E-BUSINESS MANAGEMENT

Integration of Web Technologies with Business Models

Edited by

MICHAEL J. SHAW

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Preface

This book contains a collection of articles by leading information systems researchers on important topics related to the development of e-business. The goal is to enhance the understanding of the state-of-the-art in e-business, including the most current and forward-looking research. The book emphasizes both business practices and academic research made possible by the recent rapid advances made in the applications of e-business technology. The book should help graduate students, researchers, and practitioners understand major e-business developments, how they will transform businesses, and strategic implications to be drawn.

By illustrating in detail the major e-business developments and research, the book focuses on addressing e-business management from the perspective of information systems research. In order to cover the subject matter in sufficient breadth and depth, the book is organized into the following five main sections:

I e-Business Fundamentals,
II e-Business Best Practices,
III Marketing, Customer Relations, e-Services, and Personalization,
IV Formation of New Intermediaries and e-Markets, and
V B2B and Supply-Chain Management: New Business Models and Valuation.

The sections are made up of twenty chapters that use a variety of research approaches and presentation formats, including analysis, case studies, surveys, economics, modeling, and theory, and shed light on the key ideas involved in e-business management.

The organization of the book reflects the major developments in e-business, research opportunities, and impacts. The chapters on best practices in Section II follow the e-business fundamentals set out in Section I to capture successful industry strategies. Sections III, IV, and V then describe in detail the three driving forces of e-business deployment: improving customer relations, greater orientation toward e-markets, and a much stronger emphasis on B2B and supply-chain management. The mixing of leading academic research and business best practices creates a strong synergy between emerging theory and applications throughout the chapters of the book..

The worldwide digital economy is fast evolving. Driven by the wave of innovations resulting from breakthroughs both in information technology and in business practices, e-business developments have transformed the role of each. The transformations are very much ongoing and moving at a breathtaking pace. The bursting of the Internet bubble made it necessary to adjust the direction, but the effects have propagated as quickly as ever, and to a much larger segment of the world economy. The differences between traditional and e-business enterprises are diminishing rapidly. In that sense, this book goes beyond just e-business management and is relevant to the management of most businesses. More and more traditional corporations have discovered the efficacy of e-business. There is little doubt that the e-business advances we are witnessing will leave a very noticeable mark on the history of business. I hope this book, if nothing else, helps document the evolution of important advances in research and business practices.

Putting this book together has been a stimulating and challenging experience. The synergy between the applications and theory intrigues me; the major challenge has been how to keep up with the rapid developments, while conveying a keen sense of the fundamentals. I was fortunate to have the opportunity to work with excellent authors from academia and industry. Chapters 3, 9, 14, 15, and 18 were first published in a special issue I put together as the guest editor for *Information Systems Frontiers.* Chapter 17 was published in an earlier book *Information-Based Manufacturing,* which I edited. I would like to thank Kluwer Academic Publishers for allowing me to make this book more complete by including them here.

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Chapter 1

E-Business Management: A Primer

Michael J. Shaw

Abstract: Building a successful e-business requires such enterprise capabilities as global networking, integrated business processes, sharing information with supply-chain partners, agility in responding to the market, and intelligent decision-making. At the same time enterprise systems have extended beyond the traditional business functions and include features to support supply-chain management, customer relationship management and electronic commerce. The new focus on e-business is, in part, driven by the adoption of the Web as a new channel for product distribution, marketing, and interaction with customers. The integration of the traditional as well as the Web-oriented functions is the cornerstone of a successful e-business. This paper presents an e-business framework that, on one hand, builds on the enterprise system but, on the other, encompasses the new e-business dimensions.

Key words: E-Business Management; Information Systems Research.

1. INTRODUCTION

Building their companies into successful e-businesses has become an important objective for today's enterprises. To do so requires such business capabilities as global networking, process integration, information sharing, supply-chain agility, and intelligent decision-making. This paper addresses the strategic and research issues concerning (1) how to implement these concepts in real enterprises, (2) the most desirable strategy for developing and managing business systems, and (3) the research framework for understanding the essential characteristics of e-business systems, how they evolve, and the direction in which they are moving.

Increasingly, enterprise systems have extended beyond the traditional business functions and include such new features as supply-chain management, customer relationship management (CRM), and electronic commerce. This shifting focus is driven by the adoption of the Web as a new channel for product distribution, marketing, and interaction with customers. The integration of traditional as well as Web-oriented functions is the cornerstone of a successful e-business. At the same time, information systems have become the nerve center of most enterprise systems. As enterprise operations increasingly go global, proper coordination between business, manufacturing, and the global value-adding chain needs special attention. Information systems can help provide that coordination. What makes information systems the backbone of business operations is the emerging global information infrastructure. Through this infrastructure, enterprise systems can achieve business integration and coordination. That becomes the foundation of any e-business.

2. THE WEB AS THE ENABLER FOR ENTERPRISE INTEGRATION

An effective infrastructure is essential in order to coordinate various business units and processes into an e-business,. The enterprise information system supports supply-chain processes and process coordination within and between enterprises. In addition, the infrastructure also includes (1) a global information network for supporting various electronic services such as brokerage and contracting, payment and banking, transaction processing, (2) electronic access to external data, and (3) electronic connections to customers that support such activities as filling orders and customer service. Increasingly, the way to integrate these infrastructure components is to use the Web infrastructure supported by the Internet. Using the Web infrastructure intranets support intra-organizational business processes; extranets connect enterprises to their channel partners; and the Internet links the enterprises to their customers, other institutions and agencies.

Using the Web as the infrastructure not only gives an enterprise a better means to coordinate with its supply-chain partners, but as important, it provides a new channel to reach out to customers. With the Web channel serving as the virtual storefront, there are opportunities for product marketing, customer relationship management, and product branding. In addition, a new kind of consumer process is emerging combining information aggregation, navigation, and interactive exchanges. On the one hand, it enables mass customization; on the other, the infrastructure supports quick response to market demands. Such a new channel requires new capabilities from the enterprise systems.

The Web provides a new paradigm for supporting enterprise and supply-chain processes. The paradigm is basically that of a highly flexible network with interoperable and sharable modules. A Web technology that stands out as particularly useful for supporting the implementation of such a paradigm is component technology. The component approach can potentially better enable companies to integrate the supply chains and their processes among the supply-chain partners. They not only share product, manufacturing, and customer information with their partners; increasingly, they are letting the suppliers adopt parts of their business processes and systems to enhance coordination. Traditional enterprise systems put the emphasis on process integration. With this component-based approach, we will likely see more highly modularized companies, with each unit specialized in its core competency but always prepared to link up with business partners and their enterprise system (Baldwin and Clark , 1997). The component concept can be applied at several different levels: (1) *The software and system level,* where software objects and components have been used as the building blocks to make the functional components portable and inter-operable; (2) *The process and application level,* where business processes and applications, such as order fulfillment, customer services, etc., have been managed as separate modules, sometimes run at remote sites by applications service providers (ASPs); (3) *The enterprise level,* where business units can be quickly assembled to form virtual enterprises to explore a window of market opportunities.

The general trend these developments collectively point to is that in an e-business, there will be increasing use of modularity and the component model to increase portability, inter-operability, and plug-and-play functionalities. The paradox is that the enterprise systems will be more integrated because of the greater use of modularized components.

3. ORGANIZATION DESIGNS, INFORMATION SHARING, AND COORDINATION

A distinct feature of an e-business system is its capability to adapt and react, making the organization more agile. The trend for e-business organizations to shift gradually from hierarchical to networked organizations is in line with the general trend of the economy. With the increasing use of information systems in most organizations, organizations are moving toward flatter and more adaptive structures, sometimes referred to as the market oriented networked organizations (MNOs). Instead of the command and control innate to traditional, hierarchical organizations, MNOs require more coordination; and the coordination is done in a way similar to the way goods are allocated in the marketplace, through decentralized pricing and exchanges. A supply-chain network is a type of MNO when the business units are assembled through market forces. On the other hand, a supply-chain network may be a type of hierarchical organization if it is totally vertically integrated. Electronic commerce is moving e-businesses toward the MNO model. Successfully implementing e-business technology reduces transaction costs, and, therefore, the boundaries between markets and internal organizations are shrinking (Williamson, 1986) in favor of more market orientation.

Web technology overcomes problems of system incompatibility by encapsulating enterprise systems as object components made accessible by standardized interfaces, and by defining a protocol for transmitting documents between these components. This improves e-business management by (1) reducing production costs through lower procurement and distribution costs, (2) better utilization of resources through enterprise specialization, and (3) greater integration of supply-chain activities.

The lack of information sharing is a common cause for supply-chain related problems. One example is the so-called *bullwhip effect,* in which a slight variation in demand at the consumer end gets increasingly amplified and results in wild swings at the supplier end. The bullwhip effect has four possible causes: demand-signal processing, batch ordering, price fluctuation and shortage gaming (Lee et al., 1997). In demand-signal processing, for example, since data on the quantities sold to consumers is not passed on to the upstream levels, each tier is forced to predict demand based on its *adjacent* downstream order. This results in multiple forecasts, with predicted errors escalating as the distorted demand information travels upstream. Meanwhile, supplier's production information (e.g. capacity and lead-time) is not shared downstream. This leads to a vicious cycle of shortage gaming and large demand swings. Countermeasures that can overcome this undesirable phenomenon include consumer direct ordering, sharing point-of-sale capacity and inventory data, vendor-managed inventory, and continuous replenishment programs. These solutions boil down to the need for information sharing and an information infrastructure to support it.

Information sharing has been used not only for reducing the uncertainties and smoothing out supply chains, but also for eliminating wasteful activities, efforts, and resources along the supply chains. Larger corporations have started to make information sharing across their supply chains a common practice. In order to sell to Wal-Mart, for example, suppliers must study the giant's weekly sales figures, forecast demands for their products, and place them on the shelf. In other words, information-sharing has gone beyond simply providing some type of data. It may involve a plan of action based on the data. This kind of partnership has proven to be mutually beneficial. Increasingly, the Web has become the conduit for further enhancing this kind of supply-chain collaboration.

The Web can enhance various types of coordination. It has a special impact on the coordination mechanisms that require stronger partnerships. The major risk associated with Web-based EDI is still the lack of security. Web technology can help move inter-organizational information systems to a more advanced phase, where technology such as XML will become standard, so that the information being exchanged can incorporate semantic structures. The major impact of the Web on coordinating e-businesses, in terms of forcing change in business models, will be the sharing not only of information, but also knowledge and decision processes. Eventually, they can lead to the sharing of business processes between partners, or e-processes.

The capability of the Web for executing computational models and algorithms from remote sites makes this type of collaboration much more possible than before. The component approach just discussed can help facilitate development. For example, we may see more and more third-party contract manufacturers emerge as key partners in the supply chains. To coordinate better through the Web, these contract manufacturers can put their factory scheduling routines, simulation models, etc. on the Web. Their customers can run these models from remote sites to determine orders to be placed in view of the capacity available and the production plans already in place.

4. MULTI-CHANNEL MANAGEMENT

For most e-businesses, the emerging Web channel for purchasing, distributing, and marketing has created enormous opportunities for reaching out to new markets and customers. While there are companies specializing in e-commerce and using the Web as the only channel, most companies still maintain traditional channels. How to manage the Web channel along side the other channels has increasingly become an issue for any e-business. The prominent channel management strategies used in running e-business are summarized as follows:

1. *Web enhances traditional channels.* This is a commonly used cross-marketing model. Major TV networks, for instance, often use the Web to provide more detailed coverage than their traditional channels, thus enhancing their brand and their traditional channels.
2. *Traditional channels promote the Web channel.* All e-commerce companies use traditional media to promote their brands. Some traditional retailers put kiosks in their stores to provide Web access to assist any need for additional product search, or allow customers to return goods purchased online to local stores.
3. *Web channel used to explore new markets.* Because of the specific demographics of Web users, some companies use the Web to reach out to segments of the market they do not normally reach. Furthermore, the Web enables an e-business to reach out to consumers around the world. Proctor and Gamble, for instance, uses Reflect.com to explore the market for customized cosmetics, which they do not sell through the traditional channels.
4. *Add new product lines only for the Web.* For the same reason, some companies use the Web to sell new products. This is especially effective when the business traditionally depends on powerful dealers/distributors and, therefore, selling the same products direct is not an immediate option. Also, major consumer goods companies have found the Web an effective channel to test market new product lines.
5. *Integrate the Web and traditional channels.* This is the "click and mortar" model, which is aiming at combining the best of traditional and Web channels. Pure dot-com companies need more traditional distribution channels to provide more efficient logistics and better customer services. Traditional channels need to add the Web channel to gain new capabilities for searching, navigation, and interactive, hyper-linked information retrievals.
6. *Cannibalize traditional channels.* Sometimes the new Web channel takes over the major share of the business. When this is inevitable in a given industry, a company might as well cannibalize the resources and focus its effort on the Web channel-- rather than been eaten up by competitors' aggressive Web channels. This happens in the industry where the Web will inevitably become the main channel.

7. *Building alliances between traditional and Internet companies.* The alliances recently built between car-makers and pure e-commerce companies, for example, belong to this model, which stems from the desire to build synergy between the Web and traditional channels. The alliance between Borders' bookstore and Amazon.com, in which consumers can order books online and then pick them up at a Border's local store is also a good example of this model.

What these channel-management issues imply is that the enterprise information systems for an e-business can no longer be just for integrating traditional enterprise functions in accounting, production, marketing, etc. There have to be additional components to provide capabilities for e-commerce trading, channel coordination, and dynamic market making with other e-businesses.

As with any of the other channels used by enterprises to reach their customers, the Internet has its strengths and weaknesses. It is, therefore, a risky proposition when a business relies on the Internet as its sole channel. Increasingly, it has become important for any enterprise to master how to integrate multiple channels (bricks-and-mortar stores, mail catalogues, call centers, the Internet site, portal site, etc.) and to build as much synergy among them as possible. These channels can be complementary in providing customer service, returns of goods, cross-marketing, merchandising, and other activities involved in shopping and purchasing. The use of multiple channels presents two challenges for enterprise information systems. The first is to integrate fully the channel activities. The second is to support the logistics and back-end infrastructure so that the transactions coming through the various channels can be processed seamlessly.

5. E-BUSINESS FULFILLMENT: FROM SUPPLY CHAINS TO SUPPLY WEBS

The Web infrastructure provides opportunities to redefine the fulfillment process. Increasingly, e-businesses will adopt network organizations of specialized units coordinated through electronic networks to replace the traditional hierarchical organization. Because of their agility, these network organizations can be configured and reconfigured rapidly. The Web also provides new ways to coordinate workflow, manage documents, and enhance group work.

General e-business fulfillment processes may be executed differently according to the particular business model adopted. For example, ComUSA, a computer retailer, has expanded its role in the supply chain. It started to re-label computers made by third-party manufacturers under its own name. It also oversees parts procurement, assembly at the factory, and shipping. A customer can specify his own PC configuration at a kiosk in the store or via the Web, and the PC will be built to order (Shaw, 2000). Dell Computers, on the other hand, has perfected its direct-sell, build-to-order business model by integrating the role of the retailer, the distributor, and the product brand-name company. It has achieved the fastest inventory turn-around time in the PC industry by adopting this business model. It has actually achieved a negative "cash-to-cash cycle time," i.e., the time from when it receives payment from its customers to the time it pays its suppliers! That has fundamentally changed the valuation model used to benchmark an e-business.

In running an e-business the Web-based supply chain model provides opportunities for several companies to work together and form a virtual enterprise. An example is the plan of Ingram Micro Inc., the largest distributor in the PC industry, to team up with Solectron Co, a giant contract manufacturer. Their goal is to help brand-name PC makers, such as Compaq Computers or Hewlett-Packard, to build PCs to customer orders. Instead of the PC companies handling orders and manufacturing, Ingram serves as the supply-chain coordinator to facilitate order fulfillment and shorten response time. PC "makers" such as HP and Compaq still have their brand-name labels, but they no longer actually make computers. Instead, they focus their efforts in marketing, quality assurance, product development, customer service, and building the whole "supply web" (Shaw, 2000).

There are many examples following this trend of "supply webs." Companies such as Flextronics International Ltd., Solectron Corp., Jabil Circuit Inc., and SCI systems, have emerged as highly efficient manufacturers and supply-chain managers that operate factories around the world. The electronic giants whose names their products carry – Compaq, Ericsson, and Cisco Systems – are just as quickly getting out of making things, concentrating instead on developing new products and persuading consumers to buy them. IBM also has dropped out of the business of making personal computers in 2002, and has similarly adopted the business model of outsourcing the manufacturing of its personal computers. But the story of forming a supply web is more than outsourcing the manufacturing operations. It is about the ability to form a global supply-chain quickly while being able to link with the supply-chain partners electronically. Through the e-business infrastructure, companies in the whole supply-chain (or, more accurately, the whole supply-web) act as one virtual company. The customers cannot tell that many companies are involved in the supply web. To them, the products are made by one company bearing the brand name.

This is happening because, with the Web providing the links for sharing information among channel partners and the component technology providing the interoperability to integrate business processes, companies will use more outsourcing in their business models. As a result, companies will concentrate on their specialized products while working closely with the suppliers. The ability to manage supply-chain networks will, thus, determine the competitive advantage of a company. Supply-chain networks represent the collaboration among a group of business units working together to exploit the underlying adaptability, collective capabilities, and market opportunities. The Web helps facilitate coordination among the units, reducing inventories and cycle-times. The networked nature of the Web forms a natural infrastructure to support and transform e-businesses. Because of the potential to manage e-business organizations in these dynamic, innovative ways, the fulfillment process has become an important core competency in running any e-business.

6. BUSINESS-TO-BUSINESS E-COMMERCE

The Web provides an e-business with greater opportunities to interact with the market place in managing its supply chain. As a result, there is an increasing need to shift supply-chain activities to interact more with B2B intermediaries, markets, and exchanges. This emerging focus of supply-chain management on B2B e-commerce provides an important link for an e-business to link with other e-businesses. Moreover, conducting B2B e-commerce over the Web has made e-business better connected in the global network that matches sellers and buyers.

What do enterprise systems need to incorporate to fulfill these functions? For B2B supply chains, there will be more and more *market-making* and *aggregation* activities even for the supply chains of main products and their components. As a result, the supply-chain management function for an e-business needs to coordinate and integrate the transaction flows among channel partners on a more dynamic basis. There are five B2B e-business models across a supply chain, starting from the upstream of the supply chain, they are:

- *Manufacturer direct,* such as Dell or Cisco;
- *e-distributors,* such as W. W. Grainger:
- *Neutral exchange and auction sites,* such as Freemarkets.com;
- *Buyer-side catalog aggregators,* such Ariba or Commerce One; and
- *Industry-wide (vertical) marketplaces,* such as Transora and Covisint.

In supporting business-to-business procurement, for instance, the B2B model can be based on Web-based catalogs, supply/demand aggregation, markets, or exchanges. For web-based catalog systems, there are two key considerations. First, the suppliers' product information will have to be interoperable, so that the customers can navigate between the product catalogs of different suppliers. Second, the catalog search and related activities must be integrated with the enterprise legacy systems, so that the front-end information search processes and the back-end support processes can be seamlessly integrated. For supply/demand aggregation, market, and exchange models, the key to successful e-business development is to integrate transactions across multiple sites.

A complete e-business framework must enforce integration with B2B transactions, channel partners, supply-chain processes, and customer relationship management needs are equally important for managing an e-business. The framework also includes the ability to coordinate and integrate with other e-businesses. As opposed to the emphasis on hierarchical information organization to ensure process coordination and data consistency, as is the case in traditional enterprise systems, the new generation of enterprise systems will be open, flexible, modular, and interoperable. As important, it will fully integrate with the Web channel for supporting business-to-consumer and business-to-business transactions.

The three major areas where B2B e-Commerce has made the most impact are: (a) the productivity gains made possible by transformations in processes and organizational structures; (b) the increasing opportunities to participate in electronic market-places to further improve the efficiency of both the supply- and buyer- sides; and (c) the resulting B2B infrastructure to help streamline the activities and transactions across whole supply chains. It is clear that B2B e-Commerce will continue its path of transforming supply-chain relations, industrial organizations, and inter-organizational structures.

What is less clear is how to evaluate a given B2B e-Commerce system for a specific enterprise environment. Unlike traditional engineering projects or investments in new equipment, B2B e-Commerce usually involves not only infrastructure investments, but also transformed processes and varying enterprise organizational structures. How to assess the precise valuation of B2B e-Commerce is still an unsolved problem. And a solution is much needed to make technology investment and implementation decisions. In my preliminary investigation, for the effective implementation of B2B e-Commerce, an enterprise must consider a number of process, organization and supply-chain attributes that determine the value of a B2B e-Commerce project. Therefore, it is important to identify and understand these attributes and their relationships to the implementation strategies adopted.

7. E-BUSINESS VALUATION

The contribution of IT to productivity gains has now been generally recognized, after a considerable period in which the IT productivity paradox was at the center of debate. With e-business systems now under the spot light of major capital investments, there are similar issues raised regarding the value of e-business systems. Some of the questions asked are practical ones. When millions of dollars of investments are being poured into e-business system projects in most larger companies, it is natural for IT managers to face the challenges of quantifying the value of e-business investments.

Depending on the nature of the e-business systems, the valuation can be systematically assessed on several levels, including (1) B2B Supply Chain, (2) Enterprise, (3) Operational Processes, (4), Strategic, and (5) B2C Customer Relations levels.

With respect to supply chains, the impact of Inter-organizational systems (IOS) has been positive in improving the efficiency of business processes and the overall performance of manufacturing organizations. Electronic processing and communication of inter-organizational data improves timeliness and accuracy of information, allowing firms to plan and manage such assets as inventory better. This type of impact is first and foremost on the operational level and results in faster transactions, cost reduction, higher productivity and improved quality.

