Knowledge Management and Organizational Learning 5

Meliha Handzic
Antonio Bassi *Editors*

Knowledge and Project Management

A Shared Approach to Improve Performance

Springer

Knowledge Management and Organizational Learning

Volume 5

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Prologue: Book Series on "Knowledge Management and Organizational Learning"

The book series "Knowledge Management and Organizational Learning" was born out of the editors' wish to collect in one place the most relevant ideas, theories, and practices related to managing knowledge and learning at individual and collective levels, across world regions and industries in for- and non-profit sectors.

This editorial project was a risky endeavour given the high number of already existing conferences, journals, books, and series on the same topics. Nevertheless, the project received full support from the International Association for Knowledge Management (iakm.net) whose members saw it as an integral part of the association's mission of helping the development of knowledge management (KM) as a scientific discipline.

Despite its increasing importance in academia, KM still suffers, like any other "new area", from a problem of "recognition". It aims to become an independent field, but as it has multidisciplinary roots—from psychology to computer science, from organizational science to business administration, just to mention some—it requires an integration of different perspectives and a robust clarification of its conceptual references. Research and practice often branch off in multiple directions, and no clear consensus on concepts and methods has emerged so far.

As scientists and professionals involved in KM, we need to develop "core" theories, common approaches, and standard languages that help us see the problem of managing knowledge under the same shared perspective. We also need to explore emerging new interdisciplinary and transdisciplinary ideas and align them with the foundation. The way to reach a credible agreement on what we are doing and to set a common ground for our future work calls for a capability to discuss, exchange, and, maybe, contrast our ideas and positions freely and openly. We need a place where we can do this in a rigorous but, at the same time, friendly atmosphere.

This book series is such a place. What inspires it is not the acceptance to a particular "school of thought" or "ideological" position, as sometimes happens even in the scientific world. Rather, what inspires it is a vision of KM as a "playground" where there is a lot to research, discover, and innovate and where curiosity, dialog, and openness to confrontation are the key ingredients.

With the same scrupulousness of scientific publications, but with a broader scope and more relaxed constraints than those that may characterize other editorial

channels, the series will put an emphasize on free discussions of new theories, methods, and approaches; on visions of the future and advances in the field; on critical reviews of recent or past empirical evidence; and on formulating ideas for new practical methods or applications. It aims to offer a constantly updated reference to researchers, practitioners, and also students involved in the field of KM and its application. So far, three volumes have been published as follows:

Volume 1
Advances in Knowledge Management:
Celebrating 20 Years of Research and Practice
Bolisani, Ettore, Handzic, Meliha (Eds.), 2015
http://www.springer.com/us/book/9783319095004
The goal of this introductory book is to assess the "state of KM" as a discipline and to discuss its potential prospects. It includes a collection of chapters where different authors provide their fresh views of the various hot topics for reseach and practice.

Volume 2
Corporate Knowledge Discovery and Organizational Learning:
The Role, Importance, and Application of Semantic Business Process Management
Gábor, András, Kő, Andrea (Eds.), 2016
http://www.springer.com/us/book/9783319289151
This second book offers an interesting perspective on how it is possible to extract, organise, share, and preserve the knowledge embedded in organizational processes in order to enrich the organizational memory in a systematic and controlled way, to support employees to easily acquire their job role-specific knowledge, and to help govern and plan the investments in human capital.

Volume 3
Social Knowledge Management in Action:
Applications and Challenges
Helms, Remko, Cranefield, Jocelyn, van Reijsen, Jurriaan (Eds.), 2017
http://www.springer.com/us/book/9783319451312
The third book aims to outline and examine the potential of innovative applications of social media for KM, as well as the associated challenges, risks, and issues. The book provides not only updated and sound theoretical reference but also food for thought deriving from the analyzis of experiences "on the ground".

Now, we are proud to announce the publication of this volume of the book series entitled "Knowledge and Project Management: A Shared Approach to Improve Performance" edited by Handzic Meliha and Bassi Antonio. Compared to previous volumes that address more generic KM aspects such as the overall state of a discipline (Volume 1) and two competing strategic approaches to KM, technological (Volume 2) and social (Volume 3), this volume takes KM into one specific applied context—project management (PM).

The book argues that integrating effective KM with PM is key to improving the project success rate. Accordingly, it introduces several shared KM/PM concepts and models; describes cognitive as well as spiritual and emotional aspects of project-related knowledge; reviews various codification and personalization KM strategies implemented in projects; and contrasts descriptive and prescriptive, universalistic, and contingency KM approaches. Thus, the book contributes novel theoretical approaches and clear empirical evidence of the value of integrating KM and PM. Further details about this volume are provided in the follow-up preface section.

To conclude this presentation, a few words of acknowledgement are due to the Springer editorial team led by Dr Prashanth Mahgaonkar for continued professional support; to IAKM members and our colleagues for active participation as volume editors, authors, and/or reviewers; and to dear readers whose interest in our work made the inaugural volume of the series one of the top 25% most downloaded Springer eBooks in 2015. We hope that both specialized readers and, more generally, people interested in advanced KM issues will enjoy this fourth volume as well as those to come.

International Association for Knowledge Management
www.iakm.net

Padova, Italy — Ettore Bolisani
Sarajevo, Bosnia and Herzegovina — Meliha Handzic

Preface: Volume 5 "Knowledge and Project Management: A Shared Approach to Improve Performance"

Since its beginnings twenty or so years ago, a lot has been done to advance knowledge management (KM) research and practice. Although its recognition as a scientific discipline is still debated, it has gained its place in the management scholarship. The recent appraisal of the field presented in Volume 1 of this Book Series has painted an optimistic picture and predicted a bright future for KM.

One important recommendation given for moving the field forward is turning away from the core issues of knowledge enablers, processes, and stocks towards KM outcomes and its value in different contexts. In the spirit of this recommendation, the main purpose of this book is to address the value of KM in the project environment.

The key motive for selecting project environment as a context of interest for the current book may be found in the staggering percentage (up to 70%) of reported failed projects that are not delivered on time and within budget and/or scope. The latest project management (PM) literature suggests that the main reason for such a high project failure rate is insufficient knowledge acquired and transferred from past projects to future ones.

The argument put forward in this book is that by integrating effective knowledge management (KM) with project management (PM), the overall project success rate can be improved significantly. Accordingly, this book brings together latest ideas and writings on shared approaches to improve performance founded on research and experience pursued by KM and PM academics and practitioners. Overall, the structured collection of articles presented in the book contributes novel theoretical approaches and clear empirical evidence of the value of integrating KM and PM. It provides readers with key lessons learnt from the past and guidance for future.

We are grateful to all contributors for supporting this project and giving their time and effort to make this book possible. Given that there is a visible discourse between academia and practice, one claiming that the other does not produce value, contributors to this volume are drawn from both academics and practitioners, in order to give a balanced view of both camps. A full list of authoritative contributors (in the alphabetical order) and their short biographies is provided in the Appendix.

The book is organized into four major parts, each containing two chapters. Each chapter can be read as an individual article to satisfy varying readers' interests. Hence, some chapters may exhibit a certain level of overlap in order to allow for selective reading. However, readers are adviced to first familiarize themselves with the subject matter of this book/volume and its associated book series in two brief introductory sections (prologue and preface).

Part I of the book reviews relevant concepts and models of interest for KM and PM. In particular, chapter "Traditional Project Management" presents a traditional rule-based PM methodology. This traditional approach has been under recent attacks as being inadequate to respond to modern projects circumstances. Consequently, a number of new shared KM and PM models have been proposed to address the problem. Chapter "Integration Models of Project Management with Knowledge Management" analyses some of the latest developments and assesses their potential to address traditional PM shortcomings.

In Part II of the book, the focus is on major PM knowledge areas. The two chapters in this part illustrate different types of knowledge required for effective PM. Chapter "Project Management Body of Knowledge in the Context of PMI and ISO" summarizes the core cognitive aspects of knowledge as prescribed by PMBOK and ISO 10006 standards. Chapter "Emotional and Spiritual Knowledge" extends these to include emotional and spiritual types. The assumption here is that combining art with science (i.e. fusing sentimental with rational knowledge) can assist in enhancing project success (e.g. by better identifying potential value scenarios).

The next Part III of the book is devoted to two key KM strategies (codification and personalization) for PM. Chapter "Lessons Learnt Support System" is codification orientated and is concerned with collecting and organizing lessons learnt from past project experience. In chapter "Renovating Project Management: Knowledge Personalization and Sharing", the main emphasize is on social learning and knowledge transfer in projects through personalization.

Chapters in Part IV of the book examine prescriptive (which KM strategy should be implemented) and descriptive (which KM strategy is implemented) choices in PM. First, chapter "Knowledge Management Selection Model for Project Management" tests empirically contingency approaches to KM to determine the most suitable choices in varying project contexts. A descriptive case of actual KM implementation in a large innovation project is presented in chapter "Knowledge Sharing System under Open Project Perspective: Chinese Experience" to find out if practice follows research or not.

Finally, the epilogue to the book reflects on lessons learnt from previous eight chapters. It offers a perspective on what can be expected from the merger of KM and PM and where to go from here and how.

We hope that the book will help readers to better understand the need for merger of KM with PM and appreciate its benefits. It is especially our wish for the book to help researchers get an idea of what lies ahead and how to get there. It is also hoped that the book will help practitioners to develop more suitable KM solutions for their project circumstances and turn them into successful project outcomes. With many researchers and practitioners working together in a holistic and systematic manner, we believe that, to quote David Hilbert, "we will know" because "we must know".

Sarajevo, Bosnia and Herzegovina — Meliha Handzic
Manno, Switzerland — Antonio Bassi

Contents

About the Authors

Antonio Bassi, PMP®, Degree in Electronic Engineering at Politecnico di Milano, certified Project Management Professional (PMP) by the Project Management Institute (PMI), member of the Steering Committee of the Project Management Institute—Northern Italy Chapter (PMI-NIC) 2004–2008, Project Management Lecturer at SUPSI (University of Applied Science and Arts—Switzerland), member of the project team for the definition of the ISO standards ISO 21500 and ISO 21502 (project management), project/program manager, for 15 years, on innovative projects in different market sectors. For UNI is developing the national qualification norm (italian) for the project manager. Assessor for the ISO 21500 certification. Author of numerous articles, published: Il ruolo del Project Manager, 2006, Gestire l'innovazione nelle PMI, 2007, Il valore strategico della comunicazione nel Project management, 2007, Project Manager al lavoro, 2009, Partecipare a un progetto, 2010, Maturità nei progetti—Un modello per le piccole e medie imprese, 2011 e Glossario del termini di Project Management, 2014.

Constantin Bratianu is professor of Strategic Management and Knowledge Management at the UNESCO Department for Business Administration, Bucharest University of Economic Studies, Romania. He is the founding Director of the Research Center for Intellectual Capital, and the founding co-editor of the international journals: Management and Marketing, and Management Dynamics in the Knowledge Economy. He is an active member and chair session of the ECKM, ECIC and ICICKM conferences. He has been Visiting Professor at: University of Applied Sciences, Steyr, Austria; Our Lady of the Lake University, San Antonio, Texas, USA; Tokyo University of Science and Technology, Kobe University, and Osaka University, Japan. Constantin Bratianu proposed a change from the Newtonian paradigm of understanding knowledge based on the dyad of tacit and explicit knowledge to a new paradigm based on thermodynamics, and the concept of knowledge as a field. Also, he developed an entropic model for the organizational intellectual capital based on the idea of integrators and of transformation of the intellectual capital potential into an operational intellectual capital. He used to held the position of General Director for Higher Education in the Ministry of Education and Research in Romania (1998–2000), and that of Expert for Science and Education in the Romanian Parliament (2001).

Ettore Bolisani (Laurea "Electronic Engineering" and Ph.D. "Innovation Studies"—Padua University), after being an E.U. "Marie Curie" research fellow at PREST (University of Manchester) and a researcher at the Universities of Trieste and Padua, is now Associate Professor at the Faculty of Engineering of the University of Padua. His research now mainly focuses on Knowledge Management. He was Chair of the 10th European Conference on Knowledge Management (University of Padua, 2009). He is Series co-Editor of "Knowledge Management and Organizational Learning" (Springer). He is co-founder and first President of the International Association for Knowledge Management.

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Actually he is Chief Information Officer near Exten and responsible for Defining and implementing hardware and software strategy.

He is also teacher for Agile Project Management course near SUPSI. He is coauthor for the following books about Project Management themes: PMI-NIC: "Maturità nei Progetti" (Maggio 2011) Edizioni Franco Angeli; PMI-NIC: "Gestire l'innovazione nelle PMI" (Dicembre 2006) Edizioni Franco Angeli; Politecnico di Milano "Maturità delle organizzazioni: metodi di misurazione ed osservazione sul campo" (Genn. 2006).

He collaborates with PMI to Italian version of PMBOK® Third Edition (Dic. 2004).

Liliana Mitkova is full professor at University d'Evry Val-d'Essonne, France in management science. Her areas of expertise are in the fields of Innovation Management, especially concerning patent strategy and technological market. She has worked with several French industrial groups in the domain of intellectual property management under different approaches: strategic, organizational and marketing. Mrs. Mitkova has published several articles, book chapters and has coordinated international research projects in this area, particularly with partners in China and Brazil.

Meliha Handzic is Professor of Management and Information Systems at the International Burch University, Sarajevo, Bosnia and Herzegovina. She received her Ph.D. in Information Systems from the University of New South Wales, where she was Inaugural Leader of the Knowledge Management Research Group at the School of Information Systems, Technology and Management. Handzic's main teaching and research interests lie in the areas of knowledge management and decision support, with a particular focus on the processes and socio-technological enablers of knowledge creation, sharing, retention and discovery. She has published widely on these topics in books, book chapters, international journals and conference proceedings. Presently, Handzic is an active member of several professional societies and groups including IAKM and IFIP, Regional editor of *Knowledge Management Research and Practice* and serves on editorial boards, executive and program committees for numerous international and national journals and conferences. Prior to joining academia, Handzic worked for the United Nations Development Programme in Asia and Africa. She also had a wide ranging industrial experience in Europe

Mauro Romani (Milan, 1965) has a degree in Information Science from the State University of Milan. After accumulating substantial experience as a functional analyst and consultant in the field of quality management and management consultancy (mainly in the financial and automotive sectors), he specialized as Project Manager. Since 2008 he lives in Switzerland, where as Senior Project Manager, he currently works as consultant for a Swiss bank, leading IT and organizational projects. In 2006 he obtained the PMP® credential and in 2009 the PRINCE2® Foundation certification. For some time, he has approached the academic and educational world, taking advantage of many years of experience working on projects and his keen interest in the qualitative, methodological and interdisciplinary aspects of Project Management. Since 2015 he has been giving workshops on

"Distilling Lessons Learnt", where he shares the method developed by him in order to transform the everyday work experience into articulated and structured Lessons Learnt, and therefore applicable under the Project Management discipline. The general principles of storytelling are also highlighted during the workshop, these being the narrative of our own experiences (characterized by the inevitable emotional component) which becomes the springboard for reflection necessary to the knowledge phase, as the starting point for the final transformation into Lessons Learnt.

In the last year he has been providing a specific course of Project Management for the No Profit world, addressed to the roles of responsibility in those organizations in order to improve the planning, managing and control of No Profit projects.

Nicolo Savino has a bachelor degree in Engineering Management and is currently a post-graduate student of Engineering Management at the University of Padova (Italy). He was part of the 2016 Morpheus Project Team that participated in the European Rover Competition organized by ESA. He has experience as Project Manager of a graduate student research team.

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Part I

Concepts and Models of Project and Knowledge Management

Traditional Project Management

Enrico Masciadra

Abstract

The prime objective of this chapter is to introduce the topic of project management (PM) to the reader. The chapter starts, as is appropriate, with some basic definitions of the term. Next, it describes the key principles of the traditional PM methodology. Then, it shows how these general principles are applied in some of the most popular examples of traditional PM methodologies such as PMBOK, PRINCE 2 and SIX SIGMA. Finally, the chapter ends with a discussion of pros and cons of each of these specific methodologies in different project circumstances and emphasizes the importance of making the right choice. Essentially, this first chapter sets the scene for the remaining seven chapters of the book. Together, they celebrate PM progress made so far and take the next step to move the field forward.

1 Introduction

Without a doubt, traditional Project Management is a consolidate way to manage a project to guarantee that the job will be done on time, under budget and as per client specification. This way is based to the concept of **Project Management Methodology** that establish a set of rules to be followed to meet "project objectives" statements. In other terms, it is a must to reduce failure and avoid risks because it is one of the critical success factors as well as the core competency of the management team. It is the way to guide the team through the development and execution of the phases, processes and tasks throughout the project management life-cycle.

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Project management is a practice that does not belong to any specific domain. It is a practice with a basic set of concepts and objectives. Regardless of the size, the number of activities, the effort, the duration, every project needs a project management methodology.

There are many methodologies of project management both general purpose or customized for different domains. Anyway basic principles almost are the same among methodologies and there are features to address unique problems and conditions specific to each domain.

In this scenario is important to understand what "Project Management Methodology" does it means.

The term "Project Management Methodology" was first used in the 1960s when business organizations began to look for the ways to control the gain of business objectives and organize the work into a structured entity called "**PROJECT**".

The key criteria for establishing effective relationship between the teams and departments within the same organization was identified in communication and collaboration.

Now a project management methodology is as a set of rules to manage a projects that has a definite beginning and end.

We can define a "Project Management Methodology" a combination of practices, methods and processes that determine how plan, develop, control and deliver a project in the best way. In other words It is a systematic and disciplined approach to project design, execution and completion.

Typically, a "Project Management Methodology" provides a framework for describing every step, so that a project manager knows what to do in order to deliver and implement the work according to schedule, budget and requirements.

Today we can identify two main types of Project Management Methodologies:

- Traditional Project Management
- Modern Project Management

To discuss about "Traditional Project Management" is important to have an idea of the project management definition. Project Management Institute[1] defines the traditional project management as 'a set of techniques and tools that can be applied to an activity that seeks an end product, outcomes or a service'.

But if you search "Traditional Project Management "on Google, you will find hundreds of definitions.

The "Traditional Project Management" uses tools and techniques (as called in PMBOK) in the management process. These tools and techniques have been evolved during years and are applicable for most of the domains.

Therefore, there have been a few modern project management practices introduced to address the shortcomings of the traditional method.

[1] http://www.pmi.org/

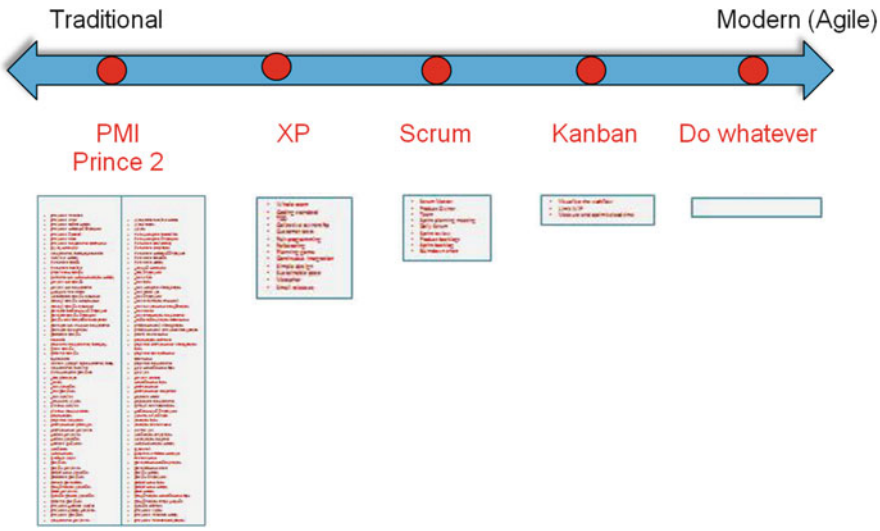

Fig. 1 Project management required rules

To understand the difference between Tradition Project Management Methodology and Modern Project Management Methodology is enough to take a look of Fig. 1. It compares the "size" of methodology requirements for most diffuses Project management techniques. It is clear that traditional project management methodologies requires lot of work to satisfy requirement defined by the methodology itself. On the other hand Agile (or modern project management methodologies) has less requirements. What methodology choose? Depends.

2 Framework vs. Standard vs. Methodology

It is important to understand what the word Framework, Standard and Methodology means to better understand different Traditional Project Management available "flavours".

Standard
Dictionary definition of Standard:

> Something used as a measure, norm, or model in comparative evaluations[2]

A Standard is a set of rules or norm that an organization define and introduces to drive internal work. This means that employees must to follow. Normally the term 'standard' refers to a document (or set of documents) that organization establishes

[2] http://oxforddictionaries.com/definition/english/standard

for others to use. For example, there are quality standards, engineering standards, coding standards, and standards for many areas of practice.
In addition, countries can establish "national standards" that must be applied inside the state or nation. For project management standards, many organizations publish standards. These include:

- PMI publishes the PMBOK® Guide along with other standards
- UK Government has PRINCE2 as a Methodology
- IPMA publishes their IPMA Competence Baseline

For project management, there are no laws that govern the use of standards or what standard to use so one can use them or not.

Framework
Dictionary definition: "a basic structure underlying a system, concept, or text" [3]

The words 'Framework' and 'Guide' are used as the same meaning: A Framework is a general guideline that an organization can adopt. The Framework identifies components that establish rules for a determinate environment. For example, PMBOK Guide is composed by many components such as processes and knowledge areas, project life cycle, stakeholders, project organizations, and other topics. In this way PMBOK describes guidelines on how to develop a WBS, a scope statement, a project plan, a stakeholder management plan; PMI defines the PMBOK Guide as a "*framework*" for managing a projects.

Other examples: ISO 31000 offers a framework for managing organizational risks. IPMA offers us with a Competence Framework.

Methodology
Dictionary definition: "a system of methods used in a particular area of study or activity"[4]

Methodology means there has a certain way to do something, like systematic process. A common project management methodology follows a project life cycle or something like that.

PRINCE2 is a Standard Methodology.
SUKAD developed a methodology that we call CAM2P™ (The Customizable and Adaptable Methodology for Managing Projects™).

Usually project management methodologies are custom built for specific organization. For example in telecom, a famous methodology is PROPS-C (Ericsson) or in avionics a famous methodology was DOD-STD-2167A.

[3] http://oxforddictionaries.com/definition/english/framework
[4] http://oxforddictionaries.com/definition/english/methodology

In the context of this chapter, we identify as "Project Management Methodology" both framework adapted for a specific organization and Standard that the organization applies to its project.

3 Methodology Structure in Traditional Project Management Methodology

A "Project Management Methodology" provides the context of planning, executing and delivering projects of any size and type. PM Methodology focuses on the realization of project objectives (in PMBOK project charter) using a methodological approach. If something change, the Project manager acts to maintain project objectives: change is the core aspect that should be managed. PM framework identifies and defines how to best manage change and methodology defines how to implement change in terms of time, cost and quality.

In traditional Project Management environment, managing projects means describing and performing the activities required to meet the specific objectives of making change.

For example, writing a book can be considered "a project" in which the objective is to write a book. This objective can be fulfilled by a series of activities, including defining the topic, collecting material, creating a draft, typing, proofreading, others. So in terms of project management, the author needs to define and then complete all the necessary activities in order to write a book.

In general, a Project Management context is a structured collection of all rules and knowledge on how to make change using a "method". Methodology does not describe an algorithm or formula project but provides an overview of various and different methods, rules, processes and standards to manage a project.

Traditional Project Management Method has a typical structure that can be found in most diffuses methodologies.

In particularly the basic schema of Traditional Project management can be presented a management hierarchical structure (Fig. 2).

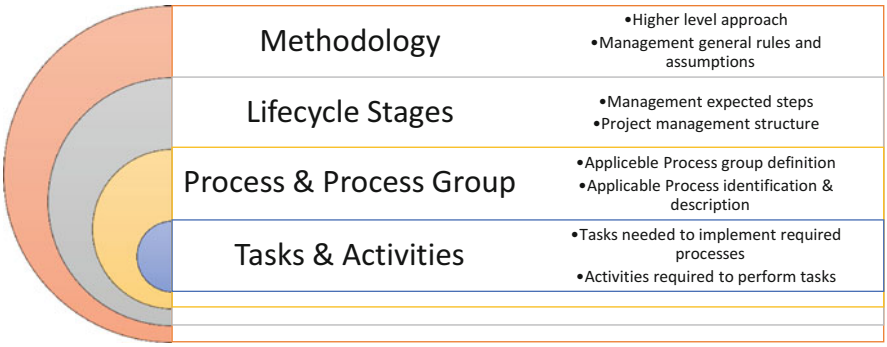

Fig. 2 Traditional project management hierachical decomposition

4 Traditional Project Management Method Overview

We can identify some common aspects to the traditional Project Management methodology, that can be summarized in 7 "common aspects" that try to guarantee project control and the respect of time, scope, cost, risk

The common aspects of traditional project management methodology are the following:

1. Project concept and start
2. Project analysis and feasibility
3. Project design and staffing
4. Project execution
5. Project verification and validation
6. Project product training
7. Project post deployment

4.1 Project Concept and Start

This is the first step for every project. As known, a project is required when something happens into an organization. Normally a project (or a number of projects) is needed to gain objectives or to modify situations no more compliant to organization mission.

In most cases, the "concept" of a Project is represented by the "business plan" or "Statement of Work" or "Business case" as called for example in Prince2.

Wikipedia definition of Business Plan: "A **business plan** is a formal statement of **business** goals, reasons they are attainable, and **plans** for reaching them. It may also contain background information about the organization or team attempting to reach those goals."[5]

Wikipedia definition of Statement of Work: "A **Statement of Work** (**SOW**) is a document, routinely employed in the field of project management, which defines project-specific activities, deliverables and their respective timelines, all of which form a contractual obligation upon the vendor, in providing services to the client".[6]

This means that Business plan contains all the informations required to start a project. Many Traditional Project Management Methodologies does not consider this step as part of the project that starts after the project charter that defines the project content.

DELIVERABLES	Project charter in PMI (plan, costs, deliverables, high level plan) or Project Initiation Document (Project Goals, Scope, Project Organization, Business Case,

[5] https://en.wikipedia.org/wiki/**Business_plan**

[6] https://en.wikipedia.org/wiki/Statement_of_work

Constraints, Stakeholders, Risks, Project Controls, Reporting frameworks, PID Sign Off, Summary) in Prince2.

Project Concept

The project concept roughly define the project objectives and scope and prepare the scenario for project start. This concept is discussed with organization key people or with customer to understand what they want. Normally who is in charge for Project concept prepare an agenda and presentation materials and share all of it with the customer (in general stakeholders) discussing about project scenario and objectives trying to clarify in the better way any aspect of possible project.

Project Start

When preliminary phase is closed, once proceeded with project start (also called project kick off) to show to all involved people what is the project, its objectives, scope, timing, cost.

Normally the Project Manager, calls for a meeting and share project contents with the customer to incorporate feedback and address any additional information or needs they may have.

Face-to-face meeting are usually recommended, but if logistics and/or costs are problem, then a conference call should serve the purpose. For project start session, is better to address these items:

SOW Discussion

SOW (Statement of Work) is a high-level overview of Work that the project should address: the SOW should be defined with the customer. During the SOW discussion, any issues, gaps, concerns, etc. should be noted so that they can be addressed either during the next phase of the project or noted as potential risks.

Review Project Phases

This item aims to tell the customer how the Project Manager, will run the project, how each phase will happen and what the expectations and deliverables are for each phase as they pertain to this specific project.

Identify the Project Team

This item aims to identify people involved to the project. Depending of the size of the project, for some of the roles there will be no name but only a role, in the same way many of the resources will not have been officially assigned yet, but the roles and responsibilities for each role will be known.

Identify Issue, Change and Risk

This item addresses how risks and issues will be handled as well as how change and change orders will be handled and executed on the project. This is very important to properly carry out the project. If organization is big or if the project is complex, a clear understanding about how manage Issue, Change and Risk (in other words project scheduling and rescheduling) will speed-up project execution.

High-Level Project Plan
An high level project plan is defined, identifying milestones, deliverables, and timeframe as well major activities. This plan shall be reviewed with project sponsor, stakeholders or within an organization discussed with top management.

4.2 Project Analysis and Feasibility

Normally, Project sponsor or in general stakeholders have performed some study and requirements analysis to define the objective of the project, its scope, cost, time, etc.

The Project analysis and feasibility aims to define details of the project and confirm or not the result of project concept and start described in the previous phase. This phase delivers at first the Business Requirements Document (BRD)[7] that should require a formal customer signoff. Without the customer signoff, the Project Manager could be trying to better define the project scope. The project analysis and feasibility establish also a common understanding of the project scope and requirements. In this phase can be produced other documents such as Functional Requirements Document (FRD)[8] or Requirements Specification Document (RSD) that can complete the project feasibility.

The Business Requirements Document contains informations required to generate other detailed documents (if requested) and is the primary input for the next phase (Project planning and staffing). It is very important that project team should understand every aspect of the business requirements and meetings with project sponsor should be carried out periodically to be shure that business requirements are clear to project team. Depending on items discussed for each meeting the project sponsor and the Subject Matter Experts for relevant business areas shall be involved. It is important that the business processes and requirements can be discussed in detail and finalized.

A periodic status reports and a formal project status meetings begin with the analysis and feasibility phase and continue throughout the rest of the project. Issues and risks are re-examined and re-assessed throughout the analysis and feasibility phase and documented as part of the status report in the form of a risk register or issues list. Project analysis and feasibility Phase Deliverables list should be:

- Business Requirements Document (BRD)
- Project Status Reports
- Project Schedule
- Revised Risk/Issues List
- Recurrent Project Status Meetings

[7] https://en.wikipedia.org/wiki/**Business_requirements**
[8] https://en.wikipedia.org/wiki/Functional_requirement

4.3 Project Staffing and Design

There are a number of factors to consider to carry out the Project design and staffing, the most important should be the project size, scope, duration, budget, objectives. These factors are common for any project but there are other factor that are unique for a project. One of them is the corporate approach to project and its governance that influence massively project approach.

Design a project is the task required to understand how project team must be organized and properly staffed to be able to execute the next phase. A staff is required in order to execute work, tasks and activities to meet project plan and deadlines. If you are a project manager, you need to have an adequate staff for executing your project activities.

To properly staff the project, is important to understand the purpose of the project. First, PM needs to understand the business goals (BRD) for the project and other related objectives. Without this understanding, PM may not be able to staff the best resources for the project.

PM has to spend some time thinking about project purpose and then try to understand the related staffing requirements. This means to understand also different skills required for project execution, in order to understand what kind of staff is required.

- Size of the project
- Budget for the project
- Identify customer priprities
- Project plan
- Project staffing

Once the staffing is complete then the Project Design phase is ready to begin. Normally the design phase is strictly connected with staffing phase but logically can be considered separated and in sequence. The goal of the Design phase is to produce and signoff the Functional Design Document (FDD).

The Design phase mainly consists to understand and translate in "design requirements" the contents of Business Requirements Document. Project Manager and Business Analyst and project team shall carry out this activity. One or more Project team people may be involved depending on the complexity of the project. Important stakeholder of design phase is also the customer that represent the "consumer" of project output. Key things that the Project Manager and Business Analyst will need to address into the Design phase with the customer in preparation for producing a solid Functional Design Document are:

- Functional specifications
- Reporting requirements
- Project constraints requirements
- Project Standard application
- Security (if applicable)

This list can vary greatly depending on the type of project, the demands of the customer and the size of the project. Status reports and formal project status meetings shall be done on regular basis throughout the Design phase. Issues and project risks must be revisited and re-assessed throughout the Design phase and documented as part of the periodic status report or as an addendum to the same report in the form of a risk register or issues list.

The Design phase shall identify the team members who will be involved in the Development effort in the next phase should be identified and assigned to the project team.

The Functional Design Document is very important because it is the basis for peer review on the delivery team side as this is truly the working document going forward for the project. The Business Analist is the primary author of the Functional Design Document, but it should be reviewed and approved by the Project Manager and review by project team leader assigned to the project. Once it has the delivery team stamp of approval, the Functional Design Document is delivered to the customer for review and ideally a swift signoff, though it is more likely to go through some iterations of revision prior to a final agreement and signature.

Design Phase Deliverables:

- Functional Design Document (FDD)
- Revised Project Schedule (revised as needed)
- Revised Risk/Issues List
- Perodic Project Status Reports
- Periodic Project Status Meeting reports
- Assignment of project team members and other support personnel

4.4 Project Development

The phase can start when the Functional Design Document and Revised Project Schedule are available. Normally the Project development phase initiate when the first draft of the documents is available, the risk is represented by changes in Functional Design Document and Revised Project Schedule.

The project development phase is the core phase of project and represent the bigger effort during the project. The phase can be splitted in the following steps:

- Project Development Kickoff meeting
- Project plan development and review (on-going)
- Revised Project schedule (on-going)
- Project development
- Periodic project status meetings (on-going)
- Project Revised risks/issues list (on-going)

To carry out the phase is better to adopt an Iterative development process with meetings with stakeholders and demos on project development progress to

stakeholders. The purpose of iterative development ensure that the developed solution meets client needs and expectations, identify scope issues as they arise, provide an opportunity for change order work/additional revenue in a timely manner and make the customer feel involved in development and continually aware of progress.

During project development phase project team, Business Analys, customer, and other vendor-side support personnel can turn away a Project Manager. Having a good project schedule pan and keeping a good check on project schedule is very important. It must be part of the periodic status report, the periodic status meetings to check the project schedule and have a good communication about what happens daily on the project. Management of the schedule is particular critical when project gets into the Development phase because of potential change orders, project reviews and feedback from the customer.

Two main deliverables shall be produced by the project development phase:

- The Technical Design Document (TDD)
- Project plan (on-going)

Other deliverables can be present depending on the complexity of the project. The project plan shall be discussed with customer to agree major milestone and project deliverables. This may make it easier for future system changes by the customer, or the vendor or it may be a document that helps the customer during future upgrades.

During the phase are important periodic status reports and formal periodic project status meetings continue throughout the Development phase. Issues and risks are revisited and re-assessed throughout the Development phase and continue to be a review item during the periodic status meetings.

4.5 Project Verification and Validation

At this point the project outputs are available now we have built something which should matches the customer's requirements and we're ready for system verification & validation before moving on to the customer side User Acceptance.

Preparation for verification and validation consists of some activities:

- The verification and validation Approach: sets the scope of system verification and validation, the overall strategy to be adopted, the activities to be completed, the general resources required and the methods and processes to be used to check the Project output. It also details the activities, dependencies and effort required to conduct the verification and validation procedure.
- Test or QA Plan (deliverable): details the activities, dependencies and effort required to conduct the System verification and validation and acceptance by customer.
- Verification Conditions/Cases documents the tests to be applied, the coverage and the expected results.

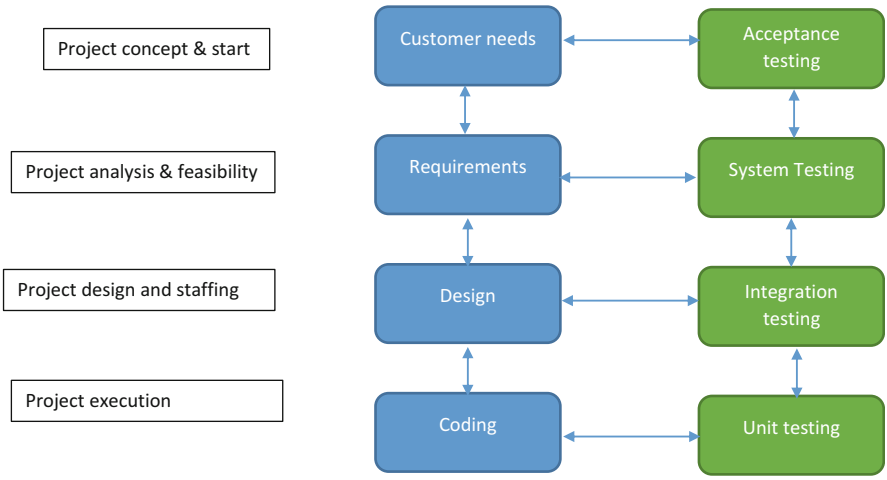

Fig. 3 Traditional project management acceptance test mapping

System Testing

Led by the project team who may have worked on the project, project deliverable must undergo testing in preparation for User Acceptance Test by the customer. All parts must be verified against the Business Requirements Document, Functional Design Document, and verification and validation. All project aspects must be tested to ensure that overall system will works as expected. If under specific standard, project verification and validation shall be done under standard rules and procedure. In this case, depending the project complexity, a specific document indicating limits, expected results and constraints shall be written.

User Acceptance [9]

Wikipedia definition of acceptance testing: **"Acceptance testing** is also known as **user acceptance testing** (UAT), end-**user testing**, operational **acceptance testing** (OAT) or field (**acceptance**) **testing**. A smoke **test** may be used as an **acceptance test** prior to introducing a build of software to the main **testing** process."

In other word is a process of verifying that a solution works for the user.

Each User acceptance test can be mapped to project phases. For example software development project can be mapped to project phases as shown in the Fig. 3.

[9] https://en.wikipedia.org/wiki/Acceptance_testing

Signoff
Once the customer (project sponsor) is satisfied with the project delivered products the Project Manager have to obtain an official signoff of the system. This is critical to ensure success and scope maintenance going forward.

Verification and validation Phase Deliverables:

- Developed system
- User Acceptance signoff
- Revised Project Schedule (revised periodically as needed)
- Revised Risk/Issues List
- Periodic Project Status Reports
- Periodic Project Status Meetings
- Weekly project status meetings

4.6 Project Product Training Phase

This phase allows sales persons and customer to understand how to use the project products. The importance of the training depend on the project product complexity. Depending of the organization practice to consider this phase part of the project.

Training is available in a number of formats including Classroom, workshop and tutorial formats. The key things that need to happen during the Training phase are:

- Develop of a Training Plan
- Develop of training materials
- Delivery of training

Training Plan and Training Materials
Develop of a Training Plan and training materials normally starts during the User Acceptance Testing activities. At that point, project products are developed by the delivery team. Therefore, the delivery team can begin the task of putting together the Training Plan and training materials based on what needs the customer has for training.

Delivery of Training
The Delivery of Training Depends on the size of the attended users, there needs to be decisions about who is being trained and the materials must be tailored for the audience. If the number of user attendee is small, then it may be practical to train nearly everyone on the developed system. If the number of user attendee is high, is recommended a different approach such as training sessions. The materials for those training sessions will need to be developed by the project team.

Deliverables
- Training plan
- Training materials
- Revised issues/risks lists

4.7 Post Deployment Phase

Post deployment Project Phase is the last phase that can be considered as part of a project. If the organization does not consider this phase as part of a project, the project itself must analyse and think about the post deployment implications. Warranty and after selling assistance is part of the product and must be considered during project analysis and execution.

Lesson learned is part of traditional project management and "user experience" is a big test for project output and a good source of information to do best next project. There are several ways to collect informations: the most useful is using trouble ticketing. This technique if well staffed should provide you with a great tracking mechanism and should provide your customer with solid support.

Once the agreed upon Post-Deployment support is complete, train the customer on your ticket submission system or ensure they have direct phone access to tech support. You'll also need to bring tech support up to speed on the customer-side project team or production contacts and provide them with any relevant information that came out of the project that will help them going forward to provide the best support possible to the customer. If you've produced a Communications Plan for this project, this is a great time to update it with post-implementation contact information on both sides of the project and re-distribute.

Deliverables
- Post go-live period support by the current delivery team
- Lessons Learned documented and delivered to delivery team, customer team, and support team

5 Traditional Project Management Methodologies Examples

There are a lot of traditional project management methodologies some of them are known and used, other specific for some application other developed by organizations. In this context we will consider only the most popular methodologies.

5.1 PMI–PMBOK

From Project Management Institute web site:

"The PMBOK® Guide—Fifth Edition is the preeminent global standard for project management. It provides project managers with the fundamental practices needed to achieve organizational results and excellence in the practice of project management.

Like previous editions, this standard presents generally recognized good practices and reflects continually evolving knowledge."[10]

The Project Management Institute (PMI) was founded in 1969 by James R. Snyder, Eric Jenett, J. Gordon Davis, E.A. "Ned" Engman and Susan Gallagher.

Their aim was to define standards for project management, defining and improving the way projects are managed, and to provide the growing number of project managers the opportunity to exchange knowledge and educate themselves in the disciplines of project management.

PMI has been recognized by the American National Standards Institute (ANSI) as an accredited standards developer. The methodology is described in the Guide to the Project Management Body of Knowledge (PMBOK Guide). The standard was published in 1987 to standardize the information and practices of project management that are generally accepted as good practice by the community of project managers.

A Guide to the Project Management Body of Knowledge, (PMBOK® Guide) Fifth Edition is the last edition of the methodology. It defines the "Project Management Process Groups and Knowledge Areas Mapping" matrix, found in Table 3.1 on page 61. This table maps the **47 processes of project** management to their corresponding Knowledge Areas, as well as to their corresponding Process Groups.

A Process of Project Management

As known, a process is a way of transforming an input into an output using proven tools and techniques. Good processes and proven practices are extremely important for a project's success. Processes are important to conduct the project in the right direction; they can also help minimize risks and uncertainty among the project manager and the project stakeholders and can help drive project from start to finish. The PMBOK Guide identifies 47 processes of project management that are instrumental to project success.

Knowledge Areas

A Knowledge Area is made up of a set of processes, each with inputs, tools and techniques, and outputs. These processes allows project manager and project team to conduct the project to success. Thus, the Knowledge Areas are formed by grouping the 47 processes of project management into specialized and focused areas. Knowledge Areas also assume specific skills and experience in order to accomplish project goals.

The PMBOK Guide version 5 identifies ten Knowledge Areas, each of which includes a detailed description of the processes associated with that area. These Knowledge Areas are

- Project Integration Management
- Project Scope Management

[10] http://www.pmi.org/PMBOK-Guide-and-Standards/pmbok-guide.aspx

- Project Time Management
- Project Cost Management
- Project Quality Management
- Project Human Resource Management
- Project Communications Management
- Project Risk Management
- Project Procurement Management
- Project Stakeholders Management

Process Groups
The 47 processes of project management are also grouped into five categories:

1. Initiating
2. Planning
3. Executing
4. Monitoring and Controlling
5. Closing

These groupings represent the logical interactions between the individual processes, that means that processes of the same process group have the same purpose. In other words, the Process Groups keep together the project management activities that are relevant to each project phase and provide a means for looking at best practices within one Knowledge Area.

For example, in the Initiation Process Group, you'll complete the individual Initiation processes like defining scope, goals, deliverables, assumptions, limitations, etc., that could be defined into the Project Charter. Within the Initiation Process Group, you would also complete all activities and processes for identifying project stakeholders. Similarly, processes required to track, review, and regulate the progress and performance of the project are all included in the Monitoring and Controlling Process Group. So, processes with a common goal or theme are grouped together into a Process Group.

Knowledge Areas represent what the Project Manager needs to know (knowledge in Project Management topics), while the Process Groups describe the actions the Project Manager and project team needs to do (how to apply knowledge in conducting a Project).

Every one of the 47 processes can be mapped to one Knowledge Area and one Process Group, identifying the proven project management principles behind the process, and at the same time providing the means to accomplish it.

5.2 PMBOK Guide and PMP

PMBOK defines a framework that helps project managers to run projects, providing the fundamentals of Project Management as they apply to a wide range of projects.

This recognized standard provides the tools and techniques to properly manage project and deliver results.

- The PMBOK Guide 5th edition is organized in three main categories:
- Thirteen sections
- Five appendices
- A Glossary

The first two sections describe Project management framework, the third section focuses on project management standards while other sections describes the ten knowledge areas that represent the core of Project Management Institute framework.

As a project manager, it is important to identify ways in which the process groups interact with each other through the life of the current project and to be able to identify processes that are applicable to your project. Not all processes are applicable to the project. It depends from size, scope, environment, etc.

Project Management Institute provide also the Project Management Professional (PMP)® certification. Details and more informations about preparation and Exam can be found on PMI website.

6 Prince2

PRINCE (PRojects IN Controlled Environments) was established by the Central Computer and Telecommunications Agency (now referred to as the Office of Government Commerce) in UK. It has since become a very commonly used project management method in all parts of the world and has therefore proven to be highly effective in various respects.

The method also helps Project Manager to identify and assign roles to the different project members of the team. Over the years, there have been a number of positive case studies of projects that have used PRINCE2 project management methodology.

This method addresses the various aspects that need to be managed in any given project.

As stated in Prince2 official site[11] there are 7 processes:

- Starting up a project (SU)
- Initiating a project (IP)
- Directing a project (DP)
- Controlling a stage (CS)
- Managing product delivery (MP)
- Managing stage boundaries (SB)
- Closing a project (CP) (Fig. 4)

[11] https://www.prince2.com/eur/prince2-processes

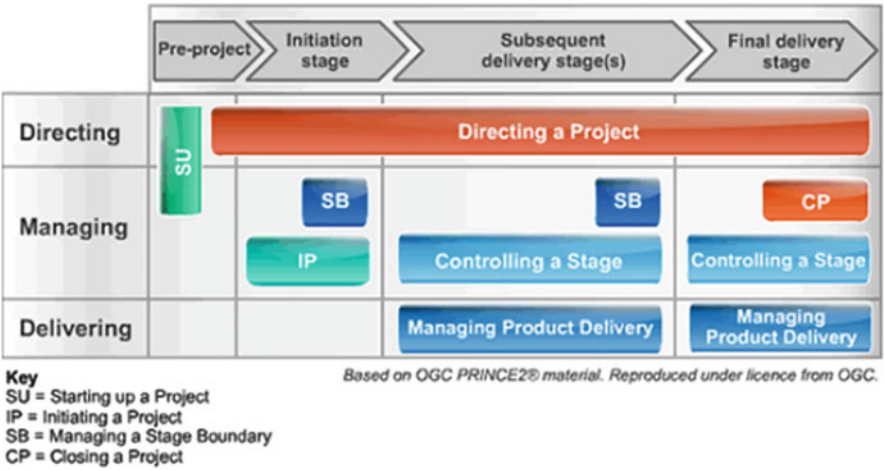

Fig. 4 Prince2 standard mapping

Differently from Project Management Institute Approach, a project can be called a "PRINCE2 project" only if the seven principles shown in the above diagram must be applied. This means that PRINCE2 is a standard and not a framework. The seven principles application will show how well the project is being carried out using this particular project management method. If adherence to these principles is not carefully tracked from the inception of the project through to the end, there is a high chance that the project will fail entirely.

Finally, with regard to the project environment, it's important to know that this project management method is not rigid. Changes can be made based on how big the project is, and the requirements and objectives of each organization. PRINCE2 offer this flexibility for the project and this is one of the reasons why PRINCE2 is quite popular among the project managers.

7 Six Sigma

The method of Six Sigma was originally developed by Motorola to improve its production processes by eliminating defects (defined as "non-conformity of a product or service to its specifications"). Today Six Sigma is one of the most popular project management methodology for ensuring the accuracy and speed of a process's implementation through eliminating or minimizing waste.

Six Sigma is not just another project management initiative or process improvement programme. Six Sigma is not just a new term for project management nor is it a mere repackaging of old concepts. It is more than that because it is a robust continuous improvement strategy and process that includes cultural and statistical

methodologies. Six Sigma is complementary with existing project management programmes and standards but differs in significant ways. Both disciplines seek to reduce failures, prevent defects, control costs and schedules, and manage risk. Generally, professional project management attempts to achieve these goals by encouraging best practices on a project-by-project basis, often through the mechanism of a project office that promulgates policy, provides templates and advice, promotes appropriate use of tools such as critical path method, and perhaps performs periodic project reviews.

Six Sigma was created in 1986 as a statistically-based method to reduce variation in electronic manufacturing processes in Motorola Inc in the USA.

