \sum_{\tau=1}^{\infty} m(\tau) I(t - \tau) \sqrt{b^2 - 4ac} \tag{6}$$

It also can be expressed by initial investment ratio after time τ, which includes replacement demand of production demand when the efficiency of initial investment decreases and each afterward discharge $\delta(\tau)$. Using discharge distribution, it is available to use previous capital stock to figure discharge demand $R(t)$:

$$R(t) = \sum_{\tau=1}^{\infty} \delta(\tau) \left[K(t - \tau) - K(t - \tau - 1) \right] \tag{7}$$

According to the above formula, adopting PIM to estimate the cumulative amount of capital investment on rural infrastructure consists of the following steps: (1) select or calculate δ; (2) determine I_0 (the cumulative amount of capital in the base year); (3) reduce the investment series of present value to get the actual investment series $I(t)$; (4) figure out $K(t)$. Using exist research for reference, this paper concretely measures the cumulative amount of capital of rural infrastructure investment of Henan province in 2000-2012.

Measuring process of cumulative amount of capital. (1) Selection of Economic Depreciation. The existing researches method on the ensure of depreciation rate of fixed assets are not consistent. Some adopt 5% as depreciation rate, some adopt 6%, also some 10%. Theoretically speaking, δ is reset rate in formula (1) while using PIM to estimate the cumulative amount of capital. Lack of condition to re-estimate fixed assets in our country, in actual calculation, we usually use depreciation of fixed assets or approved depreciation in national economy accounting. In this article, we use relative efficiency of capital goods geometrically decline to measure depreciation rate:

$$d(\tau) = (1 - \delta)^{\tau} \quad (\tau\text{=0, 1, 2}\cdots) \tag{8}$$

Here, $d(\tau)$-relative efficiency of capital goods; δ-depreciation rate; τ-time.

To measure the depreciation rate, it is necessary to know the relative efficiency and life circle of capital goods. For relative efficiency of capital goods, referring to the study of Huang Yongfeng (Huang et al. 2002), adopting legal residual value rate to substitute relative efficiency $d(\tau)$, which is 3-5%. It stands for the capital goods' relative efficiency is 5% of new capital goods when the capital goods' life circle is end.

For life circle, according to research of Huang Peimin (Huang et al. 1990), the average economic life circle of rural infrastructure investment is 15 years, its time-lag to agricultural production is 6-9 years. The latest issue of <Accounting Criteria for Enterprises> defines the use life of fixed assets such as buildings is 20 years. So it is assumed in this paper that the average life circle of rural infrastructure is 20 years. According to formula (8), we can figure out the economic depreciation rate of rural infrastructure is 13.91%.

(2) Estimation of Cumulative Amount of Capital in Base Year. Thought of availability and actual economic meaning of data, this paper selects 1990 as the base year.

Lack of relative data of cumulative amount of capital in base year, it takes method of Hall and Jones as reference (Hall and Jones 1999). When estimating cumulative amount of capital in 1960, they divided investment of 1960 by geometric mean of investment growth in 1960-1970 plus depreciation rate, namely:

$$K_{1960} = I_{1960} / (g_{1960-1970} + \delta) \quad (9)$$

Here, K_{1960} - cumulative amount of capital in 1960; I_{1960} - amount of investment in 1960; $g_{1960-1970}$ - geometric mean of investment growth in 1960-1970; δ - depreciation rate.

Selecting 1990 as base year, rural infrastructure investment of Henan province is 203 million yuan, geometric mean of investment growth in 2000-2012 is 27.88%, and depreciation rate is 13.91%. Therefore, according to the above method, cumulative amount of capital is 485 million yuan.

(3) Selection of Investment in Each Year. Investment data of Henan province in 2000-2004 are gained from <Country Construction Statistical Data> by Ministry of Construction (for some reason, we can't find data of 2003, so use presumed data in 2002-2004), other data from <Country Construction Annual Report (2005)>, <China Urban and Rural Construction Statistical Yearbook (2006)>, and <China Urban, County and Rural Country Construction Annual Report (2008)>, <China Urban and Rural Construction Statistical Yearbook (2009-2012)>.

(4) Selection of Price Index of Investment. Quarrels about the dispose of capital calculation of fixed assets in exist research is how to obtain constant price. For variation of price, fixed assets investment can not compare with net value of fixed assets. We must deal with the data of each year to convert Current Prices into Constant Prices. As this paper is measure capital calculation of rural infrastructure investment of Henan province, it directly converts price index of rural fixed assets investment from <Henan Statistical Yearbook (2012)>.

RESULT AND ANALYSIS

Result of estimation. Table 1 shows several years' actual investment, capital calculation (Current Prices) and capital calculation (1990 = 100) of rural infrastructure investment in 2000-2012 (see Table 1).

Result analysis. It is clear that capital calculation of Henan province accounts to

14352 million (1990 = 100) in 2012. It is 37582 million measured through Current Prices, 2.62 times of 1990 Constant Prices.

Based on the results in table 1, figure 1 shows the change of rural infrastructure investment in 2000-2012. From 2000, the verification is remarkable, it rises smoothly in 2000-2004 and increases rapidly in 2005 (79.52%), then it decreases sharply (-40.11%). In 2007, it climbs suddenly (100.78%). In 2008-2012, it increases consistently, only decreases by a small margin in 2011. The reason needs to be dig.

Table 1.Estimation of Capital Calculation in Henan.

Year	Investment (Current Prices)	Capital calculation (Current Prices)	Capital calculation (Constant Prices, 1990=100)
2000	1551	6095	3242
2001	1654	6901	3622
2002	1950	7892	4110
2003	1988	8782	4513
2004	2026	9587	4788
2005	3638	11891	5719
2006	2179	12416	5865
2007	4375	15064	6857
2008	4821	17789	7731
2009	4947	20262	8601
2010	9054	26497	10846
2011	8958	31769	12507
2012	10232	37582	14352

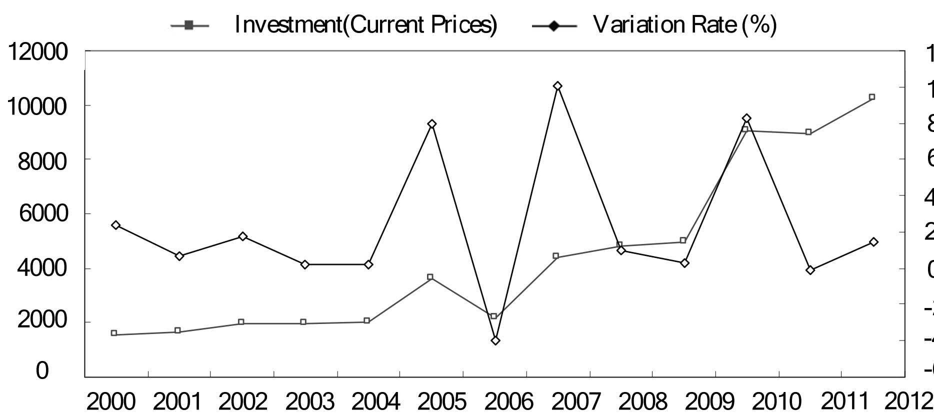

Figure 1.Absolute variation of rural infrastructure investment in 2000-2012.

Meanwhile, different from the Current Prices, the measurement of capital calculation based on Constant Prices (1990 = 100) presents constant steady growth (please see Table 1 and Figure 2). It also shows the importance of capital calculation estimation in another angle. It can supply necessary data for further study, so that the scholars suddenly become bright open on the role of capital in economic growth.

Finally, Table 1 merely shows results of capital calculation of each year in Henan. Though it increases gradually, we should pay attention to the problems such as insufficient rural infrastructure and structure unbalance. According to the principle "industry nurturing agriculture, city supporting village", it is necessary to highlight the governments' role as investment object, stretch governments' rage and scope of rural infrastructure investment.

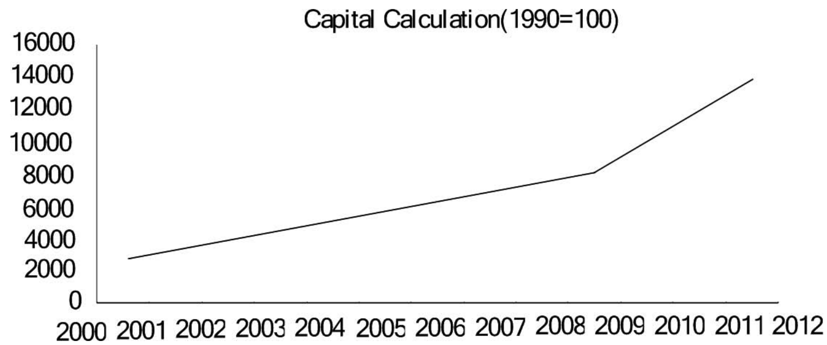

Figure 2.Relative variation of rural infrastructure investment in 2000-2012.

According to the basic requirements on public finance, build a new rural infrastructure financial support system-balanced development between town and village, fair and reasonable. Meanwhile, respect rural residents' desire, attract private flow into rural infrastructure, gradually form diversified investment pattern. Government should put the construction of irrigation and water conservancy, the advance of agricultural comprehensive productivity, improvement of peasants' production and living standards, expanding of county economy on the important place, and coordinately develop other industrial construction.

CONCLUSION

It mainly tries using PIM to estimate capital calculation of rural infrastructure of Henan province. Lack of research on capital calculation of rural fixed assets measurement, this paper mainly refers to exist relative research. Pointing to several problems of capital calculation measurement, it reasonably chooses, such as depreciation rate and capital calculation measurement of base year.

Data of capital calculation partially reflects the development of rural infrastructure investment in Henan province. Seeing from the result, it tallies with rural development of Henan province. Some parts of the measurement is assumption, for instance, as the lack of measurement of depreciation rate, it estimates the life circle. The precision of estimation may affects the precision of the final result. Meanwhile, affected by exist statistical information, use 1990 as base year, the precision may affects the final results. But it can estimate a probable range and basic trend of capital calculation of rural infrastructure investment in Henan Province by adopting the above analytical method. Also it can describes the contribution degree of rural fixed assets in the economy development. How to make a more actual estimation is still under exploration and research.