Within the firm itself, value is not uniform across processes and business units; therefore, a variety of strategies are needed. The type of business units, products, suppliers and the characteristics of the enterprise have been shown to be important predictors of the level of improvement. Understanding the value of technologies and how they benefit different users, as well as business units, is critical in increasing the adoption of such systems.

The very nature of e-business technologies gives enterprises unprecedented capabilities to focus on the customers, enhancing all activities concerning customer acquisition, retention, and services. The value of these benefits is readily quantifiable. The more difficult measurements are such intangibles as brand image, reputation, and goodwill. Moreover, the key to customer facing is also about better integration of IS on the customer end and those managing supply chains and other business processes. While e-business technologies greatly enhance relations with customers, the back-end support is critical. That is the hidden side of valuation of e-business initiatives on the business-to-consumer front.

On the B2B side, e-business systems such as IOS provides competitive advantages by increasing the bargaining power of the buying organization, better coordination among supply-chain partners and greater information available about the business processes and demands across the whole supply chain. Technologies, such as EDI, have resulted in the greater integration of firms with their suppliers. Inter-organizational technologies also lead to shifts between different forms of coordination. Choosing a specific IT-based coordination structure creates risks in the form of relationship-specific investments, shifts in bargaining power and the need for trust and commitment to an ongoing relationship. Web-based B2B e-commerce systems are radically different from other IT-based systems, and, therefore, it is questionable if the valuation methods and criteria developed previously are still valid. For example, search costs, negotiation costs, and coordination costs are significantly lower in a Web-based system, requiring researchers to include them in the valuation model. Moreover, the impact of the Web is increasingly difficult to isolate because of the transformation of processes and organizational structures. As traditional hierarchical organizations are replaced by Web-enabled, agile and networked organizations, it is critical to understand the value of the transformations and how the various systems should be integrated to derive maximum value.

On the B2C side, e-business systems generally are aimed at helping improve the whole cycle of customer relations, i.e., the acquisition, enhancement, and retention of customers. Activities involved in these different phases include direct marketing, sales force management, customer services, call-center coordination, and personalization. The value of acquiring new customers can be quantified by balancing acquisition costs and the life-time value of customers. Enhancing customer service and the retention of existing customers are strategic factors that can be measured by the additional revenues generated by the services and the opportunity costs of losing customers due to poor service.

Lastly, many e-business systems are implemented as experiments for potential future competitive and strategic positions. In a similar vein, e-business initiatives can help enhance organizational learning because of its focus on enterprise integration, customer facing, and supply-chain coordination. Managers view them as the initial steps toward greater future investments, depending on how future strategic positions and the technology should evolve. The underlying value of this type of e-business system is analogous to that of investing in financial *options.* This concept becomes especially important when considering the vast uncertainties involved in the future developments of e-business technologies.

There are several challenges involved in assessing the value of e-business technology to an enterprise:

(1) e-business technology is transformational. The adoption of e-business technology often requires changing business processes, organizational structure, and even supply-chain relationships. Because it is not an isolated component, e-business technology must be evaluated in the enterprise context.

(2) e-business technology is dynamically evolving. New versions of enterprise e-business systems arrive constantly. Sometimes they only require incremental changes, but at other times they bring about destructive innovation.

(3) e-business technology is implemented for strategic as well as for operational objectives. The intangible yet strategic benefits of e-business systems are usually the hardest to estimate precisely.

Estimating the use of wireless technologies in B2B e-procurement is a good example of the complexity of e-business valuation (Subramaniam and Shaw, 2002). While intuition pointed to improving operational benefits such as reduced process times, the preliminary results from our study, in collaboration with Motorola, show that there are some unique attributes of the wireless infrastructure, such as providing timely messages, instant authorization, the ability to handle emergencies, and greater mobility, that outweigh the operational benefits. But that may change since wireless technologies are evolving rapidly, and soon the limitations of the devices in screen size, key boards, and bandwidth may all improve to the extent that benefits can be greater for regular operational processing. There are also applications yet to be created that may leverage the major characteristics of the wireless infrastructure. The three major features of wireless are mobility, the location-specific information, and orientation toward peer-to-peer communications.

8. UBIQUITOUS COMMERCE

A significant development is taking shape in the effort to push the boundaries of electronic commerce further. With the advent of wireless, mobile technology and devices that can be taken almost anywhere and to most business environments, we will see a new paradigm for business information management. That is, the information processing power will become more person- and location-oriented, as opposed to the current paradigm that is machine-oriented based on desk-top computing architecture. Because of the ubiquitous nature of the "points of execution"; when this paradigm is implemented in electronic commerce, we call it Ubiquitous Commerce, or U-commerce. The devices used to execute U-commerce include handheld mobile devices (personal digital assistants (PDA), two-way pagers, cellular phones, net phones and in-vehicle devices), laptops, desktops, workstations, and audio/video appliances. These devises are networked together to form a strong and integrated backend and a highly mobile front-end infrastructure.

U-commerce builds on the Web information infrastructure to add three important capabilities to make the Internet access ubiquitous – mobility, an interface to address access needs of general population, and powerful distributed computing. Further, the architecture is envisioned to consist of a device-independent ubiquitous commerce platform that is integrated with the enterprise information, supply-chain network and electronic market infrastructures. U-commerce infrastructure consists of a core device-independent middleware platform, that is integrated with three major categories of information infrastructure – organization, supply-chain and market. This middleware is built on the Web infrastructure with the added capability of being accessed by consumers through a variety of wired and wireless devices. As these various devices have very different display, processing and communication capabilities, the commerce platform should be flexible enough to add new devices, but also be secure and reliable. It is critical for their electronic commerce applications to be integrated with these enterprise systems.

There are several major technological developments that have the potential to make next generation electronic commerce ubiquitous. The increasing use of small, hand-held mobile devices, wireless networks and satellites has enabled a wireless extension of the Web infrastructure. With the increasing use of small portable computers, wireless networks, and satellites, mobile commerce (m-commerce) has emerged to provide a wireless extension of existing e-commerce solutions. Built upon a ubiquitous computing environment, users do not need to maintain a fixed position in the network, which increases the mobility and decreases the cost of wiring and reconfiguring wires to support an expanding staff. It allows businesses to maintain a mobile workforce inside its daily business process. For example, GE Global Exchange Services, which recently made a deal with a wireless service provider to create a service that lets wireless devices communicate with enterprise back-end systems, such as customer relationship management. On the other hand, from the viewpoint of end customers, mobile commerce creates a new form of business interaction. Using location information, companies are able to offer the applications that merge physical presence with the virtual services. For example, by knowing that the customer is at a particular location, an organization can promote a product or service available in that location. Those services can also extend to configure the physical shopping environment to customer's own preferences.

9. OPEN ENTERPRISES, INTEROPERABLE INFRASTRUCTURE, AND SHARABLE E-PROCESSES

As opposed to vertically integrated corporations, modern enterprises form and use supply-chain networks to work with other companies to meet market demand. Because of the current rapid pace of new product introduction and product updates, an enterprise needs to be able to form a global supply chain quickly with its selected partners to explore emerging market opportunities. Ideally, there should be an interoperable "supply-chain platform," where the enterprises can plug in to be connected with its suppliers or distributors. This interoperability not only needs the support of a global information infrastructure, which is greatly assisted by the Internet, but also the availability of sharable business processes for such supply-chain activities as procurement and order-fulfillment.

The benefits of interoperable supply chains with standardized business processes have become so attractive that companies who are competitors may nevertheless adopt the same supply-chains platform and processes. Such supply chains make it attractive to collaborate to explore the increased bargaining power with the suppliers of their industry. Recent examples of such industry-wide efforts are abundant, especially in the auto and the computer industries. In the former the major manufacturers form an industry-wide e-marketplace called Covisint. In the latter a consortium call the RosettaNet, which establishes supply-chain collaboration and develops process standards. An interesting research question is how to enforce collaboration from fierce rivals in an industry. Obviously, there are enough incentives for the Big Three auto makers to collaborate in forming Covisint. A primary source of the incentives is the reduced procurement costs—which makes suppliers reluctant to join, unless there is sufficient increased volume overall. Another source of incentives for all participants comes from the fact that the supply chain will be more efficient and less wasteful (e.g., by reducing unnecessary inventories and improving the efficiency of logistics). This combination of collaborative and competitive behavior among the participants may be better understood by game-theoretical analysis. For instance, two competitors may find themselves both better off if they can form a consortium, through which they can develop common procurement to gain cost advantages.

The use of plug-and-play e-processes greatly increases a company's ability to work with its business partners even if they use different enterprise systems. It means:

- More flexible business relationships with more partners linked by sharable e-processes;
- Lower set-up costs when working with new supply-chain partners, and thus easier-to-explore, new business opportunities with greater bargaining power;
- Greater visibility and information-sharing across the supply chain, making the supply chain more efficient with less inventory;
- Greater integration in executing main supply-chain processes, such as order fulfillment, thus reducing cycle times; and
- Improved operational efficiency enjoyed by all supply-chain participants.

The idea of developing interoperable supply chains has the potential to fundamentally transform the structure of many industries. This trend will continue, and it will force companies to adjust their practices accordingly. As a result, several trends are emerging:

The Open Enterprise Model. Companies are unbundling their enterprises into modular business processes so that they can focus on their core competencies while outsourcing the non-core businesses. Furthermore, the standardized global information infrastructure enables the same companies to open up the borders of the enterprise in order to share processes and information with their partners in the global supply chains (Moore, et al., 2000). Process sharing is the key to the seamless plug-and-play infrastructure provided by the underlying supply chains. The open systems paradigm helps provide component interoperability and commonly recognized standards, which are important to establish connectivity and full integration. (Companies that used traditional enterprise resource-planning systems have painfully found that hierarchical systems, while they also achieve connectivity and integration, are too rigid, restricting, and closed).

Connectivity, Mobility, and Interoperability. Connectivity has been extended beyond simple networking, to include mobile infrastructure. The new business infrastructure will have two components: one a powerful backbone system with an interoperable platform running the major applications and business processes; the other a highly portable, networked, and mobile front-end that acts as a collection of nerve cells for data collection, information sensing, and front-end processing. At the same time it provides connectivity, the information infrastructure also provides interoperability on the enterprise and supply-chain levels.

Integration and Customer Facing. E-business systems integrate enterprise applications from customer relationship management to supply-chain management. They also help integrate business processes across the supply chain to facilitate such supply-chain processes as order fulfillment and product development. The common infrastructure is interoperable and the processes sharable. This integration of processes and enterprise systems enables companies to interact with their customer on the one hand, while remaining fully aware of the current status of supply-chain information on the other.

More Collaboration and Market Orientation. By the very nature of the Web, e-business systems are based on the principle of open systems with a market orientation. Any e-business system must be ready to be connected with a partner's system and share the common processes. The market orientation of e-business systems provides additional business-to-business and business-to-consumer opportunities and choices. Moving toward more collaboration and more market orientation seem to be two opposite goals, but e-business infrastructure helps achieve the two simultaneously. The standardized information infrastructure and sharable processes help promote collaboration; network connectivity and B2B choices enhance market orientation. We have also seen the combination of the two in e-marketplaces and other industry-wide consortia.

10. CONCLUSIONS

The e-business framework described in this paper, therefore, can be viewed as the next generation of enterprise systems, where the integration with B2B transactions, channel partners, supply-chain processes, and the needs of customer relationship management are equally important for managing an e-business. The framework also includes the capability to coordinate and integrate with other e-businesses. The new generation of enterprise systems will be open, flexible, modular, and inter-operable. As important, it will fully integrate with the Web channel for supporting business-to-consumer and business-to-business transactions.

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Chapter 2

E-Business and Beyond

Robert W. Blanning

Abstract: As the twentieth century was drawing to a close, observers of the business environments in the leading industrial nations of the world reported two salient trends. First, e-commerce (EC), rather than being a passing fad, as some had earlier suggested, was becoming an established part of the emerging postindustrial economy. Second, EC was being enlarged to become what the observers called e-business (EB). It was generally recognized the goal of EB was to establish seamless interfaces among business enterprises, their trading partners, their customers, and their governments (especially, tax and regulatory authorities), as well as internally. The internal interfaces were both cross-functional along the value chain (e.g., between purchasing and manufacturing, or between distribution and marketing) and hierarchical (i.e., at the strategic, tactical, and operational levels). Thus, EB extends EC by also including interactions with government and interactions within the enterprise. We begin by examining the ongoing transition from EC to EB, we then discuss briefly the need for EB literacy and education, and we conclude by exploring the Internet-based social and political innovations that will follow EB in the twenty-first century.

Key words: E-Commerce, E-Business, Value chain

1. FROM E-COMMERCE TO E-BUSINESS

We define commerce as the exchange of tangible or intangible items of value, such as money, goods, services, and information. Typically, this consists of the purchase and sale of goods and services, but it also includes currency exchange, along with barter and other forms of countertrade. We define electronic commerce (EC) as commerce conducted using a digital medium. Thus, commercial transactions conducted using analog media such as the mails or the telephone are not examples of EC, nor are personal e-mails transmitted over the Internet. On the other hand, e-mail used for business purposes – for example, an inquiry to a human or electronic help desk – is an example of EC. Similarly, personal Web pages are not examples of EC, but Web pages used for advertising or order fulfillment are examples of EC.

The most widely recognized forms of EC are business-to-consumer EC (B2C) and business-to-business EC (B2B), illustrated in Figure 1. (For a detailed view of EC see [Shaw et al., 2000].) There are many examples of B2C, such as Amazon.com (www.amazon.com), which sells books and other products over the Internet, and Land's End (www.landsend.com), which sells clothing and other products over the Internet. Less prominent in the public mind is B2B, although some people predict that B2B will become the "killer app" of EC. B2B began as electronic data interchange (EDI) between trading partners, such as manufacturers, their suppliers, and their distributors. Typically, EDI makes use of wide area networks (WAN) other than the Internet, such as The General Electric Company's Global Exchange Services (GXS). In addition, there are Internet-based B2B networks that link corporations to their trading partners. Examples are the National Transportation Exchange in the US, which coordinates shippers having less than full loads with shippers who wish to ship partial loads, and everythingaircraft.com (www.everythingaircraft.com), which consolidates catalog information for aircraft parts and provides purchasing services.

As we move from EC to electronic business (EB), we note that any combination of transactions between business and consumer is possible, such as the B2B2C supply chain illustrated in Figure 2. Intranets are found inside individual organizations, extranets are used for interorganizational communication, and the Internet connects business organizations and their customers. An example is Amazon.com, mentioned above, which is actually a B2B2B2C virtual organization involving publishers, shippers, the seller (Amazon), and the end customer. In practice, the supply chain can be even longer. Another example is C2C, which is the case with electronic auctions of the type provided by eBay (www.ebay.com).

There are three principal sets of issues in EC. The first is a variety of technical issues, such as message and installation security, electronic payments, interoperability, quality of service, information commerce (i.e., digital documents), and information resource discovery (e.g., intelligent agents). The second is business issues, or organizational issues more generally. These include human resource issues relevant to EB (staffing, training, providing incentives, etc.) and strategic issues (sales force automation, customer relationship management, channel conflict, mass customization and micromarketing, etc.). The third is legal issues, primarily the taxing of Internet transactions and government regulation. The regulatory issues include pornography, electronic contracts and fraud, dangerous content (e.g., instructions on how to build a bomb), and in some countries unacceptable criticism of government or other institutions.

EB is larger than any concatenation of Bs and Cs. (See the annotated bibliography at the end of this paper.) It also involves government (Figure 3). An example is the electronic filing of tax returns in the US (www.irs.gov), which is an example of both C2G and B2G. Another example is provided by the National Technical Information Service (NTIS) in the US government, which sells documents reporting the results of government-funded studies (www.ntis.gov). NTIS sells these documents to businesses (G2B), consumers (G2C), and other government agencies (G2G), the latter by means of intragovernmental budget transfers. Another example is the Business and International Trade Online Bookstore managed by NTIS (tradecenter.ntis.gov), with more than 20,000 titles available to businesses and other interested parties.

Not all government-based components of EB are commercial transactions. For example, the Federal Communications Commission (FCC) in the U.S. federal government allows electronic filing of license applications (www.fcc.gov), the Internal Revenue Service (IRS) allows electronic filing of income tax returns (www.irs.gov), and the Environmental Protection Agency (EPA) makes data bases and software (e.g., for simulating hazardous emissions) available to businesses and to other government agencies (www.epa.gov). These are examples of B2G, G2B, C2G, and G2G, even though no purchase, sale, or barter with the FCC, IRS, or EPA is involved.

Yet another extension of EC to EB is intraorganizational. This refers to activities (i.e., transactions and information exchanges) that take place by electronic means within a single organization. This may be accomplished by means of enterprise resource planning (ERP) software – such as that provided by SAP, Baan, or PeopleSoft – or by means of intranets [O'Leary, 2000]. However, intraorganizational analogue communications, such as telephone calls and written memoranda, are not considered intraorganizational EB.

The appeal of intranets and extranets – that is, the use of Internet technology for intraorganizational and interorganizational EB – is fourfold. First, for the most part it is free. Although advanced versions of Internet software may be available at a price, the basic versions can often be downloaded from the Internet without charge. Second, the software is readily available – there is no need to wait for an MIS department to develop, test, and install it. Third, the software is well tested by millions of users worldwide. That does not mean that it is completely free of bugs and potential security hazards, but such problems are quickly detected and corrected. Finally, it is cross-platform – for example, similar software, such as Web browsers, have been developed for both Microsoft and Apple Macintosh systems.

Intraorganizational activities, whether coordinated by using ERP software or intranets, are both horizontal and vertical. Horizontal activities are cross-functional, as in purchasing, manufacturing, distribution, and marketing. In this sense, they are analogous to B2B2B2B... supply chains, except that they are internal to a single business enterprise (Figure 4). Thus, electronic payments are not necessary, and financial matters are coordinated internally.

Vertical activities take place among the strategic (S), tactical (T), and operational (O) levels of an organization (Figure 5). Thus, S2T activities take place between the strategic and tactical levels of an organization, and T2O activities take place between the tactical and operational levels. For example, new product development is largely a T2T activity, and order fulfillment is largely an O2O activity. On the other hand, budgeting involves all three levels and is primarily an S2T2O activity (Figure 6). The reason is that budget guidelines are usually promulgated from the top and are then used in lower-level more detailed budget calculations. Similarly, crisis management is usually an O2T2S activity, since crises are often observed initially at the lower levels (e.g., a fire in the factory or the loss of a key account) and are then communicated to the higher levels.

2. E-BUSINESS LITERACY AND EDUCATION

EB literacy is the complex of information requirements that a person should satisfy in order to make informed decisions. EB literacy will therefore depend on the types of people to be educated and the decisions they may be called upon to make. The principal types of people are (1) technical specialists, including Web page designers, database programmers, and telecommunications developers, (2) line and staff managers in existing and potential EB organizations, (3) customers and potential customers of EB organizations, and (4) citizens and government officials.

1. Technical Specialists must be knowledgeable about many subjects, including telecommunications, Web design, and message and installation security, but the principal subject is interoperability. The interoperability issues in B2C EC are minor compared to those that will arise in EB, because B2C EC, and the Internet more generally, did not have to deal in any significant way with legacy systems and their variety of network protocols. However, the situation will be quite different with regard to EB. Interoperability is the often unrecognized problem in EB, but it will become much more prominent in the future.

2. Managers must be concerned with many issues, including security and interoperability. However, a major management issue will be the use of EB as a source of information and knowledge and therefore as an important component of an organization's knowledge management (KM) and business intelligence (BI) efforts. The purpose of KM is to capture an organization's knowledge, both implicit (e.g., by documenting best practices) and explicit (e.g., by data mining). The purpose of BI is to capture information about an organization's environment. The vast amount of information generated by EB will be useful to line and staff managers in supporting their KM and BI efforts.

3. Customers must be able to use EB technology. This will probably not become a difficult issue, since most EB software will be sufficiently user-friendly to allow inexperienced users to make effective use of it. But customers should also be aware of the business potential of EB so that they can suggest productive applications to vendors and also avoid potential problems, such as invasion of privacy, electronic fraud, and theft of identity.

4. Citizens and Government Officials must be aware of any potential dangers of EB, such as those mentioned above, so that they can enact appropriate regulatory measures. They also should understand the impact of these measures, along with other measures, such as taxation and censorship (e.g., to combat pornography), on the growth and development of EB. In addition, they should understand which measures will encourage the growth of EB and whether these will have any dysfunctional consequences. Finally, they will increasingly be concerned about the digital divide – that is, differential Internet and EB access among developed and developing nations, rich and poor citizens,

and small and large companies. With regard to companies, a divide involving small and large companies has already been observed with regard to EDI, and this will probably continue with regard to the broader area of EB.

One issue that will arise in developing educational programs for these four types of people is the technical content. This includes not only information about computers and communications, but also to legal and procedural issues. The technical requirements will clearly differ among these groups, but there is a useful guideline for designing such programs: (1) identify the decisions that the participants will be called upon to make, (2) provide the information they need to make proper decisions, and (3) provide a limited amount of information about happenings at the next, more detailed, technical level.

3. THE FUTURE: BEYOND E-BUSINESS

WHAT WILL FOLLOW EB?

The obvious answer is "business". Eventually EB will become indistinguishable from other aspects of business. This has happened with regard to such communication media as the telegraph and the telephone and will probably also happen with regard to the Internet. It has been suggested that it will take as much as a decade for this to come to pass, and the result will be a digital economy. At that point, the "digital" aspect will be taken for granted, just as business uses of the telephone are now taken for granted.