From Motorola point of view Six Sigma[12]

> . . .Six Sigma has evolved over the last two decades and so has its definition. Six Sigma has literal, conceptual, and practical definitions. At Motorola University (Motorola's Six Sigma training and consultancy division), we think about Six Sigma at three different levels:
> - As a metric
> - As a methodology
> - As a management system
>
> Essentially, Six Sigma is all three at the same time.

Sigma, σ, is a letter in the Greek alphabet used by statisticians to measure the variability in a data set. In Six Sigma these data sets normally consist or process performance metrics. From process point of view, a company's performance is measured by the sigma level of their business processes.

Six Sigma, as project methodology, requires that team leaders and teams to take responsibility for implementing the Six Sigma processes. The methodology focuses on the use of the measurement and improvement tools, and in communications and relationship skills, required to identify and serve the needs of the internal and external customers and suppliers that form the critical processes of the organization.

Six Sigma terminology uses specific names for elements within the model, for example 'Black Belts' and 'Green Belts', which denote people with different levels of expertise in Six Sigma method, and different responsibilities, for implementing it. Six Sigma teams and Six Sigma team leaders use a vast number of tools at each stage of Six Sigma implementation to define, measure, analyse and control variation in process quality, and to manage people, teams and communications.

To properly implement Six Sigma project management methodology, first the executive team has to decide the strategy and on that base should identify the essential processes necessary to meet customer expectations. A team of managers ('Black Belts') who 'own' these processes is responsible for:

[12] © Copyright 1994–2005 Motorola, Inc.

- identify and understand the processes in detail,
- understand the levels of quality that customers expect,
- measure the effectiveness and efficiency of each process performance

This means that understanding and then improving the most important 'delivery-chain' processes will increase efficiency, customer satisfaction, competitive advantage, and profitability.

Six sigma uses DMAIC process elements to to improve its processes performance. In particular DMAIC is achronym for

- D—Define opportunity
- M—Measure performance
- A—Analyse opportunity
- I—Improve performance
- C—Control performance

Figure 5 show the DMAIC Six Sigma method for project management.

Motorola emphasizes that in order for Six Sigma to achieve 'breakthrough improvements' that are sustainable over time, Six Sigma's 'process metrics' and 'structured methodology' must be extended and applied to 'improvement opportunities' that are directly linked to 'organizational strategy'.

Six Sigma leaders will work with teams to understand, analyse and measure the performance of the critical processes. Measurement is typically focused on technical interpretations of number (normally percentages) of non conformities, and a detailed analysis of processes, involving organizational structures and flow-charts.

Other tools for performance measurement and analysis can be used depending on "what" to be measured and analysed. Six Sigma does not identify specifically what analytical methods must be used. The organization and in particular the team leaders decide what tool is better to adopt. Any analytical tool can be included within Six Sigma implementation.

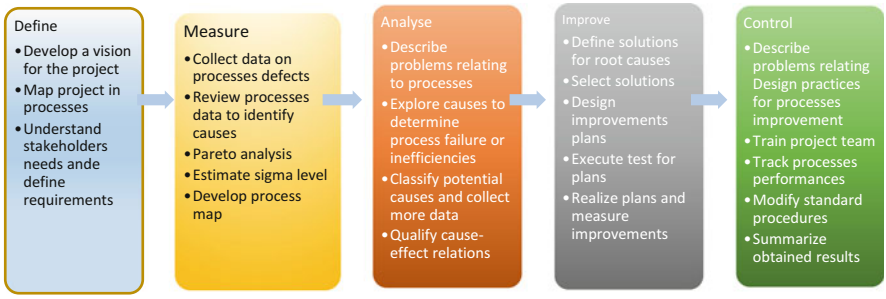

Fig. 5 DMAIC schema

8 The Pros and Cons of the Methodology

A project management methodology must be selected over many factors, the project context (both internal and external), the project type (i.e. for Software development project is suggested to use Agile methodologies instead traditional ones), in military context is better to use predefined methods or imposed project methods, and so on.

The correct methodology must help the project team to divide the project into different stages making it easy to manage and to help the project team to remain focused and deliver a quality outcome. The most important of all benefits is that it improves communication between all members of the team and also between the team and stakeholders, giving the team more control of the project. It also gives the stakeholder a chance to have a say when it comes to decision making as they are always kept informed by reports at regular intervals.

Users of PMI guide observe that it has more substantial frameworks for contract and scope management and other aspects. The PMBOK is a more generalist document in that it recognizes that life cycles and organization structures can vary by industry sector and organizational culture. It therefore provides more general guidance and covers more techniques than PRINCE2 particularly in the areas of costs and cost control, human resources, team development, procurement and solicitation. It must be stressed that as it is 'A Guide to the PMBOK' it also references further external publications and sources of information.

The flexibility of PRINCE2 allows these changes to be made run-time. Although there can be some implications and issues to the project schedule when certain changes are done run-time, PRINCE2 offers some of the best practices to minimize the impact.

Your team will also learn to save a lot of time and be more economical when it comes to the use of assets and various other resources, thereby ensuring that you are also able to cut down on costs a great deal.

When it comes to disadvantages, PRNCE2 does not offer the level of flexibility offered by some of the modern project management methodologies. Since project management, especially in software industry, has grown to a different level, PRINCE2 may find difficulties in catering some of the modern project management needs.

Integration Models of Project Management with Knowledge Management

Nermina Durmic

Abstract

The purpose of this chapter is to investigate how knowledge management (KM) aspects can be combined with project management (PM) discipline to improve project success rates and thus the quality of the final product. Several knowledge management and project management integration models are examined, and main findings show that the key factor of success lies in knowledge sharing and continuous learning activities throughout whole project development process. But to establish good knowledge sharing culture, project based organizations need to have barrier free environment, in context of transfer of lessons learned, social communicatoin, and project managers who hoard their knowledge. In addition, the chapter also discovers how other concepts like intellectual capital (IC), can nicely fiit the fusion of project management and knowledge management.

1 Introduction

Project management and knowledge management are widely used as standalone disciplines. However when merged together they become a powerful tool for organizations to compete with their competitors in a dynamic market.

Project management needs to ensure project success that organizations need, and it needs to deliver the final product in the shortest period of time possible having limited budgets. For that reason, reusing of existing knowledge among different phases of development process, discovering what kind of knowledge project teams

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need, knowledge sharing, and similar knolwedge management activities, significally help project managers to keep the project on the right track.

For the purpose of discovering ways to effectively merge these two disciplines, this section examines proposed theorethical and conceptual models proposed by Yeong and Lim (2010), Handzic and Durmic (2015), and Polyaninova (2011).

Project based organizations, which are in focus in this section, can be defined as organizations in which the majority of products are made against bespoke designs for customers. These types of organizations can be: (i) stand-alone companies that make products for external customers, (ii) subsidiaries of larger firms that produce for internal or external customers, or (iii) consortiums of organizations that collaborate to serve third parties (Sandhu and Gunasekaran 2004; Turner and Keegan 1999; Ajmal and Koskinen 2008). When referring to project based organization, authors also use terms like project organization and project environment.

2 Integrated KM–PM Model by Yeong and Lim (2010)

When defining knowledge management, Yeong and Lim (2010) rely on definition given by Bollinger and Smith (2001), who acknowledge knowledge management as a resource in terms of what the organization knows about customers, products and processes, and resides in databases or is gained through the sharing of experiences and best practices both internally and externally.

On the other side, one of definition approaches for project and project management they adapt in their work, comes from the Project Management Association of Japan (PMAJ). According to the PMAJ's Project and Program Management guide (P2M), "project refers to a value creation undertaking based on a specific, which is completed in a given or agreed time frame and under constraints, including resources and external circumstances" (Ohara 2005). The PMAJ defines project management as "the professional capability to deliver, with due diligence, a project product that fulfils a given mission, by organizing a dedicated project team, effectively combining the most appropriate technical and managerial methods and techniques and devising the most efficient and effective work breakdown and implementation routes" (Ohara 2005; Yeong and Lim 2010).

Prior to proposing their own view of integrated model of project management and knowledge management with the aim of improving project success in organizations, Yeong and Lim (2010) explored the contribution of other authors to the contemporary literature.

2.1 Project Knowledge Sharing Contribution to Project Success

Yeong and Lim (2010) find that Ismail et al. (2009) focuse their research on the significance of knowledge sharing in project environments.

The starting point for the model creation in their work was Nonaka's Knowledge Conversion Model, known as the SECI model.

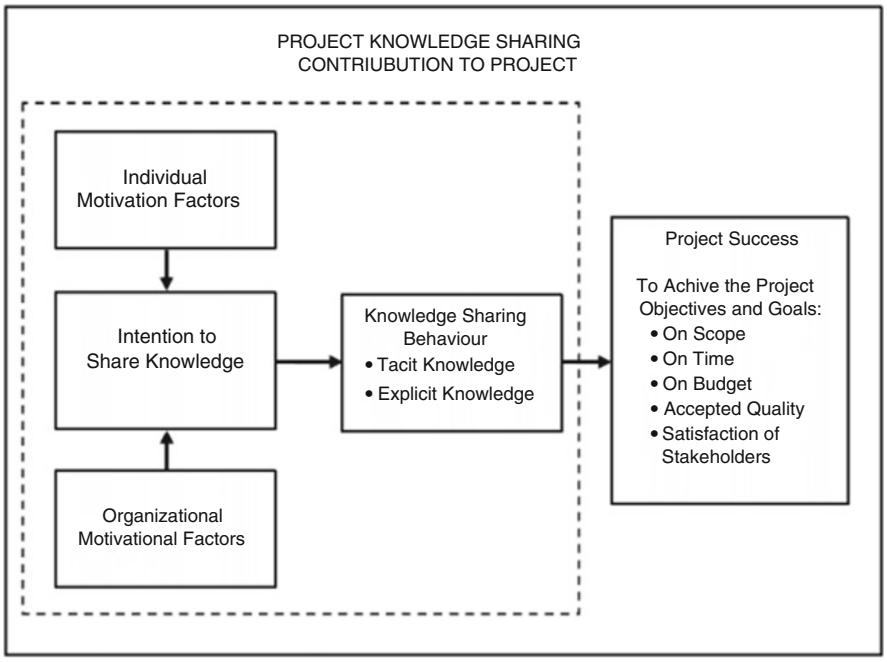

Fig. 1 Theorethical framework for project sharing contribution to project by Ismail et al. (2009)

Among all four parts of the model, representing organizational knowledge activities, Ismail et al. (2009) found that socialization of tacit knowledge was the most frequent gap in project environments, given the least attention and effort (Yeong and Lim 2010). With the aim of fulfiling this gap, Ismail et al. (2009) proposed a theoretical framework for project knowledge sharing contribution to project success, presented in Fig. 1.

The proposed model suggests that there are significant relationships between effective project knowledge sharing practice and project success. In more details, it indicates that providing appropriate motivators and removing relevant inhibitors to sharing knowledge and experience would result in more efficient and effective sharing of knowledge in projects which, in turn, would lead to an increased probability of project success. In this regard, ensuring when and how tacit and explicit knowledge is shared is essential for enhancing project success, where project success stands for achieving the project objectives and goals on scope, time, budget, accepted quality and satisfaction of stakeholders (Ismail et al. 2009).

The support for findings of Ismail et al. (2009) can also be found in the work of Lierni and Ribiere (2008) and Wiewiora et al. (2009).

Lierni and Ribiere (2008) claim that in project environments, knowledge comes primarily from explicit knowledge sources, but project managers could also strongly benefit from sharing and codifying tacit knowledge associated with the management of former projects. In this respect, they suggest following knowledge

management practices to project managers: Shared Repository of Project Artefacts; Lessons Learned and Best Practices Repositories; and Document and Content Management Systems (Yeong and Lim 2010).

The research of Wiewiora et al. (2009) wasn't discussed by Yeong and Lim (2010), but authors of this book find it as a nice confirmation of the model proposed by Ismail et al. (2009).

Wiewiora et al. (2009) carried out an empirical study on barriers to effective knowledge transfer in project based organizations. The need for a study on that topic was recognized in works of Desouza and Evaristo (2006) and Landaeta (2008). They state that project based organizations face serious knowledge needs in their projects, and tend to repeat the same mistakes too often because of the lack of effective knowledge transfer which could potentially be found in other projects within the same organization. Carrillo (2005) also says that despite a project's uniqueness, project experiences can be reused in other projects, providing valuable lessons. So, it is important to share knowledge across projects in order to avoid unnecessary reinventions of what has been already done and decrease chances for failure in that way.

Wiewiora et al. (2009) classified detected barriers to effective knowledge transfer into three categories:

- Barriers related to inter-project transfer of lessons learned, where collection of lessons learned almost never occurs, or if it does, it occurs periodically rather than throughout the performance, which causes important information to be missed or forgotten.
- Barriers related to social communication, where lack of links between project teams results in lack of knowledge sharing between them. A very big barrier in this aspect can also be a negative atmosphere created in project based organizations which makes employees unwelcome to share bad experiences. However, most interviewees agreed that social communication is the most effective way to share valuable knowledge and information.
- Barriers related to project manager, which mainly include situations when project managers hoard their knowledge, as they view it as a potential threat for them in the future.

In all three categories the biggest recognized barrier was lack of time, in terms of keeping focus on the final delivery rather than on knowledge transfer activities which could speed up the process.

When discussing the issue of knowledge transfer in project based organizations, Ajmal and Koskinen (2008) emphasize that organizational culture is very often an obstacle to such activities. They say that while knowledge management is of crucial importance for project management, it fails due to cultural factors, rather than technological oversights.

2.2 Continuous Learning Contribution to Project Success

With the aim of creating a corresponding model, Owen (2008) focuses her research on analysing the significance of knowledge reuse and continuous learning for project management. With the aim of adding another aspect to the topic, she extended the project management to programme management, relying on detail that knowledge management has been recognized as critical success factor for both project and programme management.

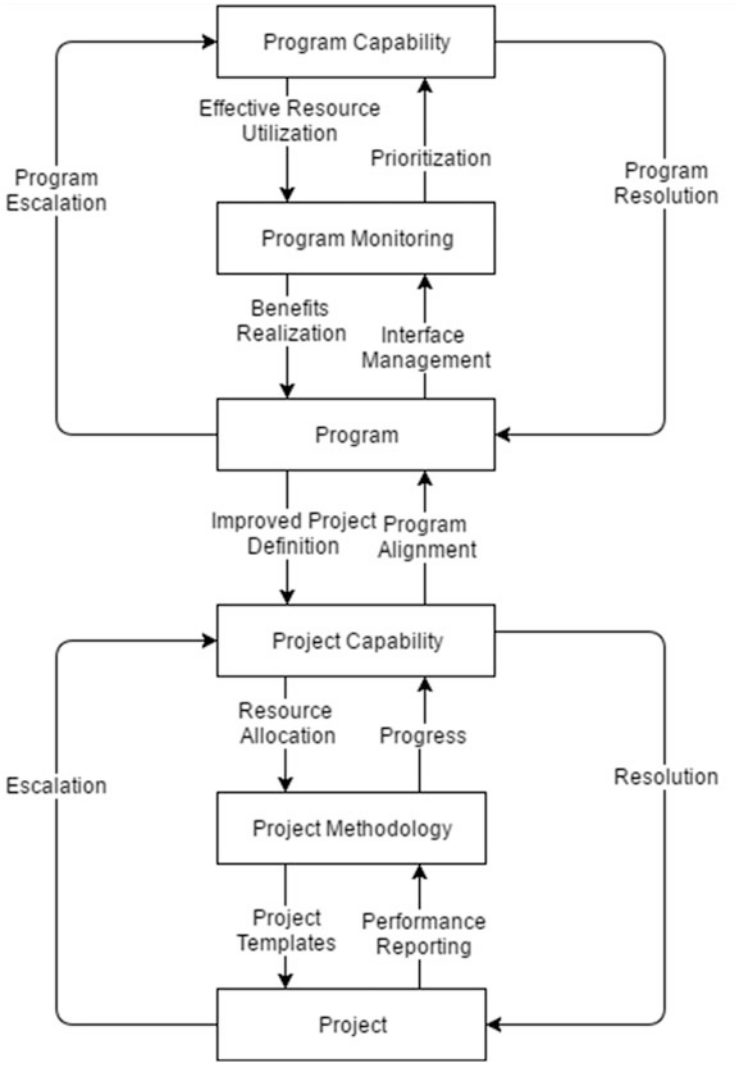

Fig. 2 Integrated KM and project/program management model by Owen (2008)

Owen (2008) starts from validated opinion that creation, reuse and transfer of knowledge can improve project management capabilities resulting in continuous learning, and provides a structure to link project/program management to knowledge management, mutually exploiting both (Fig. 2). In this aspect, Owen (2008) defines a project as a task where knowledge is created as a result of activities that are carried out by project teams.

Owen's framework suggests that project team members should be able to conceptualize the taks, reuse and apply the past knowledge and experiences supported by a knowledge management system. The framework shows how knowledge is developed at the task level which is embedded into the project methodology in the project environment and eventually improves the capability of an organization. Owen suggests that knowledge is embedded throughout the project lifecycle at both tactic and explicit levels. Tacit knowledge is captured and reused at the project level in the form of personal knowledge contributed by the project team members, while explicit knowledge is reused in terms of project documentation captured during the project lifecycle. The framework proposed by Owen uses the concept of recursiveness and extending the project to the program level, where the program is, by definition given by PMI (2008), a group of projects managed together allowing added benefit and control which would not normally be achieved from managing the projects individually (Yeong and Lim 2010).

As a conclusion, Owen highlights that in order for an organization to deliver successful projects, continuous learning needs to occur to improve its capability. Continuous learning can be derived in terms of developing guidelines for creating, sharing, and reusing knowledge in a project management environment, thus integrating knowledge management practices with project/program management (Yeong and Lim 2010).

2.3 Knowledge About Project Risk as a Contribution to Project Success

Gudi and Becerra-Fernandez (2006) deal with the significance of project complexity in integraiton of project management and knowledge management. Furthermore, their research was driven by the motivation to reduce risk and prevent failures during the development of complex systems and focus on the dynamic aspects of project management using knowledge management. They claim that the knowledge about risk assesment and nature of risky systems directly influences the final project success, so their intent was to identify knowledge management strategies, which organizations could institute in project management practices to reduce risk of failure and increase the chance of project success (Yeong and Lim 2010).

The conceptual model of knowledge management in project management proposed by Gudi and Becerra-Fernandez (2006) is predented in Fig. 3.

The model explains that project success is directly affected by project risk and team adaption, both of them having factors that they depend on. External factors like political and economic impacts, as well as the internal factors like the extent of

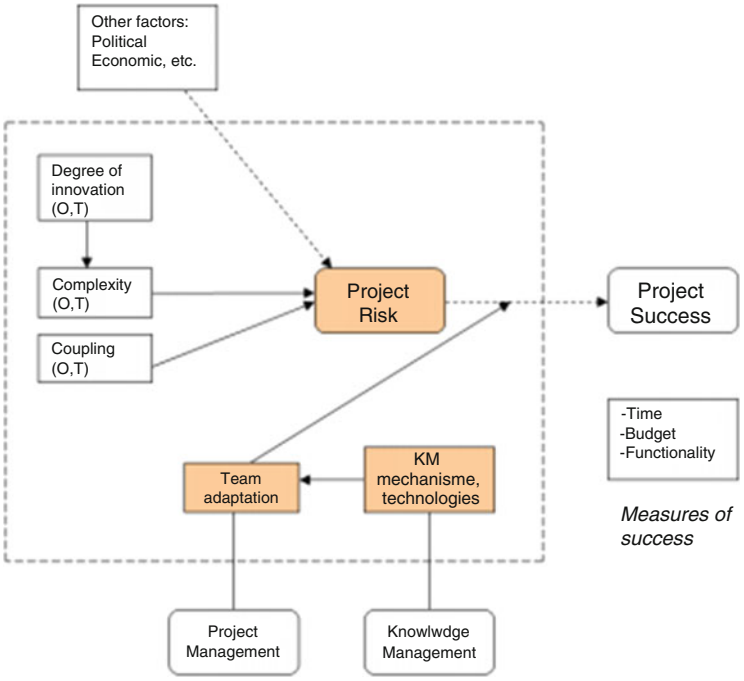

Fig. 3 Role of KM in PM by Gudi and Becerra-Fernandez (2006)

innovation, complexity and coupling, are factors that have an impact on project risk in complex project organizations. On the other hand, team adaption is influenced by knowledge management mechanisms and technologies. For the purpose of the model creation, project success is considered to be measured in terms of time, budget and functionality (scope) (Gudi and Becerra-Fernandez (2006).

2.4 KM in PM: Conceptual Model

Based on knowledge derived from analysis of the three models, Yeong and Lim (2010) proposed a theoretical framework with their view of how knowledge management and project management should be merged with the aim of improving project performance and ensuring project success.

They start their model with introducing three intervening factors that might influence both project management and knowledge management, which, in turn, influence the enhancement of project success. These factors are: (1) culture, (2) process and (3) technology, and the additional support for defining them as input factors for the model is found in earlier works of Lim and Turner.

In the study undertaken by Lim (2008), it was found that organizational culture, knowledge management process and technology provide strong support for

effective knowledge sharing, whose importance is highly by Ismail et al. (2009). On the other side, Turner (2009), in his attempt to define factors that can speed up delivery of new products, finds that change of organizational culture, the use of new technologies, and process that focuses on the quality of projects' deliverables, are the most critical ones. He explains these factors as project management practices in project based organizations Yeong and Lim (2010).

When discussing the organizational culture as a success factor of knowledge management and project management, Turner (2009) focuses strictly on international projects. He finds the reasons for this approach in facts that differences in langiages, leadership styles or methods of working may slow down the project delivery, and therefore its success as well. He suggests that in order to accomodate cultural differences from aspects of power distance, individualism, role of time, masculinity, uncertainty avoidance, or consideration of detail, appropriate project managers and project team members should be selected to participate in international project development (Turner 2009).

However, relying on the work of Kendra and Taplin (2004) that analyses all types of project based organizations, and says that the alignment of organizational cultural values with project management values enables the organization to successfully adopt project management as a new work method for improved project success, the framework of Yeong and Lim (2010) is created to be applicable to most project environments and not only international.

When discussing the process factor, which affects project environments and, in turn, project success in their proposed model, Yeong and Lim (2010) bring up two versions of process, defined by PMI (2008) documentation:

- Process derived from the work of Henri Fayol: plan, organize, implement and control.
- Process according to the PMBOK: initiate, plan, organize, execute, control and close.

Considering a general definition of process as a valuable aspect in project environment, which says that process is a structured set of activities designed to accomplish a specific organization's objective, Yeong and Lim (2010) conclude that notation of process is similar to phases of project lifecycle. Thus, they include it in the model as one of key input factors.

Finally, reasons for including technology as a success factor in the model, are confirmed by Kerzner (2009), who finds that good project management practices emphasize a cooperative working relationship between the project manager and the technical experts from the line management. In addition, Turner (2009) also claims that good project management can be achieved by achieving a balance between the different areas of technology as well as between technology and culture (people, system and organization) (Yeong and Lim 2010).

Yeong and Lim (2010) also suggest that project managers should continuously feedback and align existing knowledge from the repository and newly created

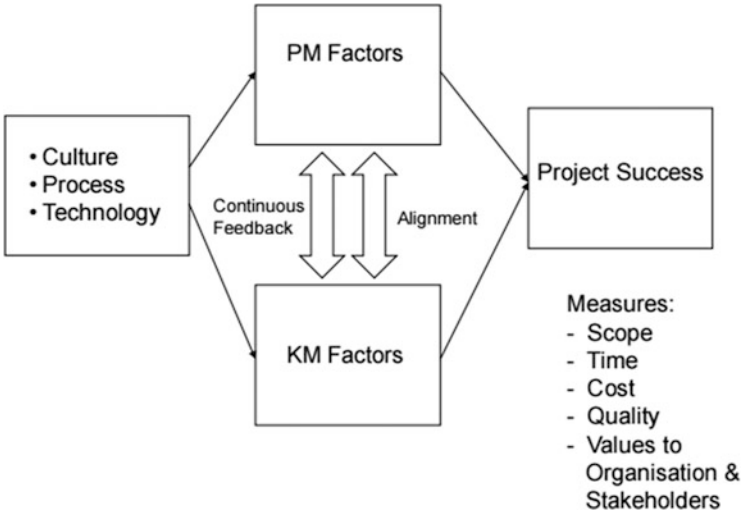

Fig. 4 Integrated KM and PM by Yeong and Lim (2010)

knowledge from the projects to enhance project success, therefore they created a link between project management and knowledge management factors as well.

Arguments for establishing this kind of link are found in the model proposed by Owen (2008). Levin (2010) also emphasizes that knowledge management must be embedded throughout the project management lifecycle, and that each project should be built relying on knowledge assets continuously being developed in an organization.

The final integrated model of project management and knowledge management, proposed by Yeong and Lim (2010), is presented in the Fig. 4.

Project success measures include scope, time, cost, quality and values to organization and stakeholders, as proposed by Ismail et al. (2009).

Yeong and Lim (2010) conclude their research by stating that knowledge is created via projects and continuous creation of innovative knowledge is essential for the survival of organizations.

3 Integrated KM–IC–PM Model by Handzic and Durmic (2015)

Handzic and Durmic (2015) agree with other researchers that a way to improve project success and thus increase organizational competitiveness, is through integration of of knowledge management and project management aspects, but the additional goal in the research they carried out was to add another dimension to integration of these two disciplines.

Given that intellectual capital refers primairly to intellectual material in its various forms that drives growth and value creation for an organization Guthrie (2001) and Handzic and Durmic (2015) found beneficial to add intellectual capital aspects to their research. In this regard, they prposed a new conceptual model that combines elements of each of knowledge management, intellectual capital and project management into a single converged model. The model was created with step-by-step approach, relying on the existing individual frameworks and concepts of each of the three disciplines.

3.1 KM Model

Handzic and Durmic (2015) approach the process of creating the knowledge management-project management-intellectual capital integrated model by ensuring that all perspectives of knowledge management that exist in literature, are included in consideration. In this respect, they discuss three types of strategies or schools of knowledge management, referring to them as "generations":

The first generation of KM can be described as technocratic (Earl 2001). It views knowledge as an object and places emphasis on the role of information and communication technologies in KM. The systems focus on formalized knowledge bases in which the knowledge of human experts is made explicit so that they can be used by non-expert workers. Knowledge directories and Yellow Pages of experts allow other workers to locate those who have the knowledge they need more easily. KM systems are designed to document knowledge processes and store best business practices. Data captured in shared databases, data warehouses and document management systems are used to support planning and decision making to meet customers' needs. Hahn and Subramani (2000) identify a number of issues and challenges related to the utilization of information and communication technologies for KM: the need to balance knowledge exploitation and exploration, overload and useful content, additional workload and accurate content. There is also a need for flexibility, evolutionary development and user acceptance of knowledge systems (Handzic and Durmic 2015).

Second generation KM is orientated towards people and organizations. It emphasizes knowledge as a competitive weapon and sees KM as a firm's strategy. Sveiby's (1997) model of Intellectual Capital (IC) incorporates human capital as one of the key knowledge assets from which organizations extract value. Other assets include relational and structural capital. The essence of second generation KM is the pooling of knowledge by networked employees and communities of practice. It focuses on organizational structures and cultures that facilitate knowledge sharing and pooling. It also considers physical spaces for greater facilitation of knowledge exchange. These facilitators are reflected in the concept of "ba" introduced by Nonaka and Konno (1998). These authors suggest that ba (or place) acts as a promoter of the knowledge creation spiral proposed by Nonaka (1998). In general, second generation KM models address issues of organizational

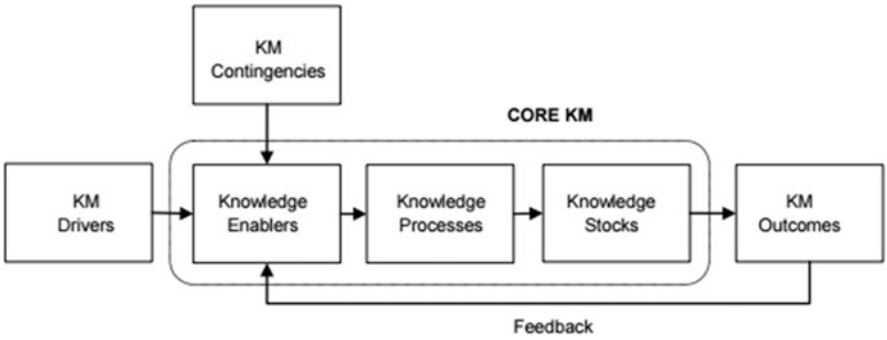

Fig. 5 Integrated KM model by Handzic et al. (2008)

culture and learning, change and risk management, and the support of communities of practice (Handzic and Durmic 2015).

Third generation KM departs from the earlier held universalistic perspective on KM by arguing that the effectiveness of a knowledge management practice depends on the context in which the knowledge is being used. A number of researchers have taken a contingent theoretical approach to KM and provided considerable empirical support for the view (e.g. Hansen et al. 1999; Snowden 2002; Becerra-Fernandez and Sabherwal 2001; Becerra-Fernandez et al. 2004). Among these, Snowden (2002) holds an interesting position that a bureaucratic context is good as a training environment, communities of practice encourage knowledge exchange through socialization, informal contexts use stories and symbols to provide shared understanding, while innovative contexts require action and risk taking to impose order on chaos (Handzic and Durmic 2015).

3.1.1 Integrated KM Model

The *context-driver-enabler-processknowledge-outcome* integrated knowledge management model, created by Handzic et al. (2008) (Fig. 5), combines and links all three generations of fragmented knowledge management approaches. Furthermore, it highlights the importance of knowledge management consciousness in a business strategy of an organization, which in context of project environment, means building knowledge management solutions to enhance project success. Thus, Handzic and Durmic (2015) use it for the core structure of the final KM-PM-IC model.

The integrated knowledge management model is composed of six main components, interrelated into core and extended aspects. Handzic and Durmic (2015) provide a detailed analysis of each aspect.

The model core views knowledge management as configurations of an organization's socio-technical knowledge enablers, knowledge processes and knowledge stocks. Supported by Nonaka and Konno's (1998) concept of ba, the model brings together technology- and people-orientated approaches to KM. It emphasizes the importance of both social and technical factors in enabling and facilitating

knowledge processes. Organizational structures, cultures and technologies are believed to be tightly interconnected (Handzic and Durmic 2015).

With respect to knowledge processes, Handzic and Durmic (2015) find that the model recognizes their dynamic nature. It covers various processes through which knowledge is moved (e.g. transfer person-to-person, person-to-document) and modified (e.g. creative idea generation, mining of hidden patterns in captured data). The underlying assumption is that the better the processes of knowledge generation, sharing, capture and/or discovery, the greater the likelihood that the knowledge needed will be available, leading to more effective and innovative organizational performance. Since knowledge is seen as the most valuable organizational asset in the knowledge economy, the model core incorporates the knowledge stock component. More importantly, it synthesizes different human- and objectorientated perspectives on knowledge and proposes a multidimensional view of the concept (e.g. human, structural and relational; explicit and tacit; know-what and know-how; etc.).

In its extended form, the model recognizes explicitly that KM is driven by forces from its surrounding external environment. Acting as strategic levers through which an organization delivers its desired outcomes, drivers prioritize projects competing for its limited resources. Typical strategic drivers of KM found across business and government entities include operational excellence, stakeholder intimacy, service delivery, growth, sustainable profitability and risk mitigation (AS5037 2003). Taking into consideration that KM creates value for an organization in the form of improved productivity, innovation, agility or reputation, the extended model incorporates the component of KM outcome. While it may be hard to identify all the immediate benefits from a KM initiative, organizations need to get some feedback on the degree to which KM fulfils their articulated drivers (Handzic and Durmic 2015).

Finally, the extended model promotes a contingency view of KM, which argues that no one solution is best under all circumstances. Various knowledge task, environment and worker related factors influence the "right" choice. Organizations need to select among multiple possible paths the one that best fits their particular set of circumstances (Handzic and Durmic 2015).

3.2 PM Model

Prior to defining the critical project management factors that affects the project success, Handzic and Durmic (2015) provide insights into the meaning of project as a notation, and significance and purpose of corresponding project management, as they see project success or failure is the ultimate outcome of project management.

They suggest several definitions of project, given by Munns and Bjeirmi (1996), Lowery (1994), Morley (2006), Diallo and Thuillier (2005), and Zouaghi and Laghouag (2012). All of them come down to a similar explanation which says that a project is a set of activities that need to be carried out in adequate period of

time, in order to achieve a specific objective. Each activity should be coordinated and controlled, and consumes different resources.

Of the main interest for Handzic and Durmic (2015) research, were information systems projects. Based on Ewusi-Mensah (1997), an IS project can be considered as an IT enabled system intended to meet the information processing needs of an organization. IS can also be characterized as a socio-technical system. There are three characteristics that make IS different from non-IS projects that organizations undertake. These are: (a) IS projects are unique in that they require intense involvement and collaboration of three groups of stakeholders: IS staff, end users, and management. Therefore, IS projects are sets of group-oriented activities, organized and executed in teams. (b) IS projects tend to be conceptual in nature. For that reason, they are very often subject to risks and uncertainties associated with them, if they are difficult to assess with any degree of reliability prior to their start. Those risks can come from the project, its nature, team or their knowledge. (c) IS projects depend on substantial capital and human resources (Ewusi-Mensah 1997; Handzic and Durmic 2015).

Finally, one of the most important aspects of IS implementation, is Project Management, as its main focus is on making sure that the project goes in the direction which will make it meet the success criteria. Definitions of project management by Cleland and Ireland (2006), Zouaghi and Laghouag (2012), Charvat (2003), White and Fortune (2002), Hoffer et al. (2008), and Attarzadeh and Ow (2008), provided by Handzic and Durmic (2015), narrow down to a common definition that explains project management as the application of knowledge, competences, tools and techniques to perform project activities, like planning, organizing, leading and controlling, in order to fulful the assigned requirements, satisfying considtions of time and money.

Based on theorethical background provided, Handzic and Durmic (2015) define two main aspects to consider for the definition of project success factors related to project management. Those are:

- Process aspects of project management
- People aspects of project management

3.2.1 Project Aspects of PM

Handzic and Durmic (2015) take into consideration Software Development Life Cycle (SDLC) models provided by Kumar et al. (2013), IBM (2012), and Hoffer et al. (2008), as SDLC models define processes of phases and activities undertaken during development of IS projects precisely.

According to Kumar et al. (2013) (Fig. 6), the exact sequence of steps in a software development life cycle can depend a lot on the methodology used, but in general all of them come down to five main phases: requirement analysis, design, coding, testing and maintenance (Handzic and Durmic 2015).

According to IBM (2012), the SDLC is also comprised of five phases, but organized differently than in Kumar et al. (2013) (Fig. 7). These phases are: planning, implementation, testing, deployment and maintenance. For smaller

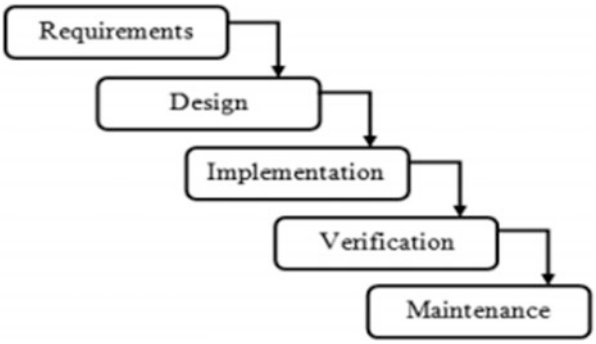

Fig. 6 Software development life cycle by Kumar et al. (2013)

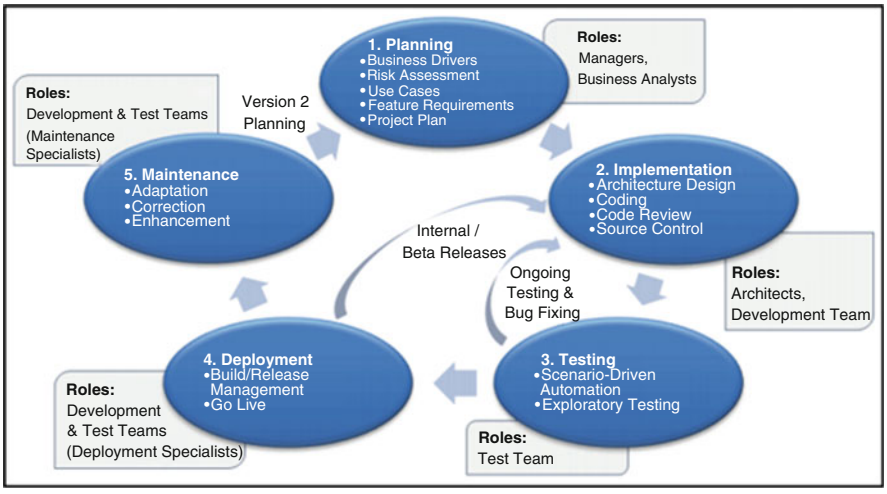

Fig. 7 Software development life cycle by IBM (2012)

teams these steps may occur unconsciously, with individuals being involved in more than one role. However, for larger organizations, where hundreds or thousands of individuals can be devoted to one project, the SDLC becomes a valuable tool for the project development process (IBM 2012; Handzic and Durmic 2015).

Hoffer et al. (2008) organize the SDLC as a set of following phases: planning, analysis, design, implementation and maintenance (Fig. 8). They highlight the following four steps: analysis, design, code and test as the heart of the IS development process. Furthermore, Hoffer et al. (2008) warn that the SDLC should not be considered as a sequentially ordered set of phases, because the specific steps and their sequence should be adapted as required for a project, consistent with management approaches (Handzic and Durmic 2015).

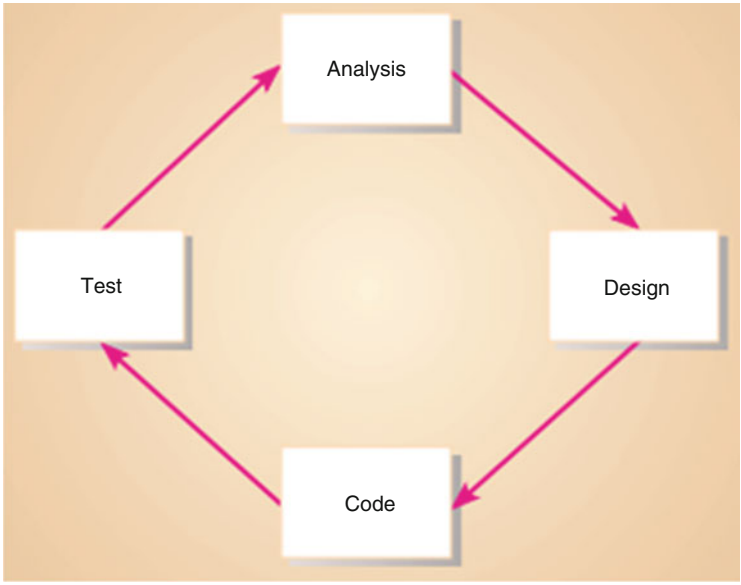

Fig. 8 Highlighted steps in software development life cycle by Hoffer et al. (2008)

Based on the comparison of similarities and differences between the phases in the above-reviewed approaches, Handzic and Durmic (2015) identified three common aspects of the project process, as follows:

1. Project planning—During the planning phase, the goal and vision of a project are determined, as well as the business requirements based on customers' requests, market projections, the competitive environment and other business drivers, and time and budget parameters. After the project business goal is set, the responsible team members proceed with the feature requirement analysis, prioritizing the partial tasks to be done during the development phase and making the final project plan (Handzic and Durmic 2015).
2. Project execution—The execution phase that comes right after planning combines design and coding activities. It involves architecture design, coding, code review and source control. Its goal is to move the problem domain towards the solution domain, so as to transform the requirement specification into structure. The design phase converts the description of the recommended solution into logical and then physical system specifications. During this phase the software architects evaluate the project and make relevant decisions about the best model to use for development and the best programming language. Once the decisions are made, the coding starts (Handzic and Durmic 2015).
3. Project verification—The final phase focuses on code verification activities, as well as the overall status of the project, the amount of work completed, the quality of work, actual costs compared to budget costs, how much time has elapsed and how much time is necessary to complete remaining work, etc. It

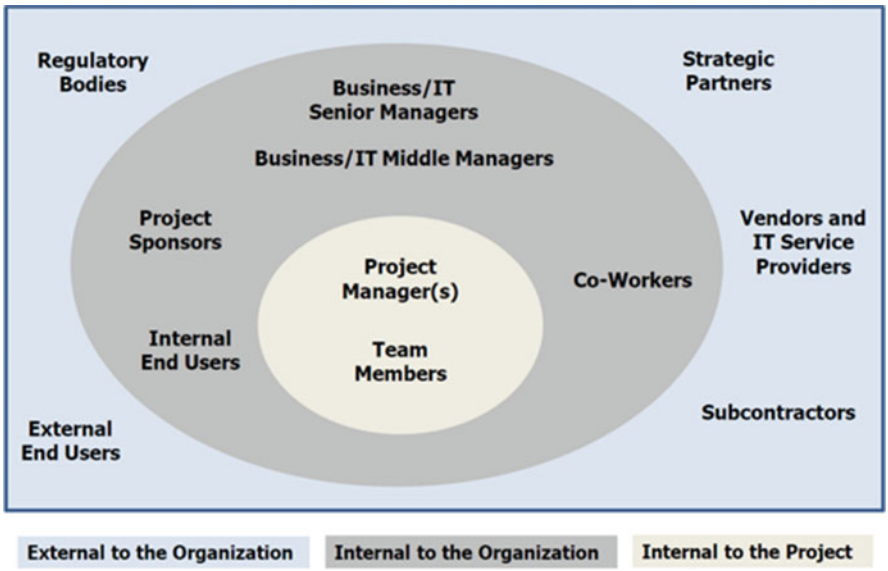

Fig. 9 People organization in typical project environment by Sambamurthy and Zmud (2012)

becomes clear whether some adjustments need to be made if a problem arises during programming, or potential risks can be predicted that could have a negative effect on one of the project success parameters (Handzic and Durmic 2015).

3.2.2 People Aspect of PM

Handzic and Durmic (2015) highligh the extraordinary importance of people aspect in project management by saying that none of the process phases explained in the previous section would be possible without people—people requesting projects, building them and monitoring them. For the definition of factors belonging to this aspect of PM, they adapt *People organization in typical project environment* model (Fig. 9), created by Sambamurthy and Zmud (2012), who classify people in project based organization into three groups:

- People internal to the project—project manager(s) and team members. Project managers are responsible for achieving project outcomes and planning, organizing and controlling project tasks, while team members are responsible for achieving the project task outcomes (Sambamurthy and Zmud 2014; Handzic and Durmic 2015).
- People internal to the organization—internal end users (employees), project sponsors, co-workers, business/IT senior managers, business/IT middle managers. Internal users use project outcomes or are affected by them. They gain benefits or suffer losses from project outcomes. Sponsors provide funding, specify project outcomes and provide political support. Co-workers possess

project-relevant expertise and perspectives. Senior IT managers hold funding and resource allocation rights, while middle IT managers hold direct authority over project team members and control access to needed resources (Sambamurthy and Zmud 2014; Handzic and Durmic 2015).

– People external to the organization—external end users (customers and suppliers), subcontractors, vendors and IT service providers, strategic partners and regulatory bodies. External end users are the people who requested the project and gain benefits or suffer losses from project outcomes. Subcontractors carry out the project tasks. Vendors and IT service providers supply project resources and carry out project tasks. Strategic partners collaborate on project activities, and regulatory bodies specify project outcomes and constrain project activities (Sambamurthy and Zmud 2014; Handzic and Durmic 2015)

3.2.3 Critical PM Factors and Project Success

Finding the support in works of Kumar et al. (2013), Bakker et al. (2009), Hoffer et al. (2008), Attarzadeh and Ow (2008) and Sambamurthy and Zmud (2014), that emphasize the direct connection between people aspect of PM and project success on one side, and process aspect of PM and project success on the other, Handzic and Durmic (2015) propose a model of critical PM factors that affect the final project success. In accordance with suggested literature they consider project success to be measured in terms of time, budget, and scope.

The model is illustrated in Fig. 10. People aspect in the model includes project team and project customer factors, while process aspect includes project planning, project execution, and project verification factors. As suggested in mentioned literature sources, project success is considered to be measured in terms of time, money and scope.

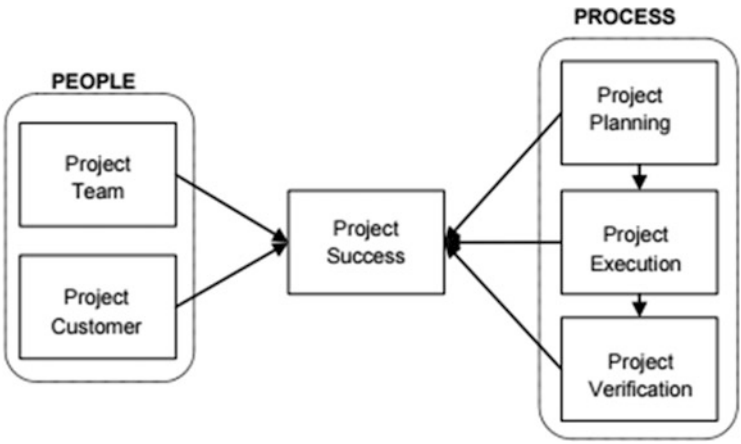

Fig. 10 Critical PM factors model of project success by Handzic and Durmic (2015)

3.3 IC Model

Handzic and Durmic (2015) adapt the definition of Intellectual Capital initially given by Stewart (1997), that says that intellectual capital is intellectual material—knowledge, information, intellectual property, experience—that can be put to use to create wealth.

In management literature, they find that the term intellectual capital (IC) refers to intellectual material in its various forms that drives growth and value creation for an organization. The term is synonymous with intellectual assets, intangible resources and knowledge capital (Guthrie 2001). One of the most recent definitions of IC describes the concept from the static "stock" perspective as "the sum of all the intangible and knowledge-related resources that an organization is able to use in its productive processes in the attempt to create value" (Kianto et al. 2014). These resources may include professional skills and experience of people, organizational technologies and features embedded in organizational processes, as well as the relationships with customers that the organizations draw upon to convert to profit and achieve competitive advantage (Edvinsson and Malone 1997; Sullivan 1998; Handzic and Durmic 2015).

While the majority of KM literature addresses the mechanisms by which knowledge resources can be managed, IC literature examines primarily the kind of intangible resources that contribute to value creation. Typically, stocks of knowledge assets are divided into human (people), structural (organizational) and relational (customer) capital.

When mapped to project environment context, human capital refers to human intellect of organizations' employees. Bontis (1998) defines the concept as a combination of employees' genetic inheritance, education, experience and attitudes. It has been recognized that a significant proportion of a company's knowledge assets is often stored in the minds of its employees. When organizational knowledge is concentrated in the minds of highly skilled individuals, they can become irreplaceable and their departure from the company may create gaps that are difficult to fill. Therefore, vital people's competencies need to be carefully identified and evaluated. In general, human capital is considered as an important source of organizational innovation and strategic renewal. According to Handzic and Zhou (2005), the success of many projects and strategies depends not only on the individual abilities of knowledge workers, but also on whether different knowledge workers and different components in the knowledge base can be combined efficiently. Collective knowledge is more than the sum of individual knowledge. It is particularly important for the long-term survival and success of a company (Handzic and Durmic 2015).