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Research on the Coupling Effect of Vulnerability and Emergency Management Availability of Critical Infrastructure

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Abstract

This paper researches on disaster-reply of critical infrastructure in emergencies from the angles of vulnerability evaluation and availability evaluation of emergency disposal. This paper provides related research system framework between vulnerability of critical infrastructure and availability of emergency management. This system creates the theory foundation for the evaluation on the ability of critical infrastructure's disaster prevention and mitigation, the formulation of emergency plan system and the creation of protective plan.

INTRODUCTION

Sudden natural disasters mainly include meteorological disasters (including flood, typhoon, drought, hail, snowstorm and freeze injury, etc), earthquake, geological disasters (including landslide, debris flow and collapse) (Zhang and Liu 2010). Critical infrastructure refers to the facilities such as transportation, water supply, gas supply, power, and communication that will have key effects in the process of disaster resisting and reducing (Maliszewski 2011). Scientifically, the defense and protection of critical infrastructure (CI) have created the main part of life-system which the human being depend and focus on (Liu et al. 2011). Critical infrastructure is a complex, co-existed and webified technological system. In emergencies, the failure or part failure of single system will fail other related systems and influence national health, territorial safety, commercial stability and government further (Liu et al. 2009; Wu and Liu 2011).

THE VULNERABILITY OF CRITICAL INFRASTRUCTURE

The concept of vulnerability originates from the research of natural disasters. Vulnerability is regarded as an ability or possibility. The ability of disaster-bearing and recovery of critical infrastructure as the main disaster-bearing body decides the influence of disaster and the effects of disaster resisting. From the 80s of 20th century, vulnerability has become a hot area in international theory community. It concerns the area such as emergency management, environmental and ecological changes and sustainable development, etc. From the 21th century, the academic community has paid gradual attention to the research of vulnerability (Janssena et al. 2006). Many international scientific plans and organizations have put the research of vulnerability on agenda. Vulnerability has become one of the most difficult problems of catastrophology.

Theory development of vulnerability. Vulnerability is the level of bad influence in disaster. The quality and quantity of the bad influence are controlled by the flexibility of the system. Flexibility shows the ability of disaster-bearing and recovery of the system. After the first report of IPCC in 1990, Watso gave vulnerability a detailed definition. He thinks that vulnerability refers to the scale or level of one system damaged by the climate change, and it is the function of sensitivity and adaption to climate change. George thinks that vulnerability as a comprehensive measure of natural and social vulnerability of one region is created by exposure, resistance and recoverability. Pearce(2006) divided risk management into four parts HIRV (the hazard, impact, risk and vulnerability). Vulnerability is defined as the sensitivity and bad influence of disaster in the aspects of human, property, industry, resource, historical construct. So he thought vulnerability was a main part of risk management. Recently, the academic community has researched the concept and creation of vulnerability gradually. (Smit and Wandel 2006; Füssel 2007; Fang and Yin 2007) Vulnerability includes more and more elements and it has changed from a common meaning to a gigantic and independent concept system.

Evaluation methods of vulnerability. Evaluation methods of vulnerability mainly include the following aspects: (1) What disturb the research object? (2) What's the character of the high (low) unit of vulnerability? (3) What's the time and space situation of vulnerability in research region? (4) What's the decisive element of situation? (5) How to reduce the vulnerability of evaluation unit? At present, research on evaluation of vulnerability has achieved many fruits in the area of natural disaster, international environment change, ecological environment, etc. Some fixed or half fixed evaluation methods of vulnerability have been deduced and applied. Evaluation methods are classified into five kinds: composite index method, coverage overlay method, function model method, fuzzy matter-element method, and risk analysis method.

Vulnerability facing disaster. Vulnerability research is applied in all areas of disaster evaluation, including flood vulnerability research, power system vulnerability research, agricultural drought vulnerability research and sea shore cities' natural disaster vulnerability research. Moreover, the model and method of vulnerability research are different according to different research objects. For example: regional difference of natural disaster's vulnerability is analyzed in China based on data envelopment analysis model; sensitivity, possibility and risk of landslide is analyzed and applied in landslide warning based on 3S; theory model of regional disaster-bearing body's vulnerability is created with the help of fuzzy comprehensive evaluation theory and the function and creative policy of disaster-bearing body's vulnerability evaluation system is created; evaluation model and calculation theory of critical infrastructure's vulnerability are used in the research on disaster resisting and reducing of critical infrastructure.

Evaluation of the research on critical infrastructure's vulnerability. (1) After so many years' development, the basic theory of vulnerability has created gradually. Its research content has developed from single environment area to catastrophology focusing on the analysis and evaluation on the ability of disaster resisting and reducing. But research space still exists in evaluation of critical infrastructure's disaster resisting and reducing ability.

(2) In the area of critical infrastructure's disaster resisting and reducing facing sudden natural disasters, vulnerability evaluation mainly focuses on the research on single disaster-bearing body or single system. The evaluation lacks analysis of overall choice for disaster-bearing system and the creation of related methodology system. Especially, the research on the protection system of critical infrastructure needs further development.

(3) Research on evaluation theory and method of critical infrastructure's vulnerability as life-system lags behind national economic development. It cannot provide the government's decision-making departments with scientific support in the aspects of critical infrastructure's plan, construction, maintenance, strengthening, update so as to influences disaster resisting and reducing level of our nation's critical infrastructure facing sudden natural disasters.

(4) The old vulnerability research mainly focuses on natural elements. At present, new challenge has been provided as the appearance of multi-subjects' blend. Vulnerability of infrastructure not only shows in its fixed physical nature, but also depends on the effectiveness of related disposal in emergencies. So the related research between the vulnerability of critical infrastructure and the effectiveness of emergency management has great influence on the protection of critical infrastructure and the research on disaster resisting and reducing.

RELATED RESEARCH BETWEEN VULNERABILITY AND EMERGENCY MANAGEMENT

The lost caused in emergencies such as natural disasters, security incidents, public health events, and group incidents not only decides fixed vulnerability of critical infrastructure, but also has direct connection with the effectiveness of disposal including an emergency system created by plan, material reserve, replied duty plan, critical infrastructure's protection plan, information resource, knowledge system focusing on any possible risks of typical infrastructure or infrastructure net. The availability also has direct influence on influence and related net caused by emergencies.

CVAT model. CVAT (Community Vulnerability Assessment Tool) which has been applied in many states of the United States is provided by the National Oceanic and Atmospheric Administration (NOAA). It is a risk assessment method in which providing the risk mitigation measures with technology support. CVAT model provides the risk managers with efficient plan and hazard reduction measures. Its way is flexible and it can test the availability of the present policy with the help of technology method such as geography information system. CVAT model includes seven steps, as is shown in Figure1.

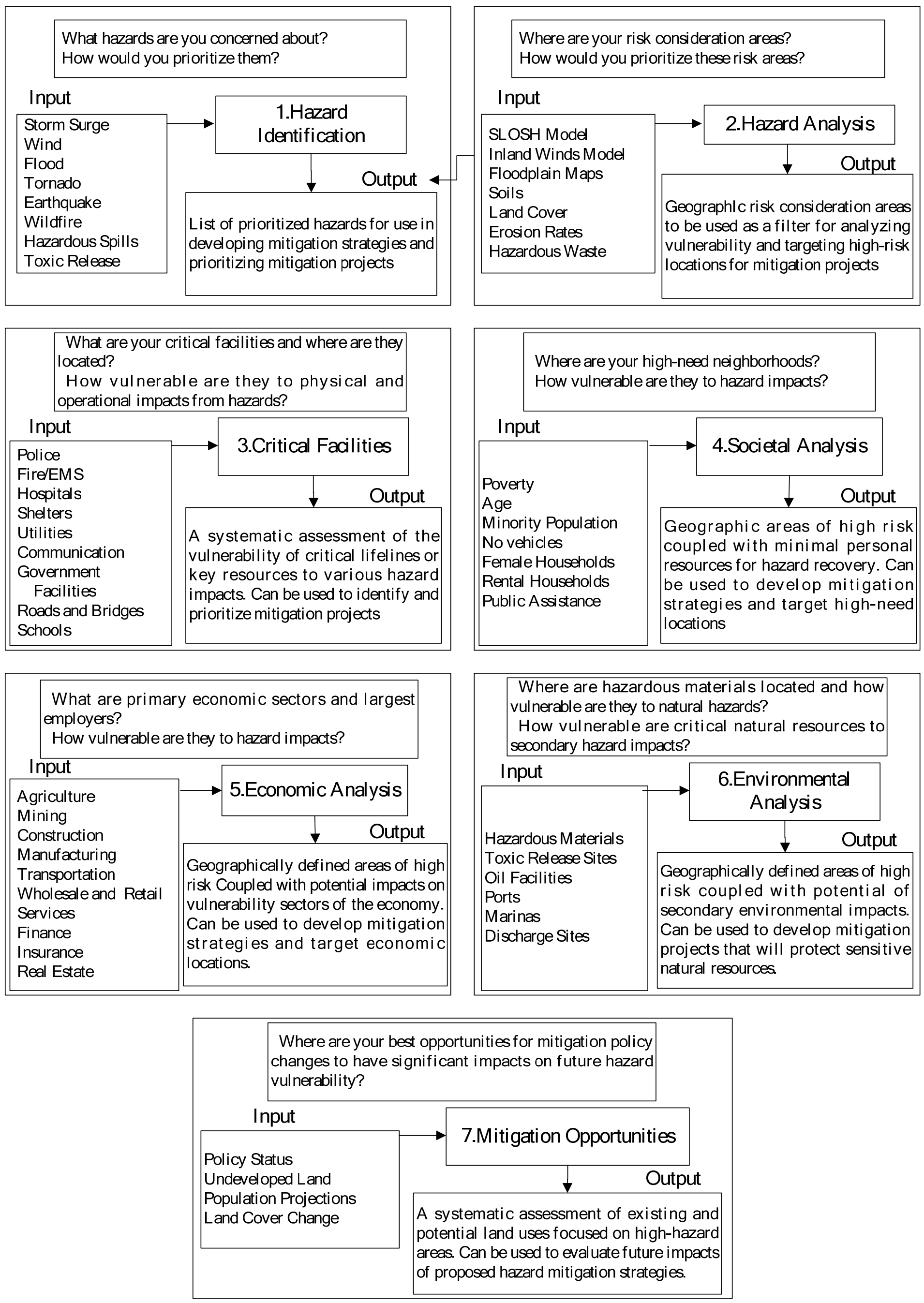

Figure 1.Community vulnerability assessment tool process.