Until this happens, companies may wish to establish management structures responsible for exploiting the benefits of EB, overcoming the pitfalls of EB, and integrating EB into the rest of their "bricks and mortar" operations. The responsible person might be called a Chief E-Business Officer (CEBO). A CEBO will need to take advantage of such technolgical developments as wireless EB and version 6 of the Internet Protocol. Another such development is the semantic web (Fensel, 2001; Hjelm, 2001), which is expected to assist in information resource identification and knowledge management.

With regard to pitfalls, the CEBO must pay special attention to channel conflict and interoperability. In addition, CEBOs will advise senior management as to activities that will be helpful in incorporating EB into their businesses – for example, by including EB issues in business plans and ensuring that EB objectives are consistent with corporate objectives. The CEBO may also recommend to senior management any changes in organizational structure and culture that will both exploit the current effectiveness of EB and also result in EB becoming an established part of the business.

The success of EB will eventually encourage governments, NGOs, and concerned citizens to develop E-Social, E-Political, and E-Cultural applications. The E-Social applications will concern education and information. Distance learning systems will facilitate learning in both EB-related and non-EB areas. In addition, networking systems will allow various communities – such as hobbyists, professionals, sports enthusiasts, and social clubs – to maintain communication among their members. In addition, the Internet and other networking systems may serve as an alternative to television and newsprint by providing in-depth news coverage.

The E-Political applications will also be information-based. An example is Vote.com, which allows citizens to express opinions, vote in non-binding referenda, and receive targeted political messages if they wish. This will become an electronic version of a town hall meeting (from the citizen's point of view) and a political version of micromarketing (from the politician's point of view). It may well affect the actions, and possibly the power, of journalists, lobbyists, and governments. It may also affect the way in which political activists form groups and take action, which may in turn influence the introduction of democratic principles into authoritarian or totalitarian political systems [Morris, 1999]. There is also concern that the rise of electronic communities will narrow the scope of information sought by their members, and that this will lead to political fragmentation [Sunstein, 2001].

The E-Cultural applications will be more varied. For example, The Internet Archive for Web pages (www.archive.com), MovieFlix for ephemeral motion pictures (www.movieflix.com), and Project Gutenberg for books in the public domain (promo.net/pg) will provide records of the world's cultural heritage. Some universities, such as M.I.T. (web.mit.edu/ocw/), are planning to put their course materials on line, which may benefit current students, faculty at other universities, and future scholars who wish to study how education has changed over time. Other sites – such as beliefnet (www.beliefnet.com) and adherents.com (www.adherents.com) – will address religious and moral issues. Thus, the Internet will provide the infrastructure for a network of e-museums that will maintain information about the world's peoples, languages, customs, institutions, and artifacts –

that is, culture – and make them available to scholars and to the public at large.

In summary, the wide-area, publicly-accessible networking technology that forms the basis of EB (i.e., the Internet, and possibly other technologies to come) will affect how people will live in the twenty-first century. In part, this will be because of EB itself, but it will also be because of the way in which EB infrastructures can be expanded to include social, political, and cultural matters that are not directly related to business.

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Chapter 3

The Neo-Intermediation

Ravi Kalakota and Benn Konsynski

Abstract: Developments in information technology and increased competition both within and outside the industry have led to the unbundling and desegregation of brokerage functions. Nimble on-line institutions like E*Trade and Microsoft Investor are usurping the roles traditionally played by full-service and discount brokerages, forcing some powerful firms to narrow their focus and others to broaden their product offerings.

These changes raise the question: will full-service and discount brokerages continue to exist as we know them in the twenty-first century? To answer this question, the authors provide a new market transformation framework called Neo-Intermediation that helps explain how leading on-line firms are desegregating and reagregating functionality in order to create value in innovative ways.

The pattern of change for brokerages is:

- Unbundling of traditional services - market players examine the elements of the buyer and seller relationship;
- Reallocation of authorities as the "customer" determines what they will do and what they will pay for in the market;
- Creation of strategic alliances with complementors - sites/products whose products complement yours. This means that if a customer has their product, they would also want yours; and
- Repackaging and emergence of both commodity and differentiated service providers that serve the needs of the "new" customer.

The authors believe that these patterns are evident in all forms of financial services and form the basis of market interventions in most service industries. This paper addresses the transformation of the brokerage services marketplace. With new patterns of intermediation emerging, the winners of the future will be those who most successfully create new context bundles that meet customers' needs.

Key words: Intermediary, Brokerage industry, Marketplace

1. BROKERAGE AT THE CROSSROADS

The technological and regulatory barriers that gave brokerage and securities companies breathing space are rapidly becoming extinct. Companies have to scramble to create viable strategies that balance many priorities: Should they defend their existing customer base or enter into new customer segments? Grow their existing business or expand into new products? Acquire, partner or go alone? Basically, companies are competing not only to offer different and better products and services, but to design robust, lucrative business models that take advantage of emerging forms of electronic commerce.

Electronic commerce - the facilitation of exchange of value over computer networks - is fundamentally changing the brokerage business in part by increasing the velocity of financial services (Kalakota and Whinston, 1997). On-line investing faced great skepticism from full-service brokerages just a short while ago (1996), but it is estimated that by the end of 1997, there were nearly three million on-line investors. To serve this growing customer base the number of on-line firms has mushroomed from a handful in 1994 to more than 50 in 1997. More rivals, including banks and insurers, are beginning to emerge (Barboza, 1998).

At a strategic inflection point in terms of providing services for time-starved, high net-worth do-it-yourself investor, the brokerage industry is transforming itself in unpredictable ways. Today fast-moving firms like E*Trade are usurping roles such as research analysis traditionally offered by full-service brokerages, forcing current market leaders to narrow their focus, and others to broaden their product offerings. Confronted with growing competition, old-guard brokers are being forced to restructure and re-focus their market offerings. Existing off-line market leaders seek to maintain their lead in value-added services through a focus on knowledge/advise - more financial planning and investment advice - rather than transactions - processing trades. Other firms are attempting to comprehend how to offer on-line services without alienating their brokers, to minimize channel conflict.

To compete, full-service brokerages are increasing the scope of their service by taking the acquisition route. Morgan Stanley, for instance, has merged with Dean Witter, Discover & Company, which had earlier acquired Lombard Securities, an on-line brokerage. But Dean Witter did not integrate that operation into its brokerage. Instead, it changed Lombard's name to Discover Direct (Investment Dealers' Digest, June 9, 1997 and Financial Times, July 11, 1997). The strategy is to have differentiated brands serve the younger, more tech-savvy investors that gravitate to on-line trading without cannibalizing full-commission business. Banks are also getting into the act. Nations Bank is putting together a broad-based financial company that includes Montgomery Securities, an investment banking and institutional brokerage firm (The American Banker, Nov. 17, 1997). While Nations Bank has broadened its product line considerably, Charles Schwab has narrowed its focus within the financial services industry to the following: retail brokerage, mutual funds, support services for independent investment managers, equity securities market-making, electronic brokerage, and 401(k) defined contribution plans.

Clearly, these firms are trying to stem the tide of disintermediation: consumers and businesses bypassing them in favor of new brokerage entrants ready to provide a wide variety of financial products and services. Disintermediation in financial services is not a new phenomenon. In the early 1990s, retail banks were faced with a competitive threat from the mutual fund industry for deposits. For a while, banks moved slowly into the mutual fund business and were not overly aggressive in lobbying the regulators to lower market-entry barriers. However, when interest rates declined sharply in the early 1990s, there was a substantial runoff of deposits in search of higher yields. To compete, many banks began offering money market and other mutual funds to their customers.

With the advent of the World Wide Web, discount brokerage firms face a comparable disintermediation dilemma. Suddenly, commissions are under pressure, customers want to trade direct, and competition is coming from non-traditional sources. To address the competitive threat, some entrenched firms are seeking refuge in the supermarket approach. With this approach, a full service firm might reason: "If on-line brokerages are competing with us for customer assets, then we must react by either establishing our own on-line channels or by acquiring brokerages." Following this typical re-intermediation path, the new conglomerate expects to reclaim its role of provider-in-the-middle by offering a wider portfolio of products and services. However, creating a financial services supermarket might be a misguided strategic choice for three reasons.

First, many successful 1990's businesses have rediscovered the virtues of adhering to their core competencies and the power of strategic outsourcing in order to gain agility. Most of the conglomerates which attempted to enter the financial services arena - learned the hard way that adding unfamiliar lines of business can dilute their ability to compete, weaken shareholder and customer loyalty and multiply management complexity. For example, American Express Co. and Sears, Roebuck and Co. were unable in the 1980's to successfully combine retail brokerage, credit card lending, and insurance sales (Crane and Bodie, 1996). The reason for failure is economic. Risk and cost sharing in the production or delivery process can enable better time to market and make providing a product/service bundle more efficient than integrating everything in-house.

Second, offering additional products to an existing customer base does not prevent customers from leaving. For instance, banks discovered that offering additional credit cards to existing customers did not stem the loss of market share to specialists such as MBNA. These specialists used credit data warehousing and decision analytics technology to build risk profiles and to better select and target prospects. Also, the decision to add new products to an existing portfolio is complicated by an uncertain environment such as the Internet. In an uncertain techno-marketplace, a firm is often making an informed guess about what it thinks is best for a customer without fully knowing what that customer's preferences and goals are.

Third, techo-enabled firms like E*Trade are putting themselves "in the middle" in a new way by providing customers with interactive and personalized services at little or no cost. This branding and trust-building approach enables the service providers to learn directly and accurately from each customer what's actually important to him or her. Armed with this intimate customer knowledge, these companies are better positioned to build loyalty and increase profits for the long term.

Clearly, re-intermediation is a difficult strategy as sustainable competitive advantage is becoming rare in the on-line environment. High performers today look for a series of short-term advantages over a long period of time instead of attempting to plot a far-sighted course in an environment with too many unpredictable variables.

2. THE EMERGENCE OF NEO-INTERMEDIATION

Innovative Internet-based intermediaries are the real threat to the entrenched players. These firms are adopting dramatically more effective means of forging interactive relationships with customers that we call: neo-intermediation. Neo-intermediation takes as given the economic functions performed by financial intermediaries and asks what is the best organizational structure to perform those functions. Neo-intermediation rests on two basic premises: 1) financial functions are more stable than institutions providing them - that is, functions change less over time; and 2) competition will cause the changes in organizational structure to evolve toward greater efficiency in market mediation.

On-line neo-intermediation is defined as a customer driven relationship that integrates content, tools, and infrastructure in the functional context of a certain configuration of complementors and suppliers. Central to the concept of neo-intermediation is the notion of added value, which is essentially the incremental benefit that the new "in the middle" firm brings to the customer.

Neo-intermediaries are pioneering new approaches with a clear aim: They are looking to exploit synergism across different product lines. They innovate more frequently and organize to seize opportunities much faster than their competitors. Why? Concentrated focus on traditional sources of competitive advantage - such as cost, technology, and differentiation - is inadequate because competitors are quick to replicate advantages. Neo-intermediaries seek to identify and rapidly respond to subtle changes in even the smallest of target markets - the individual customer. To sustain competitive advantage, neo-intermediaries have to embrace business practices that encourage deep customer insight and thinking about how to materially improve the customer's value proposition.

In the following section, we outline some forces for change in the brokerage industry that have created the need for a neo-intermediation framework.

3. FORCES OF CHANGE IN THE BROKERAGE INDUSTRY

Our research examines the pressures for change that are overcoming the inertia in the brokerage industry. Three forces are now changing the rules of the brokerage industry:
1. Changes in securities regulation;
2. Shifts in the balance of power due to the commoditization of brokerage products; and
3. Changing strategic priorities from a make model to a source model.

3.1 Changes in Securities Regulation

Securities regulation reform is transforming the players, services and market structure in the United States resulting in a general trend of industry consolidation that has attracted new competitors and strengthened existing ones (Kalakota and Frei, 1997). Three events have been particularly noteworthy.

First, negotiated commissions and unbundling of investment services in 1975. At that time, the individual investor could access the financial markets only through a full-commission broker, who provided investment advice and placed trades[1]. Under pressure from Congress, the Securities and Exchange Commission changed these policies, allowing for negotiated commissions and unbundling of investment services. These developments enabled the creation of discount brokerage firms such as Charles Schwab which could separate financial advisory services from execution services, and could execute trades at a lower cost than a full-commission broker.

Second, the lifting of the Competitive Equality Banking Act of 1987 (CEBA) growth cap. This meant that, credit card firms like Discover Card (Dean Witter), were able to compete and grow like most other companies, without the legislatively-imposed red tape of having to move assets from one legal entity to another.

Third, the passage of securities litigation reform[2]. The slow but steady dismantling of the Depression-era regulatory structure will encourage commercial banks to expand their securities business and perhaps undertake new acquisitions. Take for instance Toronto-Dominion Bank, one of the largest banks in North America (over 1,000 branches across Canada). TD Bank owns and operates Green Line Investor Services, Canada's largest discount broker. Taking advantage of the Section 20 relaxation, TD Bank has expanded its offerings in the U.S. by purchasing Waterhouse Securities, one of America's leading discount brokerage firms. Waterhouse Securities and Green Line, together, service over 1,100,000 individual investors through 120 branch offices across Canada and the United States and as far away as Hong Kong (The American Banker, Oct. 3, 1997 and Investment Dealers' Digest, Apr. 15 and Nov. 25, 1996).

The trend of large banks moving aggressively into the brokerage business will continue, and the implications are obvious: there will be more intense competition and further consolidation in financial services. In general, there is no more powerful force in transformation of market practice than that of regulation. Market deregulation, incremental reporting and governance requirements change the competitive landscape. Changes in financial services engendered by regulatory reform are merely beginning. We can expect such reforms to result in significant restructuring of the competitive landscape in the early part of the next century.

3.2 The Commoditization of Brokerage Products

In parallel to regulatory changes, technology is rapidly making commodities out of brokerage products. Commoditization, or product similarities, reduces competition to a lowest common denominator usually based on price. Most basic transaction products in the brokerage industry such as placing and executing an order, are commodities. This community has suddenly realized that the Internet and other alternative ways of reaching customers, could push product Commoditization to a further, undesirable extreme.

Commoditization is most evident in the decline in commissions. E*Trade sparked a price war by cutting commission rates in half, to $19.95 per trade. In response, Fidelity Brokerage Services set its on-line price at $28.95, which was 30% to 40% less than its standard commissions. To gain marketshare, AmeriTrade, further cut commissions to $8. Soon after, Quick & Reilly Inc. launched Suretrade, with $7.95 commissions. Web Street Securities goes even further, executing 1,000-shares of many NASDAQ stocks for free (Business Week, Nov. 26, 1997).

Commoditization is impacting brokerage industry structure. To battle Commoditization, some firms are providing retail brokerage services under distinct brand names, each of which offers a range of services and commission rates designed to appeal to specific groups of investors within the discount brokerage market. AmeriTrade, for example uses four brand names (AmeriTrade Annual Report). Accutrade, offers advanced technology delivery systems to sophisticated investors. K. Aufhauser & Company, provides third-party research and investment analysis to experienced investors. Ceres Securities, offers execution services to customers who want minimal transaction costs. eBroker provides execution services exclusively through the Internet. This branding strategy allows AmeriTrade to align the cost structures of its discount brokerage businesses with service levels desired by their customers. The logic goes as follows: For every high-margin customer it serves through Accutrade, Ceres Securities may well pick up a dozen medium- or low-margin Internet-access accounts. Economies of scale and back-office infrastructure are essential in offering these services. Small providers may be able to serve particular niches better, but they would be hard-pressed to match the combined reach of AmeriTrade.

The market trends in homogenization of service offerings and increase in price-based competition are not going to abate in the near future. However, whether brokerage companies can break free of their heritage and make product differentiation work in their favor remains to be seen.

3.3 Changing Strategic Priorities: From a Make to a Source Model

Increasingly, brokerage firms are outsourcing non-critical activities such as content services so that they can concentrate on enhancing their ability to create a unique customer context. Outsourcing is rapidly becoming a central theme in rationalizing organizational and channel structures. The reason for this: individual investors who realized that they can do better by buying trading-related functions separately. For example, they can obtain "pure" news and charting information at Yahoo, while executing trades at E*Trade.

The combination of changing customer requirements and technological improvements are motivating neo-intermediaries to discover new, more efficient ways to fulfill such basic needs as portfolio management and news monitoring. Innovative banks, mutual fund companies, and finance companies compete directly with discount brokerages, while concurrently cooperating with them to augment the traditional package of services offered by full service and discount brokerages. Smaller firms like E*Trade are partnering with complementors such as Quote.Com in order to focus on a smaller number of functions.

The bundling of brokerage services to facilitate outsourcing illustrates a movement away from the in-house "make" model to a "buy and integrate" model. However, this fragmentation of traditional functions is not an end point but part of a transition to more efficient arrangements. Although some niche companies will continue to be successful, other companies will recombine functions to meet the needs of customers better and to take advantage of new technology to produce and deliver products at lower cost.

Given that the winds of change are blowing rather strongly, firms need to comprehend implications of changes such as unbundling, vertical compression, price based competition, horizontal integration, and the need to re-examine content alliances. However, this list of factors provides neither a framework for understanding the fundamental changes under way nor a way to think about how the future might evolve. Customary incremental approaches cannot cope with the changes brought about by the Internet or provide a framework to strategize about impending changes. What does provide such a framework is a logical analysis of the desegregation and reaggregation design patterns that the brokerage industry is undergoing.

4. NEO-INTERMEDIATION FRAMEWORK

New patterns of intermediation form the basis of new market interventions in most service industries. The pattern of change are:
1. Unbundling of traditional value proposition - market players examine the elements of the buyer and seller relationship;
2. Reallocation roles and responsibilities as the customer determines what they will do and what they will pay for in the market;
3. Creation of strategic alliances with complementors - firms whose products complement yours - in order to generate traffic and build brand awareness;
4. Repackaging and emergence of both commodity and differentiated service providers that serve the needs of the "new" customer; and
5. Emergence of patterns of loyal and disloyal behaviors in buyers, sellers, and intermediaries which causes the whole process to recycle again.

These market transformation patterns repeat themselves, since they are a generic result of a given set of forces.

5. THE UNBUNDLING OF THE VALUE PROPOSITION

Neo-intermediaries are adept at unbundling and re-aggregating the value proposition based on customer context. As the Internet took off, discount brokerages like E*Trade and others realized that it would change the fundamental forces in the market, and that successful players would need to take a completely different approach. The key was to identify and scale the right features by desegregating the existing value chain. The logic goes as follows: If E*Trade can desegregate, and drive costs down, it can lead the way to new business models while establishing a well-branded position that is hard to assail.

5.1 Unbundling the Value Proposition

Rather than taking existing institutions as a given, we need to concentrate on the underlying functions that all brokerage value-chains must provide. Functionally, every on-line brokerage value chain is comprised of three main categories:

1. Distribution - Electronic distribution - Internet Service Providers, providers of home and on-line banking services and traditional banks - that must be in place to distribute the product, such as on-line advice and trading. This distribution infrastructure also helps in new account acquisition and development.

2. Customer Context - Context makes discrete content bundles more interactive, entertaining, easy to navigate and understand. Increasingly, industry leaders are less concerned with the piece parts, and more concerned with unifying them into an experience for the do-it-yourself investor. This act of framing the customer context has become a key element of on-line strategy. The proper mix of content, context and community is emerging as a new frontier. Take for instance, AOL's Motley Fool, a context creator, which has frequently updated content and a community component where people become active participants talking about stocks.

3. Tools/Content - The valuable information that is being delivered, such as real time quotes of stocks, options and futures contracts, investment newsletters, up-to date information on stock upgrades and downgrades, and charting and analysis programs. Content also includes high-end advisory services which are crucial for retaining customers. Traditionally, tools and content components were always necessary to do analysis on content. The emergence of electronic commerce has shattered the unified or vertically integrated model and has enabled the tools and content components to be de-coupled and largely outsourced.

Unbundling the value proposition requires functional decomposition. Functional decomposition, often initiated by the new market entrant, is the basic building block of any strategic design process.

To illustrate how the functional decomposition of the brokerage industry consider how the old bundle of functions is fracturing into discrete services. Figure 1 illustrates the portfolio of services offered in the brokerage industry. The objective of functional decomposition is to either eliminate non-core functions or creatively integrate functions dispersed among several different players to reduce cost, improve system coordination and responsiveness.

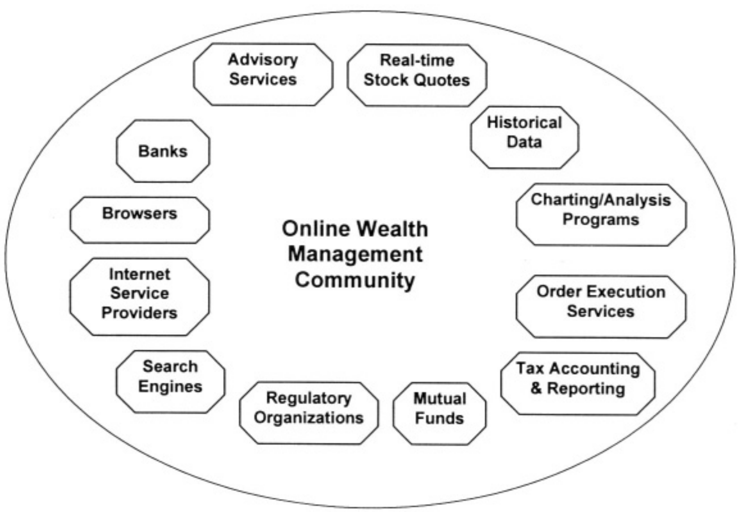

Figure 1. The Unbundling of the Brokerage Industry

5.2 Unbundling the Value Proposition – E*Trade and Microsoft Investor

Neo-intermediaries like E*Trade and Microsoft Investor have disassembled and reassembled distribution channels and content into integrated collections of functions. They are essentially controllers of customer context. Take for instance, E*Trade.