Structural capital deals with systems and procedures, mechanisms and structures of an organization that can help support employees in their actions and performance, and thus business performance (Bontis 1998). This kind of organizational knowledge is usually manifested in the organization's behaviours: its culture, infrastructure, purpose and strategy (Handzic and Zhou 2005). An organization's culture comprises basic assumptions and beliefs that govern participants' activities;

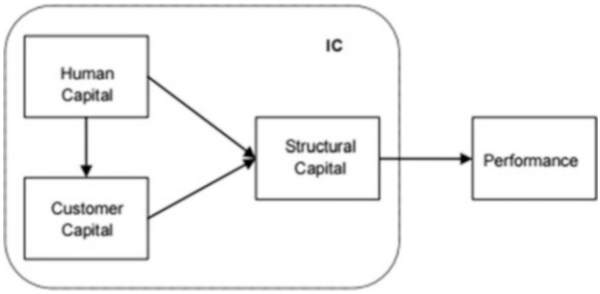

Fig. 11 Model of IC impact on performance by Bontis (1998)

infrastructure regulates participants' roles and relationships between co-workers; and purpose and strategy define an organization's mission, vision, objectives and a plan to achieve its purpose. Some organizational knowledge is manifested in the form of artefacts. Examples include books, memos, business plans, manuals, patents and products (Handzic and Zhou 2005). A knowledge artefact embodies that knowledge in an object, thus facilitating its preservation and sharing (Handzic and Durmic 2015).

Relational capital represents external organizational links. It is a valuable asset of an organization due to external environment intangibles, such as the knowledge embedded in customers, suppliers, the government or related industry associations (Bontis 1998). Such knowledge can become a critical factor in determining a firm's competitive edge in a mature and highly competitive market environment (Handzic and Zhou 2005; Handzic and Durmic 2015).

The model created by Bontis (1998), that illustrates connections between IC components and how they relate to the final organizational performance, is presented in Fig. 11.

The model is empirically tested and its main contribution is to show that that there must exist an interplay among human, structural and customer capital in order for an organization to leverage its knowledge base (Handzic and Durmic 2015).

3.3.1 Merged Model of KM--IC–PM

Based on the literature reviewed, Handzic and Durmic (2015) introduce a new conceptual model that combines factors of KM, PM and IC fields, in a way that can increase the rate of project success in organizations. The proposed model is presented in Fig. 12.

The proposed model adopted contextual contingencies and drivers of KM, as well as KM practices comprising socio-technical knowledge enablers and processes from knowledge management field. From PM field, the model adopted people (project team and customer) and process (project planning, execution, verification). elements as critical IC dimensions, and project success as PM, as well as KM outcome component. With respect to relationships, the proposed model recognizes that various motivational forces (Ismail et al. 2009) and contextual contingencies (Gudi and Becerra-Fernandez 2006) drive and influence the choice and application of KM practices in PM and thus indirectly impact project success.

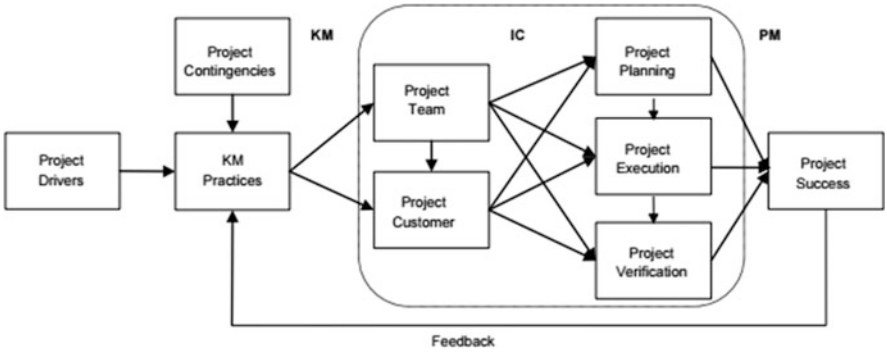

Fig. 12 Merged model of KM, IC and PM by Handzic and Durmic (2015)

The model further proposes that KM practices in terms of various social and technical knowledge enablers and knowledge processes foster the development of the project team's competencies and relationships with a project customer. Two most frequently mentioned practices include transferring of tacit knowledge via mentoring and explicit knowledge via documenting (Owen 2008; Cope et al. 2006; Lierni and Ribiere 2008). Next, the model proposes that the project team and project customer jointly influence the project process, which in turn affects project success. From the IC perspective, human and relational capital (project team and customer) contribute to performance (project outcome) indirectly via structural capital (project process). Thus, in the proposed model, project process (as a structural capital) represents a key factor that can enhance project quality and success (Handzic and Durmic 2015).

Finally, the model proposes a feedback loop to indicate the need for continuous development of both tacit and explicit knowledge assets in the project environment (Handzic and Durmic 2015).

4 The Concept of Project Knowledge Management

Polyaninova (2011) discusses the management of project knowledge, and approaches the issue of merging project management and knowledge management from the perspective of organizational and future project influences of knowledge loss. She says that if the accumulated knowledge is not recorded and shared amongst other projects, that knowledge will be lost and no longer available to assist future projects, which leads to increased future project costs and lower quality of project's deliverables.

When defining a project, she relies on definition given by Cleland and Ireland (2002), which explains project as a combination of resources pulled together to create something that did not previously exist. Next, based on Lock (2007) and Polyaninova (2011) defines project management as a way to predict as many

dangers and problems as possible and to plan, organize and control activities so that projects are completed successfully in spite of all risks.

As for knowledge management, Polyaninova (2011) agrees with Sanchez (2003) who says that KM is *a central concern—and must become a basic skill of a modern manager*. She defines knowledge management as a discipline that is focused on systematic and innovative methods, practices and tools for managing the generation, acquisition, exchange, protection, distribution, and utilization of knowledge, intellectual capital, and intangible assets (Montana 2000).

When talking about knowledge flows in project based organizations, Polyaninova (2011) says that for an effective knowledge management system, an organization should consider three knowledge bases in project implementation, identified by Conroy and Soltan (1998):

- an organization knowledge base, which includes the knowledge specific to organizations and environments in which the projects are implemented
- a project-management knowledge base, which includes the knowledge of the theory and application of project management
- a project-specific knowledge base, which includes specific knowledge acquired within the implementation of a particular project

Conroy and Soltan (1998) have also divided project-created knowledge into three general categories, as follows (Polyaninova 2011):

- technical knowledge—which relates to techniques, technologies, work processes, costs and other things that are involved in discipline-specific issues of the project
- project management knowledge—which relates to methods and procedures required for managing the implementation of projects
- project-related knowledge—which refers to knowledge about the customers and other people or entities that are of significance for the future business of the organization

Project knowledge is created within each of project phases, and management of such knowledge is called Project Management Knowledge (PKM), which stands for the link between project management and knowledge management (Frey et al. 2009; Polyaninova 2011).

Knowledge management and project management components are very similar. PM components include system, people and tools and KM components include people, technology and organizational factors. As components are analogous this allows for components from both disciplines to be placed on top of each other, so they can merge and work in conjunction with each other as shown by Fig. 13 (Awad and Ghaziri 2004; Cleland and Ireland 2006; Polyaninova 2011).

The growing complexity of project work means that an increasing number of technical and social relationships and interfaces must be taken into account by project managers in adapting knowledge and experiences from the daily work of a company and from earlier projects. Project team members frequently need to learn

Fig. 13 KM and PM components by Polyaninova (2011)

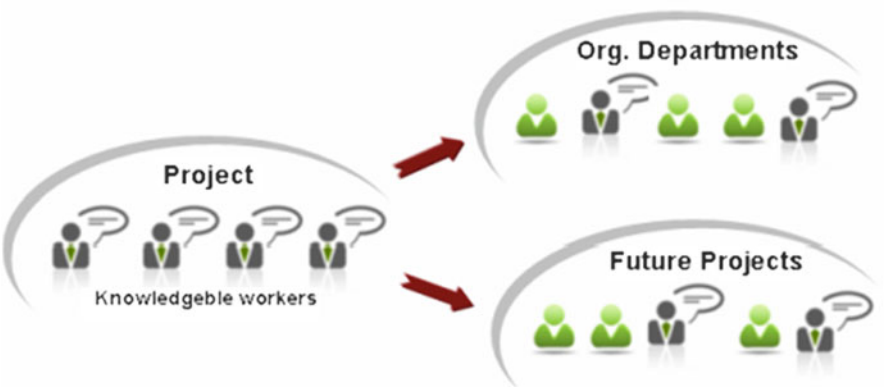

Fig. 14 Project knowledge workers and knowledge spread by Polyaninova (2011)

things that are already known in other contexts. In effect, they need to acquire and assimilate knowledge that resides in organizational memory. Their effectiveness in doing this determines their personal effectiveness, the project's effectiveness, and ultimately, the company's effectiveness (Ajmal and Koskinen 2008). Usually, knowledge from past projects is accumulated in an individual's mind or documents and repositories. People with knowledge about past performed projects assigned to similar projects where their knowledge can be shared to benefit the project implementation and widen overall organizational knowledge base as can be seen from Fig. 14 (Polyaninova 2011).

As a conclusion, Polyaninova (2011) emphasizes that good project management, with help of complementing knowledge management, is essential for improving success of current project, future projects and business of entire organization.

5 Conclusion

The purpose of this section was to explore ways to merge knowledge management and project management concepts, with the aim of improving project success rates in project based organizations, and thus organizational success. In this regard, integrated KM-PM models proposed by Yeong and Lim (2010), Ismail et al. (2009), Owen (2008), Gudi and Bacerra-Fernandez (2006), Handzic and Durmic (2015), and Polyaninova (2011) were examined.

What each analysed model emphasizes is that the essential point for enhancing project success is ensuring how and when both tacit and explicit knowledge is shared throughout project development process. Individual and organizational/environmental motivation factors, as well as intention to share knowledge are recognized as factor that strongly affect the knowledge sharing behaviour in a project environment. Furthermore, knowledge sharing in this context affects not only the success of current projects in a given time, but also of all the future projects in an organization, as reuse of existing knowledge saves project time and costs. However, a condition for a project based organization to experience benefits of knowldge sharing activities is a *barrier free* organizational atmosfere, where types of barriers authors refer to are mainly barriers related to inter-project transfer of lessons learned, barriers related to social communicatoin, and barriers related to project managers who hoard their knowledge, or use all forces to ensure soonest possible product delivery, without providing time for additional activities.

Merging of knowledge management and project management is also necessary as a support to management of continuous learning activities throughout project development process. In order to perform successfully, project management and knowledge management require continuous feedback from each other in order, as well as an alignment between existing knowledge and newly created knowledge related to project culture, process and technology.

This section also discovers that the concept of intellectual capital fulfils the fusion of knowledge management and project management. The model created by combining concepts of all three fields proposes that knowledge management foster the development of the project team's competencies and relationships with a project customer. Project team and project customer directly influence all phases of project development process, which in turn affects the project success. The final outcome of the project serves as a lesson learned or feedback that knowledge management practices applied in future projects rely on.

Literature

Ajmal, M. M., & Koskinen, K. U. (2008). Knowledge transfer in project-based organizations: An organizational culture perspective. *Project Management Journal, 39*(1), 7–15.

AS 5037. (2003). *Interim Australian standard: Knowledge management*. Sydney: Standards Australia International.

Attarzadeh, I., & Ow, S. H. (2008). Project management practices: The criteria for success or failure. *Communications of the IBIMA, 1*, 234–241.

Awad, E. M., & Ghaziri, H. M. (2004). *Knowledge management*. Upper Saddle River, NJ: Pearson Education Inc.

Bakker, K., Boonstra, A., & Wortmann, H. (2009). Does risk management contribute to IT project success? A meta-analysis of empirical evidence. *International Journal of Project Management, 28*(5), 493–503.

Becerra-Fernandez, I., & Sabherwal, R. (2001). Organisational knowledge management: A contingency perspective. *Journal of Management Information Systems, 18*(1), 23–55.

Becerra-Fernandez, I., Gonzales, A., & Sabherwal, R. (2004). *Knowledge management: Challenges, solutions, and technologies*. Upper Saddle River, NJ: Pearson Education.

Bollinger, A. S., & Smith, R. D. (2001). Managing organizational knowledge as a strategic asset. *Journal of Knowledge Management, 5*, 8–18.

Bontis, N. (1998). Intellectual capital: An exploratory study that develops measures and models. *Management Decision, 36*(2), 63–76.

Carrillo, P. (2005). Lessons learned practices in the engineering, procurement and construction sector. *Engineering, Construction and Architectural Management, 12*(3), 236.

Charvat, J. (2003). *Project management methodologies: Selecting, implementing and supporting methodologies and processes for project*. Hoboken, NJ: Wiley.

Cleland, D., & Ireland, L. (2002). *Project management: Strategic design and implementation* (4th ed.). New York: McGraw-Hill.

Cleland, D. I., & Ireland, L. R. (2006, September 11). *Project management: Strategic design and implementation* (5th ed.). New York.

Conroy, G., & Soltan, H. (1998). ConSERV, as a continual audit concept to provide traceability and accountability over the project life cycle. *International Journal of Project Management, 16*(3), 185–197.

Cope, R. F., III, Cope, R. F., & Hotard, D. G. 2006. *Enhancing project management with knowledge Management principles*. Allied Academies International Conference 2006, New Orleans, LA.

Desouza, K. C., & Evaristo, R. J. (2006). Project management offices: A case of knowledgebased archetypes. *International Journal of Information Management, 26*(5), 414–423.

Diallo, A., & Thuillier, D. (2005). The success of international development projects, trust and communication: An African perspective. *International Journal of Project Management, 23*(3), 237–252.

Earl, M. (2001). Knowledge management strategies: Toward a taxonomy. *Journal of Management Information Systems, 18*(1), 215–233.

Edvinsson, L., & Malone, M. (1997). *Intellectual capital: Realising your company's true value by finding its hidden brainpower*. New York: Harper Collins.

Ewusi-Mensah, K. (1997). Critical issues in abandoned information systems development projects. *Communications of the ACM, 40*(9), 74–80.

Frey, P., Lindner, F., Muller, A., & Wald, A. (2009). *Project knowledge management—Organisational design and success factors*. 42nd Hawaii International Conference on System Sciences, HICSS'09.

Gudi, A., & Becerra-Fernandez, I. (2006), *Role of knowledge management in project management of complex systems organisations*. NASA Knowledge Management and Successful Mission Operations Conference 2006, Houston, TX.

Guthrie, J. (2001). The management, measurement and the reporting of intellectual capital. *Journal of Intellectual Capital, 2*(1), 27–41.

Hahn, J., & Subramani, M. R. (2000). A framework of knowledge management systems: Issues and challenges for theory and practice. In *Proceedings of the International Conference on Information Systems, ICIS'2000*, Brisbane, pp. 302–312.

Handzic, M., & Durmic, N. (2015). Knowledge management, intellectual capital and project management: Connecting the dots. *The Electronic Journal of Knowledge Management, 13*(1), 51–61.

Handzic, M., & Zhou, A. Z. (2005). *Knowledge management: An integrative approach*. Oxford: Chandos Publishing.

Handzic, M., Lagumdzija, A., & Celjo, A. (2008). Auditing knowledge management practices: Model and application. *Knowledge Management Research and Practice, 6*(1), 90–99.

Hansen, M. T, Nohria, N., & Tierney, T. (1999, March–April). What's your strategy for managing knowledge? *Harvard Business Review*, 106–116.

Hoffer, J. A., George, J. F., & Valacich, J. S. (2008). *Modern systems analysis and design* (5th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

IBM. (2012). *Tutorial: The Software Development Life Cycle (SDLC)*. Arcisphere Technologies. Retrieved from http://softwarelifecyclepros.com/wp-content/uploads/2012/05/Tutorial-Software-Development-LifeCycle-SDLC.pdf

Ismail, W. K. W., Nor, K. M., & Marjani, T. (2009). The role of knowledge sharing practice in enhancing project success. *Institute of Interdisciplinary Business Research, 1*(7), 34–52.

Kendra, K., & Taplin, L. J. (2004). Project success: A cultural framework. *Project Management Journal, 35*(1), 30–45.

Kerzner, H. (2009). *Project management—A systems approach to planning, scheduling, and controlling*. New York: Wiley.

Kianto, A., Ritala, P., Spender, J. C., & Vanhala, M. (2014). The interaction of intellectual capital assets and knowledge management practices in organisational value creation. *Journal of Intellectual Capital, 15*(3), 362–375.

Kumar, N., Zadgaonkar, A. S., & Shukla, A. (2013). Evolving a new software development life cycle model SDLC-2013 with client satisfaction. *International Journal of Soft Computing and Engineering (IJSCE), 3*(1), 2231–2307.

Landaeta, R. E. (2008). Evaluating benefits and challenges of knowledge transfer across projects. *Engineering Management Journal, 20*(1), 29–39.

Levin, G. (2010, October 11). *Knowledge management success equals project management success*. PMI Global Congress, Washington, DC.

Lierni, P. C., & Ribiere, V. M. (2008). The relationship between improving the management of projects and the use of KM. *The Journal of Information and Knowledge Management Systems, 38*(1), 133–146.

Lim, T. T. (2008). *Organizational culture and knowledge management*. DBA thesis, Southern Cross University.

Lock, D. (2007). *Project management* (9th ed.). Aldershot: Gower Publishing.

Lowery, G. (1994). *Managing projects with microsoft project 4.0: For windows and MacIntosh*. New York: Wiley.

Montana, J. (2000). The legal system and knowledge management. *Information Management Journal, 34*(3), 54–57.

Morley, C. (2006). *Management d' un projet système d' information: Principes, techniques, mise en oeuvre et outils* (5th éd.). Microsoft Press.

Munns, A. K., & Bjeirmi, B. F. (1996). The role of project management in achieving project success. *International Journal of Project Management, 14*(2), 81–87.

Nonaka, I. (1998). The knowledge creating company. In *Harvard business review on knowledge management*. Boston, MA: Harvard Business School Press.

Nonaka, I., & Konno, N. (1998). The concept of Ba: Building a foundation for knowledge creation. *California Management Review, 40*(3), 40–54.

Owen, J. (2008). Integrating knowledge management with programme management. In M. E. Jennex (Ed.), *Current issues in knowledge management* (pp. 132–148). New York: IGI Global.

Ohara, S. (2005). *A guidebook of project and program management for enterprise innovation*. Project Management Association of Japan (PMAJ). https://articulospm.files.wordpress.com/2013/01/p2mguidebookvolume1_060112.pdf

PMI. (2008). *A Guide to the Project Management Body of Knowledge (PMBOK)*. Newtown Square, PA: Project Management Institute.

Polyaninova, T. (2011). Knowledge management in a project environment: Organizational CT and project influences. *Vine, 41*(3). http://arrow.dit.ie/cgi/viewcontent.cgi?article=1003&context=scschcomart

Sambamurthy, V., & Zmud, R. W. (2012) *Guiding the digital transformation of organizations*. Legerity Digital Press.

Sambamurthy, V., & Zmud, R. W. (2014). *No excuses: Realising promised benefits from digitisation*. USA: Legerity Digital Press. http://www.screencast.com/t/0FPOnsHO7uxv.

Sanchez, R. (2003). *Knowledge management and organizational competence*. Oxford University Press.

Sandhu, M., & Gunasekaran, A. (2004). Business process development in project-based industries: A case study. *Business Process Management Journal, 10*(6), 673–690.

Snowden, D. (2002). Complex acts of knowing: Paradox and descriptive self-awareness. *Journal of Knowledge Management, 6*(2), 110–111.

Stewart, T. A. (1997). *Intellectual capital: The new wealth of organisations*. New York: Doubleday.

Sullivan, P. (1998). *Profiting from intellectual capital: Extracting value from innovation*. New York: Wiley.

Sveiby, K. (1997). *The new organisational wealth*. San Francisco: Berret-Koehler.

Turner, J. R. (2009). *The handbook of project-based management*. London: McGraw-Hill.

Turner, J. R., & Keegan, A. (1999). The management of operations in the project-based organization. In K. Artto, K. Kähkönen, & K. Koskinen (Eds.), *Managing business by projects* (pp. 57–85). Helsinki: Project Management Association Finland.

White, D., & Fortune, J. (2002). Current practice in project management—An empirical study. *Internal Journal of Project Management, 20*, 1–11.

Wiewiora, A., Trigunarsyah, B., Murphy, G. D., & Liang, C. (2009). *Barriers to effective knowledge transfer in project-based organisations*. In Proceedings of the 2009 International Conference on global innovation in construction proceedings, September 13–16, 2009, Loughborough University, Holywell Park.

Yeong, A., & Lim, T. T. (2010). Integrating knowledge management with project management for project success. *Journal of Project Program and Portfolio Management, 1*(2), 8–19.

Zouaghi, I., & Laghouag, A. (2012). *Empirical study of key success factors in IS projects*. Cahier De Recherche No 2011-06, E5,Version 1.

Part II

Project Management Knowledge Areas

Project Management Body of Knowledge in the Context of PMI and ISO

Antonio Bassi

Abstract

The main objective of this chapter is the identification and analysis of the body of knowledge related to project management in the context of PMI(R) and ISO standards and norms. The chapter highlights the need to manage all the knowledge generated within the project (e.g. historical information, best practices, knowledge of the processes, lessons learned etc.) in order to improve organizational processes, reduce the time of project management and reduce the cost of the project. It also suggests that, through the correct application of these normative knowledge areas and their diffusion in the project management culture, organizations can expect to govern their businesses more effectively and efficiently.

1 Introduction

Organizations, in order to manage a project successfully, need a management system, which is able to define the rules and the tools. For this reason, many organizations have been created in order to define how the projects must be managed: they defined some project management systems. The project management is an organizational and professional discipline, characterized by the experience which evolve in people and in organizations and aimed at defining the environment and the rules for the project organization.

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1.1 Knowledge Assets

As a starting point, according to Handzic and Zhou (2005), every organization needs to have a clear understanding of which knowledge assets are important to their success and how these assets are distributed over different parts of the organization and among different functions and workers. They classify four organizational core knowledge assets:

- People—Value creation and the long term survival of organization highly depend on work of the most skilled employees and collective knowledge. Different knowledge workers and different components in the knowledge base should be combined efficiently.
- Knowledge artefacts—Some organizational knowledge is manifested in the form of artefacts, like videotapes, books, memos, business plans, manuals, patents and products.
- Structural and procedural assets—This kind of organizational knowledge is manifested in the organization's actual behaviours: its culture, infrastructure, purpose and strategy. The cultural knowledge resource comprises basic assumptions and beliefs that govern participants' activities. Knowledge embodied in an organization's infrastructure structures participants' roles, relationships between co-workers and regulations that govern the use of roles and relationships. Finally, purpose and strategy knowledge defines an organization's reason for existence and a plan to achieve its purpose in an effective manner, according to Antonio Bassi (2014a, b, c).
- Customer relationship—Knowledge about customers and the external environment including the market that the organization serves is a valuable asset. Such an asset can become a critical factor in determining a firm's competitive edge in a mature and highly competitive market environment.

1.2 Standards and Norms

Among all the organizations which define the project management criteria, recognized worldwide, we can mention the IPMA and the PMI(R). The IPMA (International Project Management Association), born in 1965 and based in Switzerland, was the first project management association to be created. The PMI(R) (Project Management Institute) is, today, the association with the biggest spread and his PMBOK(R) (Project Management Body of Knowledge) besides being an ANSI standard, is, also, the document on whom the new norm ISO21500 about Project Management, is based. Both the associations have started certification programmes for project managers, recognized worldwide.

The ISO, due to the increasing interest in the project management, decided to define, initially, the norms about some aspects and, then, about the management of the projects.

The new norms ISO9000 evolution is, now, considering the themes relative to the project management, introducing the "terms related to the quality in Project Management", such as: project, activity, evaluation of progress, management and project management plan (definitions already present in the ISO10006 norm about quality in projects).

After the ISO norm about Project Management (ISO21500), the ISO21502 norm has already been published and the ISO21504, ISO21505, ISO21506, ISO21508, ISO21510 and ISO21511 norms will be published soon testifying the great attention which the Project Management is now arousing in the ISO and in the global economic/productive contest.

Enterprise organizations increasingly have a live full of projects; many of the small, medium and large companies are already equipped with a project management system and many more will do it in the next few years because it is through a comprehensive cost control and project timing that a company can survive in the stormy sea of competition. But, what is Project Management? It's impossible to give a complete answer. We can try to give a definition that can somehow illustrate the complexity and to highlight the extreme importance and criticity of the success of organizations and consequently of the improving projects performance.

2 Project Management

To better define the project management we can use the definition given by the PMI(R) (Project Management Institute), in its PMBOK(R) (Project Management Body of Knowledge): "Project management is the application of knowledge, skills, tools and techniques to activities of the project in order to meet the requirements". Project management is accomplished through the application and integration of project management processes for initiating, planning, executing, monitoring and controlling, closing.

When organizations decide to define the project management processes, they place for themselves very specific objectives/goals, which can be divided according to whether they have a relationship with stakeholders or with the market, with external project goals or internal.

Processes are the schematic representations of the sequences of actions and activities related in a stream. These are executed until they run out in order to get the desired results. The project management processes need to be defined by organizations according to their own organizational structure, business model and type of product. The Project Management Institute has proposed 47 processes and the ISO 21500, 39 processes, divided into ten knowledge areas (Integration, Scope, Time, Cost, Quality, Risk, Human Resources, Procurement, Communication, Stakeholder) as described in the PMBOK(R) and in the ISO 21500.

2.1 Knowledge Areas

In the following Knowledge Areas are described the related processes, the descriptions are related to the processes defined by the PMBOK(R) but same description could be adapted to ISO 21500, because they are very similar.

2.1.1 Project Integration Management

According to PMBOK(R) and ISO this knowledge area ensures that the various elements of the project are properly coordinated, through project plan development, project plan execution and integrated change control major processes.

The processes related to this Knowledge Area are:

- **Develop Project Charter** is the process of developing a document that formally authorizes the start of a project and assign the related authority to the project manager.
- The main task of **Develop Project Management Plan** is to integrate and coordinate all project plans to create a consistent, coherent document, and it's almost always iterated several times. For this purpose, it uses the outputs of the other planning processes like strategic planning. The project management plan is used to: guide project execution, document project planning assumptions, document project planning decisions regarding alternatives chosen, facilitate communication among stakeholders, define key management reviews as to content, extent, and timing, provide a baseline for progress measurement and project control.
- **Direct and Manage Project Work** execution carries out the project plan by performing the activities included therein. In this process, the project manager and the project management team must coordinate and direct the various technical and organizational interfaces that exist in the project.
- **Monitor and Control Project Work** is the process of tracking, reviewing and reporting project progress against the performance objectives defined in the Project Plan. It allows to the stakeholders to understand the state of the project.
- **Perform Integrated Change Control** coordinates changes across the entire project. It is concerned with: influencing the factors that create changes to ensure that changes are agreed upon; determining that a change has occurred; managing the actual changes when and as they occur. The original defined project scope and the integrated performance baseline must be maintained by continuously managing changes to the baseline, either by rejecting new changes or by approving changes and incorporating them into a revised project baseline.
- **Close Project or Phase** to finalize all the activities to formally complete the project or the phase. This process provides lessons learned, release the organizational resources, evaluate the performance of the resources and store all data in the Historical Information repository.

2.1.2 Project Scope Management

This knowledge area ensures that the project includes all the work required, and only the work required, to complete the project successfully. It is primarily concerned with defining and controlling what is or is not included in the project.

The processes related to this Knowledge Area are:

- **Plan Scope Management** define the Scope Management Plan, the strategic plan that documents how the project scope could be defined, validated and controlled. It provides guidance on how the scope will be managed.
- **Collect Requirements** describes how the requirement will be elicited, analysed, documented and managed. The project manager must define the best approach and tools to collect all the requirements of the project. Components of the plan can include: requirements configuration management, requirement prioritization, product metrics and traceability matrix.
- **Define scope** is the process of progressively elaborating and developing a detailed description of the project and product. After the identification of the requirements, assumptions and constraints the project scope is defined. This process could be highly iteractive to better understand and develop the requirements.
- **Create WBS** involves subdividing the major project deliverables into smaller, more manageable components, and it's critical to project success. It improves the accuracy of cost, duration, and resource estimates, defines a baseline for performance measurement and control, and facilitates clear responsibility assignments.
- **Validate Scope** is the process of obtaining formal acceptance of the project scope by the stakeholders. It requires reviewing deliverables and work results to ensure that all were completed correctly and satisfactorily.
- **Control Scope** monitor the status of the project and manages changes and recommended corrective of preventive actions to the scope of the project.

2.1.3 Project Time Management

This knowledge area ensures timely completion of the project. The processes are:

- **Plan Schedule Management** establish the strategy (policies, procedures and documentation) for planning, managing, executing and controlling the project. It provides guidance and direction on how the project schedule will be managed throughout the project.

- **Define Activities** involves identifying and documenting the specific activities that must be performed to produce the deliverables and subdeliverables identified in the Work Breakdown Structure (WBS). Implicit in this process is the need to define the activities such that the project objectives will be met.
- **Sequence Activities** involves identifying and documenting interactivity logical relationships. Activities must be sequenced accurately to support later

development of a realistic and achievable schedule. Manual and automated techniques, individually or in combination, are used to perform this process activities.

- **Estimate Activity Resources** to estimate the type and quantities of resources (material, human resources, equipment . . .) to complete the activities and it to allow more accurate cost and duration estimates.
- **Estimate Activity Durations** is the process of taking information on project scope and resources and then developing durations for input to schedules, which usually originate from the person or group on the project team who is most familiar with the nature of a specific activity. The estimate should be made, or at least approved, by the person or group on the project team who is most familiar with the nature of a specific activity.
- **Develop Schedule** as a process means determining start and finish dates for project activities and for the project. The schedule development process must often be iterated prior to determination of the project schedule.
- **Control Schedule** is usually concerned with: influencing the factors that create schedule changes to ensure that changes are agreed upon; determining that the schedule has changed; and managing the actual changes when and as they occur. It must be integrated with the other existing control processes.

2.1.4 Project Cost Management

This knowledge area ensures that the project is completed within the approved budget. It is primarily concerned with the cost of the resources needed to complete project activities.

This knowledge area ensures the costs completion of the project. The processes are:

- **Plan Cost Management** to establish the policies, procedures and documentation to manage all the activities related to project cost management. It provides guidance and direction on how the project cost will be manage throughout the project.
- **Estimate Costs** involves developing an estimate of the costs of the resources needed to complete project activities. The estimator should consider causes of variation of the final estimate for the purposes of better managing the project. Cost estimating includes identifying and considering various costing alternatives.
- **Determine Budget** involves allocating the overall cost estimates to individual activities or work packages and the cost of project management activities to establish a cost baseline for measuring project performance. In reality, the estimates may be done after budgetary approval is provided, but estimates should be done prior to budget request wherever possible.
- **Control Costs** includes monitoring cost performance to detect and understand variances from plan; ensuring that all appropriate changes are recorded accurately in the cost baseline; preventing incorrect, inappropriate, or unauthorized changes from being included in the cost baseline; informing appropriate

stakeholders of authorized changes; acting to bring expected costs within acceptable limits. Cost control includes searching out the "whys" of both positive and negative variances.

2.1.5 Project Quality Management

This knowledge area determines quality policies, objectives and responsibilities to ensures that the project will satisfy the needs for which it was undertaken.

Quality planning involves identifying which quality standards are relevant to the project and determining how to satisfy them. It is one of the key facilitating processes during project planning and should be performed regularly and in parallel with the other project planning processes.

This knowledge area ensures the quality completion of the project. The processes are:

- **Plan Quality Management** identifies quality requirements and standards for the project and its deliverables and documenting the degree of compliance with quality requirements. The process provides guidance and direction on how quality will be managed and validated throughout the project.
- **Perform Quality Assurance** is performed throughout the project. It includes all the planned and systematic activities implemented within the quality system to provide confidence that the project will satisfy the relative quality standards. It assures the consistency and correct performance of all the processes defined to manage this particular kind of project. Assurance may be provided to the project management team and to the management of the performing organization (internal quality assurance), or it may be provided to the customer and others not actively involved in the work of the project (external quality assurance).
- **Control Quality** involves monitoring specific project results to determine if they comply with relevant quality standards, and identifying ways to eliminate causes of unsatisfactory results. In this regard, project results include both product results, such as deliverables, and project management results, such as cost and schedule performance. The process provides the validation of the deliverable of the project prior to submit it to the sponsor's acceptance in the Validate Scope Process and the validation of all the change requested.

2.1.6 Project Human Resource Management

This knowledge area ensures that people involved in the project are used in the most effective way.

Organizational planning involves identifying, documenting, and assigning project roles, responsibilities, and reporting relationships, which may be assigned to individuals or to groups. On most projects, the majority of organizational planning is done as part of the earliest project phases, but the results of this process should be reviewed throughout the project to ensure continued applicability.

The processes of this knowledge area are:

- **Plan Human Resource Management** identifies and documents project roles, responsibilities, required skills and creating a staffing management plan.
- **Acquire Project Team** to get the needed human resources (individuals or groups) assigned to and working on the project. The project management team must take care to ensure that the resources that are available meet the project requirements.
- **Develop Project Team** includes both enhancing the ability of stakeholders to contribute as individuals as well as enhancing the ability of the team to function as a team. Individual development is the foundation necessary to develop the team, while development as a team is critical to the project's ability to meet its objectives.
- **Manage Project Team** to track team member performance, providing feedback, resolving issues, and managing changes to improve project performance.

2.1.7 Project Communications Management

This knowledge area ensures timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information. It provides the critical links among people, ideas, and information that are necessary for success. Everyone involved in the project must be prepared to communicate, and must understand how the communications in which they are involved as individuals affect the project as a whole.

The processes of this knowledge area are:

- **Plan Communications Management** defines the strategy to determine the information and communications needs of the stakeholders: who needs what information, when they will need it, how it will be given to them, and by whom. Communications planning is often tightly linked with organizational planning since the project's organizational structure has major effect on the project's communications requirements.
- **Manage Communications** involves making needed information available to project stakeholders in a timely manner. It includes implementing the communications management plan, as well as responding to unexpected requests for information.
- **Control Communications** monitors and controls communications throughout the project life cycle to ensure the informations needs of the project stakeholders are met.

2.1.8 Project Risk Management

This knowledge area systematically identifies, analyses and responds to project risk. It includes maximizing the probability and consequences of positive events and minimizing the probability and consequences of adverse events to project objectives.

The processes of this knowledge area are:

- **Plan Risk Management** is the process of deciding how to approach and plan the risk management activities for the project. It is important to plan to ensure that the level, type, and visibility of risk management are commensurate with both the risk and importance of the project to the organization.
- **Identify Risk** involves determining which risks might affect the project and documenting their characteristics. It is an iterative process. The first iteration may be performed by a part of the project team, or by the risk management team. The entire project team and primary stakeholders may make a second iteration. To achieve an unbiased analysis, persons who are not involved in the project may perform the final iteration.
- **Perform Qualitative Risk Analysis** is the process of assessing the impact and likelihood of identified risks. This process prioritizes risks according to their potential effect on project objectives. It is a way to determine the importance of addressing specific risks and guiding risk responses.
- **Perform Quantitative Risk Analysis** process aims to analyse numerically the probability of each risk and its consequence on project objectives, as well as the extent of overall project risk. This process uses techniques such as Monte Carlo Analysis and decision analysis, like Expected Monetary Value (EMV), to: determine the probability of achieving a specific project objective, quantify the risk exposure for the project, and determine the size of cost and schedule contingency reserves that may be needed, identify risks requiring the most attention by quantifying their relative contribution to project risk, identify realistic and achievable cost, schedule, or scope targets. Quantitative risk analysis generally follows the qualitative one.
- **Plan Risk Response** is the process of developing options and determining actions to enhance opportunities and reduce threats to the project's objectives. It includes the identification and assignment of individuals or parties to take responsibility for each agreed risk response. The effectiveness of response planning directly determines whether risk increases or decreases the impact on the project.
- **Control Risks** is the process of keeping track of the identified risks, monitoring residual risks and identifying new risks, ensuring the execution of risk plans, and evaluating their effectiveness in reducing risk. Control Risks is an ongoing process for the life of the project. The risks change as the project matures, new risks are identified, or anticipated risks disappear.

2.1.9 Project Procurement Management

This knowledge area includes the processes required to acquire goods and services, to attain project scope, from outside the performing organization.

The processes of this knowledge area are:

- **Plan Procurement Management** identifies which project needs can be best met by acquiring products or services outside the project organization and should be accomplished during the scope definition effort. It involves consideration of whether to procure, how to procure, what to procure, how much to procure, and

when to procure. This process specifies the approach and the potential sellers. Solicitation planning involves preparing the documents needed to support solicitation. The solicitation obtains responses from prospective sellers on how project needs can be met.

- **Conduct Procurements** involves the receipt of bids or proposals and the application of the evaluation criteria to select a provider. Many factors aside from cost or price may need to be evaluated in the source selection decision process.
- **Control Procurements** manages procurement relationships, monitoring contract performance, and making changes and corrections as proposed and appropriate. It is the process of ensuring that the seller's performance meets contractual requirements.
- **Close Procurements** involves both product verification and administrative closeout. The contract terms and conditions may prescribe specific procedures for contract closeout. Early termination of contract is a special case of contract closeout. The key benefit of this process is that it documents agreements and related documentation for future reference.

2.1.10 Project Stakeholder Management

Everything that is described in here should not be put into the reality of each company, but must be developed critically and compared with the actual organizational needs. This way, a map of the processes is being created. This map helps the organization manage more effectively/efficiently projects.

2.2 Project Processes

Processes identified by the organizations for the management of their activities are generally divided into five groups corresponding to the five typical structure of a project, which connect the beginning and the end of the project: Initiating, Planning, Executing, Monitoring and Controlling, Closing. These are not sequential but can interact and overlap each other and, during their execution, they can also be modified. For this reason, it's difficult, therefore, to give an illustrative graphical representation of the relationships that characterize them.

– **Initiating Processes**—at this stage the project is defined and authorized. Now the project requirements are set and improved, the objectives are established in terms of time, cost and quality, the stakeholders concerned are defined and the project manager is appointed. He will have complete responsibility for the project. Generally, these processes are external to monitoring and control, and are carried out by the organizational structure;
– **Planning Processes**—through the collection of data from multiple sources, the project plan is created. It will guide the execution and the monitoring processes and it will also determine the date by which the project has to end. A key input element in this processes group is the acquisition of historical information from

previous projects, managed within the knowledge base of the organization's projects. The planning object is the "activity" determined through the analysis of the project requirements. The requirements allow the identification of the deliverables which will be produced by the project and they will be able to define the list of activities that constitute them. The planning processes allow the determination of the final date of the project and of all the "milestones", the definition of the stakeholders and its communications plan, the definition of the risk level and quality, understood as the fulfilment of quality requirements defined by the organization or by the project and the requirements defined by the customer, the identification of the suppliers and its management plan, the definition of how the resources will be managed, when they have to be acquired, when they will be released and how they should be managed and finally the definition of the project costs. For each of the activities described above we will define a 'baseline' that is, a time-plan by which the verification activities will be done during the monitoring processes of the project;

- **Execution Processes**—They allow completing the work defined during the planning phase. At this stage most of the available budget for the project is used and if they require changes the cost could be higher than similar requests made during the planning phase;
- **Monitoring and Control Processes**—They measure project performance regularly to identify variances from the project plan. The main functions of these processes are related to the detection and evaluation of the project, the dissemination of the results through reports, the integrated change management as a result of new requests coming from the sponsor. The main functions are also related to bring the project in line with the planning and ultimately make the acceptance of the deliverables in function of the acceptance criteria established during the planning phase;
- **Closing processes**—are implemented once it has been approved the final deliverables of the project or after the project was terminated. It is the stage in which, in addition to the action of closing contracts with suppliers, all data produced have to be collected and catalogued. It is the last stage but it is not unusual to have projects that end by ignoring it, considering it a waste of effort and time, not realizing that the right collection of documentation could guarantee the savings in the management of future similar projects in which you could use previous projects parts. Another important element is the collection of 'lessons learned', the collection of everything positive or negative occurred in the execution of the work. These 'lessons' enrich the corporate culture. It is the process group in which all the knowledge and the experience acquired during the evolution of the project is capitalized.

3 Issues and Challenges

It may seem evident the adoption of project management methodologies in order to address the multiple problems facing the organizations and the training of project managers for the management of processes. Unfortunately, it's not always like this,

even though in these years, there has been an increasingly attention, from the businesses, the government and EU institutions, in adopting reference models that can ensure the achievement of a high quality.

One of the most serious problems we must solve is the perception that the company management has of its organizational processes, which often are over-estimated compared to the real needs of the company. A remedy can be sought in the adoption of international standards for the detection of process maturity and their 'improvement', such as CMMI (Capability Maturity Model Integration) of the SEI (Software Engineering Institute) of the Carnegie Mellon University and the OPM3 (Organizational Project Management Maturity Model) of PMI(R).

The methodology that a company can define to manage processes all alone is not needed to get the desired improvement: it is necessary that people identify themselves with these processes, that use them as a daily work tool and, not least, it is very important the awareness of the management to support the organization's choices even through the availability of sufficient resources to govern processes. The change entails a cost that will be paid back by the competitive advantages that could arise, from improvement of the time-to-market and from the improvement of the projects performance, which therefore must be adequately supported.

This is due to the need of an enterprise project management. If there isn't a culture rooted in the organization and in people, projects will be hardly successful. The disclosure of this culture is the most difficult task that the management has to face and very often it is underestimated or neglected because it is a cost and so it has to be reduced.

It always falls in the lack of strategic vision who can not perceive the enormous medium / long-term advantage compared to an immediate investment.

What should be done to develop a culture of project management? There isn't a single solution because each organizational structure differs in persons, company history, corporate culture and management. You can give indications, suggestions on which everybody can contribute to create the culture. The culture must be born from the management, therefore it will be necessary that we invest in the training of top managers, because they will set the first processes that will take and support the organization to a better management projects and will give people a reason to change, paying attention to the balance of power which inevitably will be affected where those who lose power will attempt to keep alive the old organization. But management is not enough for this cultural change, and between the various helping tools we can certainly find the ISO 10006 about quality in project management. This standard defines how to define and manage organizational processes in a qualitatively valid way in order to pursue the goal of 'customer satisfaction'. The standard deals, not only with processes, but also defines the principles of the project organization managing in order to ensure the result and, at the same time, to help the management in optimally managing the activities. This rule is—currently—the only existing rule of the family of ISO 9000 standards that speaks explicitly about the Project Management.

It describes the principles of quality management and practices whose application is important because it affects the achievement of quality objectives in projects.

It can be used by all types of organizations, and for all types of projects, from small, simple and those very articulated, complex and long ones. The ISO 10006 can be advantageously used both by people who have experience in project management and want to be certain to apply in this area what is contained in the ISO 9000 family of standards and by those people who have experience in quality management and who are called to work in project organizations where they have to make available their knowledge and experience.

Another problem that must be solved concerns the characteristics that the project manager must have. Too often, the organizations employ, for the management of the projects, people with good technical skills but lack of knowledge in project management. Unfortunately, this always occurs due to the lack of culture of the organizations in this field. A good organizer without proper training will never be a good project manager and this will affect heavily on the project performance. It is important not only to identify the project managers' characteristics, but also to develop, in parallel, an adequate system of evaluation of candidates by those involved in the selection in organizations. The IPMA gives an important help because, with his ICB, it lists the skills that the project manager should have. ISO tried it in a first draft of its standard ISO21500 too, but in the final version the characteristics of the project managers had been cancelled because they did not come to an agreement; they are now trying again with the standard ISO21510 and in the next few years, we will see the results.

Speaking different languages, from a technical point of view, is definitely a big problem because the different standards and norms, even though they use the same vocabulary of terms, however, in some cases give different meanings. We can take, for example, the responsibility of the project manager: in PMI(R) he has the full responsibility for the results; in the English Prince2 he has only a coordinator function. And what about the risks for PMI(R)? The risk has a value both positive and negative, so it concerns opportunities and threats, while for IPMA the risk has only a negative meaning. It is therefore necessary to define a common vocabulary. In the past, PMI(R) has tried with a very ambitious project, because it wanted to incorporate the terminology in a too big area and for this reason it has failed, it retried later, but limited to the terminology used by the PMI(R). Even the ISO is trying to do the same with its norm ISO21506 under study. Its results will be visible in a few years. A group of Italian project managers has tried with the "Glossary of terms of project management", according to Bassi (2014a, b, c).

4 The ISO 10006 Approach

One of the most valuable aspects of this standard is the definition of the nine basic principles for a proper project management concerning the governance of the project and the same organization:

1. Customer Focus—The satisfaction of the requirements is necessary for the success of the project;

2. Leadership—The organization's leaders establish the unity of purpose and the direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.
3. Involvement of people—The top management of both original and project organizations should assume leadership in order to create a culture for quality:
   (a) By defining the quality policy
   (b) Providing the infrastructures and resources to ensure the achievement of project objectives
   (c) Providing an organizational structure conducive to the achievement of project objectives
   (d) Making decisions based on data and certificate information
   (e) Empowering and motivating the teams to improve project and product processes
   (f) People at all levels are the essence of the organization and their full involvement enables to put their skills to the organization's benefit.
4. Process approach—A desired result is achieved more efficiently when activities and related resources are managed as a process. The project processes should be identified and recorded.
5. System approach to management—Identifying, understanding and managing related processes as a system contributes to the effectiveness and efficiency of the organization in achieving its objectives. A project is implemented as a set of scheduled jobs, interconnected and interdependent. The project organization controls the project processes. To control the processes of the project, it is necessary to define and connect the necessary processes, integrate them and manage them as a system in line with the original organization of the system.
6. Communication is the lifeblood of the organization—The project organization should ensure that appropriate communication processes are defined and that information is exchanged between the processes of the project, as well as between the project, other relevant projects and the organization.
7. Continuous improvement—Continuous improvement of the organization's overall performance should be a permanent objective of the organization. The organization of the original project is responsible for the ongoing research to improve the effectiveness and efficiency of the processes for which they are responsible. The cycle of continuous improvement is based on the concept of 'Plan-Do-Check-Act' (PDCA).
8. Based on the project decisions data—Effective decisions are based on analysis of data and information. The information should be evaluated by "closing reports of the project" of precedent projects and information on the status of the project and performances shall be recorded.
9. Mutually beneficial relations with suppliers—An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value. The project organization should work with its suppliers defining its strategies for obtaining external products, especially for products with very long times. It can be considered a risk sharing with suppliers.

5 Conclusions

To manage effectively the projects, you should, first of all, define the culture in project management and define processes as based on the proposals of the PMBOK(R) and ISO 21500, evaluating them, according to the peculiarities of the project and the organization. Equally important, however, is the definition of project governance and organization according to what is suggested by ISO 10006. The processes and governance, however, may not work correctly if they are not supported by an effective and efficient knowledge management system that allows (project and corporate) organizations to improve according to their history as well as to reduce costs and risks.

Another important factor is the definition of a glossary within the organization to enable better communication and if it were to be adopted a glossary similar to the one defined by the PMI(R) PMBOK(R), the communication outside the organization could be facilitated.

To define a good project management system there is still much to be done because in the few past years there have been no important new tools in project management, but probably the correct application of the already known tools could be a great result. The hope is in ISO which, with the new norms and the institution's authority, could increase the awareness of the organizations.

References

Bassi, A. (2014a). *Project management human and organizational learning*. MakeLearn Conference.

Bassi, A. (2014b). *Knowledge management in project environment the way to improve the value of the enterprise organization*. IFKAD Conference.

Bassi, A. (2014c). *Glossario dei termini di project management*. Il mio libro.

Handzic, M., & Zhou, A. Z. (2005). *Knowledge management: An integrative approach*. Oxford: Chandos Publishing.

Project Management Institute. (2013). *A guide to the project management body of knowledge (PMBOK Guide)* (5th ed.). Newtown Square, PA: Project Management Institute.

Emotional and Spiritual Knowledge

Constantin Bratianu

Abstract

Project Management is a rational construct based on rational knowledge and intelligence, and on the fundamental idea that any objective can be achieved if there is an algorithmic structure of activities and an adequate managerial process. However, any project is implemented by people and that means that their work cannot be reduced to only rationality and economics. Enterprise is more important than economics, and rational knowledge should be complemented by emotional and spiritual knowledge. The purpose of this chapter is to present the main concepts and ideas of emotional and spiritual knowledge and the way they integrate into Project Management. After explaining the role of metaphors in understanding the concept of knowledge, the chapter presents the basic ideas of emotional knowledge as the wordless expression of our body when interacts with the environment. Then, spirituality and spiritual knowledge are explained as an expression of understanding our existence and work necessity. Finally, the chapter introduces three practical examples of integrating emotional and spiritual knowledge in the managerial knowledge field.