Step1: identify hazards. Step2: profile hazards. Step 3: inventory assets. Step 4: inventory society. Step 5: inventory economy. Step 6: inventory environments. Step 7: inventory hazard reduction chance.

This model has the following characters: mainly focus on the risk factors that will cause serious hazards; consider comprehensively all kinds of risks and hazards; the results of risk assessment have important guiding value for risk management and hazard reduction plan; the method of risk assessment is built up on the possibility and result of hazards. It considers the influences of hazards in the aspects of economy, society, and environment separately. But generally the hazards influence human, economy, infrastructure, ecological environment and social environment at the same time and need comprehensive consideration. It is necessary to develop a set of risk assessment system which not only includes the above advantages but suits for Chinese conditions, especially for the critical infrastructure.

Related research system. The hazard risk assessment model not only creates a set of scientific mathematics calculation method, but considers the practical application value as well. The smoothly development of risk assessment is influenced by technology, society, organization, politics and history, etc. So, the creation of risk assessment model must not only consider technology factors, but also mix the social factors concerning with it. A full risk assessment model should satisfy the following demands: mix the region and city plans to implement hazard reduction strategies; full risk communication to create unit and accurate understanding towards the risk among different departments and groups; full and reliable way of acquiring qualitative and quantitative data; reliable way of identifying risk that can be mastered by the be harmed groups so as the individuals and departments which are in charge of emergency duty; define the vulnerable group of the society accurately; full and accurate risk identification; solve the uncertainty and limitation of the mathematics model and the predictive evaluation of the professors; not totally rely on technology, data; reasonable cost within the limit of government and society.

Risk evaluation about critical infrastructure should consider its vulnerability and availability when the critical infrastructure encounters emergencies so as the relation between them. Comprehensive risk evaluation and protected system about the vulnerability of critical infrastructure and availability of emergency management should be created, as is shown in Figure 2.

Comprehensive evaluation system can be divided into three stages. Top design mainly focuses on legality, system, mechanism in the process of dealing with emergencies as a core question. This stage researches risk preference of critical infrastructure and creates top relation and the dependence of right changing.

In terms of risk preference, the appearance of hazard and related description are researched according to the analysis of emergency scene. Evaluation index for disaster-bearing body is created, disaster source of disaster-bearing system is analyzed, and vulnerability evaluation and target ability are evaluated.

In terms of the dependence of right changing, related resource stream is designed according to scene restraining. Decisive knowledge supports are provided in the following aspects: research on emergency rules, knowledge recommend and creation of knowledge depository. Information resource storage is created through the way of acquiring multivariate data, mixing multivariate information, and developing system prototype.

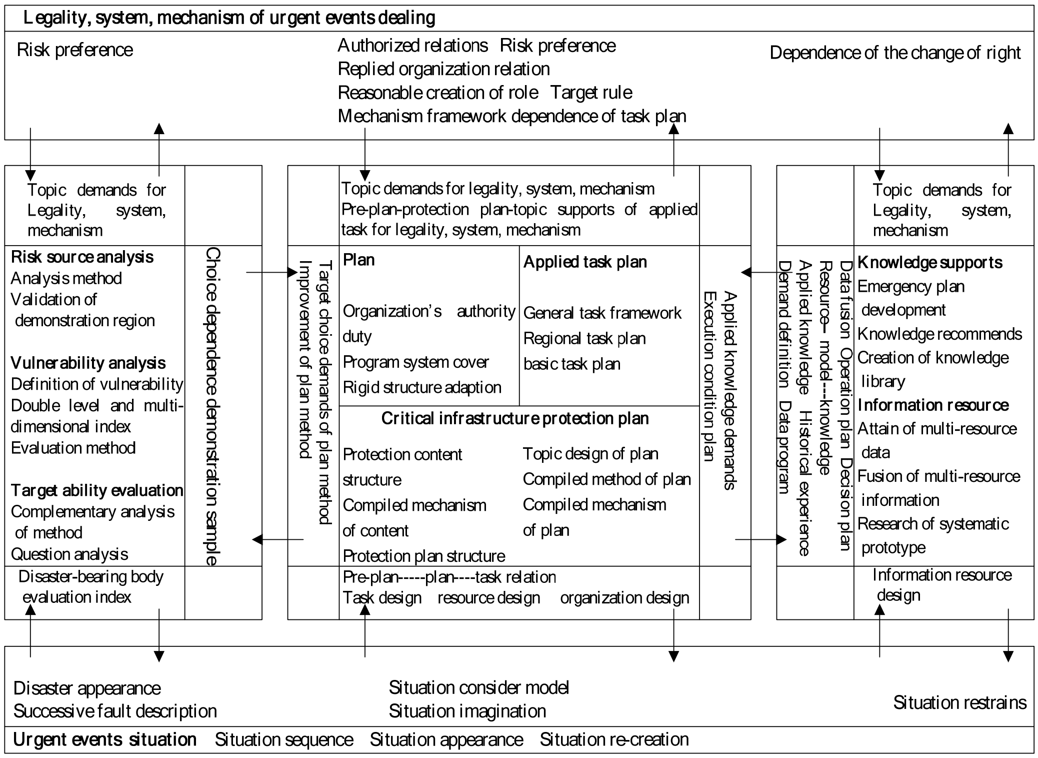

Figure 2.Related research system of vulnerability and emergency management availability of critical infrastructure.

Based on the above researches, this paper analyzes related plan, protect plan and task relation of critical infrastructure and finishes original plan to deal with task plan and protection plan for critical infrastructure. Further, in emergencies, comprehensive risk evaluation and protection system are created with the help of the following aspects: analysis of risk source and vulnerability, research on availability in emergency decision, knowledge supports and information system, protection of legality, system, mechanism.

CONCLUSION

This paper researches on risk evaluation and protection of critical infrastructure from the angle of related analysis between vulnerability and availability of emergency management. First, this paper analyzes vulnerability theory of critical infrastructure, evaluation method and real application so as to point out shortcomings of the theory. From the aspect of emergencies, this paper creates comprehensive risk evaluation and protection system for vulnerability of critical infrastructure and availability of emergency management based on CVAT model evaluation method. This system provides a new angle for the research on risk evaluation and protection of critical infrastructure. The detail model method and index system still need further studying.

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The Outlet of Real Estate College Education in Industry Transformation

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Abstract

Development of professional education has a very significant meaning for the entire real estate industry. This article describes the situation and problems of Chinese real estate education. Through combining the pressure of industry upgrading which the real estate industry now faces, it also proposes the training objectives of future talents and the reform direction of professional education.

INTRODUCTION

Under the high-speed development of real estate in these ten years in China, the real estate professional education in colleges has formed the atmosphere which pay little attention to academic study, it make one-sided emphasis on practice in order to meet the business. With the pressure of industrial upgrading the real estate is forced to change into specialization and identification in this year. In order to solve the problems, on the one hand, related majors in colleges should emphasize on the academic theory research, which can help the development of the industry. On the other hand, we should change the way of training talents, emphasize on the development of professional and theoretical lessons to meet the demand of the real estate in the future.

PROBLEMS OF REAL ESTATE COLLEGE EDUCATION

Real estate in China developed into an important pillar of national economy at an alarming rate in ten years. At the same time, the real estate professional education in colleges also ushered in a big development. In late 1990s, majors about real estate brought in an upsurge and the sum of the number of the majors in colleges was nearly 150. Till 2014, majors about real estate blossomed everywhere in China. There were totally 408 majors about real estate in academies and higher vocational education, 100 in colleges, 12 in professional and graduate education, which was benefited from the boost of real estate in 2005 (Chen et al. 2013). However, just like the real estate industry, the development of the professional education had an unprecedented scale but low quality.

The real estate industry started from 1990s, and broke out around 2005 after several years of relatively stated development. The total investment of real estate industry increased more than 5 times, which is risen from 1591 billion in 2005 to 8601 billion in 2013. The ratio of the total investment of real estate to GDP was changed from 8.6% to 15.2%. So real estate industry is the important force of the fast economy growth in China in these 10 years. But besides these, real estate industry's operating was dropped behind and had low efficient for its over-reliance on recourses like finding and land and the original development model.

Although the real estate professional education in colleges is highly developing with the industry, its quality is not high. First, real estate industry only has 20 years of history, which is on the stage of satisfied the social rigid demand. It doesn't have professional knowledge and practical experience that are consistent with China's national conditions, because it doesn't have a complete process from start to mature and a development course under different historical backgrounds (Wang 2006). Second, the development of real estate can be described as simple and crude. Instead of paying attention to scientific management and outstanding project design, to secure land resources, bank loans, administrative license or not becomes the core of the business. This also led to the shortness of space greatly in the industry for real estate professional knowledge. All these factors influence the professional education on two sides:

Professional education of real estate is not deep enough. The scale of specialized department and the proportion of capital investment are low in business organizational structure for lack of scientific and modern management system. For example, the average investment of industry-wide project planning and research and development account for only 2% of the costs. On the other hand, many talents who have professional background don't engage in related work; or in related posts but don't need that much professional knowledge. Apply their knowledge. The colleges won't have force for deep education if the knowledge cannot be used. In order to solve the problem, many colleges simple theoretical knowledge, increase the component of practical curriculum and let students practice in company directly. These steps solve the problem of how to connect students and industries, and pave the way for students' employment. However, this seems more like employee training or specialized secondary education, instead of higher education. If the talents don't meet the business needs, the scale can be reduced. When higher education serves the society, it should shoulder the responsibility to lead the advance of social productivity that we should not forget.