1. Channel Infrastructure - E*Trade leases the required network infrastructure from third parties such as America On-line, AT&T and Microsoft Network. At the back-end, E*Trade provides clearing and execution services to its own retail brokerage operations, as well as to

independent broker-dealers, depository institutions, registered investment advisors and financial planners.

2. Context - E*Trade's objective is to provide a wealth of information in a highly personalized, interactive context, which creates an entertaining environment that attracts active traders to its websites, fosters brand awareness and encourages more frequent trading. One of the new techniques for providing context in the on-line environment is to build end-user communities around specific types of stocks. By organizing its websites by stock types, E*Trade is able to aggregate targeted demographic user groups, thereby offering advertisers and sponsors access to highly defined audiences.

3. Tools/Content - E*Trade provides content and tools from sources like Quote.Com, InvestTools and other sources through ‘content alliances'. The objective is to provide individual investors with access to multiple sources of independent investing advice, research and interactive services that help them make profitable investment decisions. By outsourcing content, E*Trade benefits from access to new and fresh content, turnkey market hardened commerce systems, low costs, and a share of the revenue. The partners gain by getting access to an efficient distribution channel and a strong brand.

Clearly, E*Trade is a neo-intermediary that controls the customer context. Table 1 illustrates the relationships that E*Trade is engineering to create a customer context (E*Trade Annual Report).

Table 1. E*Trade Sourcing Relationships

Relationships	Types of Alliances
New Account Development and Distribution	〈 Internet access and service providers
	〈 Internet content providers
	〈 Providers of home and on-line banking services
	〈 Traditional Banks
Content and New Products	〈 News and Portfolio Tracking
	〈 Investment Tools
	〈 Knowledge Management Products
Existing Product Enhancement	〈 Encryption Technology
	〈 Cash Management Services
Improving Existing Operational Efficiency	〈 Market Makers
	〈 Self-Clearing Operations And Record-Keeping
International Licensing	〈 On-line investment companies outside USA
Enhance Brand Perceptions	〈 Direct Web-Marketing
	〈 Co-marketing

Microsoft Investor is taking a similar strategic road with its partnerships with such companies as PC Quote, Morningstar, Zacks Investment Research, and others. Table 2 below shows how Microsoft Investor is rapidly re-aggregating discrete products and establishing a customer context by quickly bringing innovations to market.

Table 2. Microsoft Investor Community

Services offered by Microsoft Investor	Companies Providing the Capability to the Microsoft Investor Community
Portfolio Tracking	MSN
Investment Finder	MSN
Premium Business News	PC Quote, MSNBC
Daily Editorial and Market Summaries	Free Lance Editors
Analyst Consensus Recommendations	Zacks Investment Research
Mutual Fund Analysis	Morningstar
Earnings Estimates	Zacks Investment Research
Company Profiles	Hoover's Inc. (Austin, TX).
Historical Data	CSI
Fundamental Stock Data	Media General Financial Services
Financial Statements	Zacks Investment Research
Email Notifications	MSN
Discussion Groups and Chats	Individual Forum Leaders
On-line Trading Through Leading Partners	E*TRADE, AmeriTrade, Charles Schwab, DLJ Direct, Waterhouse, National Discount Brokers

6. NEO-INTERMEDIATION: STRATEGY, STRUCTURE, AND PROCESS

The ability to rapidly re-aggregate value is a core competency which offers significant competitive advantage. As customers demand novel products to meet their evolving needs and as innovative firms discover ways to combine products to lower total cost or improve some aspect of their financial service, neo-intermediation is emerging as a competitive strategy. The first step in devising an effective neo-intermediation strategy is to consider the nature of the demand for the products. Many aspects are important - for example, customer segments, demand patterns, content partners, demand predictability, product variety, and market standards for service.

6.1 Customer Segmentation

In the new competitive space, it is increasingly apparent that content, distribution channels, and technology are not sustainable differentiators. Customer context is emerging as the key differentiator, in order to develop the right context, on-line customer segmentation is key. Critical sub-groups of the investment community exhibit unique sets of interests and appetites. Four customer segments in on-line brokerage services are evident. These segments are based on frequency of trading.

1. Passive Trader. These customers usually has a brokerage account with a full-service provider. They use the on-line medium to follow the news about stocks in their portfolio and keep abreast of market ups and downs.

2. Long-term Investor. These convenience-minded consumers want a comprehensive package of financial products like mutual funds aimed at long-term growth. They also want tools for financial planning and portfolio optimization. Breadth of offerings and ease of use are most important to this customer. The latest in technical analysis and being on the "bleeding-edge" is not a major concern.

3. Active Trader. These data-hungry investor values high-quality information, investment tools, and research. Active traders often look for stock trading, mutual funds, news, and research in one integrated, easily accessible place.

4. Hyperactive Trader. These are often day-traders who tend to do a lot of trading and hence are price conscious and value speed of execution. Simple interface, price and fast service are important issues for this self reliant customer. This segment often called "lunatic-fringe" by developers is also early-adopters of new and innovative services as they are constantly in search of better tools to gain an edge.

Active and hyperactive do-it-yourself investors move from one broker to another, always searching for a lower price or a different shopping experience. They tend to have multiple accounts. They have no loyalty to any particular brokerage, and are always in search of a better deal or a new promotion. They are endlessly interested in the experience of others, and word of mouth is seen to be the most trusted and reliable source of information.

Today, every brokerage firm wants some else's active and hyperactive customers. Why? Because even though on-line trading margins are decreasing, it's not the actual trading that generates profits. Firms make money by lending stock held in accounts, from the interest on margin loans and from the cash balances in accounts. To quickly build assets under management, new on-line brokerage entrants are "cherry picking" active and hyperactive customers aiming to pick up the profitable ones by offering them a new delivery channel, a better brand image or enticing them through highly targeted marketing campaigns. However, this is a short-term strategy because the active and hyperactive customer segments are expensive to win (as there are significant costs entailed in getting their attention in the first place), difficult to service (as they are highly demanding), and almost impossible to keep.

To create a sustainable strategy in the long-run,, firms will have to place an emphasis on understanding and responding to customers' real preferences in terms of: the content dimension (what is the customer interested in?); the technological dimension (what is the demand for new technologies such as personalization); the pricing dimension (how price sensitive is the customer); and the service dimension (what service attributes do the on-line customers value?).

If the four dimensions are in sync with one another, then the product or service hits a customer's sweet spot that we term "ease of use." Ease of use will be a key selling feature of new technologies and products in the years ahead. Ease of use has three dimensions: accessibility which implies ease of use, service and support; efficiency of new products and technologies that will make lives easier and save customers time and headaches, or contribute more directly to personal productivity; and practicality that will make things more useful and functional. If the dimensions are out of sync, then a feeling of discomfort will develop leading to potential defections.

6.2 Transactional versus Knowledge-Based Products

Brokerage products can be classified on the basis of their demand patterns in two categories: transactional or knowledge/advisory. Transaction products include real-time stock, futures and options quotes, charts, and execution of trades. Because such products satisfy basic needs, which don't change much over time, they have stable, predictable demand and long life cycles. But their stability invites competition, which often leads to price competition and low profit margins. To avoid low margins, many companies introduce innovations in terms of bundles to give customers an additional reason to buy their offerings.

Knowledge/advisory products include pre-purchase information such as analyst reports, advisories, newsletters and recommendations. These products range from commodity information to sophisticated advisory services offering model portfolio of legendary investors like Warren Buffet or well-regarded fund managers. Figure 2 shows a framework of advisory services. Knowledge products keep the investor informed and help them make better decisions.

Although knowledge can act as a transaction stimulus and enable a company to achieve higher profit margins, the very novelty of knowledge and advisory products makes demand for them unpredictable. In addition, their life cycle is short because as imitators erode the competitive advantage that innovative products enjoy, companies are forced to introduce a steady stream of innovations. The short life cycles of these products further increase unpredictability. It may seem strange to lump technology and knowledge together, but both types of innovation depend for their success on customers changing some aspect of their trading patterns or value proposition.

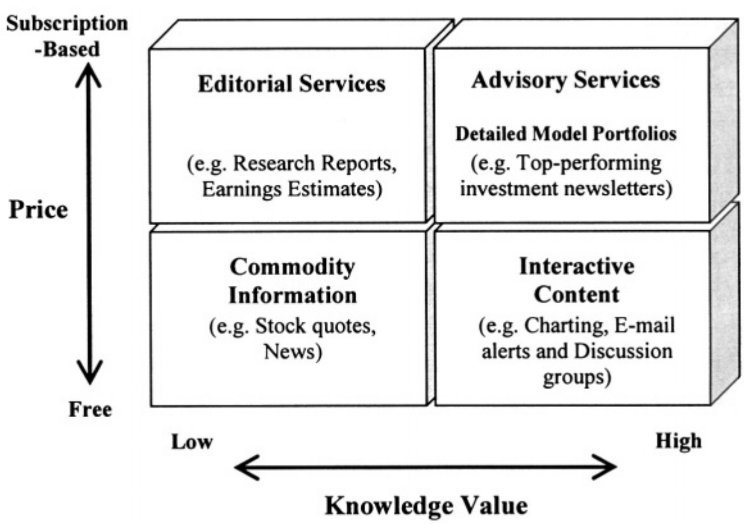

Figure 2. A Framework for Advisory Services

6.3 Innovation through Integration: Creating the Right Intermediation Structure

Having determined the nature of brokerage products and their intermediation priorities, managers can employ a matrix to formulate the ideal structure to support the effective delivery of the customer value proposition. Each category requires a distinctly different kind of neo-intermediation structure. Innovative knowledge products require a different intermediation structure than stable, low-margin transaction products. A transaction structure is aimed at reducing transaction costs of order-taking, execution, clearing, and storage. Transaction structures seek to increase efficiency of placing customer orders, and doing custodial and cash management activities.

Knowledge intermediation is more of a mediation function aimed at effectiveness. The objective is to ensure that the variety of information and advice reaching the end-user matches what customers want to buy. Knowledge costs include mediation costs of evaluating various sources, creating alliances, and establishing technological integration. Ineffective knowledge intermediation results in customer churn and dissatisfied customers.

Strategic failure is often caused by a mismatch between the type of product, a specific target segment, with distinct requirements and needs and the type of intermediation structure. The choice of a neo-intermediation context is dictated by whether a firm elects to compete on low cost, operating excellence (e.g., by emphasizing reliability), customer context creation (e.g., by emphasizing customization), or superior choice. The four cells of the matrix (Figure 3) represent the four possible combinations of products and priorities.

<u>Level 1: Low Cost Trading.</u> The customer's value proposition is simple: low or lowest price and hassle-free service. The predictable nature of transaction products makes market mediation easy because a match between supply and demand can be achieved. Companies that make such products are thus free to focus almost exclusively on minimizing transaction costs, given the price sensitivity of most trading products. In this instance, the important flow of information is the one that occurs within the chain as suppliers, resellers, and delivery channels coordinate their activities in order to meet demand at the lowest cost.

Level 2: Integrated Trading. The value proposition is to offer products that push performance boundaries. Reading early customer reaction or other market signals and reacting quickly, during the new product's short life cycle is critical in Integrated Trading models. In this instance, the flow of information occurs not only within the service chain but also from the marketplace to the service chain. The strategic decisions to be made are not about minimizing capacity costs but about creating barriers to competitive response. To do so, the firm may have to lock itself into an efficient internal process or into ties with partners.

Level 3: Integrated Account Management. Most important in this environment is providing the customer with an integrated set of products and delivery channels. For instance, Schwab provides Web access, direct dial-up access, and access through on-line service providers such as America On-line and Microsoft Investor. Also, on-line customers have access to Schwab representatives in branch offices nationwide. On the product side, Schwab provides integrated access to hundreds of mutual funds through Mutual Fund OneSource service. In this service, customers find the portfolio manager's commentary, fund philosophy and fund prospectus information. In order to hedge against uncertain demand, suppliers should be chosen for their speed and flexibility, not for their low cost.

Level 4: Trading Community. Most important in this environment is customer choice (see Table 2). This involves having a full range of services available to serve customers upon demand - this may involve running a 'see-through company', in which a variety of goods or services are available quickly through contract arrangements. The resulting networks or value-adding partnerships are like confederations of specialists. They are flexible and specialized, and they emphasize inter-firm relationships, with a pooling of complementary skills and resources to achieve shared goals. The uncertain market reaction to context innovation increases the need for flexibility and adapting to changing demand. Short product life cycles increase the risk of obsolescence. Market mediation costs are higher for Trading Community products.

By using the matrix to plot the nature of the demand for each of their product families and their intermediation priorities, brokerage firms can discover whether the process the company uses for supplying products is well matched to the product type- an efficient process for transactional products and a context responsive process for knowledge products. Companies that have a knowledge product with an efficient information value chain (upper left-hand cell) might have problems if the demand for advisory services changes. Companies that have a transactional product with a responsive information value chain (lower right-hand cell) might have problems that arise from coordination issues.

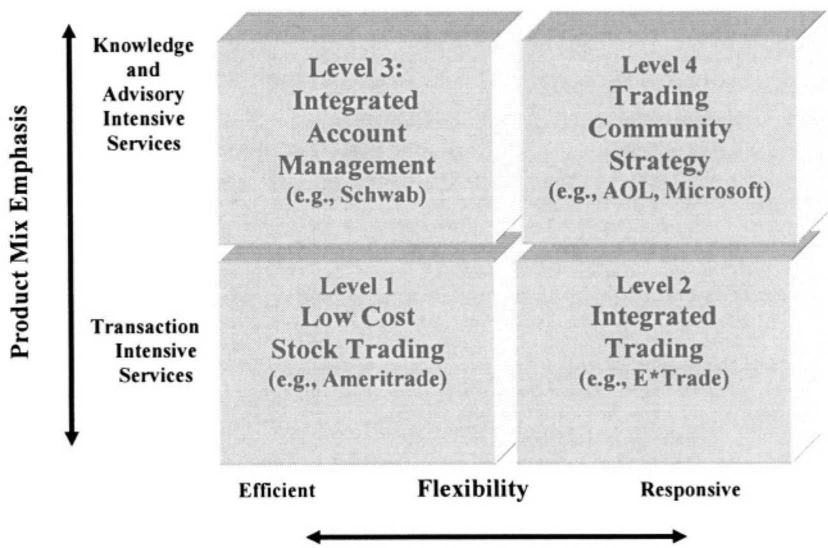

Figure 3. A matrix for four possible combinations of products and priorities.

6.4 Co-Branding and Traffic Growth

One of the challenges of an intermediary is to manage soaring branding and marketing expenses with plummeting commission rates. E*Trade has shown the brokerage industry that a firm with a great brand image can win customers and service their financial needs via products from third parties. The importance of establishing market share for new products increases the importance of effective branding. Any activity that is not central to the context creation strategy can be performed better by another organization. Along with rationalizing their activities, firms are exploring new marketing relationships and alliances with customers, suppliers, and intermediaries.

The resulting openness to partnering is producing new collaborations for the sharing of activities such as co-branding and traffic growth. Wouldn't it be nice to have other sites that refer interested customers or even sell your products? This is what Amazon.com did to become the "world's largest bookstore" with their digital associates program. On-line brokerage firms are using similar tactics to build a franchise. Once a firm finds complementor sites based on customer segments that it seeks to serve, it becomes possible to: create mutual hyperlinks and banners, exchange or place ads, promote and sell each others products.

The logic behind co-branding alliances is simple: an individual electronic commerce website can maximize its awareness and traffic through the use of strategic alliances with other websites having high user traffic. Through the use of embedded hyperlinks, higher traffic websites can refer potential customers to electronic commerce websites for potential purchases of goods or services. These agreements generally involve economic arrangements including up front payments or commissions on the dollar volume of goods sold. These payments are analogous to rent paid by traditional "brick and mortar" retail locations, and can be critical to an electronic commerce website's ability to expand.

The new linkages require relationship management skills and careful negotiations. Both participants must realize durable mutual benefits in financial terms (through increased revenues or lower costs) or hard-to-quantify benefits due to risk sharing or the pooling of expertise and market knowledge. Such mutual benefits are increasingly feasible because of advances in information technology that have sharply reduced the costs of coordinating and administering transactions between partners.

6.5 Selecting Neo-Intermediation Design Alternatives

How can a firm choose a strategic arrangement when confronted with multiple possibilities? It should rely on strategic design principles, subject to the constraints of prior commitments, resource availability, and rigidities. The design choice must meet the requirements of:

1. <u>Risk Management</u> - Risk management is a key element of strategic design. Firms in high-velocity environments, where relationships are uncertain, are creating portfolio of options for coping with inevitable uncertainty of demand. These options enable a firm to explore context design by trial and error.

2. <u>Customer Migration</u> - Neo-Intermediation design questions must be asked in the context of two different customer bases: existing customers and new customers. For a firm with an established customer base, the key question is: *How do they reach out to the technically proficient*

investors without losing their margins or alienating their existing customer base. At the same time, *how do they migrate their existing customer base quickly?* One of our favorite jokes applies very well to the problems facing entrenched players: How could God build the world in only six days? Answer: He had no installed base of customers. With no installed base, E*TRADE and other deep discount brokerages have been focused on advancing the active and hyperactive category; while firms like Schwab are more interested in migrating their existing customer on-line rather than acquiring new ones.

3. <u>Incremental Functionality</u> - How closely does the neo-intermediary structure address customers' stated and unstated requirements? Can the customer find and appreciate the value in a firm's offering? By examining value from the customer's perspective, functions might be combined to address hitherto unmet needs in innovative ways. Firms are managing functionality by designing context in a bottom-up fashion, so that the context functionality meets the anticipated requirements of the target market.

4. <u>Branding and Cost-efficiency</u> - Can the company justify a tradeoff in cost-efficiency to gain greater strategic effectiveness and coverage because of the multiplier effect that distribution has on increasing the impact of the other marketing variables?

5. <u>Long-run adaptability -</u> Can the neo-intermediary design handle possible new products and services and incorporate emergent content forms? A critical challenge in the on-line setting is the implementation of a measurement and control system for monitoring performance of an intermediation structure. These controls define the information collected, standards for performance, and ways to compare expectations with results. Without this information, there is no basis for learning, correcting mistakes, and adjusting assumptions to fit reality. Thus the end of this step signals the beginning of another cycle in the design process.

On-line distribution channels, content and branding have become evolving networks, comprising many complementary ways to reach and serve customers. Whatever the choices, many are bound to fail as it is hard to predict technology or customer behavior. However, the costs incurred - even when there is a failure - should not be viewed as losses but as investments in learning how to understand and gain access into the market. As the market stabilizes, the firm should choose to provide a specific context rather than continuing to experiment with costly options.

7. SUMMARY

Increased competition from non-traditional institutions, declining transaction costs due to new information technologies, the erosion of product boundaries in the face of new customer demands and, less restrictive regulations are accelerating the transformation of the brokerage landscape. This trend is being reinforced by World Wide Web, which is reducing industry barriers and making the underlying business structure semi-transparent.

Electronic commerce, new market practices, and increasing customer capabilities will clearly play a role in providing new products, perhaps giving rise to completely new functional intermediaries (Merton, 1995). Current thinking in e-commerce strategy has focused too much on desegregation, on technology, not enough on re-aggregation or neo-intermediation. Most of history suggests that a pure desegregation strategy won't work with customers. For instance, in PC software, the trend has been towards integrated application suites, not components. Clearly, packaging, branding and simplicity are becoming more necessary, not less. As a result, inefficient firms will be exposed and become vulnerable.

For brokerage firms, electronic commerce changes the rules of competition. It will:

- Reduce the value and importance of physical assets as they are complemented or replaced by virtual assets, chiefly knowledge.
- Desegregate the marketplace value-chain, allowing buyers to obtain financial instruments, advice and research and execution services separately. This will accelerate commoditization of many existing products and services.
- Open the way for more competition across industry borders. This will require brokerages to respond by forming alliances, with other providers of products and services. They need to examine where they can add value: Content, Context, or Infrastructure?
- Result in a contest for customer relationships and brands, requiring the adoption of a culture which is more flexible and entrepreneurial.

For customers, the implications are formidable. To mention a few:

- Customers will enjoy greater choice and more freedom to choose products and suppliers. The corollary is that they may also face confusion, unless they are more well informed.
- Customers will demand the same levels of trust and integrity in the networked world that they expect of today's off-line system.

We do not know when companies will introduce new packages of products or when new intermediaries will emerge. Clearly, financial innovation is at work in the marketplace, and that will lead to a repackaging of brokerage functions. Some of the repackaging may well be undertaken by existing full-service firms. But we should also expect new institutional arrangements to emerge. The winners of the future will be those who best package functions to meet customers' needs, not those who cling to old institutional arrangements.

Endnotes

1. This is due to the fact that all stock exchanges required brokers to charge fixed minimum commissions for trades of listed stocks.
2. The Federal Reserve's decision to expand the Section 20 securities powers of bank holding companies is likely to have a major impact in the United States.

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Chapter 4

Driving Forces for M-Commerce Success

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Abstract: Is m-commerce just an extension or a subset of e-commerce? Will it turn out to be just more hype? In this paper we discuss the realities of m-commerce and the major differences between mobile commerce and Internet-based e-commerce. Based on this understanding, we identify key factors that must be taken into consideration in order to design valuable m-commerce applications. We emphasize that the success of m-commerce relies on the synergy of three driving forces: technology innovation, evolution of a new value chain, and active customer demand.