1 Introduction

Many readers may ask what is the relationship between the title of the book and the title of this chapter, or more specifically, the relationship between Project Management and Emotional and Spiritual Knowledge. From the conventional wisdom point of view the relationship is weak and mediated by the tacit knowledge. That is because the conventional wisdom in knowledge management is based on metaphors with objects or stocks-and-flows which are focusing on rational knowledge

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(Becerra-Fernandez and Sabherwal 2010; Bratianu 2015; Dalkir 2005; Davenport and Prusak 2000; Nonaka and Takeuchi 1995; O'Dell and Hubert 2011). Changing the thinking paradigm from Newtonian logic to the thermodynamics framework by introducing *the energy metaphor*, we can discover a strong implication of emotional and spiritual knowledge (Bratianu 2015) in Project Management. Most of the books discussing about Project Management refer only to rational knowledge and methods of organizing, financing, controlling projects, and reducing the uncertainty and its associated risks in implementing the planned objectives (Heagney 2011; Kerzner 2013). However, any implementation is performed by a project team which means people with their emotional and spiritual knowledge. That knowledge cannot be replaced by any IT system or intelligent software. It is a mistake to consider that implementing a project can be done by ignoring emotional and spiritual knowledge, and their role in managing projects, fact that explain many failures in that domain.

In a very insightful essay entitled "The problem is enterprise, not economics" Henry Mintzberg (2010) emphasized the fact that "A robust enterprise is a community of human beings, not a collection of *human resources*" (http://www.Gurteen.com/gurteen/gurteen.nsf/id/we-are-not-human-resources/). That means explicitly that in any project management it is crucial to think of people as human beings, not to reduce them to a series of human resources needed to staff a project, for a given time period and use them according to the industrial management principles. People have emotions and feelings, and they believe in spiritual values and cultural traditions. Team leaders should know that influencing people, especially during periods of change and greater efforts, means to motivate them emotionally and not just selling them data and analytics. Also, cognitive science research demonstrates that decisions are emotionally charged and that values play the role of guidelines in any decision making process. All the books about project management should contain chapters about rational, emotional and spiritual knowledge and to integrate them into the complex knowledge dynamics. Project Management is not only about planning, financing, contracting, scheduling, organizing, and controlling, but also about motivating people and creating a sense of achievement which means to consider the emotional and spiritual qualities of workers and their absorptive capacity to organizational learning. All of these aspects lead in a natural way to the interaction of the rational, emotional, and spiritual fields of knowledge and its role in decision making.

The purpose of this chapter is to present the main concepts and ideas about emotional and spiritual knowledge in a complementary way with all the other chapters of the book which focus mostly on rational knowledge and rational decision making. In order to understand the new perspective on knowledge it is important to change the metaphorical way of thinking about knowledge (Andriessen 2008; Bratianu 2011). The kernel of this chapter is *the energy metaphor* and its consequences in understanding the multifield theory of organizational knowledge, or project management body of knowledge. The main ideas introduced by this metaphor are the following (Bratianu 2015): (a) knowledge is conceived as a field, which is an intangible entity; (b) there are three basic knowledge fields: rational, emotional, and spiritual; and (c) one form of knowledge can be

transformed into another form as a result of a continuous interaction between the three knowledge fields. A sustainable business requests a balance between rational, emotional, and spiritual knowledge based on positive values and primacy of community interests over individual or company's interests.

2 The Beauty of Metaphorical Thinking

2.1 Knowledge Metaphors

Writers always fascinated us with their metaphors that made our imagination to stretch out and create wonderful worlds, or to make our mind to discover new meanings and interpretations for apparently known facts and phenomena. For instance, in his well-known poem *All the World's a Stage* William Shakespeare suggests new meanings for our existence:

All the world's a stage,
And all the men and women merely players;
They have their exits and their entrances,
And one man in his time plays many parts,
His acts being seven ages.

That is a *linguistic metaphor* which is a figure of speech and an expression of the linguistic intelligence. Cognitive scientists draw our attention to another type of metaphors called *conceptual metaphors* which is crucial for our thinking (Fauconnier 2001; Fauconnier and Turner 2002; Frith 2007; Lakoff and Johnson 1980, 1999; Pinker 1994, 2008). According to Pinker (2008, p. 241), "Conceptual metaphors point to an obvious way in which people could learn to reason about new, abstract concepts. They would notice, or have pointed out to them, a parallel between a physical realm they already understand and a conceptual realm they don't yet understand." Conceptual metaphors are analogies which help us to map one experience in terms of another experience, making it possible to understand complex and new situations in terms of what we already know. That means that metaphors enable us to describe abstract concept in terms of physical objects and processes, and their attributes. As postulated by Lakoff and Johnson (1999, p. 3), "Abstract concepts are largely metaphorical" and "Thought is mostly unconscious". For instance, in the metaphor "Time is money" *money* represents the known physical object and *time* is the abstract concept for which we want to find out new meanings. Considering *money* as an economical resource we transfer some of its attributes to the abstract concept. Thus, we learn that *time* can be *wasted, saved, invested, lost, used up* or *used profitably*.

A metaphor contains a *source domain* which represents the semantic field of the known concept, a *target domain* which represents the semantic field of the less-known concept, and a *mapping process* from the source domain onto the target domain. Mapping is a selective process since not all the attributes of the source

concept can be projected onto the target concept. For instance, in the metaphor "Time is money" the physical attributes of *money* like its solid state or structure cannot be projected onto the concept of *time*. "What is projected is the cognitive topology of the source domain, that is the slots in the source domain as well as their relation with each other" (Moser 2000, p. 2).

Knowledge is an abstract concept that can be discovered by using metaphorical thinking (Andriessen 2008, 2011; Andriessen and Boom 2007; Bolisani et al. 2012; Bratianu 2009, 2011, 2015; Bratianu and Andriessen 2008; Nonaka and Takeuchi 1995; Steen 2011). As emphasized by Andriessen and Boom (2007, p. 3), "Knowledge is not a concept that has a clearly delineated structure. Whatever structure it has it gets through metaphor. Different people from different cultures use different metaphors to conceptualize knowledge." This practical infinity in conceptualizing *knowledge* leads to a large spectrum of meanings and interpretations, which represents a real obstacle in defining the concept. Moreover, people enjoy simple and intuitive metaphors which imply also a series of limitations in understanding the knowledge concept (Andriessen 2008; Moser 2000, 2004; Pinker 2008). Metaphors are involved mostly unconsciously in the process of transforming implicit knowledge obtained through direct experience into explicit knowledge through the language. They help in structuring the new meanings and integrating them into the existing semantic framework, making abstract concepts more accessible and comprehensible. "The models that underlie metaphors are not an expression of language, but an expression of thought. These models are an indication of the cognitive structuring of experience, that in turn determines actions and thinking" (Moser 2004, p. 151).

The first category of metaphors used for knowledge had in their source domain objects. Thus, metaphors like "knowledge as resources", "knowledge as assets", and "knowledge as stocks" dominated the first stage of knowledge management development. As a result of these metaphors knowledge receives many attributes of objects and becomes de-contextualized. Knowledge can be located, accumulated, stored, retrieved, packed, delivered, and used in a production process like any other resource (Andriessen 2008; Borgo and Pozza 2012; Davenport and Prusak 2000; Stewart 1999). As Bolisani et al. (2012) remark that this type of metaphors lead to an objectification of knowledge. Objectifying knowledge enables its codification and standardization in organizational contexts by using the information technology. Also, mapping organizational knowledge constitutes a direct result of using this class of metaphors based on objects in the source domains. The beauty of these metaphors resides in their simplicity and intuitiveness. As a result of this perspective, knowledge management operates with knowledge like with any other tangible resources. Leif Edvinsson (2002, p. 7) emphasizes very well this approach: "Knowledge management is about the storage, transfer and migration of knowledge. It treats knowledge as an object, like a book in a library".

Ikujiro Nonaka used extensively in his works the metaphor "knowledge as an iceberg", which may be considered a complex metaphor. It is composed of several simple metaphors of the same structure. The visible part of the iceberg represents explicit knowledge, while the hidden part of the iceberg, i.e. the part under the

water surface, represents the tacit knowledge. Referring to the way Japanese companies consider knowledge, Nonaka and Takeuchi (1995, p. 8) say that "they recognize that the knowledge expressed in words and numbers represents only the tip of the iceberg. They view knowledge as being primarily 'tacit'—something not easily visible and expressible. Tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or to share with others". The temptation of using the iceberg metaphor resides in its simplicity of separating explicit knowledge from tacit knowledge, and in considering tacit knowledge a generic concept for all the knowledge types which cannot be formalized by using a natural or symbolic language. However, that simplicity leads to the main limitations of the iceberg metaphor: (a) emotional knowledge and spiritual knowledge are mixed together without any individuality, and (b) the iceberg is a tangible object and knowledge is an abstract concept.

The next class of metaphors introduces in the source domain the concept of fluid, or flow: "Knowledge as a fluid", "Knowledge as a flow", or "Knowledge as stocks-and-flows" (Andriessen 2008; Bratianu 2015; Davenport and Prusak 2000; Nissen 2006; Nonaka et al. 2008; O'Dell and Hubert 2011; Oliver 2013). For instance, Leistner (2010, p. 6) considers that *knowledge flow* is a metaphor with a general application: "With the wider view I am taking, I claim that managing knowledge flows is something that can be applied and used in almost any type of organization". The metaphor makes the transition from the image of a solid object with a well-descriptive shape and structure toward the image of a fluid flow with a changeable form and structure, in a continuous dynamics. Nissen (2006) explains that in any organization there is a need of knowledge to flow from one place to another one to assist managers in decision making. Thus, the flow of knowledge through the whole organization gives an intuitive image of the organizational knowledge dynamics, which the metaphors based on solid objects could not offer. "Knowledge as a fluid" and "Knowledge as a flow" metaphors are more powerful in expressing knowledge attributes than "Knowledge as an object" metaphor since they take advantage of a dynamic structure of the source domain. However, these new metaphors have a series of limitations coming from the Newtonian logic behind the fluids and flows. I am referring especially to the conservation laws and to the properties of tangibility and linearity. Also, these metaphors cannot explain the transformation of tacit knowledge into explicit knowledge and that of explicit knowledge into tacit knowledge. Emotional and spiritual knowledge remain as a mix of everything that cannot be expressed in a natural or symbolic language.

2.2 The Energy Metaphor

In his insightful book *Corporate longitude: What you need to know to navigate the knowledge economy*, Leif Edvinsson (2002) remarks that we need new metaphors and thinking models in order to enlarge our understanding about knowledge and intellectual capital such that organizations can re-create themselves as intelligent enterprises. In this perspective, Bratianu and Andriessen (2008) proposed a new

metaphor for knowledge understanding based on the concept of *energy*. The metaphor "Knowledge as energy" has been then refined by Bratianu (2011, 2015) and used in opening new perspectives in understanding and explaining knowledge. The main contribution of the energy metaphor is that it overcomes the limitations imposed by the Newtonian logic since it is based on the ideas of thermodynamics. The metaphor promotes three basic new ideas:

- Knowledge is a field.
- Knowledge is a spectrum of three fundamental components: rational knowledge, emotional knowledge, and spiritual knowledge.
- Each form of knowledge can be transformed into another form during knowledge processing and decision making.

Analyzing the content and structure of the source domain of the energy metaphor, we consider that the main attribute of energy that can be mapped onto the target domain is that energy is a *field*. It is not a tangible object anymore but an intangible entity. That means that we cannot apply anymore the Newton's logic in knowledge processing like in the previous metaphors. Linear thinking should be substituted with nonlinear thinking, even if we don't have at this moment a nonlinear metric to evaluate it. The old saying that *We can manage only what we can measure* should stimulate us in conceiving new nonlinear metrics for knowledge evaluation and not in disregarding the new approach because it does not offer for the moment a new metric.

Energy manifests in the nature in different forms: mechanical energy, as potential and kinetic energy; thermal energy; electrical energy; magnetic energy; nuclear energy etc. This idea can be transferred from the source domain to the target domain, and define some forms of knowledge. Thus, the Nonakaian dyad formed of explicit knowledge and tacit knowledge can be replaced with a triad formed of three fundamental forms of knowledge: rational knowledge, emotional knowledge, and spiritual knowledge. Rational knowledge has been claimed by many philosophers starting from the antique Greece that is the only form of knowledge able to reveal the truth. For them, knowledge means concepts and ideas, and not impressions coming from our senses. As formulated by Bertrand Russell (1972, p. 153), "It follows that we cannot know things through the senses alone, since through the senses alone we cannot know that things exist. Therefore knowledge consists in reflection, not in impressions, and perception is not knowledge." This conception has been beautifully synthetized by Descartes (1997) in his famous dictum *Cogito, ergo sum!* I think, therefore I exist. Rational knowledge became the root of scientific and technological knowledge, and of our education. Western education emphasizes even today the primacy of scientific knowledge over any other form of knowledge, from primary schools up to the university programs. Open any book of decision making and you will find only mathematics, although decision making is not integrally a rational process. This dominant role of rational knowledge we find also in the field of knowledge management, heavily supported by experts coming from information science and technology where they operate

with shannonian information. No wonder that the content of this book is dedicated mostly to rational knowledge, may be with the exception of this chapter which is dedicated to emotional and spiritual knowledge.

The first two ideas of the energy metaphor lead to the conclusion that we deal with three fundamental knowledge fields at individual and at organizational levels: rational knowledge field, emotional knowledge field, and spiritual knowledge field. The third idea coming from the energy metaphor refers to the possibility of transformation of knowledge from any field into knowledge from another field. Just think of the transformation of mechanical energy into thermal energy through friction, or to the transformation of thermal energy into electrical energy like in solar cells. By analogy, we may consider that rational knowledge can be transformed into emotional knowledge, and emotional knowledge into spiritual knowledge during knowledge processing. Thus, knowledge dynamics is not conceived as a mechanical motion from one part of the company to another one through knowledge flow, but as a transformation from one form of knowledge into another one, under certain conditions and in a given social context. It means much more than the known conversion processes defined by Nonaka in his knowledge dynamics theory (SECI): socialization, externalization, combination, and internalization (Nonaka 1991, 1994). This theory departs from the Cartesian dualism of body and mind since it is based on the Japanese philosophy of *oneness of humanity and nature* (Kaufman 1994; Nakagawara 2004; Nonaka and Takeuchi 1995; Nonaka et al. 2008), but it mixes together emotions, values, intuitions, and other wordless forms of knowledge into a single generic form called *tacit knowledge*. Thus, it cannot explain the transformation of one form of knowledge into another one. Some authors, like Leonard and Sensiper (1998), transposed the concept of explicit knowledge–tacit knowledge dyad into a spectrum of explicit knowledge–tacit knowledge. Although this metaphor looks interesting, in fact it enlarges the iceberg metaphor since at any cross-section in the spectrum we identify a part of explicit knowledge and another part of tacit knowledge, and knowledge dynamics reduces to the SECI model. The energy metaphor offers a different spectrum of the knowledge field, composed of three well-identifiable forms of knowledge which are in a continuous interrelation and transformation like the triple helix of DNA: rational knowledge, emotional knowledge, and spiritual knowledge (Bratianu 2013). Thus, the energy metaphor contributes to a better understanding of the organizational knowledge dynamics, generative knowledge creation, and developing a learning organization (Argote 2013; Senge 1999; Senge et al. 1994).

3 Emotional Knowledge

3.1 Cognition and Emotion

When the energy metaphor (Bratianu and Andriessen 2008) was presented for the first time during the *9th European Conference on Knowledge Management* organized by the Southampton Solent University, UK, somebody from the audience remarked that it is a pure speculation. However, we know that many new ideas in

science have always been considered as being pure speculations. When new ideas cannot fit anymore the conventional wisdom, there should be a shift in our way of thinking by creating new paradigms (Kuhn 1970). In that situation, the conventional wisdom considers that *cognition* and *emotion* are two separate concepts, as a result of the Cartesian dualism of mind and body. According to Robinson et al. (2013, p. 3), "Our intrapsychic lives are dominated by two sorts of phenomena: thoughts (more formally, cognition) and feelings (more formally, emotion). Both are internal events that cannot be directly observed by others and, in this important sense, are subjective or at least particular to a person". In the same perspective, Le Doux (1999, p. 24) emphasizes the fact that "Since the time of the ancient Greeks, humans have found it compelling to separate reason from passion, thinking from feeling, cognition from emotion. These contrasting aspects of the soul, as the Greeks liked to call the mind, have in fact often been viewed as waging an inner battle for the control of the human psyche". Based on a literature review concerning functional magnetic resonance imaging (fMRI) in experiments focused on the activity of the prefrontal cortex (PFC), Pessoa and Pereira (2013, p. 55) remark also that "Cognition and emotion have been traditionally conceptualized as mutually antagonistic". That explains the reaction of many people when promoting the idea of integrating these two phenomena and their outcomes in terms of rational and emotional knowledge.

According to Le Doux (1999) cognitive science emerged as a new field of brain science but focused only on the part of mind that deals with rational knowledge and intelligence, which means the reasoning process. It leaves emotion out. The brain is considered like a computer and all knowledge processes studied through this metaphor. However, many cognitive scientists were interested in the functional organization of the mind, and not in its biological support. As a result of that approach, "The field of cognitive science has been incredible successful in its stated mission of understanding information processing, which turns out to mean the unconscious processing of information" (Le Doux 1999, p. 33). Performing new types of research on the brain, scientists discover that cognition and emotion are not in fact two separate phenomena, but two interacting ones. From very simple push-pull interacting mechanisms, there are more complex interactions which generate a continuous dynamics between cognition and emotion. In their concluding remarks of the review of the functional Magnetic Resonance Imaging literature, Pessoa and Pereira (2013, p. 65) show that "many of the effects of emotion on cognition (and vice versa) are best viewed not as a simple push-pull mechanism, but as interactions between the two, such that the resulting processes and signals are neither purely cognitive nor emotional. Instead, in several, the 'cognitive' or 'emotional' nature of the processes is blurred in a way that highlights the integration of these domains in the brain". That is an excellent result demonstrating that the dualism of mind and body should be replaced by the oneness conception of mind and body, such that cognition and emotion become two interacting processes supported by the same brain and body (Damasio 1994, 1999, 2003, 2012; Frith 2007; Hill 2008; Immordino-Yang and Damasio 2007; Le Doux 1999, 2002; Mlodinow 2013; Robinson et al. 2013).

3.2 Emotions, Feelings and Emotional Knowledge

Nonaka and Takeuchi (1995, p. 9) describe *tacit knowledge* as personal knowledge acquired through direct experience, fact that makes it difficult to express it: "Highly subjective insights, intuitions, and hunches are an integral part of knowledge. Knowledge also embraces ideals, values, and emotions as well as images and symbols". Thus, they recognize the existence of emotions in that fluid mix of experience (Davenport and Prusak 2000) called tacit knowledge, but they do not use the expression of "emotional knowledge". The first to use this expression were Mayer et al. (2004) in their definition of *emotional intelligence*. They conceive emotional intelligence explicitly as the capacity of processing emotional information and knowledge in concordance with cognitive science perspective. In their view, emotional intelligence is "The capacity to reason about emotions, and of emotions to enhance thinking. It includes the abilities to accurately perceive emotions, to access and generate emotions so as to assist thought, to understand emotions and emotional knowledge, and to reflectively regulate emotions so as to promote emotional and intellectual growth" (Mayer et al. 2004, p. 197). Emotional knowledge is the wordless expression of emotions and feelings (Damasio 1994, 1999; Le Doux 1999). I found very helpful to use the energy metaphor in enlarging our understanding about knowledge, by considering it as a field whose behavior is governed by thermodynamics laws and by introducing the basic idea that we can accept three fundamental forms of knowledge fields: rational, emotional, and spiritual. These fields are interacting and have the property of transforming one form of knowledge into another one in the learning and decision making processes. That means that cognition and emotion are two phenomena that interact continuously such that thoughts may generate emotions, and emotions may lead to new ideas.

Let us come back to the energy metaphor. In the source domain we have the concept of energy and in the target domain we have the concept of knowledge. Energy is not a substance but a field. Energy can manifest itself in different forms: mechanical energy, thermal energy, electrical energy and so on. One form of energy can transform itself into another form, according to some laws. For instance, the transformation of mechanical energy into thermal energy through friction is governed by thermodynamics laws. If we assign explicit knowledge to mechanical energy, then we can assign emotional knowledge to thermal energy. It is interesting to note that emotion is a phenomenon which has intensity like a thermal field, intensity which is measured by temperature. The same emotion may have different intensities in different people, like the temperature fields in different objects. Based on the energy metaphor we can introduce the concept of *emotional knowledge* in an explicit way, and we can advance the idea of transformation of rational knowledge into emotional knowledge and vice versa through psychological processes. This dynamics is very important in understanding the decision making process and people's behavior. For instance, Dan Hill (2008, p. 2) strengthens the idea that people are primarily emotional decision makers in both marketplace and workplace: "Breakthroughs in brain science have revealed that people are primarily

emotional decision makers". Similar conclusions come out of the famous book *Blink: The power of thinking without thinking* written by Malcolm Gladwell. For instance, contrasting rational knowledge and analytical thinking with emotional knowledge and emotional thinking, Gladwell (2005, p. 17) remarks that "the task of making sense of ourselves and our behavior requires that we acknowledge there can be as much value in the blink of an eye as in months of rational analysis".

Emotional knowledge is an expression of emotions and feelings. As Damasio (1999, p. 26) states, "the simplest form in which the wordless knowledge emerges mentally is the feeling of knowing", and that wordless knowledge is an emotional knowledge. Emotions and feelings are body and mind reactions to interactions between our body and any object from external environment. Sometimes, they can be generated by internal sources. For a better understanding of them, let us consider some more elaborate definitions of emotions and feelings formulated by Damasio (2012, pp. 116–117):

"Emotions are complex, largely automated programs of actions concocted by evolution. The actions are complemented by a cognitive program that includes certain ideas and modes of cognition, but the world of emotions is largely one of actions carried out in our bodies, from facial expressions and postures to changes in viscera and internal milieu."

"Feelings of emotions, on the other hand, are composite perceptions of what happens in our body and mind when we are emoting. As far as the body is concerned, feelings are images of actions rather than actions themselves; the world of feelings is one of perceptions executed in brain maps."

Thus, the body language and the brain maps are specific ways of manifesting emotional knowledge. It is a rich field of expression and it is directed both inwardly through brain maps and outwardly through facial and body expressions. Emotional knowledge created by our facial expression is encoded in microexpressions, that is configurations of facial muscles that have durations of the order of microseconds. They are not controlled by our consciousness.

Emotions contribute directly to the generation of the survival-oriented attitude of individuals. When consciousness becomes aware of the new context that interacts with our body, emotions transform into feelings. That means that neural maps created by the brain are transformed into mental images. The neural patterns that are the biological foundation of feelings generate two types of changes: changes that reflect the body state, and changes that reflect cognitive state. All of these changes carry with them *emotional information* and *emotional knowledge* (Damasio 1999, 2012). When this information and knowledge is created at the level of cognitive unconsciousness we deal practically with *wordless knowledge* which is a part of the tacit knowledge we have already discussed.

There is a large spectrum of emotions with a core of seven universal emotions: happiness, surprise, fear, anger, sadness, disgust and contempt. Some authors integrate disgust and contempt and the core emotions reduce to six. They are considered to be universal due to their manifestation regardless of gender, age, culture or ethnogeography. It is interesting to see that this emotional core spectrum contains only one positive emotion (i.e. happiness), one neutral emotion

(i.e. surprise) and five negative emotions (i.e. fear, anger, sadness, disgust and contempt). All of these emotions can be displayed on the face of people using an intrinsic genetic code. Based on many observations and experiments, Hill (2008, p. 45) remarks that "Facial expressions are uniform and universal. Indeed, even a person born blind, who could not possibly learn expressions through imitation, has the same facial expressions as everyone else". That is a strong argument in favor of considering emotional knowledge reflecting the truth much better than rational knowledge which is mediated by our motivation in expressing the truth. While rational knowledge is a result of a conscious process that can be controlled by our willingness to tell the truth or not, emotional knowledge is a result of the direct unconscious reaction of our body and mind to the interaction with the external environment.

Emotions and feelings generate emotional knowledge which is able to transform into rational knowledge, as well as into spiritual knowledge. As Gladwell (2005, p. 70) remarks, "The conversion of emotions into thoughts has allowed emotion to be studied using the tools and conceptual foundations of cognitive science". Results show that "Emotions and cognition are inextricably intertwined. Feelings influence thoughts and actions, which in turn can give rise to new emotional reactions" (O'Rorke and Ortony 1994, p. 283). Arguments in favor of this dynamics between rational knowledge and emotional knowledge have been well-documented by Daniel Kahneman in his famous book *Thinking fast and slow* (2011). Kahneman is Higgins Professor of Psychology Emeritus at Princeton University and he received the 2002 *Nobel Prize* in Economic Sciences for his pioneering work with Amos Tversky on decision making. Kahneman asserts that there are two thinking systems in our mind and they work together. "System 1 operates automatically and quickly, with little or no effort and no sense of voluntary control. System 2 allocates attention to the effortful mental activities that demand it, including complex computations" (Kahneman 2011, pp. 20–21). Although the automatic system 1 generates complex pattern of ideas, only the logical system 2 is able to constructs thoughts and to aggregate them in rational structures that can be expressed by a natural or formal language. That means that emotional knowledge is a fast outcome of our interactions with the external world and only by transformation into rational knowledge it can be processed logically and expressed in a natural or symbolic language.

4 Spiritual Knowledge

4.1 Spirituality

Although searching on internet for *spirituality* one gets many links to *religion*, the two concepts define two different realms of our thinking, even if there is a fuzzy overlapping area (Benefiel 2005; Dalai Lama 1999; Fry 2003; Fry et al. 2007; Mitroff and Denton 1999; Reave 2005; Zohar and Marshall 2000, 2004). Dalai Lama (1999, p. 22) explains the difference between religion and spirituality:

"Religion I take to be concerned with faith in the claims of one faith tradition or another, an aspect of which is the acceptance of some form of heaven or nirvana. Connected with this are religious teachings or dogma, ritual prayer, and so on. Spirituality I take to be concerned with qualities of the human spirit—such as love and compassion, patience, tolerance, forgiveness, contentment, a sense of responsibility, a sense of harmony—which bring happiness to both self and others".

Spiritual knowledge is the direct result of the process of thinking about existence, and searching for meaning and purpose in our lives, a process based on deeply held personal values (Neck and Milliman 1994). While religion is organized and operates as a social attractor (Mitroff and Denton 1999), spirituality is highly individual. Spiritual knowledge reflects the content of that field of spirituality and constitutes the third component of the triple helix of knowledge (Bratianu 2013). If rational knowledge reflects our understanding about the physical world we are living in, and emotional knowledge reflects our understanding about our bodily emotions and feelings, spiritual knowledge reflects our understanding about the meanings of our existence. Spiritual knowledge is in a continuous dynamic with rational knowledge and emotional knowledge and it powers the decision making process. When we make decisions we take our beliefs and values as guidelines and react to the given problems with a combination of rational and emotional thinking (Ariely 2010; Kahneman 2011; Le Doux 1999).

Spiritual knowledge is related also to the way of working and living. Work can be viewed as a curse like in the biblical stories or as a means of life. For many people work appears as an extension of their personality, and a tangible way an individual can measure his or her worth. If people work only for money and they do not find any spiritual value in their daily activities, they will become dissatisfied and unproductive. They will feel stress in their work efforts and sooner or later will be burnt-out. That situation is more specific to the knowledge workers than to industrial workforce (Drucker 2008). Zohar and Marshall (2004, p. 17) strengthen that view and go even further saying that "We need a sense of meaning and driving purpose in our lives. Without it we become ill or we die". Spiritual knowledge embraces our deepest sense of existence, living aspirations and motivations, values and ethical principles we live by, and ways of embedding all of these in our lives and work. Spiritual knowledge has the power of stimulating to think beyond individual interests and achievements. To think for community and society at large, in creative ways like spiritual leaders can do.

4.2 Spiritual Knowledge and Spiritual Intelligence

It is interesting to reflect upon the Latin root of the word *spiritual*. It is *spiritus*, which means *that which gives life or vitality*. That means to give a meaning to our life and to find ways of realizing our aspirations for a better possible future for the whole community. That makes the difference between *to have* and to live up to your *values* and *ideals*. Unlike physical events that have causes or generic forces to determine their triggering, human behavior is triggered by reasons and guided by

values, which leads to spiritual knowledge. That is why educations should not be limited only to rational knowledge but extended to emotional knowledge and spiritual knowledge. Unfortunately, even education in some cultures (for instance American culture), or some professional domains (for instance in business) stresses the importance of self-interest as a driving force of competition. Students in Economics are taught about self-interest and profit making. From here, they are taught how to find strategies to increase companies' profits and their shareholders the value of their investments. It is a pure rational reasoning and there are huge efforts for teaching such rational knowledge. However, profit maximization principle applied in business can easily generate greed for many managers. Wang et al. (2011, p. 545) try to distinguish between self-interest and greed as follows: "Self-interest is a motivation, widely presumed to drive most economic behavior, which aims to increase personal well-being. In contrast, greed is self-interest taken to such an extreme that, based on prevailing social norms regarding the effects of one's behavior on others, it may be perceived as unacceptable or immoral". The problem with greed is that it is a reinforcing phenomenon, which means that the more you have the more you want more.

Spiritual knowledge is processed by spiritual intelligence. Danah Zohar and Ian Marshall consider *spiritual intelligence* the third fundamental intelligence after cognitive intelligence and emotional intelligence. In their view, spiritual intelligence "is the intelligence with which we have access to deep meaning, fundamental values, and a sense of abiding purpose in our lives, and the role that this meaning, values and purpose play in our lives, strategies, and thinking processes" (Zohar and Marshall 2004, p. 64). Spiritual intelligence acts like an integrator helping us to understand our identity and sense of life. Also, it helps us to construct a vision based on our potential rich in rational, emotional, and spiritual knowledge. Thus, it might be considered as a driving force in conceiving and implementing strategies in concordance with our set of values or mindset. Spiritual intelligence is a real transformational force which is fundamental for spiritual leaders (Bass and Riggio 2006; Benefiel 2005; Daft 2008). They should be able to create a shared vision based on a set of organizational values and ethical principles.

Spiritual leadership is based on the triple helix of knowledge, but for motivating people it gives primacy to emotional knowledge and spiritual knowledge. While management is based on rational knowledge and analytics, and decision making strives to be rational and objective, leadership favors emotional knowledge and spiritual knowledge and uses rational knowledge only as a support for quantitative analyses. That is evident especially in change management when people should be motivated for a larger effort and a long term view. Reducing managerial decision to the rational knowledge and eliminating emotional and spiritual knowledge has been a historical mistake justified only by the efficiency and profit maximization principles. As Mitroff and Denton (1999, p. 91) remark with respect of the separation of spiritual knowledge from management, "We have gone too far in separating the key elements. We need to integrate spirituality into management. No organization can survive for long without spirituality and soul. We must examine ways of

managing spirituality without separating it from the other elements of management".

A good example could be the Google's philosophy about leadership known as "Ten things we know to be true". Larry Page and Serghey Brin, the founders of Google, formulated these principles when the company was just a few years old, and then they check them from time to time to see if they still hold true. The ten principles are the following:

1. Focus on the user and all else will follow.
2. It's best to do one thing really, really well.
3. Fast is better than slow.
4. Democracy on the web works.
5. You don't need to be at your desk to need an answer.
6. You can make money without doing evil.
7. There's always more information out there.
8. The need for information crosses all borders.
9. You can be serious without a suit.
10. Great just isn't good enough.

Although most of these principles follow a rational logic, we can identify easily the combination between rational knowledge, emotional knowledge and spiritual knowledge. May be principle no. 6 "You can make money without doing evil" should be found in many other business philosophies since it is a perfect blend between the rational and spiritual knowledge fields. Principle no. 10 "Great just isn't good enough" shows a deep understanding of knowledge dynamics and the power of leadership aspirations for an evolving future.

Even if we contrast business environment with academic environment, we shall remark the same force of spiritual knowledge in creating the vision framework for leadership. To illustrate this assertion let us analyze the mission statement and the organizational values of the Stanford Graduate School of Business. The mission statement: "Our mission is to create ideas that deepen and advance our understanding of management and with those ideas to develop, innovate, principled, and insightful leaders who change the world". The Graduate Business School strives for values leading to excellence:

- Engage intellectually.
- Strive for something great.
- Respect others.
- Act with integrity.
- Own your actions.

Asking faculty staff and students to "Strive for something great" represents a challenge for the spiritual knowledge field and for the organizational knowledge dynamics which should be able to find practical ways of achieving greatness.

5 Practical Examples

5.1 Managing Change

Project Management involves change, and a change process cannot be managed by using the same methods like for a steady production process. Managing change means to create a driving force able to overcome the inertial force of any steady process, and to direct the workers' energy toward achieving a given objective (Burnes 2009; Kotter 1996; Kotter and Cohen 2002). That means to have a vision about a future possible state of the project or organization and to create an emotional driving force able to increase the commitment and the effort necessary to achieve that future state and its objectives. As Kotter and Cohen (2002, p. 1) remark, "People change what they do less because they are given *analysis* that shifts their *thinking* than because they are *shown* a truth that influences their *feelings*". Instead of using the well-known mantra "analysis-think-change" Kotter and Cohen recommend the approach based on the new mantra "see-feel-change". Thus, instead of using almost exclusively rational knowledge the project management leaders should use primarily emotional knowledge which will generate the necessary rational and spiritual knowledge for change. An interesting change project described by Burnes (2009, pp. 421–424) is that of Oticon, a Danish company founded in 1904 which used to be the first hearing instrument company in the world for many decades. However, its lifecycle started to change in 1970s when the company entered the decline phase. Lars Kolind, the new President of the company came with a totally new vision of running the business based on a project management philosophy and a chaotic association of people to different projects. Changing the rigid structure of the company and the well-defined fluxes of decision making into a project management structure based on free initiative and emotional teaming of people, Kolind applied the new mantra described by Kotter and Cohen (2002) and creating this way a creative environment able to generate new ideas and products: "Departments and jobs titles would disappear and all activities would become projects initiated and pursed informally by groupings of interested people" (Burnes 2009, p. 422). That means replacing the rigid hierarchical organizational structure with an ad-hoc fluid project-based structure and to release creativity of people by encouraging their ideas and face-to-face communications. That means to recognize the importance of emotional and spiritual knowledge in direct communication and teaming-up according to individual's interests and not to top-down decisions. Overcoming the inertial thinking and changing their spiritual guidelines, people at Oticon became more creative and committed to generate new competitive advantages. After some time of chaos and understanding the new emotional and spiritual environment, workers at Oticon changed completely their behavior creating a new business climate with visible and impressive results. Oticon's sales were growing at 20% per year, after a period of 10 years of decline, and the market share increased from 8 to 12% in the 2 years following the changes.

5.2 Samsung Way

An inspired illustration of spiritual leadership can be *Samsung Way*, the organizational spirituality developed at Samsung (Song and Lee 2014). Samsung Group is the most important business conglomerate of Korea, comprising 75 affiliate companies in diverse industries. It has about 600 facilities in 63 countries performing a variety of functions, including R&D, product design, production, and procurement. Its labor force is about 500,000 employees, including all categories of professionals from PhDs to ordinary laborers. In 2014 the company was ranked the 21st on *Fortune*'s "World's Most Admired Companies list." In 2013, with an annual revenue of about US$ 201, Samsung Electronics—the flagship of the company—surpassing those of Hewlett-Packard, Siemens and Apple.

In 1987 the founder of Samsung died and the new CEO became Lee Kun-Hee, the third son of Lee Byun-Chull. With a solid business education at the best universities in Japan and USA, Lee Kun-Hee transformed almost entirely the company based on spiritual leadership philosophy and a deep understanding of the change process. For him, change is the engine of progress and the force to transform a domestic company into a world-class company. His favorite mantra is "Change everything except your wife and children". As demonstrated by Song and Lee (2014), spirituality and spiritual leadership played always an important role at Samsung. When the company was an important player only at the local and national levels, the value system adopted at Samsung comprised: contribution to the nation, people first, and pursuit of rationality. This decision guide encouraged mostly the quantitative development of the company based on economic metrics. When the vision changed its horizon from a national to a global framework, Samsung enlarged its value system by considering also: creativity, integrity, excellence, perfectionism, and co-prosperity. Based on these values the company elaborated a new strategy suitable for a fast track competitor on a global market. In 1993, Lee launched The *New Management Initiative* as a new driving force toward the global leadership. Essentially, Lee wanted "the transformation of Samsung from a quantity-driven company to a quality-driven company in terms of its mindset, systems, and practices" (Song and Lee 2014, p. 39). As it happened, the most difficult objective was the change of the mindset since organizational culture generated a strong inertial force. Chairman Lee Kun-Hee underlined that need of change and the necessity of a new strategic thinking: "The future belongs to those who explore and challenge earlier than others. In an environment that never stops changing, we need the insight to grasp opportunity fast, and the wisdom to turn a crisis into an opportunity. With strategic thinking and a preemptive and challenging mind, we can strengthen competitiveness by using our limited resources more effectively" (Song and Lee 2014, p. 77).

5.3 Antimanagement

Spiritual knowledge plays an important role in management performance or non-performance since managerial decisions are always based on a value system. Since many companies go from success to failure, from exponential development to sudden bankruptcy, from social responsibility to social irresponsibility it is important to understand this organizational behavior and its underpinning. Lange and Washburn (2012) remark that many authors prefer to discuss about *corporate social responsibility (CSR)* although the core of the problem is generated by the *corporate social irresponsibility (CSI)*. "Irresponsibility, distinct from responsibility, is often not discussed explicitly in the CSR literature, but the implication is that irresponsibility is simply the opposite side of the responsibility coin—that is, the failure to act responsible" (Lange and Washburn 2012, p. 300). To understand how the balance may incline from one side to another it is useful to come back to the metaphorical thinking and to recall the contrasting phenomenon of *particles* and *antiparticles* from nuclear physics. Let us consider the case of the *electron* and *positron*. Both particles have the same characteristics except for the electrical charge. The electron has a negative electrical charge, while the positron has a positive one. When an electron and a positron knock against each other they annihilate immediately producing a pair of gamma rays. Due to their opposite electrical charge, these particles will move in opposing directions when introduced in the same electrical field.

That effect can be mapped onto the organizational field of forces. When two managers have the same qualities with the exception of their value system, they will make decisions along their own mindset which leads to opposing outcomes. For instance, if we consider "respect for people" as a *positive* managerial value, then "disrespect for people" has the meaning of a *negative* managerial value or *antivalue*. In the first case the manager will try to motivate people by using a fair and transparent metric or rewarding framework, while the manager who has no respect for the human side of his employees will prefer a motivation system based on fear. While rational knowledge is neutral with respect to decision making, spiritual knowledge contains *values* and *antivalues* with respect to decision making. As positive values, or just values, we may consider: respect for people, integrity, responsibility, care for the environment, team spirit, striving for the best, good quality etc. As negative values, or just antivalues, we may consider: disrespect for people, irresponsibility, stressing employee, hidden the truth, malignancy, malpractice etc. The manager charged with positive values will drive the organization toward performance and competitive advantage, while the manager charged with antivalues will drive the organization toward non-performance and decline. In the case of positive values we talk about *management*, and in the case of negative values we talk about *antimanagement*. Thus, antimanagement is not a bad management but a management based on negative spiritual knowledge. This is an important issue when promoting people in high levels of decision making looking only for their rational knowledge and ignoring emotional and spiritual knowledge. Antimanagement is a new concept introduced by Bratianu (2003) for explaining

why many companies disintegrate as a result of managing on antivalues. Recent business history contains many examples of companies which collapsed due to the antimanagement practiced by managers being interested only in their own bank accounts. Among them, the case of Enron became a classic story (Benston and Hartgraves 2002; Chatterjee 2003; Lev 2002). Examples are even more astonishing when considering the emergent economies from the former European socialist countries, where antimanagement has been almost everywhere the rule due to antivalues inherited from the old society. In a larger perspective, antimanagement is based on the wrong assumptions that wealth is only about money and tangible properties, and managers' duty is to always increase the profit of shareholders, regardless the methods used in the organizational context. As Richard Branson (2011, p. 21) remarks, "The focus on profit being king has caused significant negative, unintended consequences. For over a century and a half cheap labor, damaged lives, a destroyed planet and polluted seas were all irrelevant when set against the need for profit. But this is changing".

The integrated view of knowledge based on the energy metaphor helps us to understand that knowledge creation in organizations should not be limited to rational knowledge as suggested by Nonaka's model. Knowledge creation is an outcome of organizational knowledge dynamics based on the multifield theory (Bratianu 2015) where the rational knowledge field interacts continuously with the emotional knowledge field and spiritual knowledge field. Spiritual knowledge processing is done by spiritual intelligence and the final result for organization is spiritual capital. According to Zohar and Marshall (2004, p. 3), spiritual capital is "wealth that we live by, wealth that enriches the deeper aspects of our lives. It is wealth we gain through drawing upon deepest meanings, deepest values, most fundamental purposes, and highest motivations, and by finding a way to embed these in our lives and work". In order to see the new perspective created by Danah Zohar and Ian Marshall we need to extract spiritual knowledge from the black box of tacit knowledge and make it a basic component of the organizational field of knowledge.

6 Conclusions and Further Research

Project Management has been developed as a rational decision making process based on a finite business algorithm designed to achieve a well-defined objective. It is a rational construct to build up into the future objectives within time and cost constrains, and a reduced exposure to some potential risks. However, any project development is made possible by the project team which means people with their thoughts, emotions and cultural values. If the business process can be designed based on rational knowledge, its operational development is strongly related to emotional and spiritual knowledge of the project team members. Success or failure depends on leaders' vision and the commitment of workers derived from their spiritual mind set and emotional behavior.

The purpose of this chapter is to introduce in the generous topic of Project Management the main concepts and ideas about emotional and spiritual knowledge as a complimentary part of all the other chapters of this book based on rational knowledge. Since knowledge is an abstract concept and its understanding depends on the metaphorical thinking, the first part of this chapter presents the main metaphors used in knowledge management with their attributes and limitations. Thus, it is explained how using metaphors like stocks, flows or stocks-and-flows the concept of knowledge is understood more or less in terms of some attributes of the source domains. The most frequently used metaphor is that of stocks-and-flows since it is very simple and intuitive. Also, the metaphor having in the source domain the iceberg is frequently used due to its duality of visible part similar to explicit knowledge and invisible part similar to tacit knowledge. However, all of these metaphors have strong limitations coming from the Newtonian logic and the property of linearity. The new metaphor of knowledge as energy changes completely the understanding horizon since knowledge is conceived as a field of forces, and existing in three fundamental forms: rational, emotional, and spiritual. Moreover, knowledge dynamics refers now not to motion in space but to a transformation of one form of knowledge into another form, in an interactive way.

Then, the chapter develops the topic of emotional knowledge which is generated by our emotions and feelings. Emotional knowledge is a wordless form of knowledge which is processed mostly unconsciously by our brain. We are aware of it through intuition and transformation into rational knowledge which has a conscious and explicit form. Also, the body language and the brain maps are specific ways of manifesting emotional knowledge. It is a large spectrum of expressions and it is directed both inwardly through brain maps and outwardly through facial and body expressions. Emotional knowledge encoded into facial microexpressions can be uncoded by experts and specialized software programs already in use in truth detection and neuromarketing research.

A full sub-chapter is dedicated to spiritual knowledge which contains cultural values, traditions and answers to all the questions concerning our existence and working life. Spiritual knowledge is processed by spiritual intelligence, which is considered one of the fundamental forms of intelligences together with rational intelligence and emotional intelligence. Spiritual knowledge constitutes the guiding system in decision making and the basis of the spiritual leadership. Successful companies developed their visions and missions, their organizational values sets and ethical principles based of spiritual knowledge and the spirituality framework of their management. It is important to reflect for instance to the organizational values defined by the Stanford Graduate School of Business: engage intellectually, strive for something great, respect others, act with integrity, and own your actions.

To understand the practical implications of emotional and spiritual knowledge there are some applications, described for their meaningful essence: managing change, the visionary leadership at Samsung company and the consequences of antimanagement, as a management practiced based on negative values. These examples are related directly to Project Management since any new project should have a vision, generates the need of change, and can be successful if and only if its

management is based on a healthy spirituality. The lesson project managers should learn from this chapter is that project management started as a full rational and algorithmic approach to achieve well-defined objectives, but it should open to the emotional and spiritual fields of knowledge. That is because enterprise is more important than economics and people's commitment and motivation for quality and successful work are much more important than any economic principles.

Future research on the directions opened in this chapter should focus on the dynamics of knowledge within the decision making process, which means to better understand and explained the conditions and limitations of transforming one field of knowledge into another field, and how these transformations can be used in successful Project Management.

References

Andriessen, D. (2008). Stuff or love? How metaphors direct our efforts to manage knowledge in organizations. *Knowledge Management Research and Practice, 6*(1), 5–12.

Andriessen, D. (2011). Metaphors in knowledge management. *System Research and Behavioral Science, 28*(2), 133–137.

Andriessen, D., & Boom, M. (2007, May). *Asian and western intellectual capital in encounter*. Paper presented at IC-Congress 2007, Inholland University of Applied Sciences, Haarlem.

Argote, L. (2013). *Organizational learning: Creating, retaining and transferring knowledge* (2nd ed.). New York: Springer.

Ariely, D. (2010). *Predictably irrational: The hidden forces that shape our decisions*. New York: Harper Collins.

Bass, B. M., & Riggio, R. E. (2006). *Transformational leadership* (2nd ed.). London: Lawrence Erlbaum Associates.

Becerra-Fernandez, I., & Sabherwal, R. (2010). *Knowledge management. System and processes*. New York: M. E Sharpe.

Benefiel, M. (2005). The second half of the journey: Spiritual leadership for organizational transformation. *The Leadership Quarterly, 16*(5), 723–747.

Benston, G. J., & Hartgraves, A. L. (2002). Enron: What happened and what we can learn from it. *Journal of Accounting and Public Policy, 21*, 105–127.

Bolisani, E., Borgo, S., & Oltramari, A. (2012). Knowledge as a measurable object in business contexts: A stock-and-flow approach. *Knowledge Management Research and Practice, 10*(3), 275–286.

Borgo, S., & Pozza, G. (2012). Knowledge objects: A formal construct for material, information and role dependences. *Knowledge Management Research and Practice, 10*(3), 227–236.

Branson, R. (2011). *Screw business as usual*. London: Virgin Books.

Bratianu, C. (2003). Antimanagement. *Review of Management and Engineering Economics, 2*(4), 7–15.

Bratianu, C. (2009). The frontier of linearity in the intellectual capital metaphor. *Electronic Journal of Knowledge Management, 7*(4), 415–424.

Bratianu, C. (2011). Changing paradigm for knowledge metaphors from dynamics to thermodynamics. *Systems Research and Behavioral Science, 28*(2), 160–169.

Bratianu, C. (2013). The triple helix of the organizational knowledge. *Management Dynamics in the Knowledge Economy, 1*(2), 207–220.

Bratianu, C. (2015). *Organizational knowledge dynamics: Managing knowledge creation, acquisition, sharing, and transformation*. Hershey, PA: IGI Global.

Bratianu, C., & Andriessen, D. (2008). Knowledge as energy: A metaphorical analysis. In D. Harorimana & D. Watkins (Eds.), *Proceedings of the 9th European conference on knowledge management* (pp. 75–82). Reading: Academic.