The academic research level and target of real estate major is not enough. Professional academic is an important part of education. With the development of real estate industry, related academic research becomes increasingly active, and all kinds of articles, conferences and forums are countless. For example, there are no more than 20 thousand papers about real estate each year that published on mainstream journals in China before 2005. Relatively, over 40 thousand papers each year in these ten years. As the most popular articles were quoted less than 300 times and nobody cared most of the papers, we can see that most articles are low level and without reference value. On the other hand, related academic research and industry are not connected closeness. The trend of real estate industry is influenced by policies, while the academia is few to plan for the trend of future policy and study the solutions.

The development model of real estate industry in last ten years make the professional education no important help for think-tank and training for reserve talents, it almost stay in the stage of marginalization.

TALENTS FOR REAL ESTATE INDUSTRY TRANSFORMATION

National control for the regulation of room rate keeps growing and the effect seems clear in these years. Especially in 2014, the growth of real estate investment has a marked decline under the policy of limited purchasing and limit credit. The investment of real estate is 77220 billion during January to October, it nominal increases 12.4% and compared to the same time last year, it decrease 6.8%, which starts to below the growth of the fixed asset investment in China. In the next half year, control policy started to loosen, but the central bank introduced the monetary and financial policy, which change the trend of the investment. With more and more fund flow out from property market, investment and speculative transactions in the real estate industry has a substantial decline, the volume reduces, price changes from rising to a slow decline, and the real estate crash theory becomes more popular. The author believes that the current situation determines that real estate industry won't have a massively recession, but a profound adjustment. Real estate industry is changing from the stage that compete for resources to the new development model which operational efficiency compete with each other, product differentiation strive with each other and introduce new profit.

The professional education way that sends students to the company cannot help the industry to develop during transition period. First, real estate industry need to discuss the way to develop like testing and verifying transformation method and ideal business model among education, academia and business. In this special time, academia should serve the industry; shoulder the responsibility to lead the idea and research, so that it can develop better. Second, real estate industry during transition period should train existing employees and recruit specialized talents to complete more scientific organization and management, better project planning and more strict cost control. To solve the problem during transition period, colleges should raise professional training objectives to a higher standard. In the first place, new professional talents need completed theory system and know the operating rule in the industry. In the second place, have the picture of industry without parochial vision, and understand every part of the industry. In the third place, they are good at study, adaption and solve the changes during the transition period quickly (Baxter 2007). Industry restructuring has a strict demand for the talents, while the quality of professional education determines whether the industry can transit fast and have high quality.

SOLUTION

Real estate's professional education in colleges don't have a scientific talents training way, because its vision is narrow and over meet the industry's need. Now it is a good chance for colleges to correct mistakes when the real estate is changing. If the real estate industry and the professional education want to change successfully, become the important part of the industry, they need to take measures, reform quickly, train professional ability and talents that can adapt to scientific and modern need.

Making the personnel training plan. Real estate industry has a long chain and big scale. From a global point of view, it is very important to set a united and fundamental training goal. Real estate is an integrated subject that can be divided into several parts like real estate management and administration, real estate appraisal and property and facilities management. Ministry of education distributes real estate major in undergraduate education to management; while to engineering in junior college. Such big differences make it hard to train professional talents. The author looks over some real estate major students' training plan and finds that most colleges want specialized and comprehensive talents, which lead to unclear target. What's more, they want to train applied and versatile talents without knowing its definition.

The author thinks that the total hours of fundamental courses, like management, economics, engineering knowledge and relevant legal knowledge, should be more that 70%. This is just like you need to have a strong body no matter you want to run or play balls. With solid foundation, it is easier to understand the knowledge and think deeply about industry system. At the same time, in order to make students more specialized and better to solve real problems, it needs to divide the work based on reality, subdivide majors and reduce unrelated courses. In summary, to apply unspecialized training, directional improvement and train new type of talents that have solid fundamentality and strong ability to develop the knowledge is the goal of real estate major.

Strengthen theory system and improve practical quality. In order to meet the company's need, real estate education in China paid less attention to the theory, which lead to the situation that employees in the company are not professional enough. Under the new situation, the number of professional employees will increase and requirement for professional employees will rise. It is said that deep roots with more leaves. Theory is the root of talents, because if employees want to have strong professional ability, they have to obtain steady theory knowledge. Real estate major in colleges can form basic knowledge system by learning advanced experience from at home or abroad and arrange courses reasonably. First, management means study the structure of the company, operating of business and theory and relations about project management. Second, understand details like the construction of cost and profit, investment, financing and risk control and real estate valuation. Third, engineering and relevant legal knowledge that means think about the problems that real estate industry may meet. All these can answer basic questions like how real estate industry work and operate, how project plan and complete, how industry produce value. And with the knowledge, questions that may appear in the future about the industry can be solved.

Besides, theory and practice should be connected about how to train talents. The target of practice should be clear; also time and effort should match the effect.

Many colleges connect study with practice and make students to spend more time to work in the company, but with limited effect of professional study, which have said before. It is good to practice, but only better executing can get effect. First, clear teaching objective of practice. It needs to set questions and search for solutions, instead of simply asking students to know what does the industry does. For example, what and how does a company do to complete a goal in real estate industry? Second, the effect of practice should be checked. Practice is a form of teaching organization, so checking is not only the responsibly of colleges for students, but also the feedback from teaching.

Develop academic study and improve the quality of teaching. The essence of developing academic study and building faculty is two sides of the same work. Both of them are based on the theory and reality, in order to solve the problems that real estate meet or will meet in the future. The differences are that the former one pay more attention to reflecting the result to the society and industry; while the latter one summarize research to experience to pass on the knowledge to the talents (Hefferan and Ross 2010).

Academic research about real estate is full of quantities, but lack of quality and influence. On the one hand, it is because the academia itself is impetuous and utilitarian. On the other hand, it is because that real estate industry doesn't need the research in the past times. However, now, real estate need to reform and a right way based on lot of basic knowledge. In order to have more development model in the future, colleges should encourage and organize academic study, discuss the trend of development of real estate industry macroscopically. Microcosmically， help the company to solve some problems like construction adjustment, product planning and innovate new products by cooperating with company actively, establishing horizontal issues and studying practical problems. At the same time, pass the advanced experiences to young teachers, and then to students.

Colleges should be the platform of employees in the company. According to the status, 78% of employees didn't have professional education in 2011. Now, it is the process of real estate industry reforming, and it is the process of specialization and modernization of company. So it is meaningful for employees' retraining. It is of course that colleges shoulder the task that to lead reeducation in the society. As an educational platform, colleges can not only improve employees' theory knowledge and scientific concepts, but also rich teaching content by their advice and understanding from work.

CONCLUSION

Real estate industry keeps increasing in these ten years, while real estate major in colleges falls into an awkward stage. Under the situation of national economic restructuring, real estate industry starts to slow down and professional and scientific reform should be done immediately. Relevant colleges should hold the chance to shoulder the responsibility to serve the development of the industry. By perfecting and strengthening the theory of training system, encouraging academic study and leading the reform of real estate industry through making use of the advantage of knowledge base, make the real estate major in colleges become an educational platform that concern the trend of industry, train and reserve core talents, improve existing backbone and serve the industry completely.

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Deriving Optimal Competition in Infrastructure Procurement

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Abstract

Typically, only a limited number of consortiums are able to competitively bid for Public Private Partnership (PPP) projects. Consequently, this may lead to oligopoly pricing constraints and ineffective competition, thus engendering *ex ante* market failure. In addressing this issue, this paper aims to determine the optimal number of bidders required to ensure a healthy level of competition is available to procure major infrastructure projects. The theories of Structure-Conduct-Performance (SCP) paradigm; Game Theory and Auction Theory and Transaction Cost Economics are reviewed and discussed and used to produce an optimal level of competition for major infrastructure procurement, that prevents market failure *ex ante* (lack of competition) and market failure *ex post* (due to asymmetric lock-in).

INTRODUCTION

Public-Private Partnerships (PPPs) have been widely implemented on the premise of delivering value-for-money (VfM) in the procurement of major infrastructure. However, due to the financial and technical prequalification requirements, PPPs often operate in oligopolistic or monopolistic markets, in which there are a limited number of bidders (De Valence 2003, 2012; Thu & Akintoye 2007). In a review of studies on market share in the construction industry, De Valence (2012) found that in countries such as Australia, South Korea, Japan, Hong Kong and the United Kingdom (UK), there were a plethora of small firms whereby their markets exhibited the features of perfect competition and a small number of large contractors, and in some instances accounted for up to 70% of turnover, which mimicked the characteristics of an oligopoly.

More specifically, De Valence (2012) concluded that large head contractors in the engineering construction and non-residential building sectors, and subcontractors that supply lifts and building automation systems exhibit characteristics of oligopolistic competition. Furthermore, Thu and Akintoye (2007) examined the four-firm concentration ratio (CR4) present within the PPP/Private Finance Initiative (PFI) UK market as fifty percent or more in most subsectors such as transport and health sectors. The CR4 is a common tool for analysing the types of market structure and can be used as a measure of competition (Scherer and Ross 1990). The CR4 is computed as the percentage of market share held by the four largest firms in the industry. The results show that almost all sub-sectors within the UK PPP/PFI construction market can be considered medium concentration or an oligopoly market. As a result this may lead to oligopoly pricing constraints and competition. In accordance with Neoclassical Economics, non-competitive markets with limited competitors can lead to an unbalanced allocation of goods and services, which is referred to as *Pareto* inefficiency (Kaufman 2011). Competition drives down marginal costs and creates downward pressure on price, as well as facilitating innovations in design, based on outcome-based specifications that impinge on the time, cost and quality of the project, and which influence the overall performance of the project across its life-cycle. With lower competitive tension in the market, there is a lack of incentives for contractors to be innovative in order to be price competitive, and which can affect the performance across the whole-of-life of the asset. On the other hand, empirical evidence from construction procurement shows that a high level of competition or aggressive bidding is associated with opportunistic behaviour in complex projects or market failure post-contract (Sweeney 2009).