Key words: M-commerce, E-Commerce, Wireless Communication Networks

1. INTRODUCTION

What is mobile commerce? Is it just hype? Almost every company in telecommunications is trying to figure out what m-commerce really is, and how to exploit it. From the marketers' vision, in the new world presented by m-commerce, consumers can use their cell phones and other wireless devices to purchase goods and services just as they would over the Internet using their personal computers (PCs). Specifically, m-commerce is about content delivery (notification and reporting) and transactions (purchasing and data entry) on mobile devices (Leung and Antypas, 2001). Unfortunately, in reality, m-commerce is often a highly frustrating experience. Industry observers attribute this drawback to the immaturity of mobile technology, but they believe 3G (third generation wireless digital cellular telephone technology) networks could change the situation (Colin, 2001). While m-commerce is still in its infancy, enhanced devices and networks are irrelevant unless m-commerce applications are compelling and user friendly.

Most often m-commerce is understood as mobile e-commerce (Donegan, 2000; Schwartz, 2000; Liebmann, 2000). M-commerce is supposed to enable us to buy everything from anywhere over the Internet without the use of a PC. Internet access and Web browsing is assumed to be the key to extending m-commerce to customers (Harter, 2000). In many ways, m-commerce is the continuation of e-commerce with the palm handheld, wireless laptops and a new generation of Web-enabled digital phones already on the market (Keen, 2001). Thus it was once believed that if you brought together mobile communications and the Internet, two of the biggest things in telecommunications, there would be an almighty explosion of growth. However, it has not happened yet. In many ways, m-commerce and the wireless Internet have been the victims of over-excited speculation (Darling, 2001). Among 1,700 people surveyed in Spring 2000 by *Jupiter Communications,* the majority said that they would not use nor pay for the wireless Web (Lindsay, 2000). WAP (Wireless Application Protocol) services were disappointing, particularly in Northern Europe countries, where mobile communications are most advanced and consumers know well the limitations of the wireless Web (Monica, 2000). Consequently, the enthusiasm that originally greeted the concept of the mobile Internet has waned.

Contrary to conventional perspectives on m-commerce, forward-thinking marketers should not view m-commerce as e-commerce with limitations, but rather as wireless in its own unique medium, with its own unique benefits (Cotlier, 2000). Even though wireless technology is sometimes regarded as an enhancement tool rather than a brand new medium (Ramakrishnan, 2001), successful players in the m-commerce market space must take a much broader view of the technology, the market, and potential consumers. M-commerce is not simply a new distribution channel, a mobile Internet or a substitute for PCs. Rather, it is a new aspect of consumerism and a much more powerful way to communicate with customers. Obviously, people will not shop with their phones in the same way they shop with PCs. Unleashing the value of m-commerce requires understanding the role that mobility plays in people's lives today. That calls for a radical shift in thinking (Nohria and Leestma 2001).

In this paper, we will identify driving forces for the success of m-commerce. To clarify the nature of m-commerce, we discuss several fundamental differences between m-commerce and Internet-based e-commerce. Based on this new perspective of m-commerce, we identify a set of key factors that should be considered by marketers as well as consumers in making decisions concerning m-commerce applications. Finally, we propose that the synergy of three driving forces will lead to a greater likelihood of success for m-commerce.

2. KEY DIFFERENCES BETWEEN M-COMMERCE AND E-COMMERCE

As we argued, m-commerce is not simply an extension or a subset of e-commerce. In fact, there exist fundamental differences between m-commerce and e-commerce in terms of their origins, technologies and the nature of the services they can offer.

2.1 Origin

The emergence and development of e-commerce was due to the rapid growth of the Internet. The Internet originated from several U.S. government-sponsored programs (ARPANET, CSNET and NSFNET, etc) aimed at providing a networked computing environment for researchers (Kalakota and Whinston, 1996). Starting from the early 1990s, the Internet was extended to business community applications. With such great business potential and rapid growth to millions of users, the term “electronic commerce” was coined, and e-commerce applications expanded rapidly (Turban et al., 1999). Because of widely-expanding networks and nearly free access to the Internet, e-commerce bridges distances and enables companies to display and sell goods and services cheaply to consumers and businesses around the world. In the Internet world, much is given away free or at a discount in the hope that a way will eventually be found (presumably through advertising income) to turn traffic into profits.

Contrarily, m-commerce is rooted in paid-for service in the private mobile phone industry where business competition is stiff. In the telecom world, users pay for airtime, by the size of the data packet transmitted, and by the service used for what they get (Fox, 2000). Global wireless networks are segmented and owned by different mobile operators such as *AT&T, Pacific Bell Wireless, Vodafone, Orange, Deutsche, NTT DoCoMo,* etc. Compared to almost free Internet access, high cost has been seen as a major characteristic of m-commerce (Shim and Rice, 2001). Mobile communication through cell phones is costly, and any additional services will attract extra charges. The reason is that establishing a mobile communication network requires heavy business investment with no government support (Ramakrishnan, 2001). M-commerce carriers therefore must look for a great deal of business activity to generate revenues that justify the huge infrastructure investments (Lamont, 2001).

Due to their different origins, the customer bases of m-commerce and e-commerce are quite different. Researchers and university educators were the early users of the Internet. The Internet user population was originally dominated by highly educated people. As Internet household penetration increases, the demographics of users continue to shift closer to those of the population at large (Pastore, 1999). This growth pattern is clear in U.S. and tends to be repeating in the rest of the world (http://cyberatlas.internet.com/big_picture/demographics). In contrast, other than business users, most cell phone users are young people or relatively less well-educated consumers. Over the next decade, billions of people will gain access to mobile devices, but many of them will be functionally illiterate and technologically unsophisticated users (Feldman, 2000; Barnett et al. 2000). Because of their differences in background, consumers tend to have quite different expectations for m-commerce, compared to e-commerce. For example, one reason for the low uptake of the wireless Internet in the U.S. is that most Americans already are familiar with the wired Internet and expect to pay for wireless Internet access as they do for wired access: unlimited access for a flat monthly fee (Fox, 2000).

2.2 Technology

The Internet, the fundamental infrastructure of e-commerce, adopted a well-established protocol, TCP/IP (Transmission Control Protocol/Internet Protocol), which solves the global internetworking problem and ensures that computers communicate with one another in a reliable fashion. Over the past several years, the World Wide Web (WWW) has come to dominate Internet traffic, and the vast majority of e-commerce applications are Web-based. It is also easy to connect the Internet with existing business information systems. Uniform Internet standards significantly reduced e-commerce entry costs and helped fuel the rapid growth of e-commerce.

In contrast, m-commerce services are constrained by a variety of wireless media communication standards ranging from global (Satellite), regional

(3G, IEEE 802.11a/b, DoCoMo I-mode), to short distance (Bluetooth) (Shim and Rice, 2001). Cellular carriers use different systems and standards such as GSM (Global Service for Mobile), TDMA (Time Division Multiple Access), and CDMA (Code Division Multiple Access) to compete with each other (Leung and Antypas, 2001). M-commerce applications tend to be device and carrier dependent. The wireless applications today primarily use two technologies: WAP and SMS. WAP (Wireless Application Protocol) is the display language designed for cellular handhelds. It was created by *Motorola, Ericsson, Nokia* and *Phone.com* in 1997 when they founded the WAP Forum. WAP is a derivative of the XML/HTML language family, but it is designed to operate without a keyboard or mouse. SMS (Short Message Systems/Services) is a derivative of the old numeric paging network, with additional functionality for two-way communication and support for text and attachments. There are more users of SMS today than of WAP, thanks to cheaper service and the widespread availability of low-cost, two-way paging devices from companies such as *Motorola* (Leung and Antypas, 2001).

Until now, there has been no generic world-wide framework and standard for application development using universal mobile connection and access. In fact, wireless technology is still in its infancy and hindered by limited coverage and a smorgasbord of competing standards, which can explain the slower-than-expected adoption of m-commerce in the United States (Shim and Rice, 2001). Choosing from conflicting standards, products and features, gives even hardened technophiles a headache. The pyramid of m-commerce applications thereby presents a much more complicated process, in which many pieces must fall into place before the mobile phone can be seen as a real revenue generator.

In addition to underlying networking infrastructure and standards, it is the client devices that actually determine what specific services can be delivered. The boom in e-commerce applications is actually due to the widespread use of PCs, which have a complete text input keyboard, large screen, substantial memory, and high processing power. Contrarily, various m-commerce applications rely on the use of handheld devices. These devices range from pagers, cell phones, and palmtops, to pocket PCs. Mobile devices such as cell phones and PDAs (Personal Digital Assistants) have tiny screens, some of which display only three lines of text at once (Lucas, 2001). The displays are black and white with low resolution; there are no QWERTY keyboards, and no support for animation (Leung and Antypas, 2001). Although WAP devices support a limited graphics format called Wbitmap, because mobile devices have limited bandwidth and small screens, any application that is heavily graphic or animation driven would not be suitable at this time. In addition, software applications are relatively crude. There are no cookies or session controls, meaning that if the connection is lost, the application will restart rather than continue from previous screens (Leung and Antypas, 2001). Web browsers and drop-down menus are unavailable, so companies must plan on character-based terminal applications with cursors and key entry forms. Long selection lists or deep menu layers will wear out the fingers of even the most patient users (Moustafa, 2000; Jainschigg and Grigonis 2001). However, in contrast to PCs, cell phones do have their own unique features: mobile, portable (small size), smooth voice communication, and connected to persons (primarily because of portability) rather than to home or office.

2.3 The Nature of Services

The wide accessibility of the Internet makes any e-commerce service globally available. The Web enables search and delivery of rich information, and sophisticated electronic transaction processes can be integrated easily with backend enterprise information systems. In contrast, the delivery of m-commerce applications relies on private wireless communication carriers. These services are usually delivered to a specific region, and are rather simple, more personalized, location-specific and time-sensitive. Since a mobile device usually accompanies a person wherever he or she goes, mobile services can be delivered to a person anywhere and anytime rather than to a fixed office or home. M-commerce therefore creates more of a perception of enhanced intimacy with consumers than other office-based distribution channels. Time sensitive, simple transactions such as movie ticket purchases, banking, and travel reservations are believed to be the key applications that will stimulate m-commerce (Lucas, 2001; Swartz, 2001-2). Other key drivers to m-commerce growth are location-based applications such as traveler navigation, emergency response, etc. (Seeker, 2001; Rockhold, 2001; Swartz, 2001-1).

Finally, in general we categorize Internet based e-commerce into B2C (business to consumer) and B2B (business to business). The rapid growth of e-commerce started from the booming of dot.com companies aimed at online shopping and customer services. Gradually, the emphasis shifted to B2B, and more recently e-business, to take advantage of the real business value of the Internet. In contrast, mobile commerce started from person to person communication, and gradually more services were introduced through interactions between people and systems: checking the weather, finding a local restaurant, etc. M-commerce applications can be used to serve both consumers and business people. Rather than apply B2C and B2B classifications to m-commerce, P2P (Person to Person) and P2S (Person to System) would be more appropriate to address the nature and trend of m-commerce applications. The details of m-commerce applications will be discussed in the next section.

The major differences between m-commerce and e-commerce are summarized in Table 1.

Table 1. Major Differences Between M-commerce and E-commerce

	E-commerce	**M-commerce**
ORIGIN		
Sponsorship	Government-sponsored Internet	Private mobile phone industry
Business entry cost	Low	High
Customer access cost	Free or low cost Internet access	High mobile service charge
Customer base	Highly educated computer users	Less educated cell phone customers
TECHNOLOGY		
Message transmission	Packet-switched data transmission	Circuit switched for streamlined voice communication
Protocol	TCP/IP, HTTPML	GSM, TDMA, CDMA, 3G
Standardization	Highly standardized	Multiple incompatible standards
Connectivity	Global	Mainly regional
Bandwidth	High	Low
Identity	URL with IP and domain name	Phone number
Application development	General computer applications	Device-specific applications
Interface device	Personal computers	Cell phones and PDAs
Mobility	Fixed location	Mobile
Display	Big screen	Small screen
Main input mode	Keyboard for full text input	Voice with small key pad
Main output mode	Text and graphics	Voice with small text display
Local processing power	Powerful CPU with large memory and disk space	Limited processing power with small memory chip
Software and Programming	Support a variety of programming languages	Java or specific script languages
Trend	Towards sophistication	Towards minimization

	E-commerce	M-commerce
SERVICES		
Service range	Global	Regional
Delivery destination	PC in office connected to the Internet	Person accompanied by a mobile device
Transaction complexity	Complete and complex transactions	Simple transactions
Information provided	Rich information	Simple and short messages
Timing	Less time-critical	Time critical
Location-based service	No	Yes
Target mobility	Service to a fixed point	Service to a moving target
Backend business connection	Strong connection to backend business information systems	Weak connection to backend business information systems
Service classification	B2C (business to consumer) and B2B (business to business)	P2P (person to person) and P2S (person to system)

3. KEY FACTORS IN DESIGNING M-COMMERCE APPLICATIONS

Once we have identified the major differences between wireless mobile communication based m-commerce and Internet based e-commerce, we can identify the key factors that must be taken into consideration in designing useful m-commerce applications.

3.1 Mobility

M-commerce opportunities can be very significant, if investors understand consumer groups intimately and develop ubiquitous solutions that recognize the role that mobility plays in consumers' lives (Nohria and Leestma, 2001). In business services, not being forced to be hardwired enables a company's employees to remain connected while moving from office to office, or state to state; they can tap into the corporate network from airport lounges and hotel lobbies. For individual consumers, mobile devices basically allow them to keep in touch with their friends and families anywhere and anytime. For instance, videophone users can take pictures wherever they go and send them attached with short notes to friends while shopping, traveling, or simply hanging out (Kunii, 2001). Beyond person to person mobile communication, additional value can be generated by linking mobile consumers and existing services. Mobile consumers can access various services anytime and anywhere, presenting new marketing channels for businesses. While traveling, a user may use a mobile phone to control a home burglar or fire alarm system and to turn lights on or off as if at home (Fox, 2000).

3.2 Personal identity and built in payment mechanisms

Since mobile devices, particularly cell phones, are registered by their subscribers and normally accompany the person, it becomes possible to identify and deliver personalized services to the user. A cell phone with additional security information such as a PIN number or biometric identification technology can be used to identify a person. A payment mechanism may also be built into the cell phone system. It is then possible to allow consumers to use their wireless phones as devices to make or trigger a payment (bus ticket, vendor machine etc.), similar to the use of a smart card or an ATM machine. And there are even a few vending machines that let users pay for soft drinks using their cell phones (Fox, 2000). Credit card numbers could also be replaced by cellular phone numbers for wireless transactions. Relying on a third party payment mechanism is always a big hurdle for Internet-based e-commerce because an IP address cannot identify a person. However, this difficulty could be easily overcome in m-commerce with the use of an identifiable mobile device. Hence, cell phones naturally support e-Wallet applications in m-commerce, which is crucial to the success of other applications. Certainly, systematic security solutions involving PKI (Public Key Infrastructure) and biometric services should be adopted as well (Young, 2001). As an example *Obongo* has modified its e-wallet software for use on wireless devices. A so-called m-wallet contains the cardholder's account data, name, and mailing address, and is accessed with the push of a button. Once opened, the data within the wallet are transferred to the merchant to complete the payment (Lucas, 2001). M-wallets make micro-payments easier and help carriers charge for advanced services such as digital media and game applications that consumers cannot get any other way (Swartz, 2001-2).

Besides financial services, personalization in m-commerce can migrate into entertainment (music and games, etc), content services and even personalized marketing. Since mobile operators maintain personal information on subscribers, a CD vendor, for example, could simply ask customers to verify payment information and a shipping address through their cell phone displays rather than have them fill out forms each time from scratch (Barnett, et al. 2000). Good potential applications of the content revolution are personalized software that deliver highly targeted offers for large- or small-ticket items that consumers can act upon, even while waiting in line (Lucas, 2001).

3.3 Location-Based Services

To date location-based services have been regarded as key enablers of m-commerce's future success, according to the current hype (Swartz, 2001-1). Portable geographic positioning systems (GPS) are becoming smaller and more affordable, at costs in the neighborhood of only about U.S. $200. These systems can be used not only to identify locations, but also for business to deliver location-sensitive services to users. The ability to target rich and relevant information to end-users provides great potential value in location-based applications. For instance, it would be quite useful to provide driving directions and local commercial services where users happen to be, such as near specific restaurants, movie shows, bus schedules, weather reports and guided tours in museums (Shaffer, 2000; Taaffe, 2001). Hence, one of the selling points of m-commerce applications is proximity. *Go2Systems,* in Irvine, Calif., one of a swarm of vendors eyeing the uses of ALI (automatic location identification) data, linked with *Coca-Cola* to steer wireless customers to stores selling *Coke* products (Jones, 2000). *Coca-Cola,* the world's best-known brand, has ventured into the wireless world by providing its fountain clients (*McDonalds, Burger King* and more than 800,000 U.S. restaurants) with the opportunity to attract additional business by placing their names on *Go2 Systems'* wireless services. Their 5-year, U.S. $30-million deal will allow customers to find the nearest *Coke* fountain location through their cellular phones with *Go2* location-based direction services, which include addresses, turn-by-turn directions and one-click calling (Swartz, 2001-1). *CT Motion,* a location-based services developer, provides an m-coupon application, by which the mobile user can receive an electronic coupon from a retailer in his or her specific location (Secker, 2001). Imagine that a young teenager is riding his skateboard through the park on a Saturday afternoon, when his cell phone beeps. It is a message from the *Soda X* portal that the local professional soccer team is playing tonight, and the store that he is approaching is offering him half-price tickets for the game if he buys a pair ofjeans today.

Privacy concerns are critically important while implementing location-based advertising. Pull mode may resolve the issue of privacy, when a mobile user requests information and is willing to receive an advertisement (Seeker, 2001). However, many location-based applications are still to be developed; few carriers have a strategy, let alone a business model (Swartz, 2001-1). Location-based services would have to be targeted extremely well, in order to avoid damaging trusted relationships that merchants already have with customers.

Location can be traced not only for people but also for other objects. *Cellpoint,* a supplier of location-based services (LBS) software, provides the applications used to track remote assets such as fleet vehicles and construction equipment, and also provides telemetric products that allow remote machine-to-machine communications (Secker, 2001). It is also possible to trace a stolen car or a missing child that is carrying a specially designed radio device.

3.4 Time-critical impulse purchasing

Mobile phones are carried by their owners almost everywhere and kept switched on most of the time, especially in Europe, where mobile users are not charged for incoming calls. Consumers can thus not only gain access to wireless services wherever there is a network presence but also keep tabs on time-critical information such as stock market reports or urgent messages. Time-sensitive and simple transactions are another key to stimulate m-commerce. For some applications of m-commerce such as scanning news or purchasing books or other retail items, real-time transactions are not necessary. Nonetheless, there is a great deal of value in being able to monitor dynamic information through wireless handheld devices, such as aircraft flight status, shipping status, seat reservations or stock prices, and to alert the user when the information is updated (Shaffer, 2000; Schwartz, 2000; Leung and Antypas, 2001). There will be even more value in emergency situations such as medical care, traffic accidents, emergency road service, and crime reporting. Particularly with the mandatory ALI (automatic location identification) data supplied by a few key vendors such as *Xypoint,* U.S government emergency systems like E911 (Enhanced 911) could be improved (Jones, 2000). The United States' FCC (Federal Communications Commission) mandates that the location of wireless callers be identified during a 911 emergency call. The *MapInfo*® (www.mapinfo.com) Location Management Platform (LMP) is used to enhance a carrier's 911 service by automatically routing 911 calls to an appropriate Public Safety Answering Point (PSAP) for handling and dispatch.

3.5 Special Market Niches

Mass-market consumers will be the really big users of m-commerce applications. And the customer base is large enough for potential revenue in the medium to long term (Sweeney, 2001). A single killer application would not work for everybody and there is going to be a whole set of niche applications that are relevant to each target audience. The mobile industry believes that location-based service advertising will have stimulated m-commerce so much that operators would eventually offer free phone charges to subscribers who are prepared to have advertising on their screens on a permanent basis. In particular, youth has a very powerful influence on this market (Secker, 2001). Actually, young people have been a major target of various m-commerce applications, particularly SMS and DoCoMo iMode services (Herman, 2000). Besides focusing on youth, mobile operators also suggest marketing future mobile data technology much more aggressively to business users (Parsons, 2000). In any case, for new m-commerce opportunities, carriers should be cautious about implementing applications that require changes in consumer behavior. If many technology hurdles are to be overcome, along with a corresponding unreasonable change in behavior, the application is unlikely to succeed. Additionally, price marketing is by far the most important in creating m-commerce value (Lamont, 2001). Mobile carriers therefore need to develop unique offerings for each target market segment or services targeted, according to geographical location and demographics (Schneiderman, 2001). Learning about and analyzing customer psychology, and taking marketer perspectives would help carriers segment the mass-market and target specific to m-commerce applications.

Table 2. Key Design Factors and Typical Applications

Factors	Typical Applications
Mobility	▪ Mobile communications (for business and personal contacts) ▪ Scheduling and coordination (e.g. appointment arrangements, reminders, teleconferencing, etc.)
Location-sensitive	▪ Travel navigation (driving or walking directions) ▪ Local tours (exhibitions, shopping malls, etc) ▪ Locating local services (restaurants, gas stations, etc) ▪ Locating moving objects (missing children, stolen cars, etc)
Time-critical	▪ Short Message Services (SMS) ▪ Time-critical information (flight schedules, weather reports, traffic information, stock prices) ▪ Emergency services (medical care, accident and rescue services, crime stoppers)
Personal identity	▪ Personal identification (secure entrance with biometrics check) ▪ Electronic payments (e-Wallet) ▪ Personalized location-aware advertisement ▪ Language-specific services (automatically switch to or translate to desired language)

Factors	Typical Applications
Special market niche-targeted	▪ Demographic segmentation (oriented to young people or business people). ▪ Country segmentation (tailored to specific country)

We actually need to shift our way of thinking to exploit the uniqueness of m-commerce applications that can be brought to bear in our lives, rather than to be confined to thinking within the limitations of mobile devices. The factors that need to be considered for m-commerce applications are summarized in Table 2.