Burnes, B. (2009). *Managing change A strategic approach to organizational dynamics* (5th ed.). London: Prentice Hall.

Chatterjee, S. (2003). Enron's incremental descent into bankruptcy: A strategic and organizational analysis. *Long Range Planning, 36*, 133–149.

Daft, R. L. (2008). *The leadership experience* (4th ed.). London: Thomson South-Western.

Dalai Lama. (1999). *Ethics for the millennium*. New York: Putman.

Dalkir, K. (2005). *Knowledge management in theory and practice*. New York: Elsevier.

Damasio, A. R. (1994). *Descartes' error: Emotion, reason, and the human brain*. New York: Putman.

Damasio, A. R. (1999). *The feelings of what happens: Body and emotion in the making of consciousness*. New York: Harcourt.

Damasio, A. R. (2003). *Looking for Spinoza: Joy, sorrow, and the feeling brain*. New York: Harcourt.

Damasio, A. R. (2012). *Self comes to mind: Constructing the conscious brain*. New York: Vintage Books.

Davenport, T. H., & Prusak, L. (2000). *Working knowledge: How organizations manage what they know*. Boston: Harvard Business School Press.

Descartes, R. (1997). *Key philosophical writings*. Hertfordshire: Wordsworth Editions.

Drucker, P. (2008). *The age of discontinuity: Guidelines to our changing society*. London: Transaction.

Edvinsson, L. (2002). *Corporate longitude: What you need to know to navigate the knowledge economy*. London: Prentice Hall.

Fauconnier, G. (2001). Conceptual blending and analogy. In D. Gentner, K. J. Holyoak, & B. N. Kokinov (Eds.), *The analogical mind: Perspectives from cognitive science* (pp. 255–286). Cambridge: The MIT Press.

Fauconnier, G., & Turner, M. (2002). *The way we think: Conceptual blending and the mind's hidden complexities*. New York: Basic Books.

Frith, C. (2007). *Making up the mind: How the brain creates our mental world*. Malden, MA: Blackwell.

Fry, W. L. (2003). Toward a theory of spiritual leadership. *The Leadership Quarterly, 14*(6), 693–727.

Fry, W. L., Matherly, L. L., Whittington, J. L., & Winston, B. E. (2007). Spiritual leadership as an integrating paradigm for servant leadership. In S. Singh-Sengupta & D. Fields (Eds.), *Integrating spirituality and organizational leadership*. New Delhi: Macmillan India.

Gladwell, M. (2005). *Blink: The power of thinking without thinking*. New York: Back Bay Books.

Heagney, J. (2011). *Fundamentals of project management* (4th ed.). New York: AMACON.

Hill D (2008) *Emotionomics: Leveraging emotions for business success* (Rev. ed.). London: Kogan Page.

Immordino-Yang, M. H., & Damasio, A. (2007). We feel, therefore we learn: The relevance of affective and social neuroscience to education. *Mind, Brain, and Education, 1*(1), 3–10.

Kahneman, D. (2011). *Thinking, fast and slow*. New York: Farrar, Straus and Giroux.

Kaufman, S. F. (1994). *The martial artist's book of five rings: The definitive interpretation of Myiamoto Musashi's classic book of strategy*. Boston: Tuttle.

Kerzner, H. R. (2013). *Project management: A systems approach to planning, scheduling, and controlling*. Hoboken, NJ: Wiley.

Kotter, J. P. (1996). *Leading change*. Boston: Harvard Business School Press.

Kotter, J. P., & Cohen, D. S. (2002). *The heart of change. Real-life stories of how people change their organizations*. Boston: Harvard Business School Press.

Kuhn, T. S. (1970). *The structure of scientific revolutions* (2nd ed.). Chicago: The University of Chicago Press.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: The University of Chicago Press.
Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to the western thought*. New York: Basic Books.
Lange, D., & Washburn, N. T. (2012). Understanding attributions of corporate social irresponsibility. *Academic Management Review, 37*(2), 300–326.
Le Doux, J. (1999). *The emotional brain: The mysterious underpinnings of emotional life*. London: Phoenix.
Le Doux, J. (2002). Emotion, memory, and the brain. *Scientific American, 12*, 62–71.
Leistner, F. (2010). *Mastering organizational knowledge flow: How to make knowledge sharing work*. Hoboken, NJ: Wiley.
Leonard, D., & Sensiper, S. (1998). The role of tacit knowledge in group motivation. *California Management Review, 40*(3), 112–132.
Lev, B. (2002). Where have all of Enron's intangibles gone? *Journal of Accounting and Public Policy, 21*, 31–135.
Mintzberg, H. (2010). *The problem is enterprise, not economics*. Retrieved March 15, 2016, from http://www.Gurteen.com/gurteen/gurteen.nsf/id/we-are-not-human-resources/
Mitroff, I., & Denton, E. A. (1999). A study of spirituality in the workplace. *Sloan Management Review, 40*(4), 83–92.
Mayer, J. D., Salovey, P., & Caruso, D. R. (2004). Emotional intelligence: Theory, findings, and implications. *Psychological Inquiry, 15*(3), 197–215.
Mlodinow, L. (2013). *Subliminal: How your unconscious mind rules your behavior*. New York: Vintage Books.
Moser, K. S. (2000). Metaphor analysis in psychology—Method, theory, and fields of application. *Forum: Qualitative Social Research, 1*(2), 1–8.
Moser, K. (2004). The role of metaphors in acquiring and transmitting knowledge. In M. Fisher, N. Boreham, & B. Nihan (Eds.), *European perspectives on learning at work: The acquisition of work process knowledge*. Luxembourg: Cedefop Reference Series.
Nakagawara, C. (2004). The Japanese garden for the mind: The 'bliss' of paradise transcend. *Standford Journal of East Asian Affairs, 4*(2), 83–103.
Neck, C. P., & Milliman, J. F. (1994). Thought self-leadership: Finding spiritual fulfillment in organizational life. *Journal of Managerial Psychology, 9*(6), 9–16.
Nissen, M. E. (2006). *Harnessing knowledge dynamics: Principled organizational knowing and learning*. London: IRM Press.
Nonaka, I. (1991). The knowledge creating company. *Harvard Business Review, 69*, 96–104.
Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5*(1), 14–37.
Nonaka, I., & Takeuchi, H. (1995). *The knowledge creating company: How Japanese companies create the dynamics of information*. New York: Oxford University Press.
Nonaka, I., Toyama, R., & Hirata, T. (2008). *Managing flow: A process theory of the knowledge-based firm*. Houndmills: Palgrave Macmillan.
O'Dell, C., & Hubert, C. (2011). *The new edge in knowledge: How knowledge management is changing the way we do business*. New York: Wiley.
O'Rorke, P., & Ortony, A. (1994). Explaining emotions. *Cognitive Science, 18*(2), 283–323.
Oliver, G. (2013). A tenth anniversary assessment of Davenport & Prusak (1998/2000) working knowledge: Practitioner approaches to knowledge in organizations. *Knowledge Management and Practice, 11*(1), 10–22.
Pessoa, L., & Pereira, M. G. (2013). Cognition—Emotion interactions: A review of the functional magnetic resonance imaging literature. In M. D. Robinson, E. R. Watkins, & E. Harmon-Jones (Eds.), *Handbook of cognition and emotion* (pp. 55–68). New York: The Guilford Press.
Pinker, S. (1994). *The language instinct: How the mind creates language*. New York: Harper-Collins.

Pinker, S. (2008). *The stuff of thought: Language as a window into human nature*. New York: Pinguin Books.

Reave, L. (2005). Spiritual values and practices related to leadership effectiveness. *The Leadership Quarterly, 16*(5), 655–687.

Robinson, M. D., Watkins, E. R., & Harmon-Jones, E. (2013). Cognition and emotion: An introduction. In M. D. Robinson, E. R. Watkins, & E. Harmon-Jones (Eds.), *Handbook of cognition and emotion* (pp. 3–19). New York: The Guilford Press.

Russell, B. (1972). *A history of western philosophy*. New York: Simon and Schuster.

Senge, P. (1999). *The fifth discipline: The art and practice of the learning organization*. London: Random House.

Senge, P., Kleiner, A., Roberts, C., Ross, R. B., & Smith, B. (1994). *The fifth discipline fieldbook: Strategies and tools for building a learning organization*. London: Nicholas Brealey.

Song, J., & Lee, K. (2014). *The Samsung way: Transformational management strategies from the world leaders in innovation and design*. New York: McGraw-Hill Education.

Steen, G. (2011). The language of knowledge management: A linguistic approach to metaphor analysis. *Systems Research and Behavioral Science, 28*(2), 181–188.

Stewart, T. A. (1999). *Intellectual capital: The new wealth of organizations*. London: Nicholas Brealey.

Wang, L., Malhotra, D., & Murnigham, J. K. (2011). Economics education and greed. *Academy of Management Learning and Education, 10*(4), 643–660.

Zohar, D., & Marshall, I. (2000). *SQ: Spiritual intelligence. The ultimate intelligence*. London: Bloomsbury.

Zohar, D., & Marshall, I. (2004). *Spiritual capital: Wealth we can live by*. San Francisco, CA: Berrett-Koehler.

Part III

Knowledge Management Strategies for Project Management

Lessons Learnt Support System

Mauro Romani

Abstract

This chapter describes a sample design of the Lesson Learnt Support System for project managers. The proposed system fulfills four major functions: collection, acceptance, spread and reuse. The main emphasis of the chapter is on the collection function comprising a large set of lessons learnt. These lessons are derived from the personal experience of the author gained via real cases during his extensive working career. The collected lessons are classified thematically to facilitate their codification and knowledge transfer. These lessons serve not only to determine what went right or wrong, or could have been done differently, but also to what extent. The ultimate goal of the organization should be the adoption of those best practices that can be drawn from lessons learnt. Assuming the implementation of the proposed Lessons Learnt Support System, the chapter ends by presenting a brief simulation of the system use.

1 Introduction

1.1 KM for PM

Knowledge Management comprises a range of practices to precisely identify the knowledge, interpret it and reuse it in the appropriate content.

Starting from data (data is the source material or content in the form of facts or non-facts that serves as a basis for generating information) through information (information is a product of data that has been processed into a format understandable by its intended audience) and knowing (obtained through sensory experience—seeing, hearing, tasting, smelling or feeling) it is possible to

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understand (understanding involves an interpretation of the knowledge) and take decisions if necessary (decisions require application of the understanding based upon situation-specific criteria).

Knowledge is a fluid mix of framed experiences, values, contextual information, expert insight, and intuition that provides an environment for evaluating and incorporating new experiences and information: in other words, knowledge is a system of connections between facts and ideas.

Frequently the focus is on process improvement and program enhancement.

The intervention areas of Knowledge Management in order to meet the needs of organizations are numerous, for example in customer care (information support systems used in more advanced call centers), in case management (activation systems of expert knowledge for solving complex cases) and also in Project Management.

In particular, the use of features offered by Knowledge Management to integrate the processes for the development of a project brings us closer to an actual "learning organization".

The use of Knowledge Management is certainly an essential weapon that the Project Manager has at their disposition, for the successful completion of a project. The benefits that can be derived from Knowledge Management are well known and are manifold: to encourage greater collaboration between the participants, identifying 'best practices', improve the ability of innovation and production and increase the responsibility of each participant.

Project Management is defined as the application of concepts, tools and techniques to complete a project on time and on budget, obviously responding to the needs requested by the customer. As we can imagine, making good use of the flow of knowledge, in particular its repeatability and commonality, will go to support and fill in gaps left by Project Management.

1.2 Lessons Learnt

The term "Lessons Learnt" (LL) refers mainly to the learning process, which takes place gradually through observation, participation and experience.

In particular, observation is taken to mean an indirect involvement, a kind of detection (for example, hearing or seeing), on the other hand, participation is taken to mean a direct involvement in activities, while experience is taken to mean the result of concrete events (tangible or intangible) that lead to/ensue in ways of knowing.

Lessons Learnt is a form of knowledge evaluation and is closely related to the discipline of knowledge management, which includes a range of practices used in an organization to identify and adopt ideas and experiences.

Starting from descriptive knowledge, which just provides only general descriptions, such as lemon is yellow, knowledge evaluation describes different characteristics of the fruit, such as smell, taste and texture. Not only that, but it contributes additional details, such as vitamins are contained in the lemon,

combinations of fruit using lemon, and so on. Consequently, it is knowledge evaluation that is used to retrieve and formalize "Lessons Learnt".

2 Best Practices: What Are They?

Lessons Learnt serve not only to determine what went right or wrong, or could have been done differently, but also to what extent: in any case the ultimate goal of the organization should be those best practices that can be drawn from lessons.

In literature there are different opinions about when to use the term best practices; starting from the definition of the American Society for Quality (ASQ) that specifies a best practice as "a superior method or innovative practice that contributes to improve the performance of an organization, usually by other organizations recognized as best among equals", the question is: when might one lesson learnt commonly reoccur in various contexts and thus be considered a best practice?

The result is to exaggerate and inflate in improving current practices, generating confusion and losing effectiveness.

Best practices are defined (Kerzner 2013) as "reusable activities or processes that constantly add value to the deliverables of the projects." Acceptable best practices may be present in a variety of contexts, including working relationships, and the design of templates in which Project Management methodologies are used and applied. Moreover, companies which develop methodologies by themselves have greater success, particularly when they also build their own best practices and lessons learnt from other activities.

In general the aim of using the best practices in any industry is a commitment to use the knowledge in place and the technology available to ensure conformity of behavior.

While the link between the best practices and lessons learnt is well established, in organizations there is still much to be done in developing systems that support the transfer of knowledge to finally get to the Learning Organization. This includes development and organizational change and its flexibility, in other words, organizational maturity.

The ultimate goal is to use the learning processes at the individual, group and system level to continuously transform the organization in a direction that is increasingly satisfying to its stakeholders.

3 Lessons Learnt Support Systems

What is meant by a Lessons Learnt Support System? It is nothing but a system of knowledge management, possibly accessible to members of the project team.

A Lessons Learnt Support System must be adaptable to meet the various needs of an organization, in some cases it may be departmental (for example for the

Human Resource Unit), and in others, correlated to specific functional areas (for example, Customer Relationship Management).

Moreover, Lessons Learnt Support Systems have been developed by many organizations such as all US military branches, education/research institutes and commercial companies.

3.1 Design and Implementation

The simplest approach for creating a Lessons Learnt Support System is to design it, keeping in mind the bottom-up nature of organizational learning, which nevertheless requires a good level of awareness from the employees in the Knowledge Management discipline. A significant example is the Space Engineering Program at NASA (Sells 1999) which has developed a Lessons Learnt System to ensure that the flight system complied with the requirements for the various stages of design, development, integration and testing. A Lessons Learnt database, accessible through electronic forms, was concretely created.

Generally, at least the following functionalities should be implemented:

- a "Collection" function
  To facilitate the collection of Lessons Learnt, you need to create an electronic form that includes information such as: name, date, category, enforceability, potential keywords, any attachment and obviously the recommendation (namely the Lesson Learnt). Through this module new Lessons Learnt can be collected (actually proposed).
  At the organizational level it is desirable to encourage employees to share their Lessons Learnt. As part of a specific project, it will be the responsibility of the Project Manager to use and to ensure the use of the electronic form.
  There are a number of ways to support the sharing, in particular; activating a discussion (chat) online through the Lessons Learnt system (a specific function, in which users can interact with each other, should be implemented), or a meeting to discuss face to face.
- an "Acceptance/Archiving" function
  For acceptance, and therefore the validation of a Lesson Learnt, a function that allows the designated experts to verify the Lessons Learnt pending, should be implemented in the system, that is resulting from the aforementioned collection function, by providing the designated experts the possibility to change the lessons learnt collected, even if any change must be a simple fine tuning in order to homogenize them, according to the format of those already present.
  Once this function is completed, the Lesson Learnt is officially stored and can be made available to all users.
- a "Spread" function
  About the spread of Lessons Learnt, the best choice should be to implement (or to link to) an e-mail notification: the acceptance of a Lesson Learnt should

automatically trigger an email alert to the concerned users. The alternative would be to directly highlight the new Lesson Learnt inserted into the system.
This function depends very much on the organizational context in which the Lessons Learnt System has been activated.
Additional implementation for this function is to allow the user to download (by printing or saving to a usable electronic format) any Lessons Learnt and any enclosed material in order to promote a more widespread distribution.

- a "Reuse" function
The important thing is that the Lessons Learnt System is being used not only in the phase of insertion of the contents, but also in the extraction of them. The aforementioned, works well, only if there are properly set parameters for content searches.
Therefore, to allow the users a real Lessons Learnt reuse feature in their own context, a search mechanism should be implemented. This function is the most important in a Lessons Learnt System, since it must ensure the recovery of one or more Lessons Learnt more suitable to any situation.
As mentioned, the implemented research should not only provide the possibility to search for keywords, but also allow the opportunity to take advantage of the advanced methods, based on the semantic.

4 Focus on "Collection" Function: A Concrete Method

In reality what we should try to determine is the dimension of the Lessons Learnt, that is:

- what to do or what not to do: title and description, where the former indicates its "tag", as it were, and the latter the formal presentation;
- options (not recommended): possible alternatives to the lesson learnt;
- why: reasoning behind the lesson learnt;
- pros and cons: advantages and disadvantages of applying the lesson learnt;
- cost: effort and/or risks inherent in the lesson learnt;

The above steps can be applied in order to support the experience extraction and the knowledge elaboration. Accordingly a Lesson Learnt form (composed of sections: Title, Description, Options (not recommended), Reason, Pros, Cons, Cost) can be used to formalize its dimensions.

The sections below are intended to be classified thematically in order to propose an initial codification and facilitate the knowledge transmission

4.1 The Email World for Project Managers: Some Lessons Learnt

For a Project Manager, email is a bit of a mixed blessing: it's an essential part of project communication these days but sometimes it can be intolerable. You're only

out of the office for a few days and when you get back you find dozens of emails in your inbox waiting to be read.

Absurd as it may seem, one often falls victim to a sort of internal spamming, in the sense that the email received is often a disclaimer of responsibility. No doubt about it: emails often create background 'noise' which can really hinder the work of a Project Manager.

Often a Project Manager finds himself inundated with a lot of unsolicited emails that are being bandied about between the various members of the project team, suppliers, stakeholders, etc. just because they always copy you on everything, just to be on the safe side

Although Project Managers are victims of the spamming we talked about before, sometimes they are just as guilty, copying all managerial staff involved, functional managers as well as those directly in charge.

Here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 1).

4.2 Project Managers During an Emergency: Some Lessons Learnt

More so during the critical moments, that constitute an emergency, the Project Manager is required to manage the project in an impeccable way, meaning that in addition to ensuring the execution of his/her tasks, the Project Manager must simultaneously focus the team on mitigation, if not resolution of the issue outstanding.

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 2).

4.3 Project Managers with Contractual Promises and Disappointments: Some Lessons Learnt

Concentration on operational aspects related to the delivery often leads project managers to forget the implications and the legal aspects of their business. Most of the projects aimed at the market and developed for specific customers based on a contract that is on the one hand, binding objectives products and procedures for carrying out the work and on the other hand, fixed often possible terms and penalties for all those aspects that can give rise to a dispute.

Each project would raise legal explicit (set by the main contract and by any sub-contracts) and implicit aspects, that are fixed by laws and regulations that apply according to where the project takes place and the products created by the project. It is therefore important that a Project Manager is aware of everything that can create legal problems and from this point of view, single out the risks involved while conducting a thorough analysis of these risks together with all the other factors that

Table 1 The email world for project managers: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Make the most of all-in-one email archive	Project Managers have to deal with a daily influx of emails and an ever-growing historical archive so it is essential to use forethought when archiving emails. It is better to keep all emails in your Inbox rather than sorting them into various folders which might result in information being hidden in containers that are too specific for the transversal nature of the content	• Save important mails or their contents in the official project file and keep it up-dated	Emails often represent the decision-making part of project documentation: they reflect the exchange of views and negotiations that have taken place between the various players/ roles and provide a record of project events which must not be lost	• A complementary archive is available (in addition to the official one) to help keep track of decisional moments • Exploit the "email archiving" resource in keeping with the Project Manager's role as an integrator	• Personally having to keep a centrally managed email archive since it cannot be shared with the team	• Identification of key words to facilitate search for information • Search process using a succession of filters • Distributing information on centralized management of email archive
Involve all stakeholders via email	Use Cc when sending group emails in order to share the official standpoint and project milestones (even as an exception to the	• Use standard chain of communication/ information-sharing (drafting minutes with a request for confirmation/ feedback)	To defend yourself from future attacks regarding late requests made by parties with vested interests	• Reach other interested parties as well as project stakeholders • Shift onus of understanding the decision in question	• Loss of information-sharing vis-à-vis official positions • Earn undeserved reputation as a "spammer" as a	• Dynamic mailing list, to be revised for each new decision/milestone to be communicated and shared

(continued)

Table 1 (continued)

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
	project mailing list), extending information to all who may potentially be interested and who thus have the chance to intervene			and its implications onto the recipient	result of too many Cc'd emails	
Exert pressure via email	Copy (Cc) your emails to a more senior management level than that of request recipients to exert immediate pressure on the latter	• Do not involve higher organizational level immediately, postponing this measure until a later stage	Proactively ensure the intervention of the sponsorship or most influential stakeholders	• Improve problem-solving efficiency by obtaining immediate attention and avoiding recycling and reminders	• Excessive spreading of information even on non-exceptional matters • Earn undeserved reputation as a spammer because of too many Cc'd emails	• Ensuring accuracy of email content in view of the fact that it is being submitted to the attention of more senior management
Prepare project status updates by email	Exploit virtual channels available: with the help of a structured email the status of project activities can also be formalized "at a distance"	• Organize a project status meeting	Respond effectively to unscheduled project status enquiries, making up for unavailability of resources who are supposed to meet at standard status meetings	• Reduce time needed for collecting and processing information on the progress of project activities (or part of them) • Introduce greater flexibility into control and monitoring process	• Receive potentially unreliable information without being able to consult and obtain confirmation from the source • Receive minimal information	• Accuracy of first email requesting information • Consolidating information received in the second communication recording project status

Table 2 Project managers during an emergency: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Do not neglect the Project Manager's top priorities	The Project Manager is responsible for the project. In some cases—if he has the appropriate skills—he can effectively contribute to the activities of the project team and fill a specialist/operational role but, unless agreed otherwise, he must keep to his managerial priorities or else explicitly modify/renegotiate them	• Personally perform some of the activities assigned to the project team, drastically reducing the time dedicated to own duties • Do not participate at all in specialist activities	In contributing to the work of others, the Project Manager risks neglecting priority activities he is responsible for	• Fulfill management expectations • Performance of functions required by the role filled	• Demonstrate ability to carry out own duties but lose sight of project objectives (the room is tidy but the house is on fire) • No participation in actual events of the project (bureaucratic Project Manager)	• Continual effort of trying to strike the right balance in managing the project
Understand project stakeholder expectations	Investing in communication—and integration—with senior management requires special attention, particularly in moments of crisis	• Pass on minimal information • Provide information on demand	The Project Manager is responsible for managing project information, especially in an emergency situation	• Keep channels of communication and relations with project stakeholders open • Show project stakeholders that as PM you are constantly updated on the project's progress and in control even during moments of crisis	• Distribute information to all project stakeholders without taking different needs into consideration • Manage multiple stakeholders, each with potentially different needs as regards information	• Continual effort of collecting up-to-date information on which to base status reports for project stakeholders

(continued)

Table 2 (continued)

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Do not yield to the anarchy of self-regulated reporting	Do not demote/ relegate the reporting activity to a low priority without the prior consent of those concerned	• Do not inform • Overload with information • Be excessively creative with variations to agreed communications	Project Managers are responsible for the project communication management. Part of stakeholder expectations regards receiving appropriate and timely information. Any changes to the communications plan must be negotiated beforehand	• Manage expectations • Focus on the emergency • Strengthen relationships	• Waste precious time on apparently formal issues and diplomacy • Feel isolated/ emarginated with respect to the project team	• Time and effort needed to act diplomatically • Curb proactivity

can threaten the successful completion of a project. This is to identify key preventive possible counter and safety measures (e.g. through specific insurance policies).

This means that a Project Manager should have full visibility over all aspects of the contract. Although he is not the legal representative of the organization he works for, he has to be familiar with the terms which may have an impact on the project or may be disregarded by a specific work setting.

It would therefore be appropriate in the long-term that Project Managers were involved as early as possible so as to intercept potential problems and inconsistencies before they are compelled to heavily condition the project progress.

Unfortunately this is not always possible, either as a result of organizational decisions or because of the unavailability of resources or due to the risk of producing internal conflicts during the finalization of a commercial action.

All this explains why, once the contract is acquired, it is then necessary to produce documents such as the project charter and the project plan. These two documents are not developed for legal purposes, but to ensure the project delivery. Moreover, while the counterparties are described in contracts in almost opposing terms, the project plan is based more on cooperation between the parties to ensure that the job is completed successfully through a team effort.

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 3).

4.4 Project Managers Are Grappling with the Scope: Some Lessons Learnt

It is said that the only constant in the world is "change". You can make perfect plans, but you can never take into account all the potential changes that may be necessary. The longer the project, the more needs presents itself to manage the change of the scope. Therefore, the initial scheduling must not and cannot be perfect. The Project Manager with the help of the team does their best according to the what is known at that time.

Knowing that later he will definitely manage some changes. One of the most difficult aspects of the project is to define the scope. Namely, to define what the project will achieve and what not.

Often the feasibility study does not define the scope clearly enough. So you need to find time to agree later on what the future product/service will have to do exactly. But it will not always succeed.

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 4).

Table 3 Project managers with contractual promises and disappointments: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Avoid taking part in discussions outside your mandate	Do not lead a meeting without having sufficient clout within the organization vis-à-vis the other attendees	• Postpone the meeting • Suggest a change of agenda	In the case of contractual disputes, managing customer expectations requires involving a level of management higher than that of Project Manager	• Play a technical role while remaining neutral vis-à-vis contractual positions • Involve the role with authority to allocate resources and take decisions on contractual issues	• Decision dependent on amenability of the role you need to involve • Admit to having no say in contractual matters	• Negotiate with senior management • Prepare all necessary data and information for discussion
Conclude contract afterwards even if the decision-maker absconds	Conclude contract at a later date, although project activities may already have commenced	• Leave certain contractual issues open/ unresolved	In order to have a solid basis, the project needs/cannot do without signed contractual agreements	• Obtain transparency on supply terms and conditions • Define objectives precisely • More elements for making a realistic plan	• Conduct grueling negotiations to make up for the absence of the decision-maker • Inefficiency in recycling and iterations	• Continual revision of contract

Table 4 Project managers are grappling with the scope: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Go beyond abstractions	Do not restrict yourself to addressing issues at an abstract level; each problem must be handled with the competence required of the Project Manager. Determining what is important for each player/stakeholder requires a skillful balance of management and implementation, abstraction and pragmatism	• Limit yourself to generic "high-level" knowledge • Carry out further and more detailed analyses in an attempt to know/ understand everything	The Project Manager filters detailed information according to the relevant management presentation criteria, understands its content and—if specifically requested—can go as far as personally providing further details, or alternatively, obtain backup from specialists	• Present content of interest to Steering Committee and with appropriate degree of detail/aggregation	• Possibility of getting bogged down in detail • Ineffectiveness due to excessively aggregated / abstract information	• Issue impact analysis • Defining priorities and selection criteria • Preparing information at appropriate level of detail
Verify scope	Do not accept project scope as a given: what is included (and what is not) must be confirmed	• Do nothing • Argue with whoever is responsible for defining scope	The Project Manager must have the project under control right from the start. Defining scope i.e. what is expected of the project, is an essential step	• The Project Manager must have the project under control right from the start. Defining scope i.e. what is expected of the project, is an essential step	• Waste precious time • Incur extra budget costs • Face new risks • Change the plan	• Re-elaborating information according to project standards adopted • Further involvement of project stakeholders
Do not take responsibility	Evaluate only contractual/financial	• Conclude contractual	The outcome of a project is a product/	• Concentrate on contractual	• Have a limited vision	• Relationship management to

(continued)

Table 4 (continued)

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
for contracts outside the project scope	agreements correlated with project management without taking, even involuntarily, responsibility for ratifying those correlated with service management	negotiation for service as well	service which must be managed at the end of the project and must therefore be regulated before the end of the project, involving the appropriate roles	negotiations you are responsible for • No risk of making erroneous assessments for lack of know-how	of the project's far-reaching effects • Being seen as a shortsighted bureaucrat	avoid having to negotiate on the service
Put the project in its context	Do not forget that the project is also subject to external influences (of which procurement is only an example)	• Neglect variables/ factors not directly under your control • Obsessively follow up every single sign	The project does not exist in a vacuum but in a context and is inevitably impacted by external factors as well	• Manage risks • Contextualize the project, taking external imponderables into account	• Potential tension and conflict with players external to the project • Greater anxiety and new concerns	• Monitoring, collecting and assessing information not immediately accessible to the Project Manager

4.5 Project Managers and the Plan: Some Lessons Learnt

The 'poor' time-cost-quality triangle of Project Management literature often gets distorted purely out of short-sighted opportunism. Sometimes it seems that project planning is just the Project Manager's private business.

More pragmatically, a Project Manager has to concentrate on chronological time—time as it's marked down on calendars and entered in diaries, time that's split into hours, days, months and years. But also he has to agree that it's the quality of time, rather than any date, that leaves the most lasting impression. And also that a project is dependent both on chronological time and on seizing the right opportunities (there's a time for everything: the ancient Greeks used two words to indicate time: Chronos and Kairos. The first refers to logical, sequential time while the second means an 'opportune moment', in the sense of a moment of indeterminate time in which something important happens. Chronos is quantitative, Kairos is qualitative).

Planning quality depends on having a 'Work-Breakdown Structure', a well-defined product-oriented approach, a real organization, rather than a sketchily-filled calendar.

It's the same old confusion between planning and scheduling. If there's no real commitment on the part of those involved, the Project Manager becomes a slave to the dates on a calendar. In fact, if there's no real agreement on roles and responsibilities and no clear-cut idea of how to realize the product, it's simply impossible to prepare a plan.

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 5).

4.6 Project Managers Inside Financial Data: Some Lessons Learnt

How many times is a Project Manager able to manage the financial side of a project? It depends on the context: when he is coordinating just customer resources, never! Usually financial aspects are dealt with by the appropriate company department, quite separate from the Project Manager. When he is working on turnkey projects, with colleagues in his own company he only had to deal with cost.

So it is an aspect that often falls outside the scope of a Project Manager's duties.

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 6).

4.7 Project Managers and the Quality: Some Lessons Learnt

The subject is quality, quality that is integrated with the production process from the start rather than obtained the hard way, ex post, after putting a load of mistakes right.

Table 5 Project managers and the plan: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Make your "own space" from which to dictate the pace of the project	Take all the time you need to prepare a shared plan, without compromising with project stakeholders, even at the cost of (temporarily) halting the project itself	• Compromise on planning	Planning is the mainstay of the project, even when you are acting as a facilitator (with limited field of action). Creating a project plan is a time-consuming activity which follows a typically iterative process	• Affirm (or reaffirm) your role as head of project planning • Reiterate the pivotal role of the plan in project management	• Clash with vested interests of project stakeholders	• Negotiate "space" needed to create the plan
Set realistic deadlines and milestones	Fix realistic deadlines and milestones through an iterative process of refining and sharing plans not only with stakeholders but also with the project team	• Provide a plan with no solid foundation	Planning is the mainstay of the project even when the Project Manager only acts as facilitator (more limited field of action). Unrealistic time objectives are not only pointless but also counterproductive for the project	• Reiterate impartiality of the Project Manager's role • Maintain professional ethics intact • Lay down premises for correct project management	• Risk antagonizing some project stakeholders	• Redefine and calibrate expectations

Obtain approval of the plan from Senior Management	Present the project plan to all Senior Managers who must approve it, so as to obtain formal acceptance of it prior to the Steering Committee meeting	• Avoid prior presentation of the plan • Present the plan without succeeding in obtaining prior approval	The plan—which defines how objectives are to be reached—is a crucial element which should be agreed and approved by project stakeholders	• Reach agreement on project objectives and on commitment (i.e. assigning required tasks) to achieving them	• Waste time in discussions with roles that have no say in the matter	• Cyclical elaboration, presentation and correction of plan with project stakeholders
Rescheduling dates is not sufficient	In order to define objectives and deadlines, a project needs a plan, not just a calendar	• Take a gamble and reschedule • Halt project activities until you have an approved plan	The plan is not an optional but an essential part of the agreement underlying the project. A calendar is only a reference point, by itself it cannot express/ validate any commitment	• Give the project a solid foundation • Avoid gambling with dates not supported by substantial agreements and/or existing prerequisites	• Conflict on attribution of priorities • Possible rigidity vis-à-vis the team and stakeholders	• Elaboration, construction and negotiation of various elements of the plan

Table 6 Project managers inside financial data: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Keep tabs on financial matters	Even if not required, do not let yourself be excluded from the flow of financial data but retrieve and verify project costs as far as possible	• Do nothing, as per agreement with Sponsor • Question the exclusion immediately and insist on at least being informed on the financial status of the project	In certain business contexts the Project Manager is excluded from cost control. In order to have information on the financial status of the project unofficial channels and alternative methods must be used	• Use knowledge of financial status as leverage • Obtain further elements with which to manage suppliers	• Insist on carrying out unsolicited checks which may cause a disturbance to the project Sponsor • Retrieve partial data only, and so not be able to be really effective	• Retrieval of missing data • Convincing company functions with data ownership
Check final statements/ summary sheets sent by suppliers	When a supplier is present cost control must be proactive and not restricted to simply collecting data provided periodically	• Gather and process information indiscriminately	Data provided by the supplier is the product of a different business context from your own and can sometimes prove insufficient/ unsuitable (different classification and aggregations) for the application of rules to be followed in project cost management	• Make information accessible to direct stakeholders by using language appropriate to the business context	• Produce partial reports due to incomplete transcoding rules	• Reclassification of data

Avoid using consolidation for the sake of convenience	Make clear distinction between project budget and budgets of other related initiatives	• Improperly aggregate budgets of different projects without having a corresponding high-level reference group or portfolio • Reconstruct ex-post budget values and final statements	To obtain significant financial indicators, cost data must show which resources have been allocated and where	• Ensure cost performance of project is measured correctly • Support decision-making process • Identify areas of inefficiency or intervention	• Less flexibility in reallocating resources • Maintaining a detailed system of unsimplifiable complexity	• High accuracy in data handling • Impossibility of effecting set-offs

Quality as a process ought to be the normal 'modus operandi'. It seems obvious, but the earlier it is activated the better the quality of the product.

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 7).

4.8 Project Managers and Their Team: Some Lessons Learnt

In fact, the specialized skills can be easily learned and consolidated, often directed by the nature of the project. Among the specialized skills, are also those general; including the use of project management software, document management, etc.. It is more important but difficult to detect the most common soft skills necessary for effective project management.

A Project Manager spends about half his time in communication, if this time is not spent in an efficient and effective manner, the impact on the project is significant. And the other 50% of time is required to manage conflict, negotiate, plan, organize, interact with Team and Stakeholders, prevent problems, and so on.

Some people are naturally more inclined to communicate or to treat most of the other elements mentioned, but the good news is that while the soft skills are difficult to teach according to the techniques standard, they can be achieved and strengthened through the learning process of knowledge. Moreover it requires discipline and the conscious evaluation of oneself, because we human beings find it difficult to unlearn or change a habit that is already inherent in us.

According to the literature, the main soft skills required for a Project Manager are the following:

- Problem solving
- Conflict Resolution
- Negotiation
- Motivation
- Leadership

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 8).

4.9 Project Managers Need to Communicate: Some Lessons Learnt

A Project Manager should primarily be a great communicator! Communication management is a skill that can always be improved and it is critical in trying to effectively lead a project.

A project team is typically a diverse group of people, such diversity can be cultural, geographical, organizational, functional, related to age, level of education and so on. Communication within these teams is often a *mission impossible*.

Table 7 Project managers and the quality: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Augment slide projection with printed material	Provide documentation in printed form as back-up for the particular event, including meetings with slideshow presentation	• No printed material (meeting with slideshow only)	The degree of complexity of the presentation requires a handy tool for personal use on which each participant can focus his/her attention	• Guarantee communication has maximum efficacy, stimulating active participation of attendees • Include further details for in-depth study with supporting documentation	• Enables participants to know "everything at once", to liberate themselves from the rhythm imposed by the presentation by leafing through the printed copies in front of them • Expose yourself to the risk of losing effectiveness	• Preparing material with the necessary accuracy and precision
Place emphasis on in-depth analyses	Establish an appropriate level of detail during the Steering Committee meeting by finding the right balance of efficiency and effectiveness, between the overall picture and detailed analysis	• Stick to a higher level of abstraction and leave detail to other improbable occasions	What the participants see is only the tip of the iceberg, the depth behind the presentation must be shown	• Valorize the role and work (including specialist work) of the Project Manager • Enhance credibility and mastery of project content • Greater involvement of Steering Committee	• Become a specialist unnecessarily • Sharing an excessive degree of detail can absorb too much energy and distract attention from decision-making process	• Content and documentation in various degrees of detail

(continued)

Table 7 (continued)

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Define standard in concrete terms	Make model of the deliverable to be supplied (document/object) beforehand and define its structure and type of content	• Create the model as you go along	Stipulate beforehand an agreement on quality and acceptance criteria	• Defining a sample/ example of the deliverable reduces complexity and duration of approval process	• Risk of loss of flexibility • Risk omitting potentially useful information	• Elaboration, construction and negotiation of the model and its constituent parts
Do not submit to the limitations of standard templates	Contents take precedence over strict observance of constraints imposed by use of standard Project Management templates	• Adhere bureaucratically to standard set of forms	In exceptional situations (unexpected requests, urgent feedback) it is necessary to sidestep formal rules and get down to essentials	• Supersede uncritical reactive templates in pursuit of the objective	• Introduce precedent whereby the exception (deviation from the standard) becomes the norm, with risk of destructurisation and ungovernability	• Justifying the exception • Drafting a new ad hoc form to meet the requirements of the new case

Table 8 Project managers and their team: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Observe without judging	Instead of passing judgment, restrict yourself to carefully watching and monitoring behavior and performance	• Adopt a wait-and-see policy • Renounce role as coordinator	The human factor plays a crucial part in the project's success: the Project Manager must decide whether the work performance of a resource assigned to the project is in line with expectations and take subsequent action	• Measure expected performance against project context and professional profile examined • Avoid irrelevant admixture of emotions	• Lapse into a wait-and-see attitude • Complicate matters in order to put forward and discuss evidence conclusively • Risk not obtaining a substitute resource • Make yourself unpopular	• Organizing and documenting information • Communication management with the boss of the problematic resource • Negotiating a substitute resource
Removing a resource may not be beneficial to the project alone	Substituting a person in difficulty, whose performance is inadequate vis-à-vis the project, may prevent worse happening	• Have a resource removed • Take no interest in the performance of project resources	In the case of a below par performance, the Project Manager is responsible for taking action to safeguard the project, with due deference always with regard to the human factor	• Refer the problem to those with authority to allocate resources and take decisions • Interrupt vicious circle • Break from standard mechanical responses • Offer the resource in difficulty a second chance	• Forcing the issue as regards reallocation of resources • Create difficulties for an already weakened professional position	• Organizing and documenting information • Communication management together with the boss of the problematic resource • Negotiating a substitute resource
Do not make personal attacks	When assessing problems, avoid making personal attacks on those	• Confuse personal and personality issues with	Insufficient project performance also depends on inadequate	• Demonstrate need for corrective measures by producing rigorous	• No liberating outburst of anger	• Analysis and assessment of the role and his/her performance

(continued)

Table 8 (continued)

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
	presumed to be responsible; better to remain neutral and concentrate on roles, responsibilities and performances	organizational issues	performance of certain roles, assigned to specific individuals	objective evidence based on performance measurement • Avoid triggering heated arguments which heighten conflict and worsen outcomes		• Keeping performance assessment distinct from personal observations • Identifying examples of inadequate performance

It's no wonder that to be successful you must apply the 20/80 rule, i.e. 20% of the time a Project Manager is used to monitor the project and 80% is spent on activities related to communication.

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 9).

4.10 Project Managers Have to Minimize Any Risk: Some Lessons Learnt

Risk is inevitable when undertaking projects; however the Project Manager must ensure that risks are minimized.

Once a risk is detected, a defined mitigation action is required to counter the reoccurrence of the same: the benefits of risk management are twofold. As well as minimizing the impact of a threat to the project, it increases the likelihood of delivering on time, staying within budget and ensuring quality results in response to the Sponsor requirements.

The project mood will benefit from the team members not having to experience moments of emergency when handling negative situations, especially if not expected.

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 10).

4.11 Project Managers and Their Relation with the Top Management: Some Lessons Learnt

To be effective, Project Managers must activate a channel with the upper management level, or make sure that they have a representative of that level within the project organization.

As the number of projects in organizations is growing, it is not possible that all the Project Managers may be part of the senior management level, so you must implement a mechanism to give authority to the Project Managers that do not have access or direct support to the upper management level.

This requirement must be inevitably brought to the attention, formally or informally, of the project sponsor, as soon as possible.

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 11).

Table 9 Project managers need to communicate: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Give advance notice of bad news	Share the message beforehand with members of the Steering Committee or those who are entitled to know (insist on their being present)	• Do nothing: present the message directly during the Steering Committee meeting • Share message only with project Sponsor	Bad news must be reported: due to its contents and implications the message to be brought to the Steering Committee's notice represents a marked discontinuity with respect to previous communications	• Avoid triggering a spiral of conflict and polarizing interest groups into "good guys v. bad guys", with the Project Manager caught in the crossfire between the two factions • Defend the neutrality of your role in the face of emotional reactions and act at management evaluation level • During Steering Committee meeting shift focus from the bad news (already assimilated) to corrective measures and decisions to be taken, reminding the Steering Committee of its own role	• Induce lack of confidence in project's ability to reach its objectives	• Analysis to back up previously shared information • Investing in relationship-building, to enable you to communicate with each role involved in the most appropriate manner and through ad hoc channels

Present at least one solution for every issue	Try to find possible solutions, do not simply present a list of the issues involved but describe their impact and ask explicitly for resources and decisions to implement the solution opted for	• Talk solely about the issue	The Project Manager has to go beyond identifying the problem: he must press for solutions	• Promote role of Project Manager as key actor in the problem-solving process • Concentrate efforts of Steering Committee on decision-making process, reminding them of their role and responsibilities: to provide guide-lines, manage exceptions, allocate resources, take decisions • Influence project management to move forward from recognition of the problem to agreeing on the steps needed to achieve a suitable solution	• Risk of clashes between stakeholders over options presented • May give rise to long drawn-out discussion of problem in an attempt to solve it during the course of the meeting • Risks provoking questions on details or requests for in-depth analyses that are not immediately available	• Identification of problems and issues to bring to the Steering Committee's attention • Collecting detailed back-up material

Table 10 Project managers have to minimize any risk: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Assess risks in practice	Identify and manage risks through interviews and sharing with the project team	• Ask for a risk assessment to be carried out by an independent figure • Remain paralyzed by formalism (lack of official documentation) • Refuse the job by laying down unacceptable conditions	The situation calls for a timely and effective reaction to make up for the unsatisfactory performance of an acting Project Manager who is not up to the job. Project risk assessment is urgent and there is no time for consulting books	• Gain credit with working group • Overcome entry barriers due to lack of knowledge of project as quickly as possible • Weaken the resistance of the acting Project Manager	• Take on trust sources whose degree of reliability is unknown • Expose yourself to risk of making an error of judgment	• Meticulous collection and consolidation of detailed information in line with the bottom-up approach
Defend yourself from an overdose of information	Filter information and put a limit on sustainable learning	• Consult an expert on the matter • Acquire an excessive quantity of information	At crucial moments it is important to be realistic and selective regarding the quantity and quality of information that can be processed	• Adopt a strategy of focalization • Acknowledge limitations of currently available knowledge and clearly show this as a reference modeling constraint	• Accepting that your knowledge is at suboptimal level • Wasting energy on abstractions	• Balancing unknowns with known elements

Do not take anything for granted	Assess a situation without preconceptions, really listening to the observations and findings of the parties concerned	• Accept the status quo uncritically • Exaggerate with the destructive approach • Go along with the observations of others without trying to work things out for yourself	The ability to make independent assessments (vis-à-vis vested interests), without prejudice or stereotyping, allows you to identify limitations and open up new horizons, especially in an emergency situation	• Increase possibility of removing errors • Increase range of possible options to follow • Make own contribution more effective • Waste as little energy as possible	• Risk losing credibility by admitting to having made a mistake • Waive any prefabricated certainties and put yourself on the line • Keep hunting for alternatives where none exist	• Shift in perspective • Effort of being self-critical • Analysis of new proposals
Do not underestimate even the faintest signals	Pay attention to even the slightest signs: do not let the fact that the project seems to be running smoothly at the moment lull you into a sense of false security	• Do nothing: trust to appearances and watch the project-film like a sleepy back-seat spectator	The Project Manager is responsible for day-to-day project management and for reaching goals and objectives	• Discover hidden defects and malfunctions • Prevent rather than cure • Managing the quality of processes and outputs within the project production process costs less than having to insert it ex-post	• Develop a conspiracy syndrome, dramatizing every observation	• Detailed analysis of the situation

Table 11 Project managers and their relation with the top management: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Understand when acting completely on your own is not possible	Do not be afraid to ask for help/ instructions from your boss, use the escalation process so as not to remain isolated	• Do nothing, report lack of agreement directly to the Steering Committee	Despite having done everything within the powers vested in you, agreement on a crucial element is still missing	• Overcome the stalemate • Obtain indications on what to do from your own operations manager or alternatively, pass on responsibility for this action to a higher management level • Avoid disagreements within the Steering Committee and manage their expectations	• Extend reaction time due to priority conflicts • Be seen as a trouble-maker	• Escalation communication
Obtain information from the higher management level	Propose ways of getting your direct superior involved/to contribute by means of a specific dedicated process	• Make the best of things and put up with the initiatives and/or inertia of others • Put a strain on relationship with your boss by bombarding him with requests for meetings/input	The Project Manager needs to receive information and instructions	• Manage communications and risks • Obtain indications and guide-lines • Ensure the project has more solid foundations • Build relationship with own boss/ direct superior	• Potential conflict on allocation of priorities • Emotional impact due to frustration and/or misunderstandings	• Preparations for the meeting • Flexible management of variances in communication methods, content and frequency • Negotiating with higher management level

		• Rely on improvisation				
Decode messages from higher management level	Information that is too generic or vague, even if it comes from higher up, is unusable; it must therefore be translated into more concrete terms	• Put up with ambiguity • Waste time in conjecture using the same vague language	Project impact assessment requires clear-cut information and is incompatible with systematically ambiguous communications	• Elaborate reliable forecasts on project performance • Free yourself of a role that is purely technical and become part of the wider context to the project	• Expose yourself to a conflictual situation with your own boss • Take on responsibilities not pertinent to your role	• Investing in building good relationships, particularly in terms of amenability • Transforming method of communication with your superior

4.12 Project Managers and Transversal Knowledge: Some Lessons Learnt

It is essential to pool knowledge gained from day to day experience dealing with problems or even positive situations which, although specific to a particular project phase or a certain field of work, can be transversely helpful.

In fact it is better to have the knowledge and decide not to apply a best practice instead of to not having the knowledge and finding oneself in a situation where it is necessary to apply it without being able to do so.

Again, here following some Lessons Learnt derived from the experience of the author gained via real cases during his working career (Table 12).

5 Simulation

As written, the above listed Lessons Learnt, are derived/garnered from the experience of the author, gained via real cases during his working career as Project Manager, therefore they concern elements belonging to the Project Management discipline.

Assuming we have implemented our Lessons Learnt Support System, and therefore having the four functions outlined above at our disposal, we can try to simulate the use of the system, imagining the employment of these Lessons Learnt.