This paper aims to derive an optimal level of competition in the procurement of major infrastructure from the literature, that is, a lower limit of competition level that avoids ineffective competition *ex ante* and at the same time, an upper limit of competition that avoids negative opportunistic behavior *ex post*. This is achieved by reviewing and integrating literature related to competition; the Structure-Conduct-Performance (SCP) paradigm; tendering perspectives based on Game Theory and Auction Theory; and negative opportunistic behaviour within the lens of Transaction Cost Economics.

STRUCTURE-CONDUCT-PERFORMANCE

The notion that competition can be driven by a small number of firms (oligopoly) originated from Chamberlin's (1933) seminal work in formulating the theory of monopolistic competition. Also closely related to Chamberlin's work, Clark (1940) developed the concept of “workable competition” or *optimal competition* that seeks to avoid the extreme forms of imperfect competition, which is either too weak or strong. Clark (1940) further describes workability as somewhere between “pure oligopoly, and the ruinously low prices likely to result from unlimited market chaos: more strongly competitive than the first, and more workable than the second”. The latter scenario often known as 'destructive, ruinous, chaotic or cut-throat competition' can occur in an oligopoly where the overhead costs are high and marginal costs are low. During cyclical or stand-by excess capacity in which demands fall below full-capacity levels, firms are willing to cut price well below an efficient producer's total cost of production. This scenario can be a chronic issue especially in industries exhibiting characteristics of imperfect immobility, such as bituminous coal mining and agriculture, and Clark (1940) termed these industries as “sick industries”. On the other hand, Clark (1940) observed “some of the healthiest cases of workable competition in large-scale industry” in oligopolistic industry, such as automobile production. This provides evidence that effective competition can exist amongst a relatively small number of firms.

Joe S. Bain (1950) takes Clark's argument further to the industry level and explains the relationship between the patterns of competitive behaviour and oligopoly market structure in terms of conditions of entry and market concentration. Based on Bain's prognosis, oligopolies with moderate difficulties to entry and concentration of sellers, generally display the closest approximation to workability. These oligopolies display reasonable efficiency, with low or moderate prices and profits. Essentially, under difficult and moderate market entry conditions, established firms will set prices low enough to prevent new entry and maintain reasonable efficiency in scale and capacity in the long-run, whereas the prospect of long-run efficiency is less certain under easy entry. In terms of market concentration, *ceteris paribus*, a large proportion of the market controlled by a “very few large firms and smaller firms are absent or small in number”, that is high market concentration, do not display workability; whereas, a moderate proportion of the market controlled by a similar number of large firms, and a greater number of small to medium sized firms holding the balance of the market share, that is moderate market concentration may be argued to display *quasi* competitive behaviour, such as imperfect collusion or kinked demand curve conformations. Joe Staten Bain (1951) proposes eight-firm market concentration of 65 to 75 percent as a dividing line to differentiate between effective and ineffective competition in loose and tight oligopoly respectively.

Market structures can be classified based on the degree of competitiveness in the market; using information such as market share (Shepherd 1982). Shepherd (1990,) classifies six types of market structures into two categories of competition: 1) ineffective and 2) effective. Market structures under ineffective competition are characterised by high market concentration, such as: (1) monopoly (one firm has 100 percent market share); (2) dominant firm (one firm has 40 percent to 99 percent market share); and (3) tight oligopoly (four firms have over 60 percent market share).Under effective competition, firms are not able to control prices, little collusion and low profit rates (Shepherd 1982). There are three market types under effective competition: (1) loose oligopoly (four firms have less than 40 percent market share): (2) monopolistic competition (many competitors each with a slight degree of market power); and (3) pure competition (many competitors, none of whom has market power). Based on the above, firms that operate in an oligopoly market can be in healthy competition. This has implications on infrastructure procurement, in terms of the extent of bundling and sizing of infrastructure projects, in order to generate effective competition within the limits of optimal competition.

Next, given that sealed bid auctions aim to increase competitive tension in the procurement process, the following section studies auction theory or game theory literature related to competitive bidding and the effects of the number of bidders on value of bids.

AUCTION THEORYANDGAMETHEORY

In the study of auctions and bids, there are two dominant approaches based on the assumptions of maximizing expected profits: (1) decision-theoretic approach

(Carr 1982; Friedman 1956; Gates 1967; Skitmore 1991, 2013) and the (2) game theoretic approach (Engelbrecht-Wiggans, Milgrom, and Weber 1983; Milgrom 1989; Milgrom and Weber 1982; Riley and Samuelson 1981; Rothkopfm 1969; Vickrey 1961; Wilson 1977). The decision-theoretic approach determines a satisfactory balance between the probability of winning a contract and the profit generated as a result of winning the contract. It is assumed that the bidders compete by applying a strategic mark-up, that is, a percentage mark-up to the estimated true cost of the project to form the bid value. The focus is on forecasting the distribution of bids, and determining optimal bidding by "the product of the probability of winning the contract and the profit generated as a result of winning the contract (Skitmore and Pemberton 1994)." The other approach – game theoretic approach – is based on the study of the Bayesian-Nash equilibrium, by modelling sealed bid auctions as non-cooperative games with incomplete information, and derives equilibrium bidding strategies with the assumptions that all bidders bid optimally. Game theorists have shown that aggressive bidding is associated with increasing number of bidders and reducing the value of bids (e.g., Bajari 2001; Bajari et al. 2014) and similarly, empirical studies on tendering in the construction industry show a correlation between a greater number of bidders and a reduction in the value of the lowest bid, and which is consistent with neoclassical economics (e.g., Brannman, Klein, Weiss 1987; Domberger and Rimmer 1994; McCaffer 1979; Ngai, Drew, Lo, & Skitmore 2002; Skitmore 2002).

In terms of optimal competition, Chamberlin (1933) did not specify what is considered to be a "small" and "large" number of firms. Within the game theory literature however, the focus has been on determining the lower limit of competition, that is, the minimum number of firms needed to generate effective competition. Selten(1973) was first to demonstrate that five competitors represent the dividing line between few and many, when modelled as moves in a non-cooperative game. Subsequent to Selten's influential work, Kagel and Levin's (1986) experiments indicate that auctions with 6 to 7 bidders (many) generate greater competition than with 3 to 4 bidders (small). Based on a review of empirical research and experiments, Huck, Normann, and Oechssler (2004) report that 4 and more firms are never collusive (either competitive or at Nash equilibrium); 2 is highly collusive, and 3 has reached Nash equilibrium. The literature has indicated that a minimum of 5 competitors is enough to exert high competitive pressure in the market (e.g., Huck et al. 2004; Kahn 2006; Selten 1973).As there are increased opportunities for interactions amongst firms (multi-market contacts) with repeated games or auctions, this may create opportunities for collusion. In other words, game theorists argue that cooperation or collusive behaviour is considered difficult to sustain at 5 or more competitors, even in repeated games (Huck et al. 2004).As such, this demonstrates that when four or less firms compete in a market, it creates tight oligopoly market conditions and associated pricing constraints, along with ineffective competition (Beattie et al. 2003; Shepherd 1982). More importantly, *five* competitors or bidders are derived as the lower limit of optimal competition (Huck et al. 2004; Kagel and Levin 1986; Selten 1973).

On the other hand, game theorists have also indicated the idea of upper limit of optimal competition, that is, perfect competition or intense competition leads to the convergence of the true value of the object, even when bidders have incomplete information about its value (Milgrom 1979; Wilson 1977). Capen, Clapp, and Campbell (1971) explain that when the potential competition is large, the winning firm is likely to have underestimated the value and as a result suffers from negative profits. This phenomenon is known as the winner's curse and mainly occurs in common-value settings (such as bridge construction) (Bajari and Hortacsu 2003; Hong and Shum 2002; Kagel and Levin 1986; Thaler 1988; Thiel 1988).In common value settings, bidders only have estimates of the project, and rational firms will not bid as aggressively when there are many potential competitors (Barrus & Scott 2013).In other words, having a large or excessive number of bidders does not necessarily lead to price reduction in common value auctions. As the final bid price is an optimal decision that maximises the bidder's profits and the chance of winning the bid, a larger number of bidders may result in more aggressive bidding behaviour, but not at the expense of negative profits. As bidders learn out of "a trial and error survival process that is situation ally specific" from previous tenders (Kagel & Levin 1986), and gain sufficient experience and feedback regarding the outcomes of their previous decisions, bidders will learn to avoid the winner's curse. With adequate time, this disequilibrium will correct itself given period (Kagel & Levin 1986). More importantly, game and auction theory have indicated an upper limit to competition, beyond which bid value reaches a constant.