4. SYNERGY OF THREE DRIVING FORCES

For m-commerce growth we identify three major forces that impel its growth: technology innovation, evolution of new value chains, and active customer demand. We propose that the synergy of these three forces will eventually lead to the success of m-commerce applications.

4.1 Technology Innovation

Technological progress is likely to bring about some novel applications for m-commerce. Here we identify several major technologies, improvements in which are expected to have a significant influence on m-commerce. The primary concern is with the capabilities of handhelds, the fundamentals of mobile networks, the accuracy of geographic location information, and security solutions.

1. Handhelds

Low-cost, truly pervasive devices that present multi-modal information and perform transactions naturally can dramatically change what many people do and how they do it (Feldman, 2000). In the next several years, wireless devices will improve in interface design and information presentation. In countries like China and Japan, where the written language has never fit well with a Western keyboard, handhelds that employ handwriting or speech recognition seem ideal (Herman, 2000). Wireless keypad mnemonics can also make the entry of data easier for consumers (Young, 2001).

Subscriber identity modules (SIMs) may take over due to their competitive advantage over voice or keystroke activation (Chanay, 2001). Newer devices will use expandable color screens capable of displaying up to 12 lines of text, more user-friendly keypads, and higher communication bandwidth (Lucas, 2001). Smart card memory capacity will reach 1MB by 2005. The processing capability of smart cards has increased and has given users the ability to enjoy more computationally intensive, high-value, transaction-based operations that require such features as digital signing and encryption (Moustafa, 2000). For those who crave the cutting edge, there are *DoCoMo's* (in Japan) impressive third-generation handhelds, which can capture and send high-quality color movies almost in real time (Kunii, 2001). By using a *DoCoMo* camera-phone, it is possible to imagine being in a store shopping for a gift for a child and calling your spouse to show her what you are thinking of buying.

Besides improvements in user interfaces, applications and underlying middleware configurations will allow for interactions to switch communication modes smoothly without losing clarity or the thread of conversation. The Java Card Forum has developed specifications for implementing Java on smart cards. Support of Java on SIMs will allow wireless terminals to reach the Java developer community, simplifying the development of new services (Carrara, 2000). Overall, next-generation devices are expected to combine the functions of Personal Digital Assistants or PDAs (data exchange) and cell phones (verbal communication).

2. Network infrastructure

The current (second) generation of wireless networks and handhelds supports data rates of only 9.6 kilobits per second, far below the 64 Kbps capabilities of landline copper wires. GSM (Global System for Mobile Communication), the most common cellular standard, is being extended by the GPRS (General Packet Radio System), which can support data rates of 112 Kbps, almost twice the rate of a standard computer modem and enough to support high-quality streaming audio. True third-generation (3G) networks, based on the UMTS (Universal Mobile Telephone System) standard, are predicted to raise the maximum rate to 2 Mbps -- one-fifth of the bandwidth available on the standard Ethernet in today's offices (Barnett et al. 2000) According to *Ovum,* 3G will first take hold in Asia and Europe, with the rest of the world trailing a year or two behind (Fitchard, 2001). Currently, the leader in the field is Japan's existing second-generation, or 2G, digital networks that provide always-on connections for data transmission and support a wide range of online services - from news, weather, and ticket-booking to downloads of games and ring tones (Kunii, 2001). Therefore, in the next several years, hybrid elements of 2G, 2.5G and 3G will be in play simultaneously on wireless operator infrastructure.

Bluetooth is a short-distance, radio-based, point-to-point technology that, theoretically, can go up to 1 Mbps, and has already entered the market (Herman, 2000). It will be very useful for enabling location-based applications. It allows a wireless device to exchange data with PCs, laptop computers, point-of-sale devices and other wired devices without being physically connected by wires or adapters. Bluetooth is supported by more than 1,400 telecommunications and technology companies, including *Motorola, Intel,* and *Lucent Technologies* (Lucas, 2001).

3. Geographic location technology

Location-based personalized services have been heavily touted as a major application for m-commerce. In order to deliver such services, mobile devices (particularly cell phones) should be able to keep track of an individual's physical location as he or she moves about. Some companies are focusing on underlying technologies or services such as radio-based methods for determining where users are calling from, or software and systems that blend location data with other information (Shaffer, 2000). The FCC (Federal Trade Commission) has stringent requirements for location services, in which carriers have to offer network-based systems that deliver location information with an accuracy of 300 meters for 95% of calls and 100 meters for 67% of calls (Brewin, 2001). For instance, an FCC ruling requires all wireless carriers to find a way to pinpoint the location of the users dialing 911 emergency services. Although the requirements are meeting resistance from various carriers that say they cannot reach that level of accuracy or at least need more time to do so, some can meet the requirements with the portion of their networks that uses the GSM (Global System for Mobile Communications) standard.

4. Security technology

The lack of security is said to be one of largest barriers in delaying m-commerce implementation. In particular, security is a vital issue that affects the use of mobile technology in financial services, when account details and other confidential information move across the networks

(Dezoysa, 2001-2). With regard to securing transactions, PKI (public key infrastructure) is believed to be the best method to secure end-to-end transactions (Moustafa, 2000). Besides securing wireless transactions from the cell phone to the m-commerce provider, the phone must also be secured from fraudulent use. Traditionally, the SIM card that stores the subscriber's account information is used for identifying and authenticating the subscriber to the network. There are industry standards for SIMs used in digital wireless phones that help ensure that all SIM-based terminals can support any SIM applications and services a provider develops (Carrara, 2000). Dual chip phones even have an additional SIM-size slot for an independent multi-application chip card targeted at payment, such as a bank-issued WIM card (wireless identification module) or EMV card (a payment standard defined by *Europay, Mastercard,* and *Visa International)* and other banking solution applications (Dezoysa, 2001-2).

In the near future, wireless biometric services will emerge as a common solution (Young, 2001). A biometric is a unique physical or behavioral characteristic of the human body, which may be checked automatically. The absolute verification of a user makes biometrics the highest security level. Biometrics come in many forms. In 2000, fingerprints were the most widely used biometric, accounting for 50% of the market, followed by hand geometry (15%), face recognition (12%), voice recognition (10%), handwritten signature recognition (8%), and iris scan (4%) (Biometric Industry Report, 2001). In recent years, biometrics have gone digital, and modern electronic systems are capable of distilling the arches, loops and whorls of conventional fingerprints into a numerical code. As an example, *Champion Technology,* a Hong Kong company, has launched a fingerprint recognition system, which takes only a few seconds to accomplish recognition (Leary, 2001). Biometric authentication offers some promise of strong and convenient security for cell phones, in which the subscriber's signature or fingerprint can be thought of (mathematically) as a large random number (Crowe, 2001). These are easy for the owner to present to a machine but difficult for others to fake, and they cannot be lost, stolen or borrowed.

The growing m-commerce industry eventually will settle on a set of solutions to all of the different security problems, building end-to-end solutions that are secure, cost effective and easy for consumers to use. However, successfully implementing good quality solutions relies upon the acceptance of standards (either de facto or negotiated) within the highly interdependent functions of this industry.

4.2 Value Chain Evolution

As we discussed above, m-commerce is primarily rooted in the cash-rich mobile phone industry. Therefore, equipment vendors and network operators have been dominant in the m-commerce world. And in some sense, the mobile operators own virtually all of the value chains (Donegan, 2000). Unfortunately, this operator-dominated value chain is not able to successfully deliver flawlessly integrated personalized services for mobile phone users, which is crucial to the success of m-commerce (Swartz, 2001-2).

In theory, mobile operators could compete at all levels of the m-commerce value chain, from the provision of basic technical services to the supply of lucrative, customer-facing content, but this is simply not possible, since this will spread their skills and resources too thin. This has been abundantly demonstrated in the e-commerce marketplace, where different companies tend to invest and to focus on their specific expertise at particular levels of the value chain. There are some exceptions, where dominant companies such as Microsoft and General Electric attempt to extend their reach vertically. Companies normally should concentrate on areas in which they naturally hold a competitive advantage. In m-commerce, mobile communication operators thus need to make difficult decisions about which parts of the value chain to compete in – and how - and which parts to avoid. There are many critical roles that they may be able to play and a number of business models that may be suitable in these roles (Tsalgatidou and Pitoura, 2001).

Some mobile data industry observers believe that, although Europe has a more advanced mobile communication infrastructure, the European approach to the m-commerce market will fail (Darling, 2001). They suggest that many European service providers want to own the customers and to support all the applications that customers want to perform. Some mobile operators may even want to become banks or content providers in their own right but, even though carriers have all the critical capabilities in place, including location, shopping, e-wallets, promotion and personalization, without partnerships with knowledgeable merchants and intermediaries, prospective customers will have nothing to access. Therefore, partnerships between m-commerce providers, interested content providers, and other businesses are critical to the success of m-commerce.

Providing complex data services is a very different business from running a voice network, so carriers have to choose partners to provide content, and decide which services to offer their customers. In pursuing value-added services, more entrepreneurial companies have the products and capability to get them integrated and delivered to handhelds (Goldman, 2000). Also, since capitalizing on the promise of m-commerce requires an in-depth understanding of consumer behavior, significant opportunities arise not just for providers of telecommunications services, but also for companies that have a rich and thorough knowledge of consumer behavior. However, from the merchants' point of view, building m-commerce applications will present huge challenges, so companies need to leverage superior consumer insights to develop powerful branded solutions with value outside their traditional markets, particularly when forging alliances with telecommunications carriers (Nohria and Leestma, 2001).

Table 3. Roles and Profit Sharing in the Value Chain

Role	**Tasks**	**Major players**	**Sources of revenue**
Equipment Supplier	Manufacturing innovative handhelds and equipment	*Nokia, Ericsson, Motorola*, etc	Selling phones, equipment, or sharing revenue with network operators for discounted cell phones
Network Operator	Developing and maintaining infrastructure to support mobile data communication	Traditional carriers such as *Vodafone, Orange, Deutsche Telekom, AT&T* and *NTT DoCoMo*	Charges from increased network traffic
Service Hosting	Providing basic enabling services such as server hosting, data backup, systems integration and security control	Existing Web-hosting companies and system integrators such as *Oracle*	Shared revenue with application providers
Portal Provider	Offering simple, categorized information search facilities crucial to m-commerce applications.	Internet portal service providers such as *Freeserve, AirFlash, Room33, Microsoft, Yahoo, AOL Excite@Home*.	Fees charged to application carriers and advertisers
Billing Facilitator	Handling various sophisticated billing mechanisms such as air-time-based, user patterns-based, specific application-based, location-based, etc	Network operators such as *Vodafone, Orange, Deutsche Telekom, AT&T, NTT DoCoMo* and banks and credit card companies	Transaction fees or interest charged to merchants or consumers
Application	Providing various end-	Existing Internet	Revenue from

Role	Tasks	Major players	Sources of revenue
Provider	user services such as ticket booking, e-mail checking, news scanning, and location-based services (LBSs)	content providers such as *Yahoo, AOL* and retail merchants (*Coca-Cola, PepsiCo, Procter & Gamble*, etc)	customers for services or products purchased

In a value chain, each party plays its specific role and gets its own benefits. Customer service charges depend on how much value the user receives, so there will be different pricing and business models for individual services (Seeker, 2001; Darling, 2001). Revenue sharing in m-commerce value chains, particularly in those of location-based services (LBS), involving mobile operators, equipment vendors and application developers, will require a significant amount of negotiation. As an example, *CT Motion* is an LBS application developer and equipment vendor, providing operators with a platform to enable deploying and managing LBS. *CT Motion* licenses its platform to operators, with an initial fee to cover basic hardware costs and licensing. Additional payments to *CT Motion* depend on the revenue stream from application users. Thus, revenue share will essentially depend on the value of the application. For example, a company delivering a car theft recovery service is doing most of the work and so it might receive 95 percent of the revenue. For a simple application, the majority of the revenue will go to the operator and the platform enabler (Secker, 2001).

In Table 3, we list the roles in an m-commerce value chain, the major players, and their corresponding sources of revenue.

To help observe the maturity of the various value chain components of m-commerce outlined in Table 3, and to understand where further development must occur, it is informative to consider the inter-corporate linkages of m-commerce. This can be done according to corporate contributions to required infrastructure, associated support services, and delivery of these services to customers. To this end, we have adapted the well-known University of Texas e-commerce model of Internet Economy Indicators (Whinston et al, 2001). In their model, there are four layers (Internet infrastructure, Internet applications infrastructure, Internet intermediary, and Internet commerce). M-commerce differs significantly from e-commerce, as we have pointed out, although there is some overlap in the functional nature of both. In our m-commerce value chain model, we also propose four layers:

– Communications Infrastructure,
– Applications Infrastructure,

– M-commerce Intermediary, and
– Mobile Commerce.

Reading from the top of Table 3, the Communications Infrastructure layer includes equipment suppliers and network operators. The Applications Infrastructure includes service hosting, portal providers, and software companies that develop related software products and platforms. The M-commerce Intermediary layer includes billing facilitators, content providers, brokers, and market makers. Finally, the Mobile Commerce layer includes application providers that sell goods and services to customers.

The interconnected and interdependent nature of these four layers of the value chain cannot be over-emphasized. Thus evolution in one layer will affect the other layers. For example, advances in the communications infrastructure, such as the widespread implementation of G3, will support new developments such as wireless video and bring more potential retail applications of mobile commerce that may be both time and location sensitive. But services to support these will require further evolution in both applications infrastructure and intermediaries.

4.3 Active Customer Demand

What is missing from m-commerce is compelling content that will make people want to use their handhelds to buy something. Consumers remain unconvinced about the wireless Web and user apathy towards wireless data services is believed to be one of the main factors delaying m-commerce implementation (Kelly, 2001). We propose that it is current narrowly-focused m-commerce applications (mainly on mobile Web systems) but not the fundamental nature of m-commerce, that frustrates consumers. The great advantage to people of eliminating fixed attachments to physical space, allows more strategic, creative, and flexible decisions and actually getting things accomplished (Kalakota and Whinston, 1996). Instead of waiting for killer applications to stimulate passive consumers, we propose that fundamental consumer demand is the active force that can improve the chance of m-commerce success.

The success of the cell phone industry has already proved the significance of this active driving force. Today there are an estimated 115 million cellular phone users in the U.S. (Schooler, 2001). Market growth has been quite encouraging. Compared to the U.S, in Asia and Europe mobile telephony adoption is even more advanced (Herman, 2000). In Japan, the number of cell-phone users has already reached 66 million (Kunii, 2001).

64% of the people in Finland have a mobile phone, while the rate in Sweden stands at 55.2% (Kruger, 2000). In China, the enthusiasm for mobile phones has exceeded all forecasts, and the mobile subscriber base will probably reach 250 to 300 million in 2005, up from 68 million in 2000 (Sliwa, 2001). Recently, the population of cell phone users in China has reached 135 million, making it the world leader.

Beyond enjoying the basic service of mobile verbal communication, consumers are beginning to demand much more from their cell phones. Two-thirds of Japan's cell-phone users subscribe to one of many mobile data services offered by the country's three cellular operators. Even though the actual demands vary according to different geographical locations and demographics, consumers have played a decisive role in the success or failure of m-commerce efforts. Most potential m-commerce successes will arise from consumer demand for additional value in their daily lives, and there is unlikely to be a single killer application that can spark m-commerce success. What consumers need is an adaptable package that can accommodate various m-commerce services (personalized location-specific and time-sensitive). It is the variety of cost justification criteria adopted by consumers (in turn determined by demographics, regional cultures, current fashions, etc.) that fundamentally affect their decisions concerning specific m-commerce services. According to a *Nokia* research study that focused on m-commerce services in the U.K., South Korea, Italy, USA, Brazil and Finland, the proportion of respondents that would carry out a transaction of more than U.S. $25 using a mobile device, ranged from 24 to 54 percent (Dezoysa, 2001-1). Also, 90 per cent of all end-users surveyed that would consider using m-commerce, either now or some time in the future, would be willing to pay for its use. However, this is on the assumption that the mobile device is free. It is still uncertain whether the cost of next generation phones can be subsidized by operators and, if they are not, how the added cost of paying over $150 for a mobile phone might well affect this figure (Dezoysa, 2001-1).

DoCoMo recently sold about 10,000 videophones at a U.S. $500 price, with service limited to Tokyo (Kunii, 2001). In Europe, the cost of providing advanced handhelds equipped with high tech features is also likely to be in the neighborhood of $500 or more (Carrigan, 2001). For the additional cost of high tech handhelds to be acceptable, consumers will expect to be able to access many additional services that are of value to them. In Europe, where mobile users are not charged for incoming calls, consumers can thus not only gain access to wireless services wherever there is a network presence but also keep tabs on time-critical information such as stock market reports or other urgent messages (Barnett et al. 2000). Such consumers are more likely to take advantage of these services.

The focus in m-commerce needs to be on delivering simple, time-sensitive, and compelling applications that do not require a lot of training. If it takes too much time (e.g. more than 5 minutes) to conduct an m-commerce transaction, it might as well be done with a PC. One example is notification about tickets to entertainment and sporting events. A consumer can contact a ticketing agency, such as *TicketMaster*, to request notification of availability of tickets for sale for an upcoming concert. When tickets meeting the consumer's criteria become available, *TicketMaster* sends a message to the consumer's wireless device and asks if the consumer wants to buy them or not. This is a simple yes-or-no transaction (Lucas, 2001). Any applications that require consumers to input much information will not work, because of keyboard limitations. For example, a visit to *Barnes & Noble*'s WAP site to enter credit card number, address, and shipping information requires more than 100 keystrokes (Swartz, 2001-2).

4.4 Synergy of three driving forces

The success of m-commerce relies on the synergy of three driving forces: technology innovation, value chain evolution and active customer demand. Technology innovation provides more useful functions with lower prices, creating value for customers and stimulating customer demand. Technology innovation also demands high-level collaboration through the value chain. Active customer demand provides rich revenue sources for the value chain and stimulates technology innovation and the development of new applications. Value chain evolution ensures the collaboration of multiple parties through appropriate profit sharing, which in turn supports more technology innovation. Through positive interaction loops the three driving forces will eventually contribute to the success of m-commerce. This synergy is graphically illustrated in Figure 1.

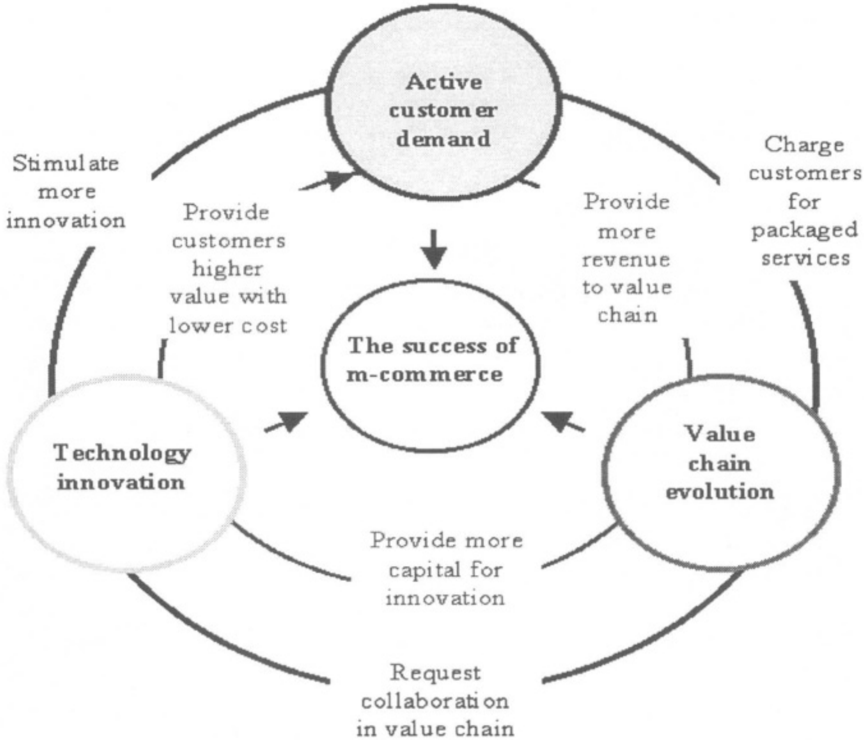

Figure 1. The synergy of three driving forces for m-commerce success

5. CONCLUSIONS

Are we ready for m-commerce? Differing perspectives of m-commerce may lead us to opposite answers. But our research into the nature of m-commerce shows that m-commerce applications are fundamentally different from those delivered in the Internet- based e-commerce environment. Simply transforming e-commerce services to cell phones or PDAs will merely expose the limitations of wireless handhelds and result in frustrating end-user experiences. Therefore, as we examine any speculation about m-commerce applications, we must attempt to exploit the unique features of mobile devices as well as to avoid their weaknesses. Furthermore, the eventual success of any m-commerce strategy depends on the synergy of the three driving forces we have identified: technology innovation, value chain evolution, and active customer demand.

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Chapter 5

e-Business Management Models: Services Perspective from the Revere Group

Todd Miller, Matthew L. Nelson, Stella Y. Shen, and Michael J. Shaw

Abstract: Despite the shake-out of dot-coms during 2000/2001, the key business drivers leading organizations to adopt Internet-based solutions still remain. However, along with the shake-out, the market has forced companies to focus, once again, on e-business management models that emphasize cost, quality and profitability. One such model, the Revere Group's Technology Solution Lifecycle, was presented in great detail, followed by four case studies illustrating the application of the model. In addition, two other e-business management models from EDS and IBM were discussed and compared with the Technology Solution Lifecycle. Common ingredients from each of the models were presented.