- Use of the "Collection" function
  Following the method proposed, the collection of Lessons Learnt would already be addressed, in fact it would be enough that the electronic form for the insertion presents the fields of the suggested table.
- Use of the "Acceptance/Archiving" function
  Either by notification via email or by direct verification of the Lesson Learnt inserted, it is clear that the essence of this feature lies in the expert ability to understand the information registered, making any adjustments without altering them but having them conformed to the defined style, thus the automatism of this function is not essential.
- Use of the "Spread" function
  Let us assume that the feature has been implemented in two ways: either through a specific section of the system (and therefore only visible to those who have accessed it) highlighting the new Lessons Learnt approved or by an automatic email notification to registered users.

  In the latter case it would be more profitable and secure for the distribution lists of users to be defined centrally and to be related to the types of Lesson Learnt defined in advance at the organizational level.
- Use of the "Reuse" function
  The minimal requirement is to have a search that includes every field of the proposed table with the possibility to input any keywords. Once the user finds

Table 12 Project managers and transversal knowledge: some lessons learnt

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
Organize restricted meetings	Hold a series of brief meetings within a short period of time and with a limited number of participants, exploiting the "divide and rule" principle	• "Oceanic" meeting with all parties involved	There is a need for an urgent analysis involving numerous specialists not easily available and/or working on different sites	• Analyze issues from various points of view • Reduce risk of neglecting an important aspect • Reduce reaction time	• Failure to set up consultations with all relevant specialists • Potential recycling and/or contention	• Greater waste of time and expenditure of energy on the part of the Project Manager
Ensure specialists take responsibility for what they do	If it is discovered ex post that an analysis has gaps or oversights, the specialists who performed the analysis should be recalled and made responsible for filling the gaps	• Take responsibility for filling gaps yourself due to lack of time, without involving specialists • Find a makeshift solution in order to keep to the agreed plan and risk lowering the quality of the solution	Output of the analysis phase consists of document deliverables which are not easily verifiable, so gaps/oversights are often discovered when the specialists who produced them are no longer working on the project, with inevitable problems of how to re-engage them	• Maintain the expected quality for the solution • Ensure agreed responsibilities and tasks are respected	• Risk of delays to the project • Increase in project costs • Start a sort of witch-hunt	• Take appropriate steps to rectify the errors and close the gaps • Relationship-building effort needed to engage with specialists
Abandon conformism	In an emergency, force a situation: insist on a meeting or decision in the	• Use escalation process • Throw in the towel	Users may involuntarily put a spoke in the wheels, since they are on the	• Reach project's intermediate objectives • Unlock potential	• Expose yourself to risk of reprimand • Force certain	• Taking unnecessary risks • Managing tensions at

(continued)

Table 12 (continued)

Lesson learnt	Description	Options (not recommended)	Reason	Pros	Cons	Cost
	best interest of the project and in accordance with professional ethics	and reduce project quality	periphery of the project and haven't (cannot have) their finger on the pulse. The Project Manager must try to remove obstacles standing in the way of the project's objectives	stalemate situation • Avoid project delays	situations and obtain undesirable outcomes	organizational and relationship level
Stopping (part of) a project requires energy	Blocking a project activity requires a special justification, particular attention and meticulous preparation	• Rely on improvisation • Dramatize the project's stop • Paralyze the project instead of stopping it officially	Closing down (part of) a project involves a drastic change in direction/objectives with respect to those driving current activities. This radical deviation is accompanied by an urgent need for new activities to be carried out before closure can be finalized	• Carry out controlled closure, saving the part of usable outcomes and/or completing those that can still create value • Lay the foundations for future project initiatives	• Risk of over-using resources for closure activities • Risk of undersizing the required activities, prolonging the closure process excessively	• Justification of the decision • Definition, planning and execution of closure activities • Working out options for a future scenario

one or more Lessons Learnt, it should be possible to download them in a predetermined format.

6 Conclusion

Returning to the theoretical level, concerning our Lessons Learnt Support System, the next step could be simply to enhance the illustrated four functions in order to get close to a complete Knowledge Management System.

Bibliography

Berke, M. (2001). Best Practices Lessons Learned (BPLL): A view from the trenches. In *Proceedings from the Project Management Institute*.

Coakes, E., Clarke, S., Jack, J., & Lehaney, B. (2003). *Beyond knowledge management*. London: Idea Group.

Harrington, J. H. (1991). *Business process improvement: The breakthrough strategy for total quality, productivity, and competitiveness*. New York: McGraw-Hill.

Kerzner, H. (2013). *Project management: A systems approach to planning, scheduling, and controlling* (11th ed.). Hoboken, NJ: Wiley.

Maylor, H. (2010). *Project management* (4th ed.). London: FT Prentice Hall.

Preskill, H., & Catsambas, T. (2006). *Reframing evaluation through appreciative inquiry*. Thousand Oaks, CA: Sage.

Project Management Institute. (2013). *A guide to the Project Management Body of Knowledge—PMBOK® Guide* (5th ed.). Newtown Square, PA: Project Management Institute.

Sells. (1999). An effective way to prevent failures and problems. In *Proceedings of Alerts and Lessons Learned*, Las Vegas, NV.

Tiwana, A. (2002). *The knowledge management toolkit: Orchestrating IT strategy and knowledge platforms*. Upper Saddle Ridge, NJ: Pearson.

Thomas, W. (2011). *The basics of project evaluation and lessons learned*. New York: Productivity Press.

Renovating Project Management: Knowledge Personalization and Sharing

Ettore Bolisani, Stefano Debei, and Nicolo Savino

Abstract

Purpose. Complex research projects, such as those regarding flight missions, are characterized by advanced technical-scientific goals, interactive teamwork, and financial or temporal constraints. Their management is based on formal project management (PM) methodologies, that offer the advantage that tasks are assigned and monitored with precision but the burden of formal duties can make interactions between researchers less effective. As the studies of Knowledge Management (KM) show, researchers need a rich exchange of knowledge and a process of mutual learning to find innovative solutions in areas of scientific forefront. In addition, new web 2.0 technologies give the opportunity to interact and exchange complex contents. Consequently, while PM methodologies remain an essential tool for researchers, there is the need to identify novel approaches that enable more effective knowledge exchanges for technical/scientific purposes. To contribute to a better understanding of these issues, this study examines if traditional PM approaches are an "automatic" solution adopted by any research team, or if researchers would spontaneously prefer more flexible ways to manage knowledge exchanges and interactions.

Design/methodology/approach. The paper investigates the "basic KM needs" that emerge from inexpert researchers working in complex projects. These

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researchers, being less conditioned by standard PM methodologies used in complex organizations, can have more propensity for the exploration of new ways to interact. At the same time, this analysis can point out the real perceptions of novice researchers about the necessity of a structured PM approach. In detail, the case study of a research team of Engineering post-graduate students, competing in an ESA (European Space Agency) student challenge, is presented. The way team members perceived the problems of KM and PM, and the way they decided to organize themselves to face these problems was systematically examined by means of direct observations, surveys, and interviews to team members. The main research questions are: How would a novice research team organize a complex research project, for combining formal management efficiency with effective and flexible knowledge exchanges? What approaches, methods or communication tools would they tend to adopt?

Implications for research and practice. In terms of research, the study contributes to the debate on the needs for new PM concepts and methods. In practical terms, it allows to draw useful lessons that can inspire the identification and design of new PM approaches, based on KM concepts and on the use of web 2.0 applications. In addition, it can provide elements for a definition of courses of PM and KM to novice researchers.

1 Introduction

Formal project management (PM) is a set of sophisticated methodologies and tools for managing research, engineering or other kinds of projects. They are based on rigorous standards, guidelines for project documentation, strict control over deadlines and milestones. Today, PM combines techniques and software tools for goal planning, task distribution, milestones control, as well as managing procedures for assessing and authorizing changes (for a complete guide, see PMI 2013).

PM is also the common practice in multi-national complex research projects. These are characterized by advanced technical-scientific goals, interactive teamwork, and strict financial or temporal constraints, but at the same time they must involve researchers working in different fields, organizations and countries, as well as administrative staff and decision-makers at a political level. Space research is a paradigmatic example: indeed, PM techniques have important roots in one the most famous US space projects, the Apollo Moon missions (Harrison 1981). The major space research organizations have long defined formal requirements, procedures, and detailed PM approaches to be applied in their flight programs and research projects (NASA 2014; ESA 1996).

Formal PM techniques offer the unquestionable advantage that tasks are assigned and monitored with precision, which is important especially in large multinational teams. However, possible counter-effects regard the inflexibility of the PM schemes and the burden of formal duties on researchers, which can limit their creativity, and make their job and interactions less effective (Coccia and Rolfo 2009). As the studies of Knowledge Management (KM) have shown (Disterer 2002;

Bresnen et al. 2003; Leseure and Brookes 2004), researchers and engineers working in a complex project need rich exchanges of knowledge contents that are difficult to formalize. They require complex forms of communications, and must perform processes of mutual learning to find innovative solutions in areas of scientific forefront. In addition, the emergence of new web 2.0 technologies gives the opportunity to interact and exchange complex contents, and offers new ways to support the management of projects (Remidez and Jones 2012), but how to apply them appropriately is still under debate (Bolisani et al. 2016).

It has been recognized that PM methodologies can be an essential ingredient of education in research and engineering (Hodgson 2002). However, there may be the need to identify new methods that enable more effective knowledge exchanges for technical/scientific purposes, and allow a better exploitation of Web 2.0 technologies. This is also increasingly important considering that new generations of researchers may be more accustomed to using social networks and related tools.

The aim of this study is to contribute to this discussion, particularly on the fundamental question of how it is worthwhile and possible to "renovate" PM methodologies especially in projects characterized by forefront scientific challenges and the involvement of large multinational or multi-organization teams. To do that, the idea is to step back from what is generally taken for granted in scientific projects (i.e. the adoption of formal PM methods) and to consider the "natural" attitude that researchers can have toward the issue of how a complex project should be carried out.

Particularly, the paper illustrates a piece of empirical research aimed at examining if formal PM methods are an "automatic" solution adopted by any research team, or if researchers, if set free, would spontaneously prefer other approaches that enable more effective knowledge exchanges and interactions. With this purpose, the basic PM and KM needs that emerge from novice researchers working a complex project are examined. In addition, this analysis, by pointing out the real perceptions of PM by inexpert students, can also provide food for thought to designers of PM and KM courses in universities.

In detail, the case study of a research team of post-graduate students in Engineering is presented. The team worked in a complex project of a ground rover vehicle that should compete for an European Space Agency (ESA) University Challenge. The way team members perceive the problems of KM and PM, and the way they can decide to organize themselves to face these problems, was examined by means of a systematic investigation involving direct observations of their interactions and decision making processes, surveys, as well as interviews to team members.

2 Critical Issues in Formal PM

As Egan (2009, p. 3) argues, formal PM implies a complete pre-definition of the project before it starts, by "*creating a detailed plan, and then executing the project according to that plan. In a formal project management environment, the project*

manager must follow procedures and practices as defined by an imposed standard [. . .]. These PM techniques are driven by rules. The emphasis is on following the plan." The advantages of formal PM have been long emphasized in the literature. As well summarized by Ortloff et al. (2009), these include: better control of financial, physical, and human resources, shorter development times at lower costs, higher quality and increased reliability, higher profit margins, improved productivity, better internal coordination. In short, PM enables an *efficient use of resources* by keeping under control the main dimensions characterizing a project, namely: scope, cost, and time.

PM methods are integral to what Pollack (2007) defines a *hard paradigm* of project-based activities: "*The hard paradigm is commonly associated with a positivist epistemology, deductive reasoning and quantitative or reductionist techniques, attributes which are often associated with rigour and objectivity. Practice based on the hard paradigm tends to emphasise efficient, expert-led delivery, control against predetermined goals and an interest in underlying structure*" (Pollack 2007, p. 267). It is an effort of giving repeatability to project activities in an uncertain world, by placing them in the "*iron cage of project rationality*" (Koskela and Howell 2002).

The unquestionable success of formal PM techniques, and their popularity, should however not conceal the risks of failure of these techniques (Cicmil and Hodgson 2006), that are associated to the rational assumptions on which PM grounds: determinism, assumption that there is no task or goal uncertainty, and controllability of actions. Koskela and Howell (2002) point out that PM techniques are, implicitly or explicitly, based on a "plan-execute-control" paradigm: a project is carefully planned in advance, then the results of this planning activity are communicated to the "operational team" to be executed, and later there is an assessment of execution quality and performance, which enables corrections in case they are needed. The drawbacks of this rational approach can be described as follows: (a) it is substantially impossible to keep plans really updated (i.e. the effort to formulate the start-up version of plans is so huge that nobody takes care of refreshing it properly, so any need for change is just annotated "at the margin", and results in minor adjustments); (b) the separation between those who make plans and those who execute them is sometimes unclear (i.e. there are overlapping roles that can create misleading situations and conflicts between controlled and controllers); (c) but even when the separation is clear enough, this can lead to communication problems (i.e. the planning office should communicate orders and tasks with no ambiguity to executors—but these, having no idea of why or how the plan was formulated, can fail in understanding the real goals); (d) despite the huge amount of metrics and performance measurement, quite often—maybe just for sake of simplicity and cost-effectiveness—the control over projects is performed just on a substantial "go/no-go" basis (in other words, formal PM produces a lot of measurement that may be difficult to use practically).

In recent studies, all these criticisms have led to new reflections on whether and how PM can be renovated, and how the counter-effects of an automatic application of formal techniques can be reduced. These reflections are especially important in

consideration of three important aspects that clearly emerge in advanced research projects, i.e.: the need to enhance and valorize the *creativity* of participants in project teams, and their *capability to explore* beyond the space of the already known solutions; the growing importance of *new media and social technologies* that can allow new forms of communications, which can be especially important for large and multinational teams; and the need to provide *new forms of professional education* to the novel generations of researchers and engineers.

The first point (i.e. *how to valorize creativity of participants*) relates to the complexity and uncertainty that especially affects large research projects in highly innovative fields and can challenge the "plan-execute-control" paradigm of formal PM. It may become important that researchers are not only kept "stuck to the plan", but must also be free to explore new or unexpected responses to scientific problems, to learn from their own experience, and to share all this with the other researchers, in a mutual exchange of knowledge. Formal PM techniques of the "hard paradigm" may need renovating with element of what Pollack (2007) defines the "soft PM paradigm", for example: focus on learning, ill-defined goals, emphasis on participation and involvement, and role of project manager as a "facilitator" rather than as "chief in command". In this view, a project should evolve toward a sort of "social environment" that may, more flexibly, face uncertain and ambiguous technical-scientific goals, unexpected results (Cicmil and Hodgson 2006), and also the expectations of external stakeholders (i.e.: politicians, industry representatives, consumers and public opinion, etc.), that can affect the conduct of researchers and can force changes in plans or project resources.

The case of space research is again paradigmatic here: the Apollo mission faced a sudden interruption due to budget cuts and to changes in political goals of the US government; similarly, the tragedy of the Columbia shuttle in 2003, with dramatic effects on the public opinion, caused a long stop in the program for "safety reasons", and also impacted on the International Space Station program, where supplying programs had to be reformulated for using alternative carriers. This debate has also gave impulse to an attempt of definition of new PM approaches (see e.g. the Agile project management techniques, developed in computer programming and now extended to other fields—Highsmith 2009).

The second point (namely, *the growing importance of new media and social technologies*) mainly refers to the upsurge of web 2.0 technologies that are now widely used in industry and research. Examples include: video-sharing applications, wikis, forums, instant chatting, shared folders, tagging, etc. Although these systems have been often introduced for private use of individuals (e.g. hobbies, social interactions, etc.), their employment is now increasingly important in business and also in scientific research (Turban et al. 2011). The capability of these systems to offer new modalities of interaction, communication and project documentation is raising the interest of practitioners, and examples of application can already be found in the literature (Remidez and Jones 2012). The novel ways of working that these systems imply, compared to structured PM information systems, raise the issue of what changes in PM methods their use would require.

The third point (namely, *the need for new forms of professional education*) is related to the new attitude of younger generations toward the new media, and to the changes in educational system that this may require. This may lead to a potentially conflicting situation. On the one hand, considering that PM techniques are increasingly important in business, specific courses—especially at graduate or post-graduate level—become more and more important (Turner and Huemann 2001; Thomas and Mengel 2008). On the other hand, teaching just formal PM techniques (as is generally done) may tend to impose rigid behaviors to young professionals, and to underestimate the need for flexibility, creativity, and capability to interact in working teams (Taylor 2010). Learning "soft" approaches that valorize social interactions and flexible management techniques can be an additional professional skill for the future practitioners (Berggren and Söderlund 2008). Also, the new generations may be more oriented toward the use of innovative communications technologies in PM.

3 KM Views of PM

The recalled debate about prospects of PM can be re-framed by using some notions and concepts that are commonly adopted in the KM literature. The relationship between PM and KM has been increasingly investigated in the recent literature (Liebowitz and Megbolugbe 2003; Yeong 2010; Handzic and Durmic 2015). It can be said that any project involves and requires explicit or implicit approaches to KM, because it involves tasks such as: storing and retrieving project documentations and past experience; supporting communications and knowledge sharing between team members; facilitating learning and competence improvement. The way PM is implemented (for example: the adoption of a structured information system as communication channel between members, or a specific format for project documentation) clearly affects how knowledge is effectively managed in a particular project, i.e. the KM approach that is adopted there. In this section, three distinct KM views are used to describe different possible approaches to PM.

3.1 PM as a Codification Strategy

This can be seen as the natural KM approach of the "hard paradigm of PM". A KM codification strategy refers to the situation where an organization can structure the knowledge that is needed to perform its core activities (Kumar and Ganesh 2011). The assumption is that it is possible to pre-define and organize the key knowledge flows that are necessary to individuals for performing their tasks. Also, in this view, the experience achieved in the past can be formalized and stored in some kind of archive (possibly digital), and can be retrieved for future re-use. The emphasis is put on explicit knowledge contents and formal procedures, and the goal is efficiency of repeatable activities. The classic PM techniques can be framed into a KM codification strategy: formal PM methods have the main goal to improve efficiency

and hierarchical control, under the assumption that a project can be planned and managed rationally. In other words, managing KM in a formal PM context means focusing on explicit knowledge contents and their rational management. As mentioned before, this view is being challenged especially in large and innovative projects, that are affected by uncertainty and involve several independent organizations. In this case, a KM codification approach limits the possibility to manage tacit knowledge flows and to treat the dynamic nature of learning processes (Coccia and Rolfo 2009).

3.2 PM as a Personalization Strategy

An opposite strategy to codification is generally called *KM personalization strategy* (Kumar and Ganesh 2011). This generally refers to the attention on individuals, in the assumption that their creativity and learning processes can help organization to better face uncertainty, unexpected problems, and complex situations that are difficult to rationally define in advance. KM personalization focuses on the essential contribution of tacit knowledge, i.e. the component that is stuck to individuals and can't be formalized and simply stored in a computer system. Seeing PM under a "KM personalization" perspective means to valorize the creative contribution of individuals to a project, in the hope that this can lead to better solutions. Clearly, this challenges a purely formal PM approach, and there is the need for methods that enhance the people's problem solving capabilities and facilitate their learning processes. Also, since tacit knowledge is hard to formalize, transferring knowledge between project team members, rather than on hard information systems, should be much more based on organizational settings that facilitate direct people-to-people interactions.

3.3 PM as a Sharing Strategy

A KM sharing strategy refers to an approach where it is assumed that individuals better work collectively, and therefore there is the need that they share and *socialize* the elements of their private knowledge (Nonaka and Zhu 2012). In the assumption that no single individual can create, possess or manage all the knowledge that is needed to perform a complex task, people are stimulated to put their experience and expertise in common, and to overcome the traditional *barriers* that, for reasons of efficiency or under the effects of hierarchies, tend to grow and to create islands of specialized knowledge possessed by single individuals or small groups. The core element of a KM sharing strategy is an organizational arrangement where people can create and share knowledge and implement collective learning processes. The KM sharing strategy can also be associated to what has been called *conversational KM* where, according to Wagner (2006), individuals share knowledge through a dialog based on questions and answers. Therefore, social interactions and tacit knowledge exchanges are important, and, in this environment, the use of Social Media can be vital: for this, Levy (2009) coined the term "KM 2.0" that underlines

that flexible and "social" technologies (i.e. forums, blogs, wikis, etc.) can bring about new ways of exchanging knowledge contents informally even in dispersed communities. For PM, the adoption of a "KM sharing strategy" means to facilitate informal communications processes in project teams to boost the connection between members so that collective learning processes and better sharing of ideas, goals and operative solutions become possible. This implies not only new organizational settings in PM but also the adoption of new media. These can, in addition, fit the attitudes of the younger generations.

4 Reconsidering PM: Empirical Research

4.1 Goals and Methodology

Can KM contribute to the introduction of novel approaches to PM, for facing the challenges of large and complex research projects? And what KM strategy can best fit this goal? Or is it possible and desirable to combine all these KM strategies in managing projects? And what can be the role of social media in all this?

This study aims to make a step toward a better comprehension of these points, by investigating the "basic KM needs" that can emerge in project teams. The idea is to analyze the perceptions of inexpert researchers working in complex projects. The assumption is that novice researchers, being less aware of the standard PM methodologies used in complex organizations, can be freer as regards the exploration of new ways to interact and new communication technologies to adopt.

In detail, the goals of the empirical study can be summarized as follows: (a) to investigate if a formal approach to PM, compatible with a KM codification strategy, is an automatic or implicit need in a research project, or if team members would (instinctively) prefer flexible and informal solutions like those that fit a KM personalization or a KM sharing strategy; (b) to derive useful lessons for the definition and design of new PM methods and tools that combine a formal approach with the need for flexibility. In practice, the study addresses these questions:

> *How would a novice research team organize its work for managing a complex research project, with the purpose to combine formal management efficiency with effective and flexible knowledge exchange? Would researchers be aware of their PM needs and the possible associated problems? What approaches, methods or communication tools would they tend to adopt?*

The unit of analysis is represented by the set of approaches, communication and management tools adopted by a multi-disciplinary project team involving novice researchers. The team is made of post-graduate, graduated and PhD students of various engineering fields, and participates in the "European Rover Challenge"—ERC (see http://roverchallenge.eu), a challenge for University teams of various countries organized in collaboration with ESA. The study explores the spontaneous decisions taken by team members about the methods and tools for managing project documentation, knowledge sharing, and task management. The research is based on

a case-study methodology (Yin 2003) that can be seen as "instrumental" in Baxter and Jack's (2008) terminology. The collection of data is based on a combination of different methods typically used in social research, e.g.: analysis of secondary data (official documents, working papers, websites, etc.), questionnaire surveys, in-depth interviews to team members, and direct observations of team activities. Also, the case-study can be seen, at least partially, a piece of qualitative longitudinal research (Farrall 1996), because it considers a project that develops along two different years with two different teams (see below).

4.2 Timeline, Methodology of Data Collection, and Variables

As mentioned before, the rover project has been examined in two steps, by involving two different project teams. The first team participated in the 2015 Edition of the Rover Challenge (here called "2015 team"), while the second team is participating in the 2016 Edition (the "2016 team"). Although team members are different, the purpose and contents of the two projects are the same; also, the experience of the first team was somewhat passed on to the second one. Data collection started in December 2014 and ended in August 2016.

The paper summarizes the results of this analysis of PM and KM problems and approaches followed by the observed teams, as is presented and discussed in the next section. Figure 1 outlines the different modalities of data collection that have been employed along the steps of the two projects. These include a variety of qualitative approaches, that made it possible to capture the broader and complex picture characterizing the situation under examination, and namely:

- observations of interactions and social processes between team members, by means of a direct but silent participation to team meetings;
- a survey by means of an online qualitative questionnaire (via the "Surveymonkey" online service), submitted to the members of the 2015 team,

Fig. 1 Example of rover for ERC (source: Morpheus internal documents)

with the purpose to analyze specific background elements affecting the project (such as, the initial competencies of team members, or the preliminary decisions about the team organization)
– interviews to selected participants, to better understand the perceptions of team members as regards the PM and KM issues of the project;
– a collection of free feedbacks (from 2015 team).

This data collection was integrated by an analysis of pertinent documentation, websites, and facebook fanpages (Table 1).

Table 1 Investigation timeline and methods of data collection

Collection of data	Modality	Goal	Time
Observation	Attending an initial team meeting	Analyzing the general context, the way team develops its organization, etc.	Kick-off of 2015 team (Dec. 2014)
Observation	Attending a team subgroup	Analyzing interaction dynamics and operative knowledge exchanges among researchers specializing in a specific part of the project	Just after kick-off time
Survey	Online questionnaire submitted to team members	Defining PM and KM competencies of team members	Just after kick-off time
Observation	Attending a team meeting	Analyzing how PM and KM problems are perceived and faced during the ongoing project by team members and in the distinct team subgroups	At about one-quarter of 2015 team's work
Interviews	Open interviews to team participants, especially those who are assigned a coordination role	Investigating the specific decisions, problems and methods of KM and PM	At about one-half 1st 2015 team's work
Free feedback collection	Quick mail questions submitted to participants	Analyzing perceptions and learning processes of team participants	End of work—2015 team
Interview	Interview with Project Manager (2016 team)	Analysis of first free comment on the renovated PM arrangements adopted by the 2016 team	Beginning of 2016 team's work
Interview	Interview with Project Manager (2016 team)	Analysis of results and unresolved PM issues in the 2016 team	Nearly end of 2016 team's work (Aug. 2016)

The main "variables", or it is better to say elements that were analyzed, are described as follows:

- KM approach implicitly adopted in the project (see Sect. 3)
- function, importance and style of leadership
- function of project manager
- kinds and mechanisms of knowledge exchange
- preferred communication tools

5 The MORPHEUS Project

The MORPHEUS project refers to the participation of university students of the University of Padova (Italy) in the "European Rover Challenge" (ERC) international competition. This competition is reserved to university-level students, with a few faculty members as mentors. The goal is to build a robot vehicle (a "Mars rover") that simulates navigational, geological and field tasks in an environment that resembles the landscape of planet Mars. MORPHEUS refers to the work done by both the "2015 team" and the "2016 team". Picture 1 provides an example of the rover being built (referring to the original designs of the "2015 team").

The "2015 team" took part in the first Edition of the competition, which ended on September 2015 in the city of Podzamcze—Poland. They started their works in the last weeks of 2014, after a formal approval by the University of Padova that also allocated a budget for the project. Next, the team was able to prepare all documents for submitting the application by 31st March 2015. The ERC jury approved the application, and the Morpheus team was among the 30 international teams that were selected for the final competition. Unfortunately, for administrative reasons, the team was not able to complete the ultimate designs, building and testing of the rover. The "2016 team", renovated in its components, started working in late 2015 and aimed to participate in the final competition of September 2016.

In the ERC Competition, all participating teams are also expected to show the real functioning of their rovers. The device must accomplish tasks such as: reaching specific locations by proceeding on an uneven terrain, retrieving different types of samples from the ground with a mechanical arm and a drill, and performing some maintenance tasks. Each project must also meet a number of requirements. First, teams must design and build their original rover and, although they are allowed to use off-the-shelf components, they must meet some technical specifications. A second important point is budget: rovers are limited to costing no more than 15,000 € in parts, equipment and external paid services (teams are not paid). In addition, each team must be able to set appropriate presentations of their work to an external audience, including a promotional video, a website describing team and project, and a Facebook fanpage. Finally, teams are expected to submit reports and documentation describing features and state of advancement.

5.1 The 2015 Edition

The 2015 team, that called its project "Morpheus", consisted of a young post-graduate students in various fields (namely: mechanical engineering, aerospace engineering, electronics, and computer science), all based at the University of Padova. The team was organized into subgroups that were assigned the task to designing a different part of the vehicle. The team had a faculty professor as mentor, assisted by a PhD student. A point to remark is that all the subgroups had to integrate and coordinate their efforts because these were all finalized to the production of the vehicle. In short, this kind of project represents a challenge in terms of involved scientific and technical competencies, PM capabilities, and KM processes.

5.2 Kick-Off

The investigation described in this paper started by attending a kick-off meeting in December 2014. All participating students were invited to share their first ideas and proposals. Students of the different subgroups, specializing in different parts of the project, had collected some materials to present. This meeting lasted about 2 hours, and highlighted a number of important points as regards the problems of PM and KM faced by team members, their awareness, and the way they were dealing with them. First of all, it was a pretty "free" meeting, with a light agenda but no chairperson nor someone taking the minutes. The discussion was substantially open, which was deemed to be important as members didn't know the opinions of the others exactly and it was necessary to have interactions and explanations. On the other hand, it was often sidetracked by marginal details. Different was also the way each group introduced themselves and their ideas. Some groups showed power point slides, others just made an "ad-lib" presentation.

The problems of PM and KM were also discussed, but mostly in terms of what technical specifications were necessary for integrating the works of each group. At that time, it was not clear if the groups had selected a person in charge or a spokesperson, although the problem was signaled. A student introduced himself as "project officer" (later called "project manager"), in charge of facilitating interactions and knowledge sharing among groups, project documentation, and also external communications (including website and Facebook page). The project officer, however, didn't play a role of "project manager" in strict sense, and had apparently little authority.

5.3 Initial Perceptions and Competencies

After this meeting, a questionnaire survey was organized with all team members. The questionnaire aimed to verify the basic notions and competencies of team members about basic methods of PM and KM (e.g.: how a project can be conducted

and managed, what problems of knowledge exchange can arise, etc.), and more generally their perceptions and feelings about these issues. In addition, the questionnaire examined the approaches and tools that team members would spontaneously adopt.

The questionnaire had a rate of response of about 50%. Some points were particularly notable. First, all members indicated they had limited knowledge of PM methods and tools. As regards the need for coordination and knowledge exchange, there was no agreement on whether knowledge sharing should be restricted to the team or extended to the external environment. With the exception of "technical documentation" (that all members think should remain private) and "competition rules" (that should be public), for the rest opinions were various.

As regards the need to store the knowledge produced during the practical activities (i.e. collection of technical data, calculations, designs, tests, etc.), members greatly acknowledged the importance of saving and sharing project documentation, especially for "*exploiting the experience in future research projects*", "*meeting the formal needs of the competition*" and for "*sharing knowledge within each sub-group*". Surprisingly, it was considered less important to "*share knowledge across subgroups*". In any case, it was generally admitted that "*lack of time*" and "*complexity of documents*" could impede an effective project documentation.

The survey also investigated the ideas of members regarding the possible methods and tools for knowledge sharing and task coordination. Notably, the importance of a "*subgroup representative*" and that of a "*project manager*" was substantially underestimated. Also, in case of interactions across subgroups, direct inter-personal and informal contacts between members were considered the best way to share knowledge.

As for communication tools, the survey showed a great variety of proposals, but there was a marked preference for simple tools such as shared repositories and folders (e.g. Googledrive and Dropbox), Whatsapp messaging, or even face-to-face meetings. While more complex and structured PM software (like e.g. Asana) was not preferred by the large majority of members.

5.4 Team Organization and Its Progressive Changes

The team had about 20 members and was organized into four subgroups that were assigned a different goal, namely: project management (earlier called "project office"); locomotion, bus and electronics; arm and drill; localization, GNC and GSE. In the practice, this configuration was the evolution of a different initial structure, for several causes: first, some original members left earlier, while others added later; secondly, it was decided that some groups would have been integrated to one another. Indeed, in the beginning, the team had not enough knowledge of the project or the competition, so it was not possible to find the most effective team structure immediately: the current configuration was the result of a learning process "on the ground".

Another issue regards the choice of the "project manager" and of the representative or "spokesperson" for each subgroup. A plenary meeting, held in January 2015, highlighted that some subgroups had not appointed their spokesperson yet, despite of the fact that this was considered important (at least by the project manager). It was therefore decided to appoint some representatives whose task should mainly be that of establishing bridges between subgroups. Since some groups were not active in deciding their representatives, the decision was substantially taken by the project manager, not on the basis of a specific criterion but by selecting the people that apparently were more active in their respective subgroups.

A second aspect is the level of general coordination of the project. Despite a student was nominated as project manager (as mentioned before), apparently he didn't have sufficient authority over team members. As was clear during the interviews to single subgroup members, this caused a tension between the expectations about this pivotal role (witnessed by claims like "*he should coordinate activities*" or "*he should act as interface between groups*") and the real acceptance of a leading role: for instance, the suggestions of project manager about how to use a particular PM software or the need to write minutes of meetings, were often disregarded.

5.5 Interaction Tools and Mechanisms of Knowledge Exchange

Both at team's and subgroups' level, participants tended to adopt methods and tools to archive and retrieve project documentation, to communicate and coordinate tasks, and to monitor project activities (i.e. budget, technical requirements). However, the selection was different between groups, and the adopted criterion often unclear.

Of course, there was a difference in practical needs: for example, software programs generally use a system to share and co-program the code, but this situation is rather peculiar because it implies exchanging explicit and formal elements of knowledge. This was not the case of other subgroups.

In addition, there was a difference in the tools used to communicate messages and contents, and in those that were employed to store documents and make them available to others. For communications, emails were largely preferred; but when members had to send instant messages (like e.g. "*let's meet at 3*"), Whatsapp was the most popular platform. The advantages ascribed to these tools were their widespread diffusion and user-friendliness. Indeed, some members proposed to use other systems such as Telegram (an instant messaging service that some people considered to be more powerful than Whatsapp), but this software was not so popular in the team. For storing and sharing documents, the whole team and all subgroups adopted public file hosting services such as Googledrive and Dropbox. There was an effort to introduce the same tool for all team members and subgroups: Googledrive folders were employed as personal archives of each subgroup (but accessible by all the others), and another folder was for documents of general

interest that subgroups intentionally shared. However, each subgroup tended to use just its own folder.

As mentioned, the project manager insisted that all subgroups would use Asana, a PM software that supports various teamwork activities. This proposal was discussed and even accepted by team members, but in the practice, the system was not used.

5.6 KM Issues

During the interviews with the members of each subgroup, two contrasting points arose. On the one hand, there was general awareness of the complexity of the project and the need to coordinate activities by means of effective knowledge exchanges. On the other hand, there were different perceptions in relation to the specific competences and goals of each subgroup, which can also explain the variety of tools and methods adopted locally.

A general issue was the task coordination among subgroups. Apparently, it was not a matter of time scheduling or task assignment, but rather the necessity to share essential knowledge about "*what the other groups are doing*", as was often declared during interviews.

This is a key point for several reasons. The design of some components of the rover strictly depends on the design of other components: for example, the subgroup that designs electronics needs to know the essential specifications of the mechanical arm, the drill device, the electric motors, etc. However, due to time constraints, it was not possible to wait for the others to complete their task. Also, a technical solution could change over time, and this affected what other subgroups were doing. So, constant information flows concerning what the other subgroups were doing was extremely important.

In the team, there was widespread awareness of this problem, but the proposed solutions diverged. As mentioned, the project manager wanted to use a single structured PM system like Asana, that not only allows to store and share contents but also to coordinate tasks and timing. The use of this system is aligned with the standard PM techniques, but found scarce acceptance by team members. As declared in the interviews, the main reasons were that "*the system is complex to use*", that "*it is not flexible*" and especially, that "*its use requires too much time*".

A different proposal was to pre-define appropriate "project interfaces": these consisted of some essential documents with the technical requirements that each single component of the rover had to meet to integrate with the other components (for example: physical dimensions, requested electric power, mechanical power, etc.): the assumption was that, once these "interfaces" were established, each group should have worked on its own freely, with less need to interact with others. The problem was that it is difficult to define these technical specifications in advance, especially in projects, like the one under examination, that represent a complex challenge at least compared to the knowledge and competence possessed by researchers.

Another aspect that required coordination between subgroups was the economic budget that, as mentioned, must not exceed 15,000 € for the whole project. This point, however, had apparently found a good and balanced solution, probably because it is a simpler and clearer point that doesn't need particular explanations to be understood by the different members.

There was also awareness that a coordinator between subgroups would have helped the effective undertaking of the project activities. However, this role was generally seen not as a "commanding function" but, rather, as a facilitator of team interactions: someone who enables knowledge sharing, who takes care of meeting organizations, who checks that subgroups interact and are aware of what the others are doing, etc.

In addition, there was the issue of what knowledge should be shared among groups, and in what formats. A subgroup, for example, mentioned that "*shared folders are useless if they contain a long list of files written in technical language that is specific for that subgroup*", and that it would have been more effective that "*each group can share some synthetic reports that just present the essential points of what they are doing*" in a clear language. It is however admitted that compiling these reports "*would be time-spending*".

Spontaneous interactions were also perceived to be necessary, especially for people needing to explain themselves better. Here, electronic communications were signaled as an opportunity, but also something to be used properly: as a member affirmed "*sometimes we start an email discussion, everybody posts a comment, then others comment on these comments, and in the end one loses the thread*".

Face-to-face intergroup and intra-group meetings were also deemed to be important. There was, however, no standard way to use this practice: some subgroups had systematic meetings, others met only occasionally. Plenary meetings of all team members were expected to be flexible and open to discussion, because they were seen as an opportunity to share essential knowledge, to let the team know the state of the project, and more generally to learn from others. However, in these open sessions, participants could easily be sidetracked and, in the end, waste their time if there was neither structured agenda nor a chairperson governing the discussion.

5.7 End of 2015 Teamwork

Team 2015, as mentioned, was not able to fully complete its task and could not present its rover at the final trial competition. After the conclusion of this first edition of the project, the participants were asked to express their opinion about the experience they made. Two team members accepted to provide information, and their opinions are commented on below.

Coordination Within Each Subgroup Intra-group communication was considered insufficient. Computer systems were mainly used as a repository of technical documentation. Formal meetings were not employed, and informal interactions

were preferred. There was no or little role of internal group leader. There was an agreement to distribute tasks among members, but this decision proved to be not very effective, and in any case no strict deadlines or goals were assigned to people.

Inter-group Coordination The critical points previously mentioned were even more serious in the case of inter-group coordination. Communications were considered ineffective, as one interviewee affirmed: *"There was no real inter-group communication, and this led to confusion and, generally speaking, caused delays"*. The lack of a fully appointed team leader, able to ensure the compliance with deadlines and goals, was also seen to be a big problem. Another interviewee declared that the key point was the inappropriate "*PM approach, i.e.: calling and managing meetings, selecting team participants and assigning tasks, checking the compliance with deadlines, communicating clearly, producing project documentation appropriately*".

Learning Needs A lesson learned in the project was the crucial role of a project leader, and the necessity to improve PM application. However, according to the interviewees, what appeared to be essential was not the use of formal or sophisticated PM techniques, but simply to give some order to the project. In other words, according to them, before being trained in "hard" PM techniques or formal communication systems, team participants should be first learn how to manage a meeting, to organize individual project tasks, and to comply with assignments and goals. What may be called "soft" PM skills.

6 The 2016 Team

The experience of 2015 team provided inspiration for the organization of 2016 team that started working in late 2015 with the ultimate goal of participating in the second edition of the Rover Challenge. The new team had the same name (Morpheus) and about 30 members, divided into four subgroups (Mechanical system, Electronics, Software & control, and Outreach). Instead, the control and communication structure changes. The tasks of "project coordination and external communications", that were previously assigned to the same person ("project office"), were split between different people in relation to their specific competences: a student of engineering management (more skilled at organizational processes and their management) and some students of "soft" sciences (i.e. economics, communications sciences) were added to the organizational chart. This was considered important just in consideration to the problems that had emerged in the 2015 team.

As regards PM, just like in the 2015 team, it was considered important not to have a "project manager" in traditional sense (i.e. someone "in command"), but rather a person that can make some order to activities and communication flows, monitor the state of the project and the compliance of deadlines and goals, and help

to keep groups stuck to their assignments. In other words, a sort of "soft" coordination role. The attempt was to manage this second edition of the project by adopting a proper balance between rigorous order and free creativity, and by focusing on the improvement of communication flows among all team members. One of the first tasks of the PM function was to create a communication form to be used by each group for briefly communicating the results achieved to others. This simple tool was considered to be more easy-to-use than formal PM tools but, at the same time, structured enough to give some order and clarity to inter-group communication flows. Another innovation was the use of three software packages that were expected to facilitate coordination: a "Chart organizer" that outlines the team structure and the functions of each member, a "Gantt Chart organizer" that summarizes tasks and deadlines, and a "Work Breakdown Structure organizer" that summarizes the parts of the project and their costs. These diagrams were made visible (in pdf format) by all members and used as a reference and a self-monitoring of the achieved goals, but were only be handled at the "Management" level. This means that they didn't represent an additional burden to members but will only help them to give some order to their respective work.

6.1 Final Lessons from Team 2016 Experience

The work of Team 2016 is almost finished, and it is now possible to make some final comments. First of all, despite the efforts, it must be said that the completion of the rover is at risk, maybe due to some initial technical decisions (i.e. adoption of a particular kind of component) that made the assembly more difficult. To overcome these problem, a change in the project has been recently introduced.

However, according to the project manager, a major problem was the insufficient coordination between team members. Compared to Team 2015, some solutions were introduced and really helped: for example, some simple PM tools to monitor the state of the project and to keep participants informed about advancements. Another important step, that was later made, is the decision to work in the same place (i.e. a laboratory), so that the people can also share ideas, problems, and perceptions immediately and informally. In addition, as mentioned by the project manager, *"the key role is that of project leader. This was his first experience, and he had to face a lot of problems"* and to learn quickly. Apparently, it is a question of competence, of overall *"vision of the project"*, and of *"charisma*".

Also, the key functions of a project manager emerged. It was clear that a complex project requires that someone is assigned the full-time responsibility of monitoring tasks, notifying advancements, and checking problems even in minor aspects of the project. The project manager should work in strict connection with the project leader, that must be kept informed about the state of the project in real time,

As regards communication technologies, and especially social media platforms, these clearly help to keep members informed about what's up in the various subgroups and the hot issues, and to establish a repository of documents that can

be easily accessed. However, as said by the project managers, *"what remains essential is the work on the ground"*, meaning that communication technologies were useful as a complementary tool but could not replace the direct interactions between team members. Also, to use technologies properly and to keep knowledge flows efficient, the proliferation of different platforms should be avoided, and for this it may be "*important to establish some essential usage rules, agreed by all members. In our case, this was done gradually*".

A final comment regards the capability to "learn on the ground". Due to the uncertainties affecting the project, the knowledge gap of team members, and the absence of a "dues ex machine" capable to always "take the right decision at the right time", it resulted impossible to define the overall structure of the project from the early beginning. All the results—both technical and organizational—were achieved step-by-step, with a painful effort of mutual learning by participants.

7 Discussion

The main lessons that can be learnt from the case-study are summarized in the following points.

Balance Between Codification, Personalization and Sharing The study shows that novice researchers may have a spontaneous orientation toward "creative anarchy" but at the same time, even if they don't have particular knowledge of PM practices, they are aware of the importance of giving order to their activities. A notable point is that the complexity of research projects can make it difficult to structure them completely in advance, or at least, when the team doesn't have enough scientific/technical knowledge for setting plans properly. Here, an approach that combines flexibility and capability to learn progressively on the one hand, with a structured planning approach on the other hand can be successful. Another point to mention is that excessive burden of administrative duties should be avoided, otherwise researchers may tend not to use formal planning methods. In addition, it is apparently not essential that all project members perfectly know and use all the sophisticated PM methods that this discipline requires: they should just know and apply some essential rules, while the overall management duties can be assigned to a specific person (i.e. the project manager).

Leadership and Authority The case is also an exemplary situation that shows how leadership may find it difficult to be recognized in a research team composed by peers, where there is no external imposition (i.e. not like it would happen in a company). So, a hyper-rational paradigm, where a project leader has the function to pre-define and pre-code all the KM needs of the team members, appears to be not appropriate. Especially, in a complex project where nobody really "knows enough", it is difficult to find someone that can have a complete and clear vision of what to do and how to act in advance. In these situations, a useful function of a leader may not be intended in hierarchical terms (i.e. strict control over tasks and schedule) but

rather in terms of a "facilitator", that enables teams to achieve knowledge personalization and sharing goals effectively. In KM terms, this resembles the pivotal role of coordinator in a Community of Practice (Bolisani and Scarso 2014) rather than that of a "chief project officer" in a formal meaning. This function requires general competences, solid enough to understand the elements of knowledge that the single subgroups in a team need to exchange, but not necessarily hyper-specialized in a particular technical area. Especially, a charismatic and influential personality appears to be important to set a course and keep to it, but also awareness and capability to understand the positions, opinions and also requests of the other team members.

Knowledge Exchanges As mentioned, a key point is how to facilitate knowledge sharing within subgroups and between them, an element that is generally neglected in formal PM techniques, where flows of communications are simply "orders" (from leadership to executors) and "performance measures" (vice-versa). In a complex research project, the single members must be put in condition to interact and learn from one another, and therefore to share complex elements of knowledge. Here, the lesson is that frequent and direct contacts may be still essential, and in some cases more important than a formal repository of documents that are shared in the team. Clearly, the possibility to meet in person may be in contrast to the lack of time that team members generally suffer from. Also, purely free meetings can have ineffective results if this leads to sidetracking and complete anarchy. Again, a combination of different solutions is important, and should be reached step-by-step.

Communication Tools In a team of young people, one would expect these be spontaneously oriented toward innovative communication tools such as social networks and web 2.0 applications. The case shows these systems are effective (and really used) only if they are user-friendly and if researchers are familiar with them. This may explain why researchers may even prefer face-to-face meetings than complex services that need a lot of time to be used. Also, communication tools can lead to information overload: for example, too long discussions posted in a social network, or storing any kind of documents in a repository, can reduce efficacy. Coordination and knowledge exchanges shouldn't be simply "left to technologies", but require the personal involvement of individuals.

8 Conclusions

The analysis contributes to the debate on the needs for appropriate PM approaches that combine efficiency of traditional structured methods with flexible KM practices that help researchers to share and exchange knowledge. Particularly, it allows to get some useful lessons for reflecting on a renovation of PM methods, based on KM concepts, and on the potential of web 2.0 applications. The focus on

"grassroot" researchers can help to go back to the real foundations of the problems and to identify the really "basic needs" of KM in a complex research environment.

In KM terms, the case-study shows that an *appropriate balance between a codification approach to PM* on the one hand*, and a personalization and sharing approaches* on the other hand should be pursued. The investigation reveals that, when involved in a complex research project, even novice researchers become quickly aware of the necessity to give order and structure to their work. However, being not possible to pre-define all tasks, goals and milestones in advance, flexibility, capability of learning, and knowledge sharing become essential ingredients as well. This complex mix appears to be the real challenge of a renovated PM program. Another important message is that PM methods are still very important, but maybe it is not necessary that all team members know every technical detail of project management, as they shouldn't have the excessive burden of all the formalities that a hard PM approach requires. The functions of team leader and project management, however, become even more important here. These people should have good knowledge not only of the entire project, but also of the PM methods, and especially of how to apply them in a rigorous but flexible way.

A last comment regards web 2.0 technologies. It is true—as the PM literature recently has suggested—that new communication media can help overcome the limitations of hyper-structured PM information systems. At the same time, it must be recalled that not everything should be left to technologies, and that inter-personal communications remain important to share knowledge, perceptions, ideas, and to boost mutual learning in an advanced research team.

Implications for Research The study can give inspiration for new investigations into the opportunities and problems of PM and KM in complex research project, well beyond the case analyzed. Three points appear particularly interesting for a future research agenda, namely: (a) the efficacy and appropriate configuration of new web 2.0 tools in complex research projects; (b) the ideal governance structure that combines a control over time and tasks with a flexible knowledge exchange between team members; and (c) the role of leadership in peer-to-peer research teams.