TRANSACTION COST ECONOMICS

In addition to the lack of competition as a factor of market failure, Transaction Cost Economics (TCE) also envisages market failure occurring *exposit* due to post-contractual opportunistic behaviour. For instance, asset specificity in construction projects tends to be higher post-contract when the investment has been made, and the costs of replacing the main-contractor, subcontractor, or supplier are higher both financially and in terms of the implications for project progress. This is in contrast to pre-contract when there are plenty of alternative main-contractors, subcontractors, or suppliers in the market (Winch 2001). This change to a form of bilateral monopoly post-contract is known as 'fundamental transformation' (Williamson 1985).The more plentiful supply of bidders – the more stark the fundamental transition – and it is logical to expect, on average, more bidders in projects that are seen as attractive by contractors due to their assessment of the potential for variations, for example arising from incomplete documentation including lack of clarity in specifying requirements. Projects that are subjected to the dynamics of change and are locked into long-term contracts, such as an extremely complex PPP, create opportunities for post-contractual negative opportunistic behavior. This can open up opportunities for hold-up *ex post*. For example, Sweeney examines the major infrastructure market in Australia and observes that contractors can use low bid tendering strategies to win contracts in an extremely competitive market, and adopt a claim strategy resulting in high variation claims *expost* (Sweeney 2009). Amaral, Saussier, and Yvrande-Billion (2013) also point out that bidders may bid more aggressively to win contracts with a high potential to be renegotiated post-contract, given the chance to renegotiate after winning the contract. This shows that the current contracting practice could have resulted in *ex post* market failure, as opportunistic behaviour is not uncommon in the construction industry, especially for complex projects associated with high uncertainty, and the market can perceive the project to be lucrative in terms of a potential for variation claims, and the opportunity to make superior profits post-contract (Sweeney 2009).

Furthermore, research in construction procurement has provided empirical evidence of an upper limit of competition. Gupta (2002) examined the effects of the number of bidders on bid value based on 1740 highway construction projects in the US over a five year period. The empirical results indicate that the absolute level of competition creates downward pressure on price. That is, the value of winning bids decreases as the number of bidders' increases, but the effect on value becomes insignificant when the absolute number of bidders reaches a maximum number; in other words, a competitive threshold is reached. Gupta determines this competitive threshold to be near and up to 8 bidders in an open tender (or equivalent expressions of interest).Thus, Gupta (2002) has made the important contribution in terms of surfacing an optimal upper level of competition from a production costs and benefits perspective. Also highly relevant, Skitmore (2002) analyzed ten data sets (representing 1,234 projects), this time in a different sector than Gupta and mainly from the building industries in various countries, including US, UK and Belgium. Skitmore's (2002) findings are consistent with Gupta's study, where the regression curves show that the value of the lowest bid decreases until *eight bidders*, and remains constant as the number of bidders or competition increases. Skitmore (2002) concludes that there is a tendency for the value of bid to be significantly higher than the pretender estimate when the competition is below eight bidders; conversely, the value of bid comes close to the pretender estimate or, in some instances, is lower than the pretender estimate when the competition is greater than eight bidders.

Since production costs and benefits ratio has been shown empirically to become negligible greater than eight bidders, then this upper limit can be used to assess the efficacy of the project's specified requirements. In so far as, when tenders attract unusually strong interest beyond eight bidders, then this can be an indication of a lack of specified requirements and the likelihood of variations leading to *ex post* market failure. Moreover, Skitmore's (2002) and Gupta's (2002) empirical evidence establishes the validity of using competition as an indicator of testing the goodness of a model in terms of setting a project on a path towards delivering superior VfM. On this basis, a number of bidders in the range 5 to 8 inclusive is established as a suitable dependent variable and proxy for VfM; and an optimal response and reflective of the extent to which the procurement of the project has been optimised in relation to size, bundling and exchange relationship (Teo 2014).

In terms of a measure of competition, the extent of anticipated or expected competition, rather than the actual competition, is more likely to be a determinant of a firm's bidding strategy in a sealed bid auction. As firms do not know the actual number of bidders at the time of preparation of bids in practice, studies on auctions have been criticised for assuming that the number of bidders is known(Amaral et al. 2013). Ngai et al. (2002) propose that potential competition is dependent on market conditions; a reflection of supply capacity utilization in the industry; and can be measured as the “likely number of competitors for projects in the market”. This is affirmed by the empirical studies by De Silva et al. (2009) in road construction procurement and Amaral et al. (2013) in London bus transport; where their statistical analyses indicate that the expected number of bidders is more effective than the actual number of bidders in explaining the value of the bids; and bidders appear to be more aggressive when the number of expected number of bidders is large. Similarly, in terms of PPP procurement, and Teo (2014); Teo, Bridge, and Gray (2013) use the number of Expressions of Interest (EoI) to demonstrate the contractor's willingness to bid as a more relevant measure of expected competition. As such, 5 to 8 EoI is derived as the optimal level of competition.

CONCLUSION

To conclude, aPPP project needs to be sufficiently large to justify leveraging private finance but, on the other hand, not too large so as to yield insufficient competition, or *ex ante* market failure arising from small bidding numbers, or conditions akin to monopoly supply. At the low level of potential competition or low EoI, SCP and game theory have indicated that, 4 or less firms demonstrating their willingness to bid for a project creates tight oligopoly conditions and associated pricing constraints, along with ineffective competition. As such, 4 or less EoI can be used as an early indication of market failure *ex ante* arising from a *lack of competition associated with size or level of bundling* of the project. At the same time, a balance needs to be struck, as too much competition becomes counter-productive and can be an indicator of market failure *ex post*. This is because the market can be signalling the prospect of gains arising from poorly specified requirements or a lack of predictable requirements, which leads to hold-up arising from variations in the PPP long-term contract. TCEhas indicated that high number of bidders or EoIs (over 8), can be seen as an early indication of market failure *ex post* arising from the prospect of *lack of flexibility or possibility of renegotiation*;

As such, *5 to 8 (inclusive)* EoI is derived as an optimal level of competition, and an early indication of avoiding market failure *ex ante* arising from a lack of competition; and *ex post* arising from a lack of flexibility. It is expected that projects within 5-8 EoIare potentially on a path to superior VfM, whereas projects with sub-optimal EoI are expected to have room for VfM improvements in their procurement dimensions.5 to 8 EoI is derived as a valid and early indicator of the optimal configuration of a project's key procurement dimensions (including a PPP or non-PPP approach). Further quantitative and empiricalresearch can be carried out to test the reliability of 5-8 EoIs in generating an optimal level of competition in the procurement of major infrastructure.

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An Integrated Framework for Exploring the Vulnerability Due to Passengers' Aberrant Behaviors in an Urban Metro System

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Abstract

Metro case statistics results indicate that the passenger's aberrant behaviors (PAB) are becoming one of the major sources of metro disruption in China, which affects people's day-to-day life and social economy significantly. However, so far less attention has been paid to this theme. To fully explore the vulnerability due to the PAB (VDPAB) in urban metro system (UMS), this paper presents an integrate analysis framework for measuring passenger induced vulnerability at both the metro station level and metro network level. Distinguished from orthodox methodologies, the proposed framework lays stress on incorporating pre-incident analysis in VDPAB assessment process. Appropriate methods can be applied in each section of the framework and what fundamental points need to take into account are explained through a concrete metro case.

INTRODUCTION

For the reason of scarce land, enormous population and the urgent needs for economic development, urban metro system (UMS) in China is playing an essential role for mobility in urban area. By 2013 19 cities in China have rail transit lines in operation and another 21 cities have rail transit lines under built or been officially approved. It is foreseeable that in the near future China may expect a new challenge coming from safety and reliability aspect of metro operation.

Compared to other public transportation systems, any type of incident taking place on a UMS will be particularly felt because of the amount of passengers who rely on this means of transport and its greater vulnerability. Among numerous incidents that may disrupt normal operation of UMS, such as equipment and system fault, staff error, passenger behavior, natural disasters, terrorist attacks and etc., metro passengers whose behaviors act directly on metro operation make metro station become an problem-prone place. This point of view has been proved by the 135 nationwide incidents (including vehicle breakdowns, passenger impact, severe weather and any other near-miss events) that were collected by our research group with the time span from 2002 to 2012. Incident statistics shows that at least 65% of the metro incidents in China were caused by various types of passenger's aberrant behaviors (PAB) which lead to 19 min average time of metro delay and 57 casualties in total. The worse is that the number of the PAB incidents in China is on the rise seeing the data from recent years (the increase rate are 12%, 14% and 18% respectively for 2010, 2011 and 2012).

It is therefore necessary to know the crucial factors that can play a decisive role in PAB incident formation as well as the vulnerable elements of a metro network (links or nodes) regarding both the benefits of metro operation companies, designers and local government. To fully understand UMS vulnerability due to passengers' aberrant behavior (VDPAB), this paper firstly define the contents of vulnerability of UMS, and then spend a lot of ink on analyzing passengers' aberrant behaviors (PAB), which as stated previously is a new but of great importance theme facing by UMS in China. At last, we propose an integrate VDPAB analysis framework for UMS in which comprehensively incorporate vulnerability analysis at both metro station and network level, as well corresponding key points are explained.

VULNERABILITY OF URBAN METRO SYSTEM

To date plenty of vulnerability research has been done for transportation network. These studies can be differentiated according to whether they apply graph theory and complex network indicators (Matisziw et al. 2009) or accessibility and serviceability indicators (Berdica 2000; Jenelius et al. 2006; Taylor et al. 2006; Balijepalli and Oppong 2014) when measuring system's vulnerability. The latter is always related to transportation system/network. We begin this section with examining the status of vulnerability studies in transport area, and then explain the importance of adding pre-accident analysis into the existing vulnerability analysis practice. Table 1 summarizes some crucial methods for network/system vulnerability analysis in the transportation field.

As can be seen from Table 1, most of vulnerability research concerned with transportation field was carried out from a geographical perspective and with the scope of whole network, as it is often for transport planning and maintenance purpose. In these cases, accessibility measured by travel cost related indices (e.g. travel time) was frequently used as the indicator of vulnerability in an after-incident analysis, where hazard scenarios were predetermined. There are rarely literature focusing on what cause the incident and how the related factors combine to form an incident or a hazard scenario. From risk prevention point of view, however, a pre-incident study should be merged into the orthodox methodologies so as to establish a more exhaustive framework for vulnerability analysis.