Key words: e-Business, e-Commerce, Business Model

1. INTRODUCTION

Managing an organization's e-business adoption strategy has proven to be a daunting task. Strategic decisions with far-reaching implications must be made on a timely basis. The collapse of NASDAQ's high-tech (dot-com) stocks during 2000 / 2001 offers painful proof of the extraordinary challenges associated with managing e-business. Gone are the days of evaluating new venture start-ups based on burn rates, over-inflated revenue estimates and the vita of a silicon-valley cowboy. Indeed, the "irrational exuberance" in dot-com company stock market valuations (warned by Federal Reserve Chairman Alan Greenspan) has come to fruition. The market has forced companies to focus, once again, on the basics: cost, quality and profitability. Lock-step with this *back-to-the-basics* pendulum swing, is the utilization of a business model that is long-term focused, profit-based, and includes the unique challenges (and opportunities) with conducting commerce via the Internet. That is, this business model should enable the cost, quality and profitability basic necessities, utilizing a long-term profit-based business plan, while simultaneously accommodating the unique business issues associated with e-commerce. This chapter refers to such models as e-business management models.

The purpose of this chapter is to identify key e-commerce business drivers and to document e-business management models utilized in industry. One particular e-business management model will be explored in great detail. Entitled the *Technology Solution Lifecycle,* this e-business management model was developed by *The Revere Group* based out of Deerfield, IL. This chapter will describe each stage of the *Technology Solution Lifecycle* and present four case studies illustrating actual organizations that have adopted an e-business strategy utilizing this model.

This chapter will also explore other e-business management models, at a higher level, from the EDS and IBM corporations. In addition, the emerging business models, based on recent trends of e-commerce companies, will be presented and discussed. Comparisons will be made between all of these e-business models, with an emphasis toward highlighting the common (key) ingredients among each.

The chapter is organized as follows. *Part II* will provide an overview and background information on *The Revere Group.* *Part III* will identify key business drivers leading toward the growth in e-business. *Parts IV* and *V* will document the stages in the *Technology Solution Lifecycle* management model and present the four case studies, respectively. *Part VI* will discuss other e-business management models from industry and highlight the common (key) ingredients among each.

2. THE REVERE GROUP

The professional-services industry revenue is projected to grow by 18% in 2001 to $138 billion. The environment that pushed for e-business projects has changed. Twelve to eighteen months ago the emphasis was on creative web-sites. Currently, however, as of the beginning of 2001 the emphasis has shifted back to basics (cost savings, reduced market lead times, and increased quality). Several reasons account for these changes including NASDAQ's high-tech (dot-corn) collapse and fears of recession. Companies are now seeking business skills from the professional-services industry, and not just Internet expertise. It's expected that 1 in 4 professional service firms will survive.

Founded in 1992, The Revere Group is a business and technology consultancy focused on helping mid-tier companies maximize return on their technology investment through the design, implementation, and management of e-business and enterprise solutions. The Revere Group is headquartered near Chicago in Deerfield, Illinois, and also has offices in Boston, Charlotte, Chicago, Cleveland, Denver, and Milwaukee. It employs more than 425 people.

> "We're seeing a return to the basics. No longer can new business or technology initiatives be pursued based on a hot business model. They must be grounded in reality, with a clear path towards achieving the critical dimensions of competitive advantage: Time, Cost and Quality. At The Revere Group, strong, experienced teams help clients realize results in these areas by providing real answers to their complex business and technology challenges."
>
> *Todd R. Miller, President, The Revere Group.*

Any astute business person will tell you that success is not about having a killer business plan, but effectively implementing one. In the recent past, many companies, dot-coms and brick and mortars alike, found themselves led down the primrose path of the New Economy only to find that a cool web site and an ad on the Superbowl does not an e-business make. Rather, there are some very real operational and technological hurdles that companies face as they attempt to achieve their strategic vision. The Revere Group helps mid-market and larger companies achieve market leadership by addressing critical operational and technological challenges. The Revere Group provides a broad base of technology and business consulting, specifically around their client's buy-side, sell-side and enterprise operations.

3. KEY BUSINESS DRIVERS

Despite the shake-out of dot-com companies during 2000, the key business drivers leading organizations to adopt Internet-based solutions remain.

3.1 Supply-Chain Management

A supply-chain is an avenue where inter-organizational flows of material and information, as well as financial transactions take place. It is called a "chain" because traditionally all the flows were linear, starting from the suppliers, to manufacturers, distributors and the final consumers. The focus of chain partners was managing material flow – how to complete the process from inputs to products and deliver to customers smoothly. Therefore, supply-chain management was very often equivalent to logistics management, mainly dealing with materials replenishment, warehousing and shipping.

As the Internet is serving as a superior communication channel, the old chainlike buyer-supplier relationship has been changed into a supply network where suppliers, manufacturers, intermediaries and customers are all connected and are able to interact with others directly (see Figure 1). On this view, the new supply-chain management will shift its focus from old material flow management to a combined flow of material, information and financials. The supply network is a critical component of any e-business strategy, such as build-to-order, driving enterprises toward e-business.

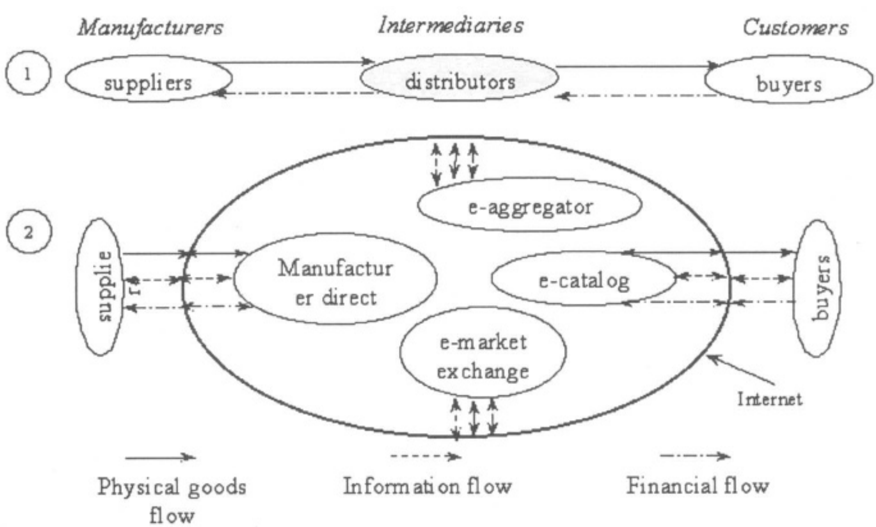

Figure 1. Traditional vs. Web-based Supplier – Buyer Interactions

This new supply-chain management is aimed to achieve two objectives: (1) seamless coordination among chain partners and (2) real-time collaboration.

Information sharing has always been the key to coordination. With the advancement of communication technologies, such as intranet, extranet, electronic data interchange (EDI), and virtual private network (VPN), companies have already started to coordinate their purchasing, production, and distribution activities to reduce cycle times and cut operational costs. Vendor-Managed-Inventory (VMI) and Just-In-Time (JIT) are two typical examples. Although there are many successful industry stories, such kind of coordination was usually initiated by and limited to large corporations who have a significant power over their downstream or upstream partners. The Big-Three automakers achieved substantial savings in direct purchasing by ordering their major suppliers to do business via EDI. Likewise, P&G greatly improved its channel efficiency through EDI-enabled continuous replenishment (CRP).

Internet-based supply-chain management creates an even wider avenue for coordination. With very little cost as compared to EDI, all supply-chain participants can receive and exchange information on purchasing, production, and shipping at real-time. Ultimately, the old static supply-chain with production forecasting and planning on retrospective data will be replaced with a responsive supply-chain: the manufacturer "knows" what the end customer wants at the time he/she orders; the same information also goes to the suppliers who immediately arrange the necessary materials and parts for the manufacturer. Then the manufacturer makes the product and fulfills the order in no time since the carrier has the shipping information and has arranged proper delivery of the product. Thus efficiency is achieved as a result of supply-chain coordination, and is reflected in the reduced inventory as well as shortened cycle times at every level.

Real-time collaboration is the most important and unique feature of Internet-based supply-chain management. Because the Internet is ubiquitous and "always on", it allows people at different geographic locations to work on the same project collaboratively to speed up the project progress and improve resource utilization. This collaboration can be even more enhanced with advanced technologies such as Internet video conferencing and 3-D imaging. The biggest automotive industry-wide exchange (Covisint) has already planned to conduct collaborative product design through this on-line exchange.

3.2 Web-Enabled Mission Critical Applications

The criticality of an application to an organization depends on that organization's line of business. For example, reservation systems are mission critical to airline organizations. Production control and logistics applications are mission critical to manufacturing organizations. Inventory and purchasing applications are mission critical to retailing and distributing organizations.

The development of web-enabled applications offers no exception to the criticality of key applications to an organization. The emergence of new Internet-based businesses spanning every industry offers excellent examples. Web-enabled consumer grocery selection and purchasing systems are mission critical to Internet-based home-delivery organizations. Auctioning systems and electronic catalog applications are mission critical to Internet-based vertical community service providers. Stock trading and security applications are mission critical to on-line trading organizations.

3.3 Internet-Enabled Workflow

The workflow from one company or one department to another used to be a black box, the downstream had to "guess" and wait for it passively. This picture is being changed as a result of Internet communications. Imagine that the company gets an automatic e-mail notification of receipt once it has placed an order with the supplier, a notification of shipping when the products are shipped, and another notification of receiving when the goods arrive at the company's dock. During the course, the company can check the status of the order or even request for acceleration so that they can schedule production accordingly. This transparent workflow allows e-business process redesign to achieve better resource scheduling and planning.

3.4 Integration of Customer-Facing Front-End with Enterprise-Wide Back-End Applications

The four primary value chain activities (inbound logistics, operations, outbound logistics, and service) defined by Porter involve the interactions among three parties: the suppliers, the manufacturers, and the customers. It is safe to say that although the pattern of interaction has been changed in doing e-business, the value creation activities and the direction of the flow stay the same.

Since the ultimate goal of enterprises is to create value to shareholders through selling goods and services, any customer-facing front-end systems should work to make it easy for customers to select, purchase, and be serviced. Therefore, most companies have been putting a lot of effort into improving the user-friendliness and functionality of their front-end systems to enhance the richness of communication and create better customer experience of e-commerce. In addition, unlike traditional channels that are usually built on proprietary networks, those applications are based on Internet technologies, ensuring the reach of product offerings. Two examples are the Customer Relationship Management (CRM) application from Siebel, and order management application from Art Technology Group.

Nevertheless, the value to the customer cannot be delivered without back-end operations. Enterprises have been implementing enterprise resource planning (ERP) systems to integrate and optimize their internal operations, such as production, Engineering, financial controlling and human resources. Increasingly, those enterprise systems are integrating web connections to leverage the speed and ubiquitous nature of the Internet. For example, SAP's R/3 system is Internet compatible and can be combined with other types of software under the enterprise umbrella. Moreover, application packages from PeopleSoft, JD Edwards and others are able to serve specific functional needs, such as human resource management.

At the other end of the value chain, as discussed earlier, there are also many applications, web-based or non-web-based, that companies use to increase their procurement efficiency and manage the collaboration and coordination with their suppliers. The enterprise procurement packages from Ariba and CommerceOne and the supply-chain management application from i2 Technologies are the well-known examples in this category.

However, e-business becomes possible only after all those bits and bytes are put together. Companies like Oracle have developed applications that integrate the customer-facing front-end with enterprise-wide back-end applications, creating an e-Enterprise that stretches its virtual boundary both forward and backward to interact with its customers and suppliers directly via e-commerce activities (see Figure 2).

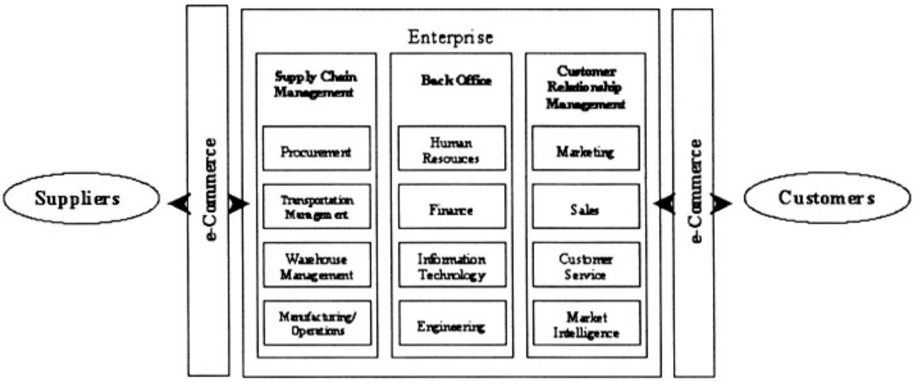

Figure 2. Extended Enterprise

3.5 The Market Evolution and Complexity of e-Commerce / e-Business Development

Looking retrospectively, we can see that today's e-business is very different from the e-commerce that we talked about just a couple of years ago. E-Commerce / e-Business is creating tremendous impact on our economy and its subsequent economic rules. The volume of e-commerce as a percentage of the nation's GDP is increasing at an increasing rate. The nature of e-commerce / e-business is getting more and more complex as the market evolves (see Figure 3).

The first generation – e-Commerce emerged as companies rushed to set up their homepages to claim their web appearances. All sorts of dot-coms, fueled by enormous venture investments, appeared in many business sectors by simply setting up a web server and a database. The number of web sites selling goods and services directly to consumers mushroomed. However, most of these dot-coms were started under such hype that their revenue projections were too aggressive to realize. Not surprisingly, a stock market slump hit the dot-com world extensively in early spring 2000 after these companies continuously failed to deliver business profit.

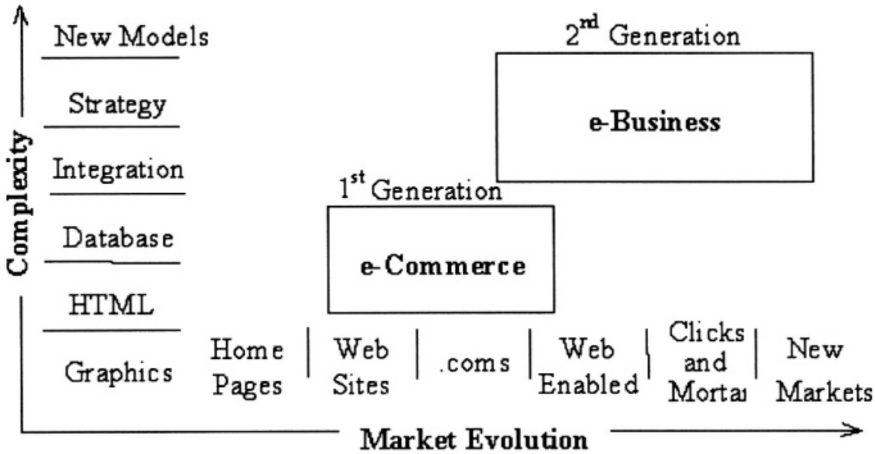

Figure 3. The Market Evolution and Complexity of e-Commerce / e-Business Development

It was the crash of the dot-coms that has lead us to rethink the value of e-commerce / e-business and how we can achieve it. This is where the second generation of e-business comes into place. Second generation e-business is characterized by the emergence of "mission critical, industrial strength platforms" that support new markets and new models. It is now widely understood that a successful e-business is built on a business model with a valid value proposition, a clearly defined e-business strategy, and an integrated information technology (IT) infrastructure that facilitates the strategy. The venue of conducting e-business has also been greatly expanded, especially with the growth of business-to-business (B2B) e-commerce. From implementing individual web-based applications to transforming traditional businesses into click-and-mortar, enterprises are continuously exploring new opportunities and new markets for e-business.

4. TECHNOLOGY SOLUTION LIFECYCLE

The Technology Solution Lifecycle was developed by the Revere Group. The Technology Solution Lifecycle is an e-business management model that can enable organizations to leverage the vast opportunities available through the Internet channel and to systematically integrate e-business into an organization's core competencies. The lifecycle is a six-step iterative process that begins with developing a technology Strategy and concludes with measuring the financial and operational performance of the strategy in the Analyze stage. If the returns are unsatisfactory, an organization must *exit* or *adjust* their strategy, which initiates the lifecycle process again. The following are descriptions for each of the six-steps included in the Technology Solution Lifecycle. Section VI includes four case studies as illustrations of applying the Technology Solution Lifecycle.

4.1 Strategy

Perhaps an organization's strategy is *pure e.* That is, the organization is an Internet-based company with a supply chain and distribution channel that is solely based through the Internet. Examples of such organizations include on-line stock trading, Internet service providers (ISP), Internet search engines, or MP3 music providers. Alternatively, however, for most organizations that have been in existence for a while (say longer than 4 or 5 years) they are seeking to develop a technology strategy. That is, they're seeking to embrace the Internet and rapidly leverage all of its opportunities into their existing and future business models.

The Technology Solution Lifecycle approach begins with Strategy, which uses an organization's target market segments as a jumping off point for defining the technology strategy. For each target market segment, initiatives are identified that will drive internal efficiency or revenue growth. The Strategy phase begins with Visioning Workshops, which captures the executive vision and draw out a set of solution possibilities, goals and/or "wish lists." These ideas serve to guide the team through the entire strategy proceedings.

The Revere Group's comprehensive e-business diagnostic methodology is called **e-Point**^{sm}. This methodology provides a thorough view of potential e-business initiatives within an organization and the impact each initiative can have on a business. The goal of **e-Point**^{sm} is to identify the intersection of target market segments, internal functions and processes, and best applied technologies. The convergence of these three variables represents possible opportunities or "e-Point" solutions. This unique approach to identifying e-business initiatives ensures that organizations will not miss an opportunity. The **e-Point**^{sm} methodology is summarized in figure 4. The example outlines Revere Group's approach to applying **e-Point**^{sm} to Supply Chain functions.

The Revere Group's **e-Point**^{sm} framework offers a comprehensive view of how an organization can begin to assess, structure, and plan for the new e-based technologies. With supply chain management (SCM) functions along the vertical axis, market segments along the horizontal axis and x-net capabilities along the third axis (outward), the model enables an organization to triangulate (e-Point) toward a strategy. For example, targeting an e-Point in the upper right quadrant of the graph would indicate an organization's strategy is impacting all of their SCM functions across all of their market segments. Expanding this targeted strategy outward along the third axis indicates an organization is planning to apply this strategy to their internal intranet, the external Internet, and outward to their value-added SCM-based extranets. Similar graphs could be developed for an organization's other targeted strategy areas (distribution channel management, customer relationship management, product support management, etc.).

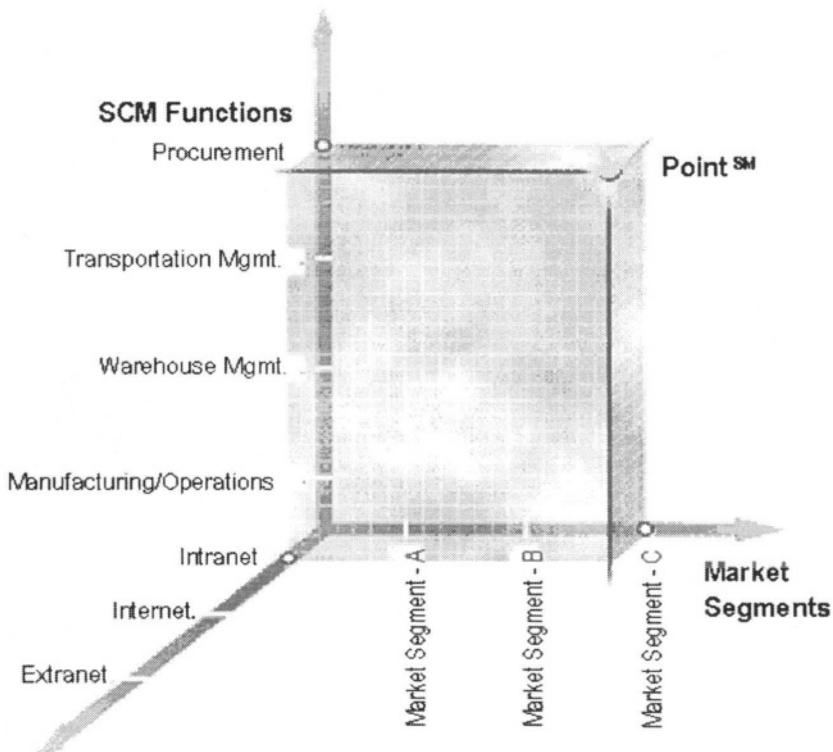

Figure 4. e The Revere Groups e-Pointsm

e-Point[sm] has been deployed by The Revere Group for clients in the insurance, manufacturing, banking, .com, services, consumer products, distribution, non-for-profit and other industries, resulting in business solutions that generate bottom line benefits to the company.

For engagements requiring expedited solutions delivery, The Revere Group brings to bear its recently launched accelerator, the r-Factory. The r-

Factory provides a hi-tech, off-site development environment designed to foster innovation and creativity. Here the company assembles multi-disciplinary teams of clients and consultants, meshing the strategy, e-marketing, technology and process components to speed progress from concept to reality.

4.2 Marketing

The next step along the Technology Solution Lifecycle is Marketing. Regardless of the selected strategy chosen, all organizations must initiate their lifecycle with some form of presence on the Internet. At a minimum, this could begin with a simple web-page announcing the five W's (*who, what, why, where, and when*) about an organization. In fact, by 1998 / 1999 most organizations had upgraded these basic 'introductory' web-sites to include creative web-page designs and offer basic content services (on-line user manuals, product support, FAQ, etc.).

Working under the basic premise that a click on a web-page is *significantly cheaper* than a phone call to a product support help-desk, this is where the decisions become more challenging. At this point, organizations must begin to design a *content strategy* for their web-site. Will the web-site content be more customer relationship focused (on-line sales order tracking, customer purchase history, customer specific web-pages) or will the content be more supply chain focused (e-procurement, electronic cataloging, shipping status tracking)? The opportunities seem endless.