Implications for Practice And Education In addition, the study can provide elements for a definition of new courses of PM and KM to novice researchers. PM standard methodologies are essential for the work of professional researchers, but the practice shows that researchers also need effective ways to implement multidimensional knowledge exchanges in complex research projects. The necessity to provide a background culture in PM results confirmed in the study. However, this culture should not be limited to the formal PM tools, because this may lead just to a professional hyper-standardization of PM competencies (whose limitations are today well known, as mentioned before). Instead, PM education must also include new "soft" skills (like e.g.: how to manage a meeting, how to fruitfully share knowledge, how to learn from the others' experience or to facilitate the others' learning processes). For this, a combination of PM and KM courses can be

appropriate. Also, the appropriate use of new social media in PM should not be neglected in a PM education program, but students should be made aware of the potential but also risks or limitations of these applications: here, the lessons of KM can be particularly helpful. Finally, it becomes important to facilitate a real interaction between different specialization (technical or scientific competencies on the one hand, and social or economic capabilities on the other hand) that need integrating in any complex research project.

Limitations The main limit of this study is that findings regard a specific project. The extension of the investigation to other cases, or the application of other methods of analysis can lead to further improvements. Also, the study just analyzed novice researchers, while it would be interesting to verify if similar or contrasting results can be obtained by analyzing projects involving expert researchers.

References

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report, 13*(4), 544–559.

Berggren, C., & Söderlund, J. (2008). Rethinking project management education: Social twists and knowledge co-production. *International Journal of Project Management, 26*(3), 286–296.

Bolisani, E., & Scarso, E. (2014). The place of communities of practice in knowledge management studies: A critical review. *Journal of Knowledge Management, 18*(2), 366–381.

Bolisani, E., Scarso, E., & Padova, A. (2016, June 15–17). Cognitive overload and related risks of social media in knowledge management programs. *11th IFKAD—International Forum on Knowledge Asset Dynamics*, Dresden.

Bresnen, M., Edelman, L., Newell, S., Scarbrough, H., & Swan, J. (2003). Social practices and the management of knowledge in project environments. *International Journal of Project Management, 21*(3), 157–166.

Cicmil, S., & Hodgson, D. (2006). New possibilities for project management theory: A critical engagement. *Project Management Journal, 37*(3), 111–122.

Coccia, M., & Rolfo, S. (2009). Project management in public research organisations: Strategic change in complex scenarios. *International Journal of Project Organisation and Management, 1*(3), 235–252.

Disterer, G. (2002). Management of project knowledge and experiences. *Journal of Knowledge Management, 6*(5), 512–520.

Egan, B. D. (2009). *What is formal project management and who needs it?* Expert Reference Series of White Papers, 1–800, Global Knowledge Network Training, Ireland. Retreived from http://www.globalknowledge.ie/content/files/documents/white-papers/pm/231458

ESA. (1996). *Space project management. Project phasing and planning* [online]. European Space Agency. Retreived from http://www.lr.tudelft.nl/fileadmin/Faculteit/LR/Organisatie/Afdelingen_en_Leerstoelen/Afdeling_SpE/Space_Systems_Eng./Expertise_areas/Systems_engineering/References/doc/ecss-m-30a.pdf

Farrall, S. (1996). *What is qualitative longitudinal research?* [online]. Papers in Social Research Methods—Qualitative Series n. 11, London School of Economics and Political Science. Retreived from http://www.lse.ac.uk/methodology/pdf/QualPapers/Stephen-Farrall-Qual%20Longitudinal%20Res.pdf

Handzic, M., & Durmic, N. (2015, September 3–4). Realizing value from knowledge assets: Empirical study in project environment. *Proceedings of the 16th European Conference on Knowledge Management*, Udine.

Harrison, F. L. (1981). *Advanced project management*. Aldershot: Gower.

Highsmith, J. (2009). *Agile project management: Creating innovative products*. Upper Saddle River, NJ: Pearson Education.

Hodgson, D. (2002). Disciplining the professional: The case of project management. *Journal of Management Studies, 39*(6), 803–821.

Koskela, L., & Howell, G. (2002). The underlying theory of project management is obsolete. In *Proceedings of the Project Management Institute Research Conference*, Seattle, pp. 293–302.

Kumar, J. A., & Ganesh, L. S. (2011). Balancing knowledge strategy: Codification and personalization during product development. *Journal of Knowledge Management, 15*(1), 118–135.

Leseure, M. J., & Brookes, N. J. (2004). Knowledge management benchmarks for project management. *Journal of Knowledge Management, 8*(1), 103–116.

Levy, M. (2009). WEB 2.0 implications on knowledge management. *Journal of Knowledge Management, 13*(1), 120–134.

Liebowitz, J., & Megbolugbe, I. (2003). A set of frameworks to aid the project manager in conceptualizing and implementing knowledge management initiatives. *International Journal of Project Management, 21*(3), 189–198.

NASA. (2014). *NASA space flight program and project management handbook* [online]. National Areonautics and Space Administration. Retreived from ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20150000400.pdf

Nonaka, I., & Zhu, Z. (2012). *Pragmatic strategy. Eastern wisdom, global success*. Cambridge: Cambridge University Press.

Ortloff, D., Popp, J., Schmidt, T., & Mielke, M. (2009). A customer-driven approach to product engineering of micro and nano devices—Requirement analysis. In *Proceedings of the 13th International Conference on the Commercialization of Micro and Nano Systems*, Copenhagen.

PMI. (2013). *A Guide to the Project Management Body of Knowledge: PMBOK Guide* (5th ed.). Newton Square, PA: The Project Management Institute.

Pollack, J. (2007). The changing paradigms of project management. *International Journal of Project Management, 25*, 266–274.

Remidez, H., & Jones, N. B. (2012). Developing a model for social media in project management communications. *International Journal of Business and Social Science, 3*(3), 33–36.

Taylor, R. G. (2010). Systems thinking for project management: Implications for practice and education. *Acta Structilia, 17*(1), 79.

Thomas, J., & Mengel, T. (2008). Preparing project managers to deal with complexity–Advanced project management education. *International Journal of Project Management, 26*(3), 304–315.

Turban, E., Bolloju, N., & Liang, T. P. (2011). Enterprise social networking: Opportunities, adoption, and risk mitigation. *Journal of Organizational Computing and Electronic Commerce, 21*(3), 202–220.

Turner, J. R., & Huemann, M. (2001). Project management education in project-oriented societies. *Project Management, 7*(1), 7–13.

Wagner, C. (2006). Breaking the knowledge acquisition bottleneck through conversational knowledge management. *Information Resources Management Journal, 19*(1), 70–83.

Yeong, A. (2010). Integrating knowledge management with project management for project success. *Journal of Project Program and Portfolio Management, 1*(2), 8–19.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). Thousand Oaks, CA: Sage.

Part IV

Knowledge Management Implementations in Project Management

Knowledge Management Selection Model for Project Management

Meliha Handzic

Abstract

This chapter proposes and empirically tests a contingency knowledge management (KM) selection model for project management (PM). Essentially, the proposed model posits a mediating role of project factors in the choice and impact of KM on project success. The evidence from two empirical studies provide full support for the contingency model and its proposition that the appropriate KM for PM depends upon project complexity. In particular, the empirical findings show that with increased project complexity, customer-related intellectual capital (IC) and personalization KM strategy tend to have greater importance for project success than team or process IC and codification KM strategy. These findings contribute valuable insights for researchers and provide useful guidance for project managers. The chapter also suggests plausible directions for further research to address current limitations.

1 Introduction

Traditional project management prescribes one valid way of managing all projects, whatever the circumstances. Accordingly, popular standards such as PMBOK by the Project Management Institute (PMI 2013) are based on a common approach to every project management task, irrespective of the nature of the project. Furthermore, most project management literature assumes that all projects are fundamentally similar and that "one size fits all" (Shenhar 2001).

Some scholars felt intuitively that this was wrong and called for rethinking project management theory (Andersen 2008). Others reported exploratory

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empirical research that showed how different types of projects were indeed managed in different ways (Shenhar 2012). Overall, it appears that the universal "one size fits all" approach does not hold anymore. So, scholars, as well as practitioners, are looking for alternative ways to manage modern project domains and improve their success. Andersen (2008) advocates the adoption of an "organisational perspective". The organisational perspective defines a project as "a temporary organisation, established by its base organisation to carry out an assignment on its behalf". This view of a project as a temporary organisation enables scholars to learn from general organisation theory and apply lessons learnt to the field of project research.

Following the above-mentioned recent developments in project management research, the purpose of this chapter is to address the issue from an organisational perspective. Specifically, it adopts two popular schools of thought: a contemporary knowledge-based view of the firm (Grant 1996) and a classical contingency theory of management (Lawrence and Lorsch 1967) as a theoretical basis for developing a novel conceptual model of project management. The chapter also provides much needed empirical evidence of its merit by testing the model in the context of software engineering.

The chapter is structured as follows. After this brief introduction, Sect. 2 describes the knowledge-based view (KBV) and contingency theory (CT) and their application in a project environment; identifies project complexity as a major contingent factor and presents a conceptual model that encompasses these ideas and serves as a theoretical basis for empirical investigation. In Sect. 3, two empirical studies examining the influence of project complexity on the relationship between project-related knowledge assets management and project performance are presented and the implications of their findings discussed. Finally, Sect. 4 concludes the chapter with a summary of research contributions and recommendations.

2 Literature Review

This section draws on representative management literature to derive a novel knowledge-based contingency model of project management. After adopting an organisational perspective of a project, the review compares traditional task-based and contemporary resource-based views, as well as universal and contingency theories of management. Then, it integrates the ideas from resource-based and contingency approaches in a conceptual model that serves as a theoretical basis for subsequent empirical examination.

2.1 Organisational Perspectives of a Project

Earlier parts of this book offer detailed definitions of a project. This chapter provides only a brief summary of views from the organisational perspectives. The

literature offers two such definitions. The first one is based on the task perspective and conceptualises a project as a temporary endeavour (PMI 2013; Sambamurthy and Zmud 2014). As such, it involves a set of interrelated activities to achieve a specific outcome (e.g. product, service or result), and terminates once the desired outcome is achieved. The second type views a project as a temporary organisation within an organisation that is needed to produce some outcome using predetermined project resources (Andersen 2008; Shenhar 2001).

While both definitions recognise project's temporary nature and its objectives, the first one focuses primarily on project process, while the second one emphasises the role of project resources in reaching project objectives. In this chapter, the organisational perspective's definition of a project is adopted as it better suits current research objectives.

The foundation of this definition can be found in the resource-based view (RBV) of the firm (Penrose 1959). RBV conceives a firm as a collection of productive human and material resources that can be put in use in different ways and provide a variety of services to add value to the organisation. The recent extension of the resource-based view of the firm termed the knowledge-based view (KBV) of the firm considers knowledge as the most important organisational resource. The following paragraphs discuss the importance of KBV in the project context.

The knowledge-based view (KBV) of the firm considers knowledge as the key resource and an important determinant of firms' organisation and behaviour. In the sense of KBV, the ability to leverage the required knowledge plays a critical role in competitive performance in the new economy (Drucker 1993; Grant 1996). Therefore, projects are facing two challenges: to identify what kind of knowledge assets they have and need to improve the rate of project success, and to address mechanisms by which they can better manage these assets. In general, intellectual capital (IC) literature addresses the first, and knowledge management (KM) literature the second challenge.

Intellectual capital (IC) literature primarily examines the kind of knowledge resources that drive growth and contribute to value creation. To succeed, organisations need to have a clear understanding of which knowledge assets are important to their success and how these assets are distributed over different parts of the company and among different roles and employees. According to Grant (1996), the portfolio of knowledge assets is typically determined by an organisation's strategic plan. To date, the most popular classification of knowledge assets (or intellectual capital) was proposed by Sveiby and Edvinsson in the 1990s (Sveiby 1997; Edvinsson and Malone 1997). It contains three components: human, relational and structural capital. According to Molodchik et al. (2014), human capital (HC) includes the abilities of management and human resource capabilities. Structural capital (SC) covers innovation and internal process capabilities. Finally, relational capital (RC) involves networking capabilities and customer loyalty.

In the context of projects, literature discusses a variety of internal and external types of project-related knowledge assets. Handzic and Durmic (2015a) grouped them into: project team, project customer and project process. Essentially, these reflect human, relational and structural components of intellectual capital involved

in projects. The project team as human capital (HC) includes people internal to the project and consists of project manager(s) and team members. The project team is responsible for executing project tasks and achieving project outcomes. The project customer as relational capital (RC) defines involvement and networking with internal or external end-users who requested the project and gain benefits or suffer losses from project outcomes. Project process as structural capital (SC) covers typical project phases and activities. The exact sequence and number of steps in the process depends on the specific life cycle methodology applied (Sambamurthy and Zmud 2014).

The contention of Grant's (1996) knowledge-based theory of the firm is that value is created or added to an organisation, its customers and stakeholders, through harnessing the knowledge resident in an organisation. Human, structural and relational capital, are all assumed to affect business performance (Bontis 1998). However, different organisations may require different types and combinations of knowledge assets. Hence, an important challenge for a project is to determine which type of knowledge capital is best suited for its particular needs.

Project success is the ultimate target value expected to be realised through harnessing project-related intellectual capital. Typically, project success is defined in terms of three criteria: time, budget and scope. In order to be successful, a project needs to be completed within the defined time, budget and scope constraints (Sambamurthy and Zmud 2014). Although some authors have questioned this "Iron Triangle" evaluation approach (Bronte-Stewart 2015), unfortunately, failure of projects is all too common and poses a great problem to practitioners. Throughout literature, it is derived from empirical studies and described in general or specific figures. One of the potential reasons given for a high project failure rate is that they do not possess and/or do not engage their knowledge assets in more beneficial ways to enhance the success rate of these projects (Yeong and Lim 2010). The field of knowledge management offers a promising solution for this problem.

While intellectual capital (IC) literature addresses knowledge from the static "stock" perspective, knowledge management (KM) literature focuses more on the dynamic "flow" perspective of knowledge (Kianto et al. 2014). One of the most famous KM models, called SECI, formalises knowledge creation as the process of continual interplay between tacit and explicit dimensions of knowledge (Nonaka and Takeuchi 1995). The model proposes four modes, termed socialisation, externalisation, combination and internalisation, through which explicit and tacit knowledge are exchanged and transformed.

A step forward is made by Bratianu and Orzea (2013) in their entropic model of IC, where the new idea is that knowledge is conceived as a field composed of rational, emotional, and spiritual knowledge, and each form of knowledge can be transformed into another one within a continuous dynamics. While in the stocks-and-flows metaphor the logic is Newtonian, in the field metaphor the analogy is made with energy and its transformation in concordance with thermodynamics laws (Bratianu 2011, 2015). Furthermore, IC is conceived in two stages: a potential IC and an operational IC, like with mechanical energy which can be in a potential state or kinetic state. Based on the same metaphor, the potential IC is transformed into

operational IC through the work of integrators. They are conceived as field of forces able to integrate resources and capabilities of an organisation. The most important integrators are: management, leadership, and organisational culture. An organisation with a high level of IC may have a rather weak operational IC if the integrators are not efficient.

Different knowledge processes can be further grouped into two distinct KM strategies: codification and personalisation (Hansen et al. 1999). The first of the two mentioned KM strategies, termed codification, is a document-centred strategy. Typically, it involves externalisation of knowledge from experts and its storage in knowledge repositories and knowledge maps where it can be accessed and used easily by anyone in the organisation to locate and deliver knowledge (Davenport and Prusak 1998). In general, the key advantage of codification is considered relatively effortless knowledge reuse, while its main disadvantage is seen in decontextualisation, i.e. the absence of context-specific details about the stored knowledge that weakens its connection to reality.

The other of the two widely acknowledged KM strategies, namely personalisation, is a community-based approach. It focuses on knowledge creation in teams and its transfer through collaboration and social interaction between people (Nonaka and Takeuchi 1995). As with codification, there are several advantages and disadvantages associated with personalisation strategy. Thus, personalisation represents an excellent approach for bringing the organisation in touch with people who have deep knowledge and experience in its application. However, it makes the transfer of knowledge across the organisation slow, as it is based on person-to-person interactions.

The choice of a knowledge strategy is a matter of pursuing the right balance between personalisation and codification (Hansen et al. 1999). In general, the emphasis depends on the focus of the organisation's strategic direction and the nature of its business. The codification approach is believed to work well when there are repeated (or similar) tasks and knowledge can be reapplied and reused. In contrast, the personalisation approach is assumed to be a preferable choice if work tasks are unique and employees rely on tacit knowledge to solve problems. These assumptions seem to be in accordance with the contingency approach to KM.

2.2 Contingency Approach to Project Management

Contingency theory (CT) contends that there is no single best way to manage in all circumstances. In other words, the optimal management is contingent upon various internal and external factors. Effective organisations must tailor their management style to their particular circumstances (Encyclopedia of Management 2009). Thus, organisational structures and procedures need to fit the organisational environment. They should also have a proper fit between their subsystems, as well as between management styles and the nature of tasks and work groups.

Factors that influence the contingency theory are numerous. Some of these include the following: the size of the organisation; how the firm adapts itself to

its environment; differences among resources and operations activities; assumption of managers about employees; strategies and technologies being used.

The classic contingency theory of Burns and Stalker (1961) presents two important and diametrically opposed ways of organising a system: mechanistic and organic. The first involves a high level of formalisation, centralisation, specialisation and standardisation and a hierarchic structure. The organic system is the opposite of the mechanistic system. It is characterised by fluid definitions of function and interactions that are equally lateral as they are vertical. The major influence here is the level of uncertainty in the environment. The mechanistic approach is suitable for stable industries, while the organic approach is more appropriate to industries undergoing change.

So far, contingency theory has been studied extensively in the context of leadership (Fiedler 1967) and decision making (Vroom and Yetton 1973), but its principles are only starting to find their way into project research. A question being asked is whether projects are sufficiently different to warrant fundamentally different contingency approach to organisation, planning and control. In response to this question, Andersen (2008) identified and described a wide range of project classification systems. These indicate that projects vary in size, complexity, risk, strategic importance and life cycle stages. They also differ in terms of the products they deliver, industries and world regions where they appear, and contractual and billing arrangements they use. However, the author warns that the existing project typologies do not rest on a theory, or even a skeleton of a theory which could tell us what these different categories mean. For the purpose of this chapter, "complexity theory" is adopted as a basis for discussing different project types.

At present, there is no unified complexity theory that would provide an agreed definition of the concept. Instead, a number of different fields address the issue with some points of resemblance, overlaps and complementarities (Hasan 2014). Among these, behavioural decision theory appears to offer the most suitable reference point for discussing the complexity concept in the project environment. Decision theory considers complexity in terms of the objective properties of the task and the subjective reaction of the individual. Among objective complexity properties, Wood (1986) has introduced component, coordinative and dynamic dimensions of the task. These refer to a number of cues or acts, form and strength of their relationships and changes over time.

On the other hand, Campbell (1988) has proposed task complexity as a primary psychological experience that may be evoked for reasons other than task, such as anxiety and fear. Investigators have also identified a number of environmental factors that contribute to complexity. Some of these include time and money constraints, significance, irreversibility and accountability. In general, constraints are recognised as stressors, while others may be related to important status or financial consequences for the decision maker or client. In addition, literature identifies knowledge, ability and motivation as those individual characteristics that make the problem more or less complex. More importantly, the contingency theory suggests that complexity impacts strategy choices and affects subsequent performance.

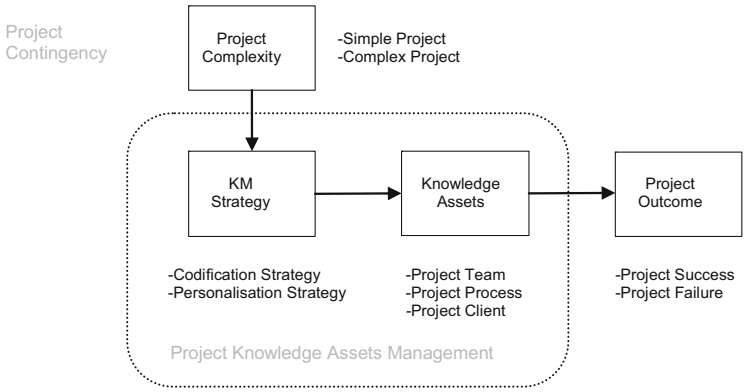

Fig. 1 Proposed knowledge-based contingency model of project management

From the perspective of the above theory, the "perceived" complexity of a project is expected to increase with the objective and/or subjective complexity due to project task, environment and/or people involved. This, in turn, is expected to affect the management of project-related knowledge assets and subsequent project outcome. Based on the above, it is argued here that "perceived" project complexity may be a good means for measuring differences among a wide variety of projects. It is therefore adopted as a major contingent factor of PM.

2.3 Description of Knowledge-Based Contingency Model of Project Management

Prior work on KVB and CT encouraged the development of an integrated knowledge-based contingency project management model that would treat different projects differently. The proposed model shown in Fig. 1 is adapted from Handzic and Durmic (2015b) for the purpose of current research. Essentially, this model draws on the general ideas from the knowledge-based view of the firm and the contingency theory of management and applies them in the project context. The resulting model encompasses four interrelated elements: (1) project complexity (simple, complex) as a major project contingency, (2) KM strategy (codification, personalisation) and (3) knowledge assets (team, process, client) as basic components of the project-related knowledge assets management, and (4) project outcome (success, failure) as the ultimate end-product of project management. The model was tested empirically in the context of software engineering projects. The following section describes empirical studies that examine the proposed relationships among model elements.

3 Empirical Studies

The literature review identified a number of proponents of the contingency view of management. However, there is a general lack of empirical evidence to support this view in both knowledge management (KM) and project management (PM) literature. The following two studies partly fill the existing void and contribute to the improved understanding of the right project—project management fit.

These studies form a part of a larger research undertaking linking project management with knowledge management. The first study, based on Handzic and Durmic (2015a), examines the role of project complexity in the impact of knowledge capital on project success. In the second study, based on Handzic et al. (2016), the focus is on the role of project complexity in the selection of knowledge management strategy for addressing project-related knowledge needs.

Each individual study is described in terms of its research background and objectives, relevant concepts and models, research methodology applied and results obtained, as well as the discussion of their significance and implications. Their research contributions are provided in the concluding sections.

3.1 Study1: The Role of Project Complexity in the Impact of Knowledge Capital on Project Success

3.1.1 Introduction

The current information systems (IS) and/or software engineering (SE) literature reports that up to 70% of these projects fail because they are not delivered on time, within budget and/or scope (King 2003; Frese and Sauter 2003). As already mentioned in Sect. 2.2, insufficient knowledge acquired and transferred from past projects to enhance the success rate of future projects is given as the most likely reason for such a high project failure rate (Yeong and Lim 2010).

In a typical software project environment, valuable knowledge can be found in project teams, clients and methods. These represent human, relational and structural dimensions of intellectual capital (IC) suggested by Sveiby (1997) and Edvinsson (1997) as critical competitive knowledge resources. A question that arises is how useful different dimensions of project-related knowledge capital are for project performance. The contingency perspective suggests that it depends on the project complexity.

While the contingency approach has received considerable conceptual attention (Hansen et al. 1999; Snowden 2002; Becerra-Fernandez et al. 2004), there has been very little empirical attention placed on it. Therefore, in response to the lack of empirical evidence, this study aims to examine whether and how project complexity (as a major contingent factor) influences the importance and impact of project-related knowledge capital on project success.

To accomplish this, a wide variety of projects were examined in a highly competitive information technology (IT) sector. Software projects are considered particularly challenging as they tackle a wide variety of business and technical

issues, demand the involvement of business and technical resources and pose difficulties in describing the project outcomes.

3.1.2 Project Success Measures and Factors

Three concepts extracted and adapted from the model shown in Fig. 1 that are of interest to this study are: project success (as the ultimate desired outcome of project management), project-related knowledge capital (as the most valuable project resource) and project complexity (as a major contingent factor).

Project success is evaluated from the project supplier point of view. Three primary criteria for judging software project success or failure are based on Sambamurthy and Zmud (2014): (i) outcomes: whether or not a project's specified outcomes are achieved; (ii) budget: whether or not a project's established budget is exceeded; and (iii) schedule: whether or not a project's established delivery dates are met.

With respect to relevant resources, the focus is on project-related intellectual capital as the most important factor of success (Stewart 1997). It is interpreted from the static (stock) view (Kianto et al. 2014) as the sum of all the intangible and knowledge-related resources that a project is able to acquire and use in the attempt to achieve success. Following the traditional classification model (Edvinsson and Malone 1997; Sveiby 1997) it is divided into human (HC), structural (SC) and relational (RC) capital. In addition, a multi-dimensional view of all three categories is acknowledged (Molodchik et al. 2014).

Handzic and Durmic (2015a) defined project-specific IC dimensions as follows: (i) project team as human capital consisting of the abilities of management (e.g. project team leader) and human resource capabilities (e.g. project team members); (ii) project process as structural capital covering internal process capabilities (e.g. project planning, execution and verification); and (iii) project customer as relational capital involving networking capabilities and customer involvement.

From the IC perspective, synergistic combinations and interactions among its human, structural and relational capital can contribute to project success. However, from the contingency perspective, different projects may require different types and combinations of knowledge assets. In particular, the contingency theory suggests a positive relationship between the level of project complexity and the level of human capital needed for successful project performance.

Based on the above review of relevant concepts and theories, a research model presented in Fig. 2 was proposed as a theoretical basis for empirical investigation. Essentially, the model suggests that the perceived project complexity mediates the role of the project's three knowledge capital dimensions [project team (HC), project process (SC), project customer (RC)] in project success. The study tested these propositions via a field survey.

3.1.3 Research Methodology

A descriptive survey, with a questionnaire as an instrument, was selected as the most suitable method for this research, as its main goal was to inspect and define the

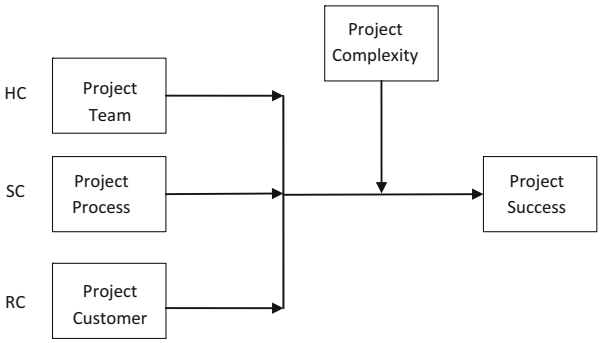

Fig. 2 Research model

broad range of project-related knowledge dimensions having an impact on project success. The questionnaire was designed based on the project success factors identified during the literature review, and participants were asked to assess the implementation and quality of each of them for one of the latest projects they worked on.

Google forms were used for questionnaire creation. Five-point Likert scales with 1-strongly disagree and 5-strongly agree were selected as most negative and most positive end points for items assessment. The questionnaire was divided into three main parts: (1) personal and demographic information, (2) project details focusing on complexity assessment of project selected by research participant, and (3) project success factors assessment, examining 82 items in total, classified into project team, project customer and project process categories.

The target group of research participants were software engineering (SE) professionals in American and European companies, involved in a project development process from both technical and business aspects. The questionnaire was distributed to recipients by using two approaches: (1) by sending a questionnaire to IT organisations so that they can spread it among their employees, (2) by sending a questionnaire via an online link to SE professionals directly. The second approach was proven to be very slow, but with a much greater response rate than the first one.

Data collection was completed with a response rate of 25%. Out of 662 questionnaire responses received in total, 59 cases were removed during a data cleaning process. The remaining 603 usable responses were analysed with the Microsoft Excel spreadsheet programme. Relevant descriptive statistics were calculated and are presented in the following section.

3.1.4 Results

Demographic Information

The first section of the questionnaire examined the participants' personal and organisational demographic information. Out of 603 participants, 62% worked on projects in European IT organisations, while 30% were involved in projects in American IT organisations. The other 8% covered Asian and Australian IT organisations.

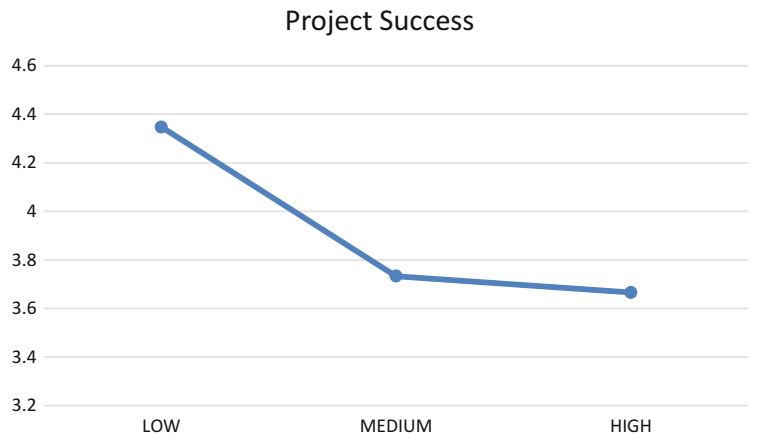

Fig. 3 Project success by project complexity

In order to produce more detailed results considering many different perspectives when assessing the selected projects, diversity in participants' roles in organisations was preferred. As results indicate, 34% of research participants held the role of a software developer, 15% participated as quality assurance engineers, and the other 51% included project managers, product managers, business analysts, software architects, database administrators, programme managers, etc.

Project Success by Project Complexity

In order to examine if project complexity had an impact on project final success and in which range, the tested projects were classified into three groups with respect to their complexity: (1) projects with high complexity, (2) projects with medium complexity, and (3) projects with low complexity. Afterwards, the success rates were calculated for each group. The results are presented in Fig. 3.

As Fig. 3 explains, on a scale of 1 (unsuccessful) to 5 (successful), highly complex projects have a success rate of 3.62, meaning that they usually get completed with average success. The result for projects with medium success is not much different, having the success rate of 3.7. Projects with low complexity are most likely to largely succeed, as the success rate for this kind of tested projects is 4.45.

Importance of Knowledge Capital by Project Complexity

Once the impact of project complexity on project success was determined, the next aim was to investigate the differences in the importance of knowledge capital for the success of each of the project groups. According to the results presented in Fig. 4, it can be seen that project process (structural capital) was given a rate of 3.46 for projects with low complexity, 3.43 for projects with medium complexity, and 3.56 for highly complex projects, meaning that the structural capital was recognised as the most effective for the low complex project among all tested projects.

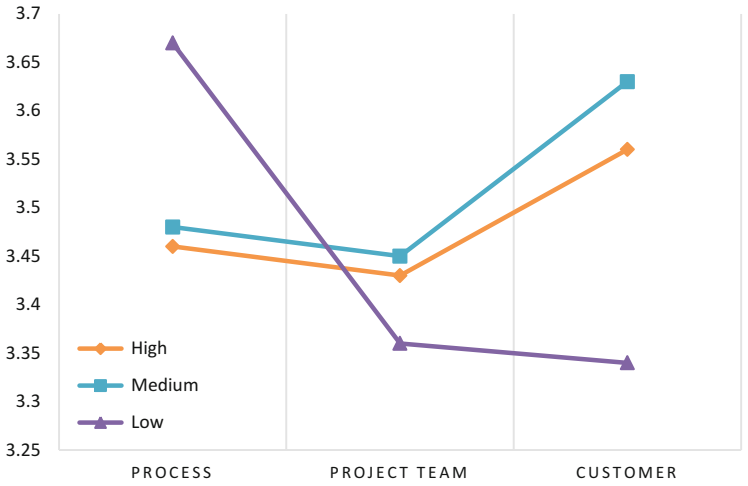

Fig. 4 Importance of knowledge capital dimensions by project complexity

Furthermore, the effectiveness of project team (human capital) was rated very closely for each tested project group: 3.43 for highly complex projects, 3.45 for projects with medium complexity and 3.36 for projects with low complexity. Finally, the project customer (relational capital) was shown to be rated with the least value for low complex projects, which is 3.34. This rate is higher for highly complex projects and projects with medium complexity, and it is 3.56 and 3.63, respectively.

When these results are further analysed, it can be seen that the importance of each knowledge capital type for projects with high and medium complexity is similar, while it drastically changes and has opposite values for projects with low complexity.

3.1.5 Discussion

Main Findings

The results of this study provide empirical support for the contingent model of knowledge capital impact on project success. It showed how project complexity mediated the role of different types of knowledge capital in project success.

Specifically, a project's external relational capital (project customer) was found to be more important than a project's internal human and structural capital (project team and project process) in moderately-to-highly complex projects. For simple projects, structural capital (project process) was more important than the other two types of knowledge assets (project team and customer). Such findings are consistent with the earlier mentioned contingency theory propositions in knowledge management, claiming increased value of people with increased complexity of the knowledge domain.

Implications for Research and Practice

The results of this study make two important contributions to research. Firstly, they fill the existing lack of empirical evidence of the contingent nature of knowledge capital importance and performance impact. Secondly, they provide valuable insights on how different project characteristics and knowledge assets influence project success.

The findings also provide useful guidelines for software project managers on how to best organise and utilise their available knowledge assets (i.e. project team, customer and process) in alignment with project complexity in order to enhance project success. Nevertheless, these implications need to be interpreted with caution due to the following study limitations.

Limitations and Future Directions

Some of the main limitations of the current investigation are methodological. Thus, convenient rather than systematic sampling was used that could weaken the strength of causal inferences. Previously untested measures for assessing software projects success factors were applied that could affect their reliability. Most data were collected from European SE professionals, so the question is whether results would hold in different world regions or among software users. Finally, only perceptual, subjective views of project complexity were captured.

These limitations need to be addressed by applying different methods in different locations and with different subjects and measures in order to verify and generalise current findings. The study also opens a number of questions for future research. More specifically, future research is recommended to extend current examination to include both static (knowledge capital) and dynamic (knowledge practice) aspects of knowledge management in project management, as well as in other relevant contexts.

3.1.6 Concluding Remarks

This study empirically tested a part of the proposed knowledge-based contingency model of project management (see Fig. 1) linking concepts from several fields of study (e.g. IC, KM, PM) in order to determine whether and how value from knowledge assets is being realised in a project environment.

The results provided full support for the contingency model tested. Most importantly, the results demonstrated that there was an increased relative value of external (relational) over internal (human and structural) knowledge capital for project performance with increased project complexity.

As such, these results make valuable contributions to research and practice of knowledge management, intellectual capital and project management by providing much needed empirical evidence that should guide practice.

3.2 Study 2: The Role of Project Complexity in the Selection of Knowledge Management Strategy for Addressing Project Knowledge Gaps

3.2.1 Introduction

Management literature recognises that one of the key criteria for survival and/or advancement of businesses operating in today's changing economic environment is to continually learn and transform their knowledge into improved and innovative products and services (Drucker 1993; Stewart 1997).

Software engineering (SE) has been widely recognised as knowledge-intensive business, so the ability to identify and leverage the required knowledge assets should play a critical role in software projects success. Despite this recognition, knowledge management (KM) literature discussing software engineering knowledge and its management is scarce (Aurum et al. 2003). The purpose of this study is to address this problem by examining the nature of knowledge management among individual software engineers.

Specifically, the current study aims to examine how different KM strategies (codification, personalisation) are being used for closing software engineers' knowledge gaps in different types of project-specific knowledge (team, process, client) in the context of software projects of varying complexity (simple, complex).

3.2.2 Research Concepts and Model

Three concepts extracted and adapted from the model presented in Fig. 1 that are of interest to this study are: gaps in project-related knowledge (as the most important factor of failure), knowledge management strategy (as a means to close existing knowledge gaps) and project complexity (as a major contingent factor).

Generally speaking, a knowledge gap occurs between what the organisation needs to know and what it actually knows. In a project environment, knowledge requirements include both internal and external types: internal, related to project team and process, and external, related to project client (Sambamurthy and Zmud 2014). Examples of team-related knowledge include leader and member responsibilities, team composition, commitment, participation, communication, motivation, technical skills, etc. Process-related knowledge covers typical project phases and activities such as planning, execution and termination. Finally, client-related knowledge involves networking capabilities and involvement of either internal or external end-users who requested the project and gain benefits or suffer losses from project outcomes.

Given that knowledge has been widely recognised as fundamental for the survival and/or advancement in modern economy (Drucker 1993), all knowledge-based organisations need to become learning organisations. The concept of a knowledge gap helps to identify the right learning strategy for the organisation. The method involves identifying gaps in the required knowledge and setting an adequate KM strategy for each of these gaps. Traditionally, management literature makes a distinction between two major KM strategies: codification and personalisation (Hansen et al. 1999). Both strategies have certain advantages and

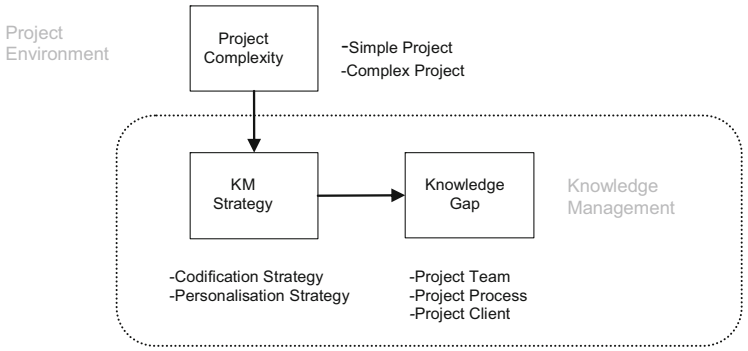

Fig. 5 Research model for current empirical study

disadvantages as previously mentioned in Sect. 2.2. Essentially, codification is document-centred and enables easy knowledge access and reuse, but lacks context-specific details. In contrast, personalisation is people-orientated, characterised by rich but slow knowledge transfer. The contingency perspective suggests that the choice of a preferred strategy for management of project-related knowledge will depend upon project complexity.

The definition of project complexity adopted for this study is the same as that used in study 1 presented in Sect. 3.1. It considers both objective and subjective aspects of complexity (Wood 1986; Campbell 1988). Objective project complexity refers to component, coordinative and dynamic dimensions. Subjective project complexity includes environmental constraints, significance, accountability and irreversibility, as well as project people's knowledge, ability and motivation. It is expected that the "perceived" project complexity due to objective and/or subjective complexity will influence the choice of a KM strategy for closing project-related knowledge gaps and thus impact subsequent project success. The aim of this study is to examine this proposition empirically in the context of software projects.

Based on the above review of relevant concepts and theories, a research model presented in Fig. 5 is proposed as a theoretical basis for empirical investigation. Essentially, the model depicts three interrelated research constructs: project complexity (simple, complex), KM strategy (codification, personalisation) and knowledge gaps in project-specific issues (team, process, client).

The model was tested empirically in the context of software projects in order to answer the following research questions: (1) whether and what kind of gaps exist in software engineers' project-related knowledge areas; (2) how do software engineers' KM strategies address these gaps; and (3) whether and how are these KM strategies influenced by varying project complexity.

3.2.3 Research Methodology

Research Design and Instrumentation

A descriptive survey, with a questionnaire as an instrument, was selected as the most suitable method for this research, as its main goal was to provide a broad picture of people's personal knowledge management practices in a project environment (Judd et al. 1991).

The questionnaire was designed based on the concepts identified during the literature review. Google forms were used for questionnaire creation. Five-point Likert scales with 1-strongly disagree and 5-strongly agree were selected as most negative and most positive end points for items assessment. The questionnaire was divided into three main parts: (1) personal and demographic information, (2) project details focusing on complexity assessment of project selected by research participant, and (3) knowledge gap assessments, classified into project team, client and process groups, with preferred KM strategy choices for closing specified gaps.

Research Subjects and Procedure

The target group of research participants was a population of European software engineers (SE) involved in a project development process from both technical and business aspects. The questionnaire was distributed to recipients by sending a questionnaire via an online link to professionals directly. Participants were asked to respond to all questions in relation to the latest project they had worked on.

Data collection was completed with an acceptable response rate. Out of all questionnaire responses received, in total, 73 cases were usable and were analysed using the Microsoft Excel spreadsheet programme. Relevant descriptive statistics were calculated and are presented in the following section.

3.2.4 Results

Demographic Information

The first section of the questionnaire examined the participants' demographic information. Out of 73 participants, 56 or 77% were male and 17 or 23% were female. They held a variety of managerial, developmental and technical roles, were between 22 and 58 years old, and had between 0.5 and 33 years of professional experience. The average respondent was a 30-year-old male with 5 years of working experience

Knowledge Gaps

In order to examine the participants' existing knowledge gaps (between needed and possessed knowledge) their responses were classified into three groups with respect to the gap size: small, medium and large. These were presented graphically in Fig. 6 by three project-related knowledge types (team, process, client).

The figure shows that subjects rarely reported large gaps in any of the three knowledge areas. However, they admitted medium gaps more frequently and small gaps less frequently in client- than team- and process-related knowledge areas.

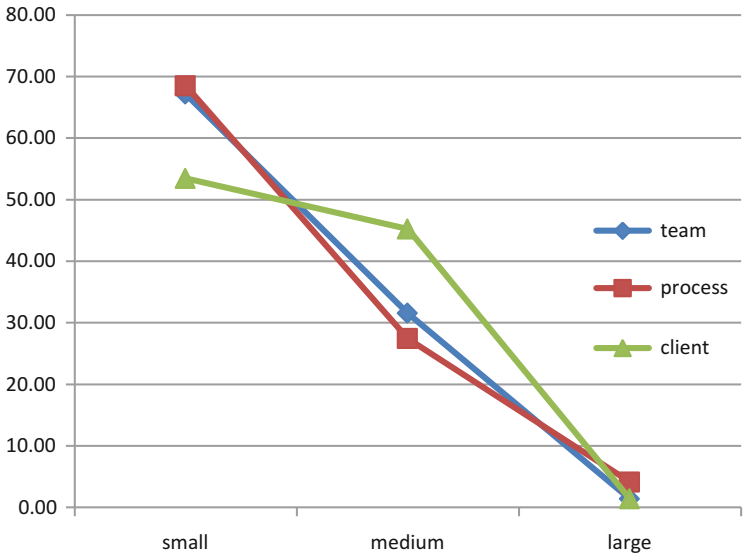

Fig. 6 Knowledge gaps by project knowledge types

About one half of responses indicated a medium gap in client knowledge areas (46%) compared to about one-third responses in team knowledge areas (31%) and process (27%) knowledge areas. The other half of responses about client knowledge areas (53%) and the majority of responses for team knowledge areas (68%) and process knowledge areas (69%) indicated small gaps. Less than 5% of responses indicated large gaps in project knowledge, with 1% of responses for client, 1% for team and 4% for process issues.

Preferred KM Strategies

Once the gaps in the three knowledge areas had been identified, the aim was to examine preferred KM strategies for closing those gaps. According to the results presented in Fig. 7, it can be seen that personalisation was more frequently reported as preferred over codification in relation to all three knowledge areas. In addition, this trend is slightly more evident in the case of the client-related knowledge gap.

Overall, more than a two-third majority of responses indicated personalisation as the preferred KM strategy over codification, irrespective of knowledge type. More specifically, responses indicated 69% of preferred choices for personalisation compared to 31% for codification, with respect to closing team- and process-specific knowledge gaps. In the case of client-related knowledge gaps, responses indicated even stronger preference for personalisation (75%) over codification (25%).

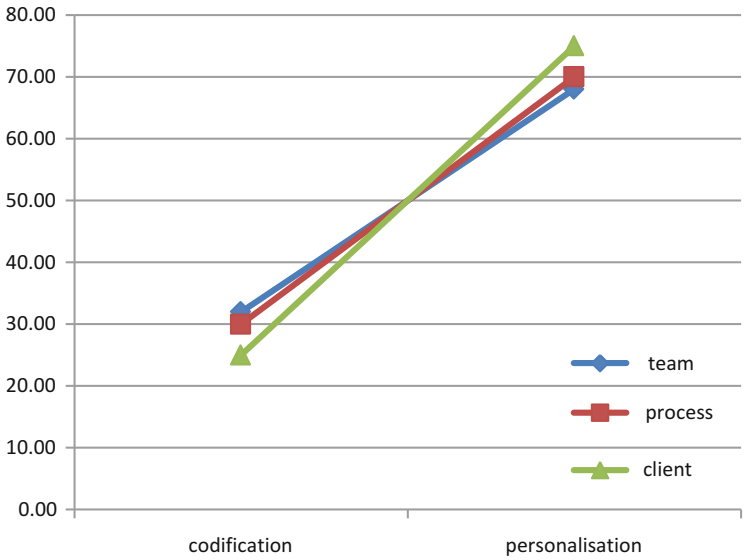

Fig. 7 KM strategies by project knowledge types

Importance of Project Complexity in KM Strategy Choice

In order to examine if project complexity had an impact on KM strategy choices and in which range, the tested projects were classified into two groups with respect to their perceived complexity by respondents: (1) simple projects (or projects with low-to-moderate complexity) and complex projects (or projects with moderate-to-high complexity). Then, preference indices were calculated as ratios of personalisation and codification strategies by project complexity for all three knowledge types.

The overall results from Fig. 8 indicate that the preference for personalisation KM strategy over the codification KM strategy for closing knowledge gaps more than doubled with increased project complexity.

In particular, with increased project complexity (from simple to complex) the average preference index value increased to 2.7 (from 1.8) for team-specific knowledge gaps. An even greater increase in the average preference index value to 3.7 (from 1.5) was indicated for knowledge gaps in process-specific issues. The highest preference index value of 4.5 in complex projects, compared to 2.3 in simple projects, was indicated for knowledge gaps in client-specific issues.

3.2.5 Discussion

Main Findings

In summary, the results of this study: (a) reveal a widespread existence of sizeable gaps in project-specific knowledge, especially in client-related issues, among

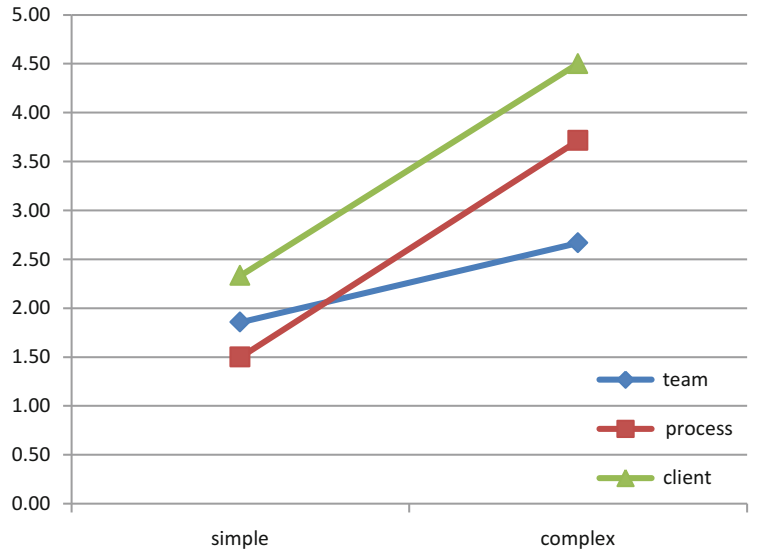

Fig. 8 KM strategies by project complexity

surveyed software engineers; (b) indicate clear preference for personalisation over codification, as a personal KM strategy, for closing gaps in required project knowledge irrespective of type, and (c) show even greater preference for personalisation over codification in complex rather than in simple projects.

Specifically, over one half of participants self-reported average (medium) gaps in client-related issues, compared to about one-third of participants who exhibited similar gaps in team- and process-related areas. Only a few participants reported large gaps in their project-related knowledge. These findings suggest that software engineers are lacking the most in the most important knowledge area for complex projects success (Handzic and Durmic 2015a). The potential reason for such findings may be in the numerous ambiguities surrounding project start and activities that should be completed before the start (Savolainen et al. 2011). The following recommendations have been given to remedy the situation: gain a holistic understanding of the customer's business, learn about the project objectives by reading available documents and participating in project meetings, and develop a common understanding of the project between project customer and supplier.