Thus, UMS vulnerability can be interpreted essentially akin to Berdica (2002) who first proposed the definition of vulnerability in the road transportation system. Vulnerability of UMS is the measure of crucial/decisive factors in hazard scenarios derived from disruptions at metro station or subsystem level, as well as the assessment of the susceptibility of the whole network to these concluded hazard scenarios. When it comes to present study, disruptions are particular to PAB incidents and susceptibility here implies system's ability maintain its serviceability against a hazard scenario.

Table 1.Classification of Transportation Network/System Vulnerability Assessment.

Sources	Indicators	Specific Indices	Type of TNS	Risk/Hazard types	Risk/Hazard analysis	Scope
Berdica (2000)	Sensitivity	Travel time, trip length etc.	R	TA/PF	SAS	WL
Jenelius (2010)	Importance	Travel time	R	NE	DSD	WL
Taylor et al. (2006)	Accessibility	Travel time, Hansen, ARIA	R/RT/A/W	NE	DSD	WL
Sohn (2006)	Accessibility	Distance, travel time	R	N	SAS	WL
Jenelius et al. (2006)	Importance and exposure	Travel time	R	NE	DSD	WL
Scott et al. (2006)	Robustness	Travel time, traffic flow, spatial characteristics	R/RT/A/W	NE	DSD	WL
Nagurney and Qiang (2007)	Efficiency	Number of trips per unit cost	R/RT/A/W	NE	DSD	WL
Yang and Qian. (2012)	Resilience, the most signify loss	Users' final lost time	R	NE	DSD	WL
Berle et al. (2011)	Resistance, resilience	Not quantitative	W	TM/PF/MT/N	SSA	WL
Rodríguez-núñez et al. (2014)	Serviceability, criticality	Travel time, the number of missed trips	RT	NE	DSD	WL
Balijepalli et al. (2014)	Serviceability, importance	Loss of capacity	R	NE	DSD	WL

Note: types of transportation network/system (TNS) analyzed: R: road; RT: rail transit; A: air transport; W: water transport. Risk/hazard types: NE: not explicit; TM: terrorism and malevolence; TA: traffic accidents; PF: physical failure; MT: manmade or technological; N: natural. Risk/hazard analysis: DSD: designated scenarios directly; SAS: some analysis before confirming scenarios; SSA: separate and specific analysis. Analysis scope: WN: whole network; L: line; N: node.

METRO PASSENGERS' ABERRANT BEHAVIOR

As yet, there has been little work in analyzing metro passengers' behavior except some studies on metro suicide behavior in terms of epidemiology (Gershon et al. 2008; Lin and Gill 2009; Niederkrotenthaler et al. 2012). So in this section we are going to analyze metro passengers' behavior and its impact on metro system.

PAB patterns. The PAB is the kind of passengers' behavior that can lead to direct or indirect casualties, facilities or subsystem damage, operation delay and any other consequences that may endanger metro's normal operation. In order to detect the performance of the PAB, we conduct a field observation based semi-structure interview towards Nanjing metro from Aug. 15th to Sept. 2nd in 2013. During this period, 20 metro employees whose work contact directly with passengers and 10 random selected metro riders took part in the investigation. Upon the results of field investigation and 88 passenger related cases study, 12 main patterns of PAB are summed up and further divided into 3 categories as violations, errors or slips and lapses, and environmental influence in accordance with Reason's behavioral model (Reason et al. 1990; Elliott et al. 2007; Sullman et al. 2011) (see Table 2). Table 2 in the meantime indicates the percentage of each PAB accounting for the 88 cases, hazard occurrence place and potential consequences given the PAB occurred. It is noticeable that the most dangerous places in a metro station is the "interface" between the waiting zone and operation zone as 82% of the PAB cases were found to happen in this area.

PAB formation mechanism. To gain a qualitative understanding of PAB, figure 1 illustrates a common formation mechanism among the heterogeneous PAB patterns. A metro passenger's behavior can be affected by many factors, such as psychology, physiology, other passengers' influence, train running, station safety facilities and etc. These internal and external factors have their own status that may be normal (prevent the PAB from occurring), critical or abnormal (boost the PAB). A PAB incident occurred means those incident-promoting factors (IPF) are out of control of the incident-impeding factors (IIF). The crucial IPF of a given disruption (incident) reflect system's vulnerable points. We describe the mechanism simply through a real case called "Forcing Riding" behavior (case1):

Case 1 Time: Sept. 24, 2012 at 7:05 AM. Location: Maigaoqiao station of line #1 in Nanjing metro. Event: at morning rush hour, a passenger tried to force a carriage door open just after the door began to close. The driver noticed the danger when doing observation work and informed station attendants who finally stopped the passenger. Consequences: carriage door malfunction, train operation delayed 10 min, no one got injured.

Table 2.The Metro PAB Performance Patterns and Its Potential Occurrence Place, Consequences and Case Proportion.

Categories	PAB patterns	Hazard occurs at…	Potential consequences	Case proportion (%)
Violations	Jumping into/lying on track area	TA	C/D	30
	Carrying prohibited articles	SH/TA/PF/T/PW	C/E/D/F/TO	1
	Forcing the door open when getting on/off	PF/T	C/D	14
	Fiddling with metro facilities (e.g. emergency button)	PF/T	D	2
Violations	Leaning against the screen/carriage door	PF/T	C/D	0
	Crossing the safety line when waiting at platform	PF	C/D	11
Errors or slips and lapses	Falling into track area	TA	C/D	15
	Belongings falling into track area	TA	C/D	3
	Misuse metro facilities (e.g. emergency button)	PF/T	D	7
Environmental influence	Crowded stampede	SH/TA/PF/T/PW	C/D	3
	Conflicting between passengers	SH/TA/PF/T/PW	C/D	9
	Sudden illness	SH/TA/PF/T/PW	C/D	5

Note: SH: station hall; TA: track area; PF: platform; T: train; PW: passageway; C: casualties; E: explosion; D: delay; F: fire; TO: toxicosis.

In this incident, passenger was anxious to catch the train and lack of safety awareness (psychological IPF). Though station attendant finally stopped passenger's forcing behavior, it seems not timely (metro staff IPF). If the station attendants can detect the incident themselves and take action at once, the result may be better. Carriage door anti-pinch function failed (safety facility IPF). Albeit the impeding effects from driver sufficient observation (driver IIF), the PAB incident occurred because the total IPF effects overpass IIF effects.

METHODS CAN BE APPLIED IN CRUCIAL FACTOR IDENTIFICATION REGARDING PAB

(1) Probabilistic Risk Analysis (PRA). The most common logic diagrams adopted by practitioners of PRA are Fault Trees (FT) and Event Trees (ET). FT and ET can be used complementarily to generate incident scenarios, which are sequences of events,within the identified list of incident causes defined from whatever available evidence we may have; the ET provides the basic scenario space of events and pivotal points, while the FT or master logic diagram (MLD) is used to quantify the initiating events (IE) at pivotal points

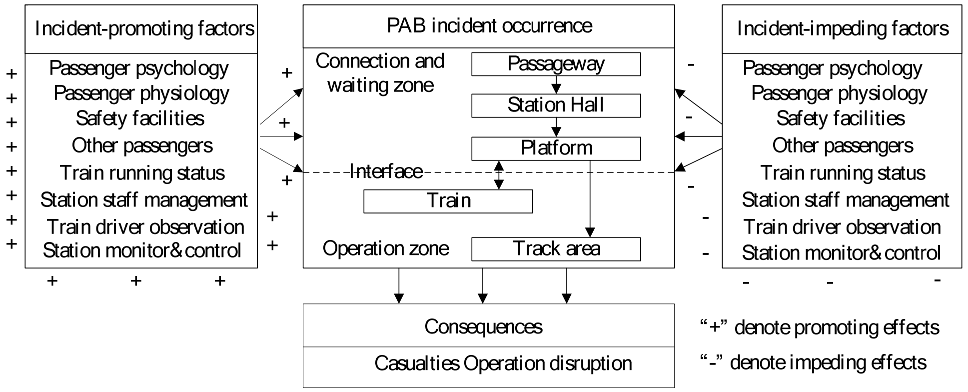

Figure 1.Formation mechanism of PAB incident.

(Garrick et al. 2004; Fleury and Brenac 2001; Kim et al. 2003; Ahn et al. 2008; Aven 2007). Based on this logic, hazard assessment and vulnerability assessment can be linked to create a representation of integrate incident scenario model (see Figure 2).

We continue to use case 1 exemplify the steps of modeling a PAB incident scenario through the model in Figure 2.

(i) "Forcing Riding" is set as the top event that initiates a disruption at "interface" area of the metro station since the purpose here is to seek the crucial factors promoting the IE but not generate as many IE as possible.

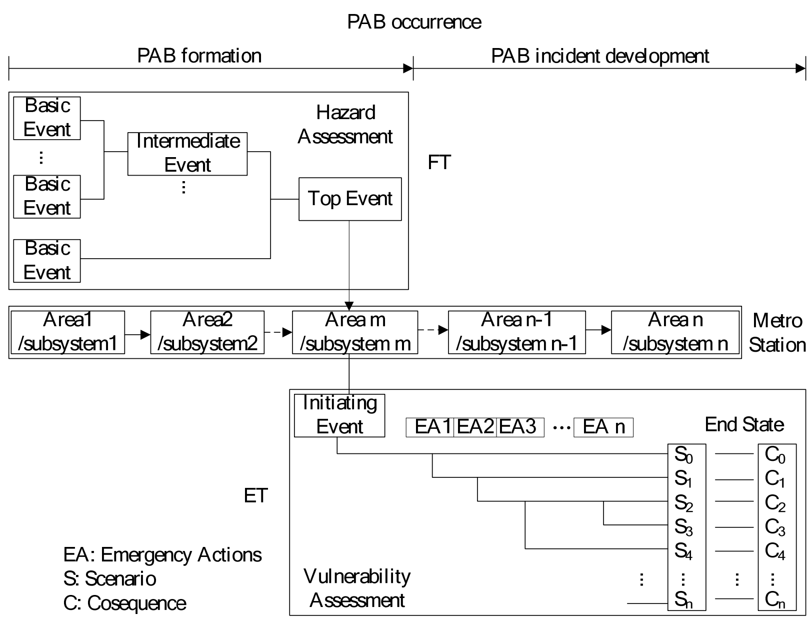

Figure 2.Integrate incident scenario model.