With respect to KM strategies, the two-third majority of participants selected personalisation over codification as their preferred KM strategy for closing knowledge gaps irrespective of type. However, preferential choice of personalisation over codification was over two times more frequent in complex rather than in simple projects. In addition, it was most prominent for client-related knowledge. Such findings are consistent with prior empirical evidence of increased value of people over structures and procedures with increased project complexity (Handzic and Durmic 2015a). They are also consistent with the contingency theory propositions

in knowledge management (Becerra-Fernandez et al. 2004; Hansen et al. 1999; Snowden 2002), claiming increased value of people's tacit knowledge and sharing through socialisation (Nonaka and Takeuchi 1995) in novel and complex tasks at hand.

Implications for Research and Practice

The results of this study make two important contributions to research. Firstly, they fill the existing lack of empirical evidence of the contingent nature of knowledge management in general, and in project environment in particular. Secondly, they provide valuable insights into project influences on people's choices of preferred KM strategies for addressing their gaps in required knowledge.

The findings also suggest useful guidelines for software practitioners on how to pursue the right balance between personalisation and codification strategies in alignment with project complexity and related knowledge needs in order to enhance subsequent project success. Nevertheless, these implications need to be interpreted with caution due to the following study limitations.

Limitations and Future Directions

The main limitations of the current investigation are methodological. Convenient rather than systematic sampling was used that could weaken the strength of inferences made. Previously untested measures for assessing factors under investigation were applied that could affect their reliability. Most data were collected from European software professionals, so the question is whether results would hold in different world regions or among software users. Finally, only perceptual, subjective views of respondents were captured.

These limitations need to be addressed by applying different methods in different locations and with different subjects and measures in order to verify and generalise current findings. The study also opens a number of questions for future research. Future research is recommended to extend current examination to other contingencies that may affect knowledge management, as well as decomposing both static (knowledge stock) and dynamic (knowledge practice) aspects of knowledge management for a deeper understanding in the project environment, as well as in other contexts. Also, it would be interesting to study projects in construction or heavy industry sectors where the teams and processes may differ significantly from SE domain. In the complex domains such as construction or heavy industry, the emotional knowledge might be more important than rational in organising and leading people. Also, in change projects, emotional and spiritual knowledge become increasingly important in comparison with rational knowledge.

3.2.6 Concluding Remarks

This study empirically tested a part of the knowledge-based contingency model of project management (see Fig. 1) linking concepts from several fields of study (e.g. IC, KM. PM) in order to explore the nature of individual KM strategies of software engineers in varying projects.

The results provided full support for the contingency model tested. Empirical evidence indicated the existence of sizeable knowledge gaps, especially in client-related issues. More importantly, the results demonstrated that there was an increased preference of the personalisation over codification KM strategy for closing knowledge gaps with increased project complexity.

As such, these results make valuable contributions to research and practice of knowledge management, intellectual capital and project management by providing much needed empirical evidence that should guide practice.

4 Overall Contributions and Recommendations

This chapter looked at what are believed to be the most important concepts and theories concerning traditional and contemporary approaches to project management. It identified the fundamental difference between these two approaches in universal versus contingency, and task versus knowledge (resource)-based perspectives.

Drawing on ideas from the knowledge-based view (KBV) of the firm and the contingency theory (CT) of management, the chapter made two important contributions to the body of project management (PM) knowledge: (1) A conceptual knowledge-based contingency model of PM that applies essential KBV and CT principles to project context; and (2) much needed empirical evidence that fills the existing lack, and confirms the contingent and knowledge-based nature of project management.

The empirical findings lead to the following recommendations for practice: (1) when faced with highly complex projects, managers should pay much greater attention to external client-related knowledge needs and "haves" than internal team- or process-related knowledge. The opposite recommendation is valid for simple projects (see study1 for details); and (2) when faced with highly complex projects, managers should choose personalisation to exchange tacit knowledge with experts, while codification may be a less costly and more efficient choice to reuse captured process-related knowledge in simple projects (see study2 for details). Such recommendations are supported by classic Burns and Stalker's (1961) organic versus mechanistic propositions.

However, for the time being, these contributions and recommendations are limited to software projects. Future research may replicate current investigation in different project contexts and with different participants (e.g. users). Future research applying different research methods and objective measures is also recommended to address the weaknesses of survey design and untested subjective measures used in the current research. Finally, one plausible area for extended research may be in the nature of knowledge management at different project stages (e.g. before, during and after). These are only some of the many potential opportunities and challenges facing prospective researchers.

References

Andersen, E. S. (2008). *Rethinking project management: An organisational perspective*. Harlow: Pearson Education.

Aurum, A., Ross, J., Wohlin, C., & Handzic, M. (Eds.). (2003). *Managing software engineering knowledge*. Berlin: Springer.

Becerra-Fernandez, I., Gonzales, A., & Sabherwal, R. (2004). *Knowledge management: Challenges, solutions, and technologies*. Upper Saddle River, NJ: Pearson Education.

Bontis, N. (1998). Intellectual capital: An exploratory study that develops measures and models. *Management Decision, 36*(2), 63–76.

Bratianu, C. (2011). Changing paradigm for knowledge metaphors from dynamics to thermodynamics. *Systems Research and Behavioral Science, 28*, 160–169.

Bratianu, C. (2015). *Organizational knowledge dynamics: Managing knowledge creation, acquisition, sharing, and transformation*. Hershey, PA: IGI Global.

Bratianu, C., & Orzea, I. (2013). The entropic intellectual capital model. *Knowledge Management Research and Practice, 11*(2), 133–141.

Bronte-Stewart, M. (2015). Beyond the iron triangle: Evaluating aspects of success and failure using a project status model. *Computing and Information Systems, 19*(2), 21–37.

Burns, T. E., & Stalker, G. M. (1961). *The management of innovation*. London: Tavistock.

Campbell, D. J. (1988). Task complexity: A review and analysis. *Academy of Management Review, 13*(1), 40–52.

Davenport, T. H., & Prusak, L. (1998). *Working knowledge*. Boston: Harvard Business School Press.

Drucker, P. F. (1993). *Post-capitalist society*. New York: Harper Business.

Edvinsson, L. (1997). Developing intellectual capital at Skandia. *Long Range Planning, 30*(3), 366–373.

Edvinsson, L., & Malone, M. (1997). *Intellectual capital: Realizing your company's true value by finding its hidden brainpower*. New York: Harper Collins.

Encyclopedia of Management. (2009). *Contingency approach to management*. Visited February 2, 2016, from http://www.encyclopedia.com/doc/1G2-3273100055.html

Fiedler, F. E. (1967). *A theory of leadership effectiveness*. New York: McGraw-Hill.

Frese, R., & Sauter, V. (2003). *Project success and failure: What is success, what is failure, and how can you improve your odds for success?* Visited November 23, 2014, from http://www.umsl.edu/~sauterv/analysis/6840_f03_papers/frese/

Grant, R. (1996). Towards a knowledge-based theory of the firm. *Strategic Management Journal, 17*, 109–122.

Handzic, M., & Durmic, N. (2015a, June 10–12). The role of project complexity in the impact of knowledge capital on project success. In *Proceedings of the 10th International Forum on Knowledge Asset Dynamics (IFKAD 2015)*, Bari, pp. 199–208.

Handzic, M., & Durmic, N. (2015b). Knowledge management, intellectual capital and project management: Connecting the dots. *The Electronic Journal of Knowledge Management, 13*(1), 51–61. Retrieved from http://www.ejkm.com

Handzic, M., Durmic, N., Kraljic, A., & Kraljic, T. (2016). *The role of project complexity in the selection of knowledge management strategy for addressing project-related knowledge needs*. Working Paper, International Burch University.

Hansen, M. T., Nohria, N., & Tierney, T. (1999). What's your strategy for managing knowledge? *Harvard Business Review, 77*(2), 106–116.

Hasan, H. (2014). Complexity theory. In H. Hasan (Ed.), *Being practical with theory: A window into business research* (pp. 49–54). Wollongong: University of Wollongong.

Judd, C. M., Smith, E. R., & Kidder, L. H. (1991). *Research methods in social relations* (6th ed.). Fort Worth, TX: Harcourt Brace Jovanovich College.

Kianto, A., Ritala, P., Spender, J. C., & Vanhala, M. (2014). The interaction of intellectual capital assets and knowledge management practices in organisational value creation. *Journal of Intellectual Capital, 15*(3), 362–375.

King, J. (2003). *Survey shows common IT woes persist*. Visited November 23, 2014, from http://www.computerworld.com/s/article/82404/Survey_shows_common_IT_woes_persist?taxonomyId=014

Lawrence, P. R., & Lorsch, J. W. (1967). *Organization and environment: Managing differentiation and integration*. Boston, MA: Harvard University.

Molodchik, M. A., Shakina, E. A., & Barajas, A. (2014). Metrics for the elements of intellectual capital in an economy driven by knowledge. *Journal of Intellectual Capital, 15*(2), 206–226.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge creating company: How Japanese companies create the dynamics of innovation*. New York: Oxford University Press.

Penrose, E. (1959). *The theory of the growth of the firm*. Oxford: Oxford University Press.

PMI. (2013). *A guide to the Project Management Body of Knowledge (PMBOK Guide)* (5th ed.). Newton Square, PA: Project Management Institute.

Sambamurthy, V., & Zmud, R. W. (2014). *No excuses: Realizing promised benefits from digitization*. USA: Legerity Digital Press.

Savolainen, P., Verner, J. M., Land, L. P. W., & Low G. C. (2011). What happens before a project starts? Project start-up from the supplier perspective. In *Information systems development—Business systems and services: Modeling and development*. doi:10.1007/978-1-4419-9790-6_52.

Shenhar, A. J. (2001). One size does not fit all projects: Exploring classical contingency domains. *Management Science, 47*(3), 394–414.

Shenhar, A. J. (2012). *Why one size does not fit all*. Hoboken, NJ: The SPL Group.

Snowden, D. (2002). Complex acts of knowing: Paradox and descriptive self-awareness. *Journal of Knowledge Management, 6*(2), 100–111.

Stewart, T. A. (1997). *Intellectual capital: The new wealth of organizations*. New York: Doubleday.

Sveiby, K. (1997). *The new organization wealth: Managing and measuring knowledge-based assets*. San Francisco: Berrett-Koehler.

Vroom, V. H., & Yetton, P. W. (1973). *Leadership and decision-making*. Pittsburgh: University of Pittsburgh Press.

Wood, R. E. (1986). Task complexity: Definition of the construct. *Organisational Behaviour and Human Decision Processes, 37*(1), 60–82.

Yeong, A., & Lim, T. T. (2010). Integrating knowledge management with project management for project success. *Journal of Project, Program and Portfolio Management, 1*(2), 8–19.

Knowledge Sharing System Under Open Project Perspective: Chinese Experience

Liliana Mitkova and Xi Wang

Abstract

Knowledge sharing is considered as a main driver for successful project management, especially in an open perspective. This chapter is focused on the practical evidence of China's knowledge sharing system from the institutional and organizational perspectives. At the institutional level, the authors point out the government regulation to construct a system of specific Chinese knowledge sharing mode between firms, universities, research institutions and market allowing the success of open model. At the organizational perspective, the analysis underlines the progressive building of knowledge sharing system in China at the example of Huawei case study.

1 Introduction

The open innovation model has been widely adopted in the last decade so as to adapt to the rapid knowledge exchanges, shorten lifecycle of the products and high international competitiveness. This model proposes to enhance firm's innovative ability by acquiring knowledge from external sources, as well as by using external paths to market for internally generated technologies (Chesbrough 2003; Gassmann and Enkel 2004). The central idea of the open model is that firms cannot rely entirely on their own research and can benefit from technological and market discontinuities into the open innovation projects by sharing knowledge with other

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institutions and organizations. In fact, the knowledge sharing is a key component of open projects. Lichtenthaler (2011) underlines the link between these two concepts defining open innovation as "systematically performing knowledge exploration, retention, and exploitation inside and outside an organization's boundaries throughout the innovation process".

The management literature proposes various approaches that refer to how organizations create, retain, diffuse and share knowledge (Bogers 2012). Actually, the knowledge sharing, meaning how an organization obtains access to its own and external organizations' knowledge, has emerged as a key issue in the broad field of technology transfer and innovation activities, and more recently in the field of open project management. Cummings (2003) suggests three types of researches dedicated on knowledge sharing in open innovation perspective. First, the analysis investigates how different forms and location of the knowledge affect the modes of sharing process. Second, the studies focused on the types of practices and rules of engagement adopted by different actors that shape the management of the flows of resources and knowledge in the innovation projects. Third, the researches dedicated on specific structures and instruments through which the parties seek to facilitate knowledge sharing. However, despite these studies, how to effectively manage knowledge sharing in the open innovation projects is not yet fully understood (Enkel et al. 2009), especially the specificities in knowledge sharing practices in different countries (Kostova 1999). Generally, countries differ in their institutional characteristics; consequently the organizational practices reflect the institutional environment of the country where they have been developed and established; and, therefore, when practices are transferred across borders, they may not 'fit' with the institutional environment of the recipient country. Hence, the main purpose of this chapter is focused on the second approach, offering an overview of the specific measures and practices implemented in the Chinese innovation system in order to encourage knowledge sharing in the projects.

A company's capacity to make use of knowledge sharing has been viewed as a source of sustainable competitive advantage by Chinese firms and their successful integration in the innovation landscape. China is determinate to enhance the companies' competitiveness and to be defined as an "innovation-oriented" country by 2020 and a "leading science power" by 2050 (Chen and Li-Hua 2011). In general, the innovation policy has been promoting by strengthen the internal R&D capacities and recently by adopting more open approach towards the international technologies in order to catching-up and improve the internal innovative performance (Chen and Qu 2003). The recent literature debates the relative importance of different national policies' instruments as a major determinant of China's innovation system improvement (Hung 2009; Liu 2010). The academic works put the accent on the external factors influencing the implementation of open model in China (Savitskaya et al. 2010), mainly the role of the intellectual property system and government instruments (Deng 2009).

This chapter focuses on the knowledge sharing system from institutional and organizational perspective in order to show how this system encourages the implementation of open innovation project in China. At institutional level, the analysis

points out the government regulation supporting the building of typical Chinese knowledge sharing modes. At organizational level, the study reveals the process of knowledge sharing implementation into the firms at the example of Huawei case as a typical High-tech enterprise in China.

2 Knowledge Sharing into Open Innovation Perspective of Projects

Knowledge sharing become an important focus in the strategic management field, where knowledge is seen as the most strategically-important resource (Grant 1996) and a principal source of value creation (Teece et al. 1997; Nonaka 1991). Indeed, "in many industries, the importance of developing abilities to better utilize the knowledge contained in the firm's network has become apparent" (Bresman et al. 1999, p. 441). Moreover, the very basis for some organizational activities is the sharing of knowledge both between units and with outside partners and clients (Cummings 2003). From general point of view, knowledge sharing characterizes an activity through which knowledge (i.e., competences, skills, expertise, etc.) is exchanged among friends, families, communities, or organizations (Bukowitz and Williams 1999). In fact, it is a two-way or dual process, including both the supply of new knowledge and the demand for new knowledge, enquiring and contributing to knowledge through activities such as learning-by-observation, listening and asking, sharing ideas, giving advice, recognizing cues, and adopting specific patterns of behaviour (Bosua and Scheepers 2007). In addition, knowledge sharing is referred to the provision of information tasks targeting the open collaboration to solve problems, develop new ideas, or implement policies or procedures (Wang and Noe 2010). From innovation's perspective, Nonaka and Toyama (2003) consider knowledge sharing such as critical stage in the transfer process which fosters the collaboration and communication, and enhances open innovation projects (Liebowitz 2002).

With the technology transfer and the open innovation research, the implementation of the knowledge sharing process becomes the key innovation success factor for the companies. Recent studies (Chesbrough 2003; Spencer 2003) stress that future innovations are dependent on more open and holistic knowledge searching. To establish knowledge sharing process requires appropriate methods and practices, in other words, a medium to encourage open innovative activities. Chesbrough and Teece (1996) argue that open and networked innovation processes need to be carefully structured. In this vein, Binz-Scharf (2003) considers that the establishment of the knowledge sharing system could be analysed at two different levels: inter-organizational and organizational.

The inter-organizational knowledge network is characterized by the types of actors and the fluidity of their links defined as "all actors within an observable knowledge network that have their own cognitive knowledge networks, which refer to their perceptions of the overall observable knowledge network" (Contractor et al. 2000). The first dimension refers to the role of various actors in the knowledge

sharing, considered as either the individuals or the organizations (Albino et al. 1999). The knowledge networks fluidity is supported by macro-level variables and instruments (Binz-Scharf 2003; Cummings 2003; Rousseau 1985). For example, the external variables affecting knowledge flows concern the legal system, structural characteristics, national policy and cultural norms (Gupta and Govindarajan 1991; Contractor and Sagafi-Nejad 1981). In addition, the structural arrangement between the main actors can serve to shape the flow of assets, the depth and breadth of interaction between them, and the incentives for collaboration.

At organizational level, the main characteristic symbolizing the implementation of knowledge sharing system is the degree of formalization of the sharing processes: the formal type of organizational coordination mechanism defined as "hierarchy"; and the informal type of the mechanism described as "social networks" (Powell 1990). Actually, the hierarchical structures are used to coordinate knowledge processes in complex organizations or systems with multiple specialized units (Tsai 2002). However, the centralization in hierarchical structure might restrain knowledge sharing in different units and levels unless they were required to do that by the higher authority. Moreover, the organizational-level researches highlight lower economic and time costs (Mansfield et al. 1979), relationship links (Hansen 1999) business strategy (Grant 1996), tacitness and embeddedness (Zander 1991) as key variables for encouragement of knowledge sharing into innovation process. Likewise, organizational culture related to the innovation process basically representing the set of behaviours, technical skills, resources and technology assets attitudes and values belonging to and shared by the members of an organization is also important for the knowledge sharing development (Albino et al. 1999).

In the recent innovation and knowledge management literature, the importance of external knowledge sources and utilization of networks in the innovation project have been strongly emphasized (Caloghirou et al. 2004; Spencer 2003). Open innovation model has been appeared as a new paradigm pouting the accent on the opening up of organizational boundaries in order to use and recombine internal and external knowledge to develop and commercialize valuable innovations (Chesbrough 2003). In fact, the open innovation model is based on knowledge sharing because this process is defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough 2006). Islam also underlines the interactions between the concepts of open innovation and knowledge sharing. Furthermore, Kirschbaum (2005) considers that "open innovation is finding and selecting innovative knowledge flows that is right for the organization" and requires firms to develop both their "internal knowledge" and "adaptive capacity" to use the external knowledge (Buganza and Verganti 2009). In the same vein, Laine and Laine (2012) claim that the importance of open innovation project belongs to different knowledge sharing processes. Indeed, researches identify three main knowledge sharing processes in the open innovation projects (Enkel et al. 2009):

- the outside-in process enriching the company's internal knowledge through the integration of suppliers, customers and external knowledge sourcing. This innovation process can be described as knowledge internalization (Zemaitis 2014). There is positive relationship between firm performance and open innovation project through effective engagement in knowledge sharing with other firms (Wang and Li-Yinag 2014);
- the inside-out process, which refers to earning profits by bringing internal knowledge to the market, sharing IP and transferring ideas to the outside environment. This process could be referred as knowledge externalization (Zemaitis 2014). This knowledge sharing process impact also company technical and financial performance (Lichtenthaler 2011; Glasson et al. 2006);
- the coupled process "refers to co-creation mainly with complementary partners through alliances, cooperation, and joint ventures during which give and take are crucial for success" (Enkel et al. 2009). As a coupled process, knowledge sharing combines the inbound and outbound processes of open innovation by allowing firms to jointly develop and commercialize innovation. This process can be described as knowledge co-creation (Zemaitis 2014). The value of such collaborative innovation, both in terms of economic welfare and corporate competitive advantage, has grown tremendously in recent years (Verspagen and Duysters 2004; West et al. 2014).

At organization level the implementation of these three knowledge sharing processes requires some organizational arrangements (Naqshbandi and Kaur 2011; Chen et al. 2012). In particular, the organizational structure and internal knowledge sharing network are considered as the starting point for the implementation of the open innovation projects (Chiaroni et al. 2010). The academic works recognize the essential organizational mechanisms that encourage knowledge sharing in the innovation projects: the role of top management to promote changes (Chiaroni et al. 2010); the building of partners' network encouraging the acquisition of external knowledge (Perkmann and Walsh 2007; Chesbrough and Crowther 2006); the formalized processes for evaluating external knowledge to complement the existing explorative network (Chesbrough 2006) and the creation of specific networks dedicated to the knowledge sharing.

Henceforward, the open innovation paradigm offers a framework of possible knowledge flow ways and different collaborative degrees in the project (Chesbrough and Crowther 2006). Although the fact that knowledge flows are available and partnership networks create value, an effective knowledge management experience is still needed to enhance knowledge absorption capacities. Actually, the knowledge management within open innovation project implementation is an emerging field and has the support from the industrial community. This context leads to the conclusion that a better understanding of knowledge sharing practices in the open innovation projects at organizational and inter-organizational levels is still necessary. The next part will present the Chinese experience in a practical perspective to highlight the main opportunities and constraints of knowledge sharing system.

3 Development of Chinese Current Knowledge Sharing System

In order to illustrate the building of knowledge sharing system in China the main current practices at inter-organizational and firm's level are developed in this chapter.

3.1 Inter-organizational Perspective

In general, Chinese innovation policy has been promoting by strengthen the internal R&D capacities and recently by adopting more open approach in order to catching-up and improve the internal innovative performance (Chen and Qu 2003). Since 2006 Chinese government has emphasized the strategic policies for implementation of "indigenous innovation model" (Li-Ying and Wang 2014) promoting knowledge sharing mostly at domestic level. The main purpose of the national innovation policy is to encourage the knowledge sharing between the three main actors: universities, government-led research institutes and private enterprises (see Fig. 1). For example, the Chinese government becomes an active participant in the national knowledge system, supporting the sharing of the knowledge flow between the government institutions, local players and firms. This role includes first, the establishment of an enabling environment via appropriate laws, especially

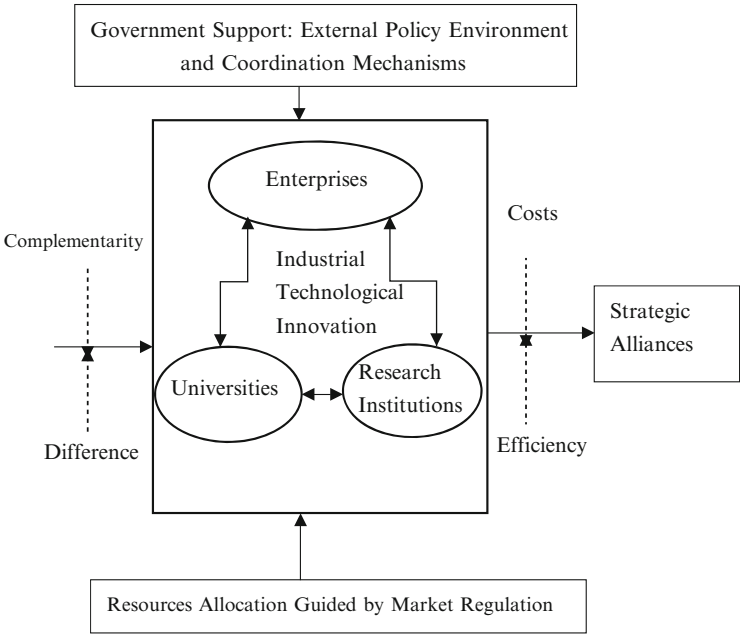

Fig. 1 Knowledge sharing mechanism

IP rights and financial regulations for knowledge sharing; second, the development of an internal "horizontal" knowledge sharing system between different governmental institutions at strategic level; and third, the founding of vertical sharing concerning the coordination between different levels of players within the government institutions. To implement this strategic aims the Chinese government introduces various actions. For example, the government has promulgated and implemented the National Knowledge Management Standard GB/T23703 that specifies the main rules and ways for the knowledge shearing. Moreover, in July 2009, the Chinese Ministry of Science and Technology (MOST) with the collaboration of other five ministries had jointly launched the National Technical Innovation Engineering General Plan. Then, in December 2009, was launched the programme "Building and Implementing: Measures on Promoting the Development of Industrial Innovation and Strategic Alliance (Trial)".

Furthermore, at local level, the domestic institutions also take active roles in the knowledge sharing process. In this sense, they set up special funds for stimulating industry-university-research cooperation, mainly based on innovation joint programmes and R&D collaborations. For example, the subsidies and incentives for Science & Technology intermediary service institutions are established. These institutions realize different tasks aiming the encouragement of the knowledge sharing activities: quality measuring, testing and certification services, technology consulting and technology trade intermediary services. Moreover, the subsidies for investment in industry-university- research cooperation programmes as well as for S&T incubators' development are introduced.

The Chinese efforts in indigenous innovation face the challenge of building knowledge sharing modes and innovation network with global impact. At inter-organizational level the knowledge sharing is implemented by three main forms of consortium: project programme, industry technology alliance and scientific research alliance:

- The project cooperation programme is a temporary organized knowledge sharing structure established by different actors to accomplish a specific scientific research aims in a given time span. The goal is to create a technological consortium between firms setting up various mechanisms for sharing in the research and production activities. This consortium is based on strong structure, procedures, timeliness, etc. This innovation project team collaborates usually for the development of key technologies or to tackling key problems. Hence, the knowledge sharing structure lacks of continuity because the teams are always disbanded once the task is completed. Therefore, this consortium is suitable for a short time project within specific areas of knowledge sharing, but is not conducive to real-time updates and further optimization of the knowledge.
- The industry technological alliance is established between enterprises, universities, research institutions or other types of organizations. This consortium, based on common agreement, encourages the joint technological development and the sharing of risks, benefit and complementary advantages. In general, when the technological alliance is based on government funding, the members in

Table 1 Vehicle industry alliance

Organizational Goals	Immediate objective: to promote harmonization of technical standards in the industry; Long-term objective: to master the core technology of electric vehicles, to create an internationally competitive Chinese electric car companies and brands
Knowledge sharing goals	– integration of resources and technical cooperation – intellectual property sharing – knowledge sharing for technology diffusion and transfer
Organizational Funding	Dues and an initial capital of 1.3 billion Yuan from State-owned Capital Gains—SASAC (State-owned Assets Supervision and Administration Commission)
Organization and Management	SASAC centralized the coordination process and the leadership, setting up the council, the secretariat and the main Committees.
Knowledge Sharing Mechanism	Members share common technologies developed by the Alliance; own internal technologies developed by companies are shared on the market; sharing of the common technologies outside of the Alliance via technological transfer

this alliance should share common technologies with each other or even with other organizations outside the alliance under certain conditions. Table 1 illustrates the case of the Vehicle Industry Alliance, which is government founded. But, if the alliance is based on a cost-sharing mode between the members and partly subsidized by government, the partners can require a paid knowledge transfer to the organizations outside of the alliance.

– The scientific research based alliance is funded by the government or firms with the main task of knowledge sharing and research activities. Generally, this form needs a joint investment of enterprises, research institutions and universities funds in order to establish a collaborative R&D institutions, laboratories or technology centre. The alliance is a long-term and sustainable structure for knowledge sharing.

3.2 Organizational Perspective: Huawei Case Study

Huawei technologies, founded in 1987 in Shenzhen, China, becomes one of the world's leading information and communication solutions provider. At present, the group invests in three main business domains: operator network business, company business and consumer business. In the field of operator network business, Huawei's wireless market is experiencing steady growth, network products and solutions have been used in the vast majority of operators. In optical transmission Huawei became leader in software defining network technology in the end-to-end network architecture Soft COM. The telecom software business continues a rapid growth and the group reshapes the Smart Care CEM industry standards. In terms of enterprise business, Huawei launched a globally data centre for the storage of intelligent products and solutions. And in consumer business, Huawei has laid a foundation for product design, quality and cost control and was listed as one of the

world's top Smartphone manufacturers. At present, Huawei is a leading global ICT solutions provider, present in more than 170 countries, and serving more than 3.5 billion people all around the world.

The firm's innovation strategy is based on independent research activity in the 23 research institutes of Huawei in China, Germany, Sweden, UK, France, Italy, Russia, India, etc. Currently, Huawei adopted an open orientation of the innovation process through two ways: inbound orientation by the research collaborations with the international leaders in addition of the patent acquisitions and outbound approach by cross-licensing to obtain the technologies at low price and to establish the international standards.

Regarding the outside-in activity, the group develop mainly R&D collaborations with different partners such as firms, academic and research institutes. In particular, 28 joint innovation centres have been created promoting knowledge sharing processes between partners. Huawei also approved patent acquisitions for $300 million in order to enrich the patent portfolio and enhance its technological capabilities.

Concerning the inside-out activity, Huawei signed cross-licence agreements with few international partners (Ericsson, Nokia, Siemens and Qualcomm). The licensing fee in 2010 is $0.22 million with aim to participate in the telecommunication standards and to provide outward licences for basic patents, according to the principle of FRAND (fair, reasonable and non-discriminatory terms). By the end of 2011, Huawei has joined 130 industry standards organizations, such as the 3GPP, IETF, ITU, and submitted more than 28,000 proposals to these standards organizations.

To implement the open innovation processes Huawei develops intensive knowledge sharing policy (see Table 2). The initial stage of this policy (1987–1991) is devoted to the Inter-enterprise knowledge sharing process. At this phase, Huawei interacts occasionally with public institutions and with few small firms because of the lack of capital and technology. Then, the second stage corresponding to the beginning of the telecommunications equipment manufacturing (1992–1999), is characterized by cross-border knowledge sharing. At this stage, Huawei acquires patents (for example, Huawei spent $50 million to introduce IBM's IPD integrated management model) and also starts to transfers the internal technological knowledge. The third stage (2000–2002) is dedicated on the intensive improvement of the internal knowledge sharing. The group develops specific technical platform for knowledge sharing including Domestic and WAN, Lotus Notes R6, conference calls and other tools intensifying the communications between employees and experts. Likewise, Huawei focuses on promoting knowledge sharing within the enterprise and improving employee's technological innovation capability to communicate with external environment. The next step (after 2003), related to the international development of the group, involves inward and outward interactive knowledge sharing. The collaborations with research institutions, such as universities, State Key Laboratory, but also with Intel, IBM, SUN, Microsoft, HP and other multinational companies are established. After 2008, Huawei focused the efforts on open innovation culture, developing in parallel knowledge sharing tools, open projects and social networks.

Table 2 Development of Huawei's knowledge sharing system

Simple knowledge management (Up to 2008)	Isolated knowledge and IT systems Lack of Knowledge Management specialists Lotus Notes office platform and knowledge base
Infancy stage (2008–2010)	Web2.0 technology, Building social platforms Knowledge management has established with dedicated team 3ms knowledge-sharing platform Development of knowledge-sharing communities E-learning platform
Development stage (2011–2012)	Strengthen knowledge management awareness Set up a full-time team-level knowledge management Continue consolidation, construction, optimization 3ms Knowledge-sharing platform (including communities of practice) Web office environment Exploration of the external players
Deepening stage (After 2013)	Promotion knowledge sharing with the wider business in new areas Mobile terminal access The integrated knowledge management platform More intelligent knowledge push Strengthening social networks

The development of external collaborations and knowledge sharing is subordinated by the Strategy and Development committee, which is one of four subcommittees of the Huawei board of directors (with Human Resources committee, Finance committee and Audit committee). Its main role is to define the medium and long-term R&D strategy, patent protection as well as the major forms of knowledge sharing processes. To encourage this new orientation Huawei especially pays great attention to improve the staff's consciousness of intellectual property rights, technological capabilities for knowledge sharing and open orientation of the innovation projects. The training courses dedicated to the IP rights and technological platforms are put in place as well for new employees as for senior engineers and research teams.

4 Conclusion

The latest academic and managerial works highlight the major role of knowledge sharing system in the innovation management especially in the case of an open innovation model. Traditionally, the debates dedicated on the Chinese innovation system focuses on the barriers for open model (Savitskaya et al. 2010). Nevertheless, the implementation of the open model in China passes upon the development of various measures supporting the knowledge sharing system at two main levels: inter-organizational and organizational level. At inter-organizational level, the government aims to encourage the building of a sustainable intermediary platform for knowledge sharing by the establishment of:

- government portal website for firms' and public government information providing public services and policy advice;
- government knowledge management centre for knowledge sharing, innovation and IP protection;
- government knowledge feedback platform in order to test the efficiency of knowledge sharing measures.

These knowledge platforms allow the optimization of the information process, the communication and the transfer as well as the development of information services that improve knowledge management mechanisms.

At organizational level, the implementation of knowledge sharing system into open innovation perspective puts in evidence some general characteristics:

- the establishment of specifics structures (defined "consortium") for knowledge sharing and open innovation collaboration with strong framework and management procedures;
- the management of the knowledge sharing processes by centralized and formal mechanisms;
- the improvement of enterprise knowledge sharing system claims long-term organizational learning.

The case of Huawei made possible to illustrate the evolution of Chinese knowledge sharing forms based mainly on outside-in and inside-out processes. This case study helps to identify the key barriers for development of large knowledge sharing process between main actors. The first concerns the lack of proper technical support, effective computer network, communication system and technological platform in the enterprises facilitating the knowledge sharing. The second is the deficiency of the information system into the firms (slow speed of information transmission and a serious phenomenon of information recession and distortion) that make difficult the interactive communication and coordination between internal players. Moreover, the competitive relationship between employees, the independence of departments and the difficulty of knowledge transfer across the hierarchical levels are also important factors affecting knowledge sharing system. Third, various cultural restrictions are evident. The only one-way learning and communication in the traditional centralized organization as well as the formal hierarchy prevent the multidirectional communication between the external informal groups and internal actors. At the end, it is necessary to improve the incentive mechanisms supporting the knowledge sharing. The interactions with external and internal actors are relied on the employees' voluntary, with lowest level of satisfaction to promote the employees' enthusiasm of contributing their knowledge.

This analysis at inter and organizational levels highlights the evolution of Chinese management culture in term of knowledge sharing recently mentioned in the literature (Abrami et al. 2014). We may consider that Chinese innovation system is just entering in its last stage according to the analysis of Li-Ying and Wang (2014). After previous stage of "importation-absorption-assimilation"

Chinese innovation model inaugurate different knowledge sharing mechanisms to develop open innovation projects.

References

Abrami, R. M., Kirby, W., & McFarlan, F. W. (2014, March). Why china can't innovate. *Harvard Business Review*.

Albino, V., Garavelli, A. C., & Schiuma, G. (1999). Knowledge transfer and inter-firm relationships in industrial districts: The role of the leader firm. *Technovation, 19*, 53–63.

Binz-Scharf, M. Ch., (2003). *Exploration and exploitation: Toward a theory of knowledge sharing in digital government projects*. Dissertation. Gallen: Universität St. Gallen.

Bogers, M. (2012). Knowledge sharing in open innovation: An overview of theoretical perspectives on collaborative innovation. In C. P. Heredero & D. Lopez (Eds.), *Open innovation at firms and public administrations: Technologies for value creation* (pp. 1–14). Hershey, PA: IGI Global.

Bosua, R., & Scheepers, R. (2007). Towards a model to explain knowledge sharing in complex organizational environments. *Knowledge Management Research and Practice, 5*(2), 93–109.

Bresman, H., Birkenshaw, J., & Nobel, R. (1999). Knowledge transfer in international acquisitions. *Journal of International Business Studies, 30*(3), 439–462.

Buganza, T., & Verganti, R. (2009). Open innovation process to inbound knowledge: Collaboration with universities in four leading firms. *European Journal of Innovation Management, 12*(3), 306–325.

Bukowitz, W. R., & Williams, R. L. (1999). *The knowledge management fieldbook*. London: FT Press.

Caloghirou, Y., Kastelli, I., & Tsakanikas, A. (2004). Internal capabilities and external knowledge sources: Complements or substitutes for innovative performance? *Technovation, 24*, 29–39.

Chen, D., & Li-Hua, R. (2011). Modes of technological leapfrogging: Five case studies from China. *Journal of Engineering and Technology Management, 28*(1), 93–108.

Chen, J., & Qu, W. G. (2003). A new technological learning in China. *Technovation, 23*(11), 861–867.

Chen, J., Wu, H., & Jin, J. (2012). How firms implement open innovation: From the perspective of organizational change. *Journal of China University of Geosciences (Social Science Edition), 12*(1), 74–80.

Chesbrough, H. W. (2003). *Open innovation: The new imperative for creating and profiting from technology*. Boston: Harvard Business Press.

Chesbrough, H. (2006). Open Innovation: A new paradigm for understanding industrial innovation. In H. Chesbrough, W. Vanhaverbeke, & J. West (Eds.), *Open innovation: Researching a new paradigm* (pp. 1–12). Oxford: Oxford University Press.

Chesbrough, H., & Crowther, A. K. (2006). Beyond high-tech: Early adopters of open innovation in other industries. *R&D Management, 36*(3), 229–236.

Chesbrough, H. W. & Teece, D. J. (1996). Organizing for innovation: When is virtual virtuous? *Harvard Business Review*, August 2002, The Innovative Enterprise, 127–135.

Chiaroni, D., Chiesa, V., & Frattini, F. (2010). Unravelling the process from closed to open Innovation: Evidence from mature, asset-intensive industries. *R&D Management, 40*(3), 222–245.

Contractor, F. J., & Sagafi-Nejad, T. (1981). International technology transfer: Major issues and policy responses. *Journal of International Business Studies, 12*(2), 113–135.

Contractor, N., Carley, K., Levitt, R., Monge, P. R., Wasserman, S., Bar, F., et al. (2000). *Co-evolution of knowledge networks and 21st century organizational forms: Computational modeling and empirical testing*. Urbana-Champaign, IL: University of Illinois.

Cummings, J. (2003). *Knowledge sharing: A review of the literature*. Washington, DC: World Bank.
Deng, P. (2009). Why do Chinese firms tend to acquire strategic assets in international expansion? *Journal of World Business, 44*(1), 74–84.
Enkel, E., Gassmann, O., & Chesbrough, H. (2009). Open R&D and open innovation: Exploring the phenomenon. *R&D Management, 39*(4), 311–316.
Gassmann, O., & Enkel, E. (2004). *Towards a theory of open innovation: Three core process archetypes*. R&D Management Conference, 6 July, Lisabon, Portugal
Glasson, J., Chadwick, A., & Lawton-Smith, H. (2006). Defining, explaining and managing high-tech growth: The case of Oxfordshire. *European Planning Studies, 14*(4), 503–524. http://dx.doi.org/10.1080/09654310500421147
Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal, 17*(S2), 109–122.
Gupta, A. K., & Govindarajan, V. (1991). Knowledge flows and the structure of control within multinational corporations. *Academy of Management Review, 16*(4), 768–792.
Hansen, M. T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly, 44*(1), 82–111.
Hung, S. W. (2009). Development and innovation in the IT industries of India and China. *Technology in Society, 31*(1), 29–41.
Kirschbaum, R. (2005). Open innovation in practice. *Research-Technology Management, 48*(4), 24–28.
Kostova, T. (1999). Transnational transfer of strategic organizational practices: A contextual perspective. *Academy of Management Review, 24*(2), 308–324.
Lichtenthaler, U. (2011). Open innovation: Past research, current debates, and future directions. *The Academy of Management Perspectives, 25*(1), 75–93.
Liebowitz, S. (2002). *Rethinking the networked economy: The true forces driving the digital marketplace*. Dallas, TX: AMACOM Division of the American Management Association.
Liu, X. (2010). Can international acquisition be an effective way to boost innovation in developing countries? Evidences from China's TFT-LCD industry. *Journal of Science and Technology Policy in China, 1*(2), 116–134.
Li-Ying, J., & Wang, Y. (2014). Find them home or abroad? The relative contribution of international technology in-licensing to "Indigenous Innovation" in China. *Long Range Planning*. http://dx.doi.org/10.1016/j.lrp.2014.03.00
Mansfield, E., Romeo, A., & Wagner, S. (1979). Foreign trade and US research and development. *The Review of Economics and Statistics*, 49–57.
Naqshbandi, M., & Kaur, S. (2011). A study of organizational citizenship behaviours, organizational structures and open innovation. *International Journal of Business and Social Science, 2*(6), 182–193.
Nonaka, I. (1991, November–December). The knowledge creating company. *Harvard Business Review*, 96.
Nonaka, I., & Toyama, R. (2003). The knowledge created theory revisited: Knowledge creation as a synthesizing process. *Knowledge Management Research and Practice, 1*(1), 2–10.
Perkmann, M., & Walsh, K. (2007). University-industry relationships and open innovation: Towards a research agenda. *International Journal of Management Review, 9*(4), 259–280.
Powell, W. (1990). Neither market nor hierarchy: Network forms of organization. *Research in Organizational Behavior, 12*, 295–336.
Rousseau, D. M. (1985). Issues of level in organizational research: Multi-level and cross-level perspectives. *Research in Organizational Behavior, 7*(1), 1–37.
Savitskaya, I., Salmi, P., & Torkkeli, M. (2010). Barriers to open innovation: Case China. *Journal of Technology Management and Innovation, 5*(4), 10–21.
Spencer, J. (2003). Firms' knowledge-sharing strategies in the global innovation system: Empirical evident from the flat panel display industry. *Strategic Management Journal, 24*, 217–233.

Teece, D., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*, 509–533.

Tsai, W. (2002). Social structure of "coopetition" within a multiunit organization: Coordination, competition, and intraorganizational knowledge sharing. *Organization Science, 13*(2), 179–190.

Verspagen, B., & Duysters, G. (2004). The small worlds of strategic technology alliances. *Technovation, 24*(7), 563–571.

Wang, Y., & Li-Yinag, J. (2014). When does inward technological licensing facilitate firm's NPD performance? A contingency perspective. *Technovation, 34*, 44–53.

Wang, S., & Noe, R. A. (2010). Knowledge sharing: A review and directions for future research. *Human Resource Management Review, 20*(2), 115–131.

West, J., Salter, A., Vanhaverbeke, W., & Chesbrough, H. (2014). Open innovation: The next decade. *Research Policy, 43*(5), 805–811.

Zander, U. (1991). *Exploiting a technological edge: Voluntary and involuntary dissemination of technology*. Doctoral dissertation. Stockholm: Institute of International Business.

Žemaitis, E. (2014). Knowledge management in open innovation paradigm context: High tech sector perspective. *Social and Behavioral Sciences, 110*, 164–173.

Epilogue

The epilogue to this book brings together previous chapters and reflects on what we have learnt so far and what still needs to be learnt in the future. The eight chapters of the book convincingly show that both KM and PM factors could have influence on project success. They also indicate that by integrating KM strategies with PM practices in the project lifecycle, the likelihood of project success may be enhanced. Furthermore, the book suggests that while project organisations have become common, KM in project organisations is still underdeveloped with many open issues and controversial points. However, rather than obstacles, these can be seen as exciting challenges for future study.

What we have learnt from two chapters in Part I of the book is the multitude of existing definitions of KM and PM-related concepts and models. Focusing on traditional PM, chapter "Traditional Project Management" describes the most popular current standards, frameworks and methodologies (e.g. PMBOK, PRINCE2, Six Sigma). Practitioners worldwide rely on guidance provided by these tools and techniques as they proved to be applicable in most past project situations. However, they are not without limitations. The chapter points to major shortcomings of these predetermined or imposed rule-based approaches in contemporary situations, and calls for more human control over the projects. This is where KM enters the stage.

In this regard, chapter "Integration Models of Project Management with Knowledge Management" explores the latest literature on combining KM with PM frameworks and developing integrating models in order to improve the success rate of projects. The chapter illustrates a number of theoretical "merged" KM and PM models that describe the key shared concepts: project success, project knowledge, KM strategies for projects, and project contingencies of KM. They provide a good basis for exploring different aspects of integrated approaches and their applications. Grounded on the efforts of scholars from KM, IC and PM, chapter "Integration Models of Project Management with Knowledge Management" also provides a useful collection of references for readers and serves as a useful signpost for defining future research agendas.

Part II of the book deals with knowledge competencies in the project environment. The two chapters in this part of the book make an important contribution to the body of references on PM-related knowledge areas. They also highlight the

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multifaceted nature of PM knowledge. More importantly, the book advocates a meeting of the rational scientific with the artful emotional and spiritual aspects of knowledge for effective PM. The main findings of chapter "Project Management Body of Knowledge in the Context of PMI and ISO" reveal that the prevalent focus of internationally recognised PM standards and frameworks (e.g. PMI, ISO) is on cognitive (scientific, rational) knowledge for reducing the uncertainty and associated risks in implementing the planned objectives.

However, chapter "Emotional and Spiritual Knowledge" draws our attention to other components of the knowledge spectrum and their relevance in PM. In particular, the chapter argues that any implementation is performed by a project team which means people with emotional and spiritual knowledge. Through the introduction of the energy metaphor, the chapter allows us to better understand the emerging broader PM body of knowledge.

The next Part III of the book examines the mechanisms underlying KM in the project environment. Chapter "Lessons Learnt Support System" discusses one of the most frequently adopted KM practices to help project managers: a shared repository of project artefacts—lessons learned and best practices. The chapter presents a catalogue of lessons learnt from former projects. These lessons that the author provides us with are plentiful and they may serve as a prime explicit knowledge source for project managers. Readers could strongly benefit from their reuse.

The other important KM function is to handle the tacit knowledge and experience in a project environment. Thus, in addition to codification, chapter "Renovating Project Management: Knowledge Personalisation and Sharing" offers an analysis of a more flexible and less explored personalisation strategy and its contribution to renovating PM for facing the challenges of large and complex research projects. The conclusion drawn from this chapter is that there is a need for a balance between two strategies to give order and structure to one's work on one hand and to allow flexibility and knowledge sharing on the other hand. This complex mix remains the real challenge of a renovated PM programme.

Chapters in Part IV of the book compare a prescriptive approach for selecting the right KM strategy in PM with a descriptive model implemented in a large open innovation context. Empirical evidence from research presented in chapter "Knowledge Management Selection Model for Project Management" supports a contingency choice of KM strategy upon the project complexity. Based on the evidence found, the author proposes that personalisation approaches are more suitable for complex projects while codification better fits situations where projects are simpler. These results not only clarify that there is no "one-best-way" to approach KM, but also that complex problems require social KM approaches.

Whether and how practice follows the latest research-based recommendations is shown in chapter "Knowledge Sharing System under Open Project Perspective: Chinese Experience". This chapter illustrates the evolution of Chinese KM strategy in an open innovation context. Here, knowledge sharing has emerged as a key issue in innovation activities. At the institutional level, the analysis points out the government regulation supporting the building of typical Chinese knowledge

sharing modes. At the organisational level, the study reveals the process of knowledge sharing implementation into the firms with the example of the Huawei case as a typical high-tech enterprise in China.

The overall conclusion that can be drawn from our analysis of this book so far is that a powerful combination of KM and PM can create a synergy effect in order to deliver successful projects. Continuous learning needs to occur throughout the project lifecycle to improve project-related competencies. This can be achieved by developing and implementing appropriate guidelines for creating, sharing, and reusing knowledge in a project environment, thus integrating KM practices with PM.

In addition, the book opens a window towards the future. On a conceptual level, fresh perspectives are needed for evaluating project success that go beyond the "iron triangle" (i.e. time, cost, scope) model to take into account more subjective and context-specific issues. Novel approaches are also required for developing broader taxonomies of PM knowledge encompassing ethical and aesthetic dimensions in addition to cognitive ones. Further on the research horizon, conceptual merger models could provide a foundation to conduct empirical research to better understand how project success might be improved via integrating KM and PM. Future empirical research could also study more closely the capture and sharing of existing knowledge and the creation of new knowledge in different phases of the project lifecycle.

In the end, readers can notice that this book offers just a sample of possible views and positions on integrating KM with PM and its potential future. All book chapters are written by different authors and reflect their peculiar views and interests, but give an overall optimistic tone to the entire book. Other argumentations and visions may be added. However, our purpose was not to provide an exhaustive explanation of all shared KM and PM issues, but rather to provide food for thought to those interested in pursuing future critical research. The use of a diverse set of research methods would give objectivity and lead to proven practical applications, thus making significant contributions to both KM and PM disciplines.

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