(ii) Construct a FT like model that provides the logic between the IE and basic events. Evidence from expert's opinions and accident history should be adopted to identify the events and relationships that contribute to the "Forcing Riding" behavior, in case 1 such as high volume at platform, long departure interval of the train, poor management of station staff and etc.

(iii) Develop hazard scenarios resulted from "Forcing Riding" behavior through the ET to establish levels of consequences. A pivotal point here is an emergency action (EA) used to specify system success or failure. For case 1, one action is "the driver discovered the danger". Two branches for this action "Yes" or "No" lead to the next branch or a certain end state.

(iv) Quantify the basic events and hazard scenarios on the basis of the collectivity of relevant evidence.

(v) Assemble the scenarios according to consequences levels that reflect in time length of metro delay and number of casualties.

(2) Theory of Planned Behavior (TPB). To explain why people behave the way they do, numerous models have been devised. Among TPB is a well-known frame of reference, according to which people's intention to perform a certain behavior is determined by their attitude towards the behavior, their subjective norm, and perceived control over the behavior (Ajzen 1991) (structural diagram of TPB see Figure 3) (Ajzen 1991). To date TPB and its extended variables including moral norm (Zhou et al. 2009; Moan and Rise 2011; Chorlton et al. 2012), past behavior (Elliott 2003, Forward 2009; Chorlton et al. 2012; Dinh and Kubota 2013), self-identity (Chorlton et al. 2012; Elliot 2010; Zhou et al. 2009) have been applied to measure a variety of traffic behaviors, especially to traffic behaviors with the intention to violate, e.g. speeding (Parker et al. 1992; Elliott 2010; Forward 2006;Forward 2009; Steg and Brussel 2009; Dinh and Kubota 2013), dangerous overtaking (Parker et al. 1992; Forward 2006; Forward 2009) and risky road-crossing (Zhou et al. 2009; Evans and Norman 2003).

According to a widespread but informal convention, the indicators of TPB constructs are obtained by means of self-reports and the measures of TPB's constructs can be direct or indirect (Ajzen 2002). Actually there is no sharp criterion for judging which measure method is more appropriate in a study, but it is empirically conditional on research purpose and should be decided at the very beginning of the investigation. If the ultimate aim is to predict the behavior or test the predictive power of additional variables, direct measure always helps (Forward 2009; Zhou et al. 2009; Steg and Brussel 2009). Indirect measure, on the basis of the corresponding beliefs of each TPB constructs, is efficient when the final goal is to examine the beliefs or motivations underlying the behavior (Elliott et al. 2007; Chorlton et al. 2012). Moreover, a small pilot study is always required in indirect measure to elicit salient behavioral, normative, and control beliefs (Ajzen 2002; Elliott et al. 2007; Chorlton et al. 2012).

AN INTEGRATE FRAMEWORK FOR ANALYZING THE VDPAB

The proposed methodical framework (see Figure 4) for passenger behavior induced vulnerability analysis includes three main steps and two different but connected analysis levels.

The incident analysis phase aims at identifying all the potential and worth focusing passengers' behaviors of aberration and screening out those of significant importance as the further analyzed aberrant behaviors to be put into next steps. Supposing sufficient history data of PAB incidents from nationwide are available at hand, two types of PAB should upmost be focused on: (i) the PAB with highest frequency; (ii) the PAB with most dangerous outcomes. Nevertheless objective data is considered by many to be the most difficult challenge, intelligence information and field survey can provide evidence for the screening process.

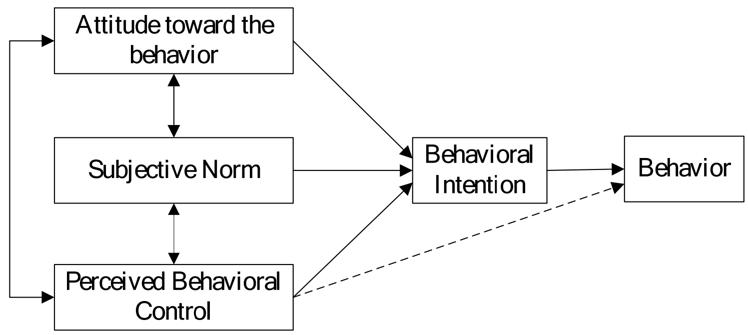

Figure 3.Theory of planned behavior.

The next step "vulnerability analysis at metro station level" which is initially proposed in present study has been amply described in the previous sections. In short, any influence factors from environmental to personal that lead to a PAB should be detected and screened to structure the hazard scenarios. Probabilistic-based (e.g. Probabilistic Risk Analysis, Bayesian Theories) and self-report-based (e.g. Theory of Planned Behavior, Health Belief Model) methods can be used to identify the crucial/decisive factors from the hazard scenarios. Furthermore, hints or priorities for metro facilities design and metro station safety management would be obtained on the basis of station level vulnerability conclusions.

The last step of the analysis is that of accounting for network level vulnerability within the context of the inputting scenarios generated from the prior steps. It is to say in the present integrate framework the output of the station level vulnerability assessment is the input to the network level vulnerability assessment. As suggested by previous studies (Rodríguez-núñez and García-Palomares 2014; Balijepalli and Oppong 2014), serviceability indices like average travel time, loss of capacity are so far proper indicator in measuring vulnerability from a network scale analysis. Depending on the obtained results, network improvements and emergency plan modification may be proposed to reduce the vulnerabilities of UMS.

Let's turn to the concrete example. The actual occurrence of Case 1 is one of many different pathways through an ET like logic diagram (potential scenarios) that results from the IE "Forcing Riding" behavior. This scenario lead to the consequence of 10 min delay in morning rush hour at Maigaoqiao station and 0 casualties and is linked to consequence level 2 by assuming "no effect" to be level 0, "delay less than 30 min" be level 1, "delay more than 30 min but under 120 min" be level 3 and "delay more than 120 min" be level 4 (casualties and influence of time period can be converted to delay time measurement).

Similarly, all the potential scenarios derived from "Forcing Riding" with the same or different time and space foundations are going to be assembled according to consequence levels and then be set as the hazard scenarios for network vulnerability assessment.

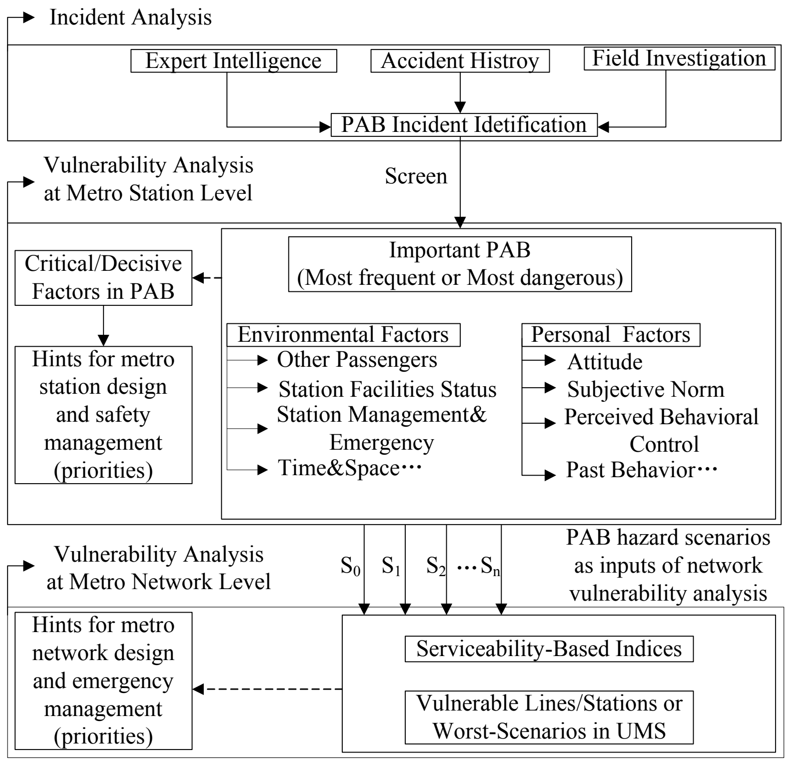

Figure 4.Integrate framework for analyzing the VDPAB in UMS.

CONCLUSIONS

Vulnerability of public transportation is a field of great safety and economic importance. This paper firstly describes the definition of the UMS vulnerability and then looks into the general formation mechanism of PAB incidents. Finally an integrate framework which consists of two correlated analysis levels has been put forward. Specifically, structuring the potential hazard scenarios derived from important PAB and their corresponding consequences level is the hardcore of the station level analysis, where the crucial/decisive factors of promoting the development of PAB should be identified as the vulnerable points of metro station. The generated hazard scenarios are subsequently used as the inputs of network vulnerability analysis. To continue network level analysis, serviceability-base indicators are deemed as suitable ones.

The probabilistic-based approach (e.g. PRA) provides a good model for identifying crucial factor of PAB incidents occurring at metro station. The model, however, still stays in conceptual stage for the sake of difficulty in quantifying the likelihood of IE. In view of behavioral change model, the self-report-based approach like TPB, which comprehensively takes both environmental and personal factors into account, are therefore recommended in this study to explore the crucial factors underpinning the PAB and in hope of changing the aberrant behaviors.

Our methodology can be useful to exhaustively identify and assess the passengers induced vulnerability of UMS, so that structural or organizational measures can be proposed to protect the vulnerability in UMS. In-depth research may be directed to: (i) taxonomy on PAB; (ii) modify probabilistic-based approaches according to available evidence; (iii) examine motivations underpinning PAB.

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