The key issues on e-marketing are succinctly captured in the following excerpt from the company's white paper, "The Good News About e-Marketing".

> "Hi, Dave, welcome back. How's the cordless driver you purchased during your last visit? Did you know we are having a sale this week on drill kits for that 1/2-inch T-handle driver? And if you purchase a kit today, we'll include a 12-volt industrial work light that clips onto your Cosco workbench for free. So tell me, what do you need today?"

An awfully personal salesman, isn't it? In fact, he treats every customer who stops by just like this. All 15,234 of them. And best of all, he works 24-hours a day, seven days a week. He'll even go to customers' homes to inform them of special offers or answer questions. Seem impossible? No, because this salesman is a web site. And, believe it or not, customers will expect this type of treatment within the next two to three years.

It's true. The Internet is changing the rules of sales and marketing. Drastically. And it's not just for "dot-com" companies. Even companies selling business-to-business will have to adapt to the new ways of marketing.

These changes, like all changes, pose threats as well as opportunities. Business could be lost in a click - literally. Or customer loyalty could be cemented for a lifetime. Organizations agile enough to adapt will be positioned for successful growth in the future. Those that don't will likely struggle.

- First, re-prioritize your marketing efforts. In place of traditional one way communications, think of continuous communications that focus on building customer relationships on a one-to-one level.

- Second, always gather information. During a customer's or prospect's first visit to the web site, the relationship is established and the company begins to understand the visitor's preferences.

- Third, use traditional forms of marketing to drive customers to your web site and filter them into the Communication Continuum

- Fourth, choose a single-source provider. In this new business environment, a company's web site is becoming the single most critical component of the marketing strategy in terms of building and maintaining the brand.

Although the landscape has changed in the e-world, the philosophy of branding has not. Branding remains a strategic marketing function that requires a well thought out game plan. A successful brand is built with long lasting impressions - not a fleeting message based on a series of shotgun marketing campaigns. Launching a web site or participating in a web exchange does not guarantee a brand's success. Active steps must be taken to continually build brand equity with all of an organization's constituents on a personalized basis.

The focus of the Marketing stage is to create on-line branding and drive traffic to the site—in effect leveraging the power of the Internet to the company’s best advantage. There are four key planning and design activities for an effective marketing strategy:

1. **Marketing Strategy**
   The Revere Group's philosophy about marketing strategy mirrors the philosophy about strategy in general -- it should complement the enterprise's overall business strategy. On the sell-side, the Internet is simply another vehicle for an organization's sales and marketing activities. The Revere Group incorporates brand and identity definition, sales and distribution channel optimization, and media planning activities into a comprehensive strategy designed to lead the maximum number of visitors to a web-site.

2. **Branding Strategy**
   Consideration must be given to two different facets of online branding: extend an existing brand, or create a new one over the Internet channel. Experienced professionals can assist an organization in leveraging this new medium to its best advantage, whether that is establishing how to extend an existing brand or defining the development of a new brand.

3. **Media Planning**
   New technology always brings with it new media placement considerations. An organization must recognize the need to evaluate all available media outlets as vehicles for delivering a message to the marketplace. The Revere Group can guide media planning activities with vast experience that uniquely positions them to be a qualified partner in weighing the pros and cons of various Internet medium placement options.

4. **Multiple Media Creative Design**
   The new Internet medium presents new challenges not only for media placement, but also for creative design. Designers capture the essence and key functions of an organization's e-business initiatives that act as guides through the creative design process to synthesize e-Marketing and branding strategies. The designs capture an organization's brand and drive traffic to the web-site.

4.3 Process

The next step along the Technology Solution Lifecycle is Process. In broad terms, this step includes three elements: business process redesign, revenue / cost impact analysis, and an assessment of the impact on the extended enterprise. A long-standing traditional notion in the IT industry is the concept of envisioning the business process first, prior to applying the information technology solution that could enable the business process. As

Michael Hammer indicated in his article *Reengineering Work: Don't Automate, Obliterate,* "We have the tools to do what we need to do. Information technology offers many options for reorganizing work. But our imagination must guide our decisions about technology – not the other way around. We must have the boldness to imagine taking 78 days out of an 80-day turnaround time, cutting 75% of overhead, and eliminating 80% of errors. These are not unrealistic goals. If managers have the vision, reengineering will provide the way" (Hammer 1990).

Hammer's article was published in 1990, long before the emergence of the Internet as a strategic (and essential) channel in supply chains or distribution networks. However, Hammer's core point is still very applicable today. If an organization wishes to formulate a technology-based strategy, the core business process must first be developed (or reengineered) to fully leverage this new channel. To date, there's no better illustration of this principle's applicability to the Internet than with the Dell Computer Corporation. Prior to launching Dell Online, Dell overhauled and streamlined key business and manufacturing processes. In short, Dell incorporated modularity into their product design, restructured logistics requirements with key suppliers, launched cell-based assembly operations towards lean and flexible manufacturing, and negotiated longer-term contracts with 2/3 fewer suppliers. As a result, Dell PCs were not manufactured until customer orders were received (made-to-order), thus completely bypassing the existing retail distribution channel. Again, this Dell Direct Model enabled the 'disintermediation' of their existing retail distribution channel long before the emergence of the Internet. This enabled Dell Online to seamlessly extend their operations through the Internet channel as natural progression that comprehensively supplemented their existing processes already in place.

The ROI on this investment is simple to calculate. Customer orders via the Internet were simply validated and e-mailed to production. Since customer orders were already made-to-order, manufacturing plants were oblivious to orders received over the phone versus the Internet. This not only saved sales agent's time, but it also allowed Dell to increase quotas for sales agents handling orders from the Internet. In addition, to increasing inventory turns and reducing the amount of antiquated parts and PCs sitting on retailer's shelves. Dell also linked technical manuals (that were already developed for help-desk technicians) to the web-site. This not only reduced the volume of calls to the help-desk, it also reduced the length of the average call to the help-desk.

The key in the Process stage is to design and / or reengineer the business processes first, prior to fully launching the strategy, to insure the seamless and successful utilization of the this new Internet channel.

To realize positive business impact from an e-business initiative, an organization must identify what it wishes to improve or create. The Revere Group's goal in the Process stage is to identify process innovations associated with e-business initiatives. They first work through an "as-is/to-be" gap analysis and then apply best practice frameworks to the uncovered issues. The best practice frameworks include:

- Process models
- Proven methodologies
- Functional architectures
- Business process innovations samples

4.4 Build

The next step along the Technology Solution Lifecycle is Build. This stage includes the physical build-out of the organization's technical infrastructure and application architecture necessary for the new strategy. This stage also includes the formal development and systems integration of the new Internet-based information system. Many of the traditional steps in the systems development process include requirements structuring, systems analysis, technical design, and implementation. Significant technical developments such as RAD (rapid application design), CASE tools, beta releases and beta sites have expedited this entire process. Other issues to consider during the e-build stage include scalability, security, personalization and interactivity.

The Revere Group's methodologies and technical frameworks expedite the process of building and implementing business plans. The Revere Group has developed a Process Management Methodology (PMM) based on the Project Management Institute's (PMI) Project Management Body Of Knowledge (PMBOK) model. PMI is a global organization recognized for its leadership in establishing a common set of project management practices. Following are the elements of the Revere Group's methodology that improve upon or exceed PMI guidelines:

- Process methodology also includes our consultants' collective experiences on hundreds of projects under management.

- PMM consistency by assigning to every project a Project Management Advisor (PMA) responsible for assisting/mentoring project managers and ensuring project execution quality.
- In the event a client pursues several initiatives at once, a Project Management Office (PMO) is developed to oversee all projects at one client site.
- Projects are executed using predefined "practice sets"—a flexible set of guidelines specifically developed to guide the design, development and implementation of a particular type of application solution.

Although this stage may be technically challenging, by the time an organization reaches this point in the lifecycle, the major decisions have already been made for all practical purposes. The remaining decisions are tactical in nature and better left to those experts.

4.5 Manage

Several options are available to organizations for the ongoing manage stage in the lifecycle. Application Service Providers (ASP) such as Breakaway and US Internetworking offer viable alternatives to organizations wishing to avoid large up-front systems development time and cost. Many of these organizations offer attractive software lease arrangements, along with scaleable networking options. Some of the benefits of the ASP business model include:

- Lower entry investment with no capital expenditures required
- Fees aligned with a company's growth via a pay-as-you-go user, per month service metric
- Management of integration, maintenance and cyclical upgrades to software and hardware
- Dramatically lower total investment for the customer
- No incremental IT headcount required at company’s location

Another alternative for organizations is Managed Service Providers (MSP). MSPs are available to organizations wishing to outsource their *entire* infrastructure and networking operations. The traditional providers include IBM, EDS, Oracle, etc.

4.6 Analyze

The final stage in the Technology Solution Lifecycle is measuring the return from the strategy. This is a crucial and essential step. Performance indicators need to be established to monitor both the *operational* and *financial* performance of the strategy. If the strategy is not performing to standards, improvements must be made or the organization must exit the strategy. Tools such as key performance indicators (KPI's) and Click Stream Analysis are available to measure operational performance and effectiveness. Basic financial performance indicators include ROI, productivity ratios, and profitability measures.

All business initiatives are engaged with the expectation of results. The Analyze methodology ensures the results are either achieved or the business initiative investment is reevaluated. The Revere Group guides an organization through the evaluation in the Analyze stage throughout the Technology Solution Lifecycle -- starting with a definition of expectations and ending with invest/divest decisions. The Analyze methodology is built on the following principles:

- Net positive returns -- financial or otherwise -- are the basis for justifying every business initiative
- Expectations are predefined measurements of success
- Measurements of success should be tracked and updated throughout the Technology Solution Lifecycle
- The scope of e-business returns extend beyond traditional ROI

By transforming these four principles into a full lifecycle methodology, this has created the ability to build expected results and measurements into the core of e-business solutions. There are three key deliverables of the Analyze methodology:

- e-Business Case
- Measurement Plan
- Invest/Divest Initiative Evaluation

1. e-Business Case

   The Business Case is used to frame and then capture the expected results of an e-business initiative. The Business Case is used to complete impact assessments, calculate ROI, NPV, IRR, and support invest/divest decisions. The Revere Group's methodology analyzes both quantitative and qualitative measurements. ROI, channel cannibalization, increased revenue, increased margin and increased on-time delivery of the product or service are examples of quantitative measurements. Qualitative measurements are those that are difficult to measure but are critical for success, such as customer satisfaction, improved customer service, understanding a visitor's behavior when using an on-line store, and the ability of the on-line community to generate loyalty. This approach defines the window of opportunity during which the actual results from the initiative are evaluated against the plan.

2. Measurement Plan
   The Measurement Plan is a detailed definition of:
   - The metrics that will be tracked
   - The goal for each metric
   - How and where the metrics will be tracked
   - How often the metrics will be reviewed

3. Invest/Divest Initiative Evaluation
   The Revere Group's experience dictates that the evaluation period for e-business initiatives should typically occur within six months. The final deliverable in the Analyze process is to evaluate actual results against the business case plan. With the measurements gathered in the Manage step, this can help with an invest/divest decision. The "invest" case dictates further planning for expanding the initiative. The "divest" case may indicate the end of the initiative or it may indicate that further analysis is required to guarantee success of the initiative. In the latter case, The Revere Group can assist clients with reevaluating the Business Case and the overall e-business strategy in light of actual results.

Once this analysis is complete and established as an ongoing process, the organization's overall technology-based strategy needs to be re-evaluated. In effect, this brings us back to the beginning of the Technology Solution Lifecycle.

5. CASE STUDIES

CASE #1: IPIX(CRM)

Interactive Pictures Corporation (iPIX®) is headquartered in Oak Ridge, Tennessee with co-headquarters in Palo Alto, California. Prior to their initial public offering on August 5, 1999 the company was already recognized as a leader in interactive photography and immersive imaging for the Internet. The company's patented technology changes the way people create and view images, immersing them in a 360° x 360° spherical environment. Viewers can easily navigate IPIX™ images on a personal computer screen by moving a cursor inside the image. Leading companies use IPIX™ technology in their online marketing and e-commerce initiatives

In fact, mega-sites such as eBay and Realtor.com® are using PIXcast™ to integrate a dynamic imaging layer into their web sites and iPIX imaging can be found on 22 of the top 25 Media Metrix web sites. iPIX currently serves over 30 million image views per day on web sites worldwide, a statistic that is already exceeding previous image view projections!

The company earned triple digit sales growth during 2000 to nearly $41 million in revenues by the end of third quarter 2000. Although iPIX had not earned a net profit as of the end of third quarter 2000, gross profits were soaring faster than revenue growth and company officials were optimistic about the future.

Despite these prospects for a phenomenal future the company had significant challenges to overcome. First, the company was growing at an incredible rate. The increased customer accounts and the associated exponential growth in images served per day were causing severe strains in infrastructure and networking capacities. In addition, the complexities from serving customers on a global basis with timely and accurate exchange of data and images were mounting. iPIX's e-strategy was to provide world-class personal customer service to their global customer base and exceed customer expectations.

In an attempt to overcome these challenges and achieve its e-strategy, iPIX re-thought its e-functions and triangulated in on these challenges. First, in partnership with the Chicago-based consultancy Bridge Strategy Group, a recognized leader in e-business strategy development and implementation, iPIX conducted a rigorous application selection process to assess the functional, technical and architectural fit of several leading CRM applications. Second, out of this partnership with Bridge, iPIX selected Vantive Enterprise software to personalize their customer service. The iPIX customer contact center will have access to complete customer histories, including previous calls and orders and current order status, as well as a full resolution knowledge base. These tools will allow iPIX to offer tailored and speedy solutions for each customer. In addition, the software will allow all iPIX departments to share vital information about promotions, distribution and orders. Third, iPIX selected The Revere Group as a business process consulting and integration partner.

Thus far, the results from this e-strategy have been mixed. iPIX, along with every company in the Information Technology industry, has been significantly impacted with the devaluation of the IT industry during 2000. However, from a business process and delivery perspective, iPIX is commonly regarded as the ‘first-mover’ in this market. iPIX is recognized for superior customer service and for providing an industry-leading technical solution.

CASE #2: PEAPOD, INC.

Peapod, Inc. was founded in 1989 by brothers Andrew & Thomas Parkinson. Headquartered in Skokie, Illinois, Peapod provides services locally in eight metropolitan markets: Chicago, San Francisco/San Jose, Columbus, Boston, Houston, Austin, Dallas and Long Island, and nationwide through their “Peapod Packages” service. The total number of customers was approximately 90,000 by the end of fiscal year 1998. With 1998 revenues of $69 million, Peapod captured approximately 30% of full-service online grocery sales and became the nation’s leading Internet grocer.

Originally, PeaPod fulfilled on-line orders by picking, packing, and delivering grocery from their allied traditional supermarkets in each market. As the grocery industry consolidated, a potential conflict of interest emerged between PeaPod and those independent grocers, especially over customer and brand ownership. PeaPod’s customer service was at stake when these partners became increasingly wary of sharing strategic information. Consequently, their revenue model was in question unless the company could find a proper way to handle their relationship with these partners.

Realizing logistics as the key to their problem, PeaPod reorganized their logistical business unit and moved from original supplier/retail-based fulfillment model to a centralized, dedicated fulfillment model.

The theme of centralized fulfillment is centralized distribution and inventory management. Under the new model, all orders are picked, packed and delivered from dedicated inventory at centralized warehouses, where Peapod maintains control of the fulfillment process. The centralized model supports increased product offerings through the use of “perimeter” retailers (e.g. HBA, perishables) and promotes delivery efficiencies by allowing certain items to be cross-docked on the day of delivery, thus eliminating the need to warehouse additional products. A series of analyses were done in terms of warehouse layout and design, route leveling, and capacity requirements at different markets. Moreover, the company upgraded their picking devices, and leveraged the Internet to manage their supply chain.

So far the company has established four centralized distribution centers in Chicago, San Francisco, Long Island and Boston. PeaPod expects this new fulfillment model to bring benefit to the company in the form of increased control over customer service quality and reduced overall order fulfillment costs. This improved cost structure then give them the flexibility to reduce customer fees, resulting higher customer demand for their services.

The new model also means that PeaPod continues to receive goods from major wholesalers in various markets, such as Jewel Food Stores in Chicago, Walgreens and Andronico's in San Francisco, and the Stop & Shop Supermarket Company in Boston. This allows the company to keep their low prices and share cross-marketing efforts.

PeaPod is a typical example that shows how companies can redesign and manage their supply-chain when their e-strategy causes conflicts among their strategic partners. However, like other e-retailers, PeaPod still cannot generate enough volume to make the margin and for the company to realize the proper return of its e-strategy. As more and more brick-and-mortar grocers - their partners, are setting up on-line stores, the company now faces serious question of how to compete and win over those competitors in the cyber business arena. A Dutch company purchased PeaPod late in 1999.

CASE #3: NATIONAL TRANSPORTATION EXCHANGE (NTE)

Formed in 1994, NTE, formerly The National Transportation Exchange, is privately held and based in Downers Grove, Illinois. In March of 1995, it launched the beta version of the first on-line transportation exchange, and very quickly, full production implementation was ready by August of that year. In 1996, the exchange started serving a small segment of the industry - dry freight in the Midwest. The operation has grown ever since to contain more than 600 member companies today.

There have been huge inefficiencies in the $400 billion trucking industry. First, the complex trucking routes create a great challenge for logistics planning and coordination. Some estimates say that 30-50% of the industry's capacity is underutilized. In addition, the trucking companies have to accommodate the random shipping needs of different companies. As a result, it is estimated that over 70% of the trucks on highways will return empty. Finally, there is a lack of timely and effective communication mechanisms. On one hand, trucking companies does not know to whom that they can sell its extra capacity on the road. However, on the other hand, customers found it very difficult to find a trucker for their ad hoc needs.

NTE's e-strategy focuses on solving the most critical issue of the industry: lack of effective mechanisms with which to establish supply/demand market matching and pricing of transportation capacity with shipping needs.

As they found out, there are significant difference between the shippers and truckers. While a shipper usually has an information horizon of 1-12 months, a trucker typically has an information horizon of 9-12 months. Therefore, they created a business e-marketplace to mediate this difference and enhance information flows, matching unused capacity with loads waiting for pick-up. (e-function)

As a neutral third-party, NTE operates the on-line exchange based on standardized processes for matching demand and supply. The exchange provides a public trading place for member shippers and carriers to buy and sell transportation capacity at dynamically determined prices. In addition, they quickly developed applications that provide a standard means for data capture and reporting. Their system will automatically filter tenders based on a company's business rules, leaving only those compatible trading opportunities.

The exchange has created a great impact on improving the information visibility and reducing waste and inefficiencies in the industry. Most trades are made within 3 hours after a shipment is tendered. Both member shippers and carriers are already enjoying the financial benefit that it brings. On average, the exchange saves customers 15-30% over their traditional shipping costs, and raises the profit from $30-50 to $150-500 per TL carrier.

CASE #4. DMA

In the restaurant industry, the steady growth of chain restaurants throughout the country created the need for vendors with national capabilities that can provide a wide variety of food and food service items to all of a chain's stores at an agreed upon, competitive price, supported by timely delivery and detailed reporting services. In response, several large national food service distributors appeared. However, their appearance directly threatened the prospects of their regional counterparts.

As a result, about a dozen years ago, a group of 14 large, independent regional distributors joined together to form Distribution Market Advantage (DMA), serving the nation's leading national and regional restaurant chains.

Each of the 14 members is among the largest distributors in their markets. Collectively, they operate more than 50 large warehouses, approximately 3,500 trucks, and carry 12,000 items. Together, they generate $9 billion in combined sales and serve every portion of the contiguous United States plus Alaska and the Caribbean.

As a cooperatively owned marketing organization, DMA consists primarily of a sales staff that calls on chain restaurant buyers to set up national distribution plans, and a staff that provides the administrative and reporting services that members and customers need.

Under the master distribution program, all DMA members provide products at the same price to all of a specific customer's stores in their markets. Each member receives its own orders from the local stores, delivers the products, invoices the stores, and pays a fee to DMA for the sales and management services.

While DMA was enjoying quite a success in serving about 30 chain restaurants, which together operate approximately 4,000 individual restaurants, its members' regional focus and their individual proprietary order processing system were the major obstacles in competing with national distributors.

The national distributors, such as Sysco and Alliant, were known to be working on a web-based system. However, the differences in the multiple systems used by different DMA members were starting to become an operating issue for the restaurant chains. For example, when a store manager is transferred from one state to another, the ordering site and ordering process of the DMA member serving the store can be quite different from what the manager was using previously.

In response to this problem, about two years ago, the DMA members decided pursue an e-business solution – revamping its customer-facing ordering system. The project was twofold. On one hand, the 14 members were determined to collectively build a centralized, Internet-based customer ordering and reporting system for their national accounts, thus eliminating their hassle of working with the many different fax, phone, and dial-up ordering systems being operated by the individual distributor warehouses. On the other hand, each distributor must be able to use the site's source code to set up their own similar web sites that are customized with their own names and logos.

The centralized system provides a common "look and feel" order entry interface that can be accessed through the Internet by each store of every chain customer. When the user enters an ID number, the site automatically recognizes the store and its distributor and calls up the inventory and ordering screens from that distributor. The system allows users to fully search and utilize dispjay capabilities, but only products and pricing authorized under the chain's master agreement will be available to the store placing the order. Within seconds after the order is finalized, it is electronically forwarded to the distributor and an electronic acknowledgement is sent to the store. Each evening, members download to the site any products being added or deleted from their own inventories so the information is available to stores placing orders the next day.

Started in the summer of 1999, the project went through four stages. The first stage was a series of intensive Joint Application Development (JAD) sessions to identify a list of specifications of the common web site but also leaves the room for each member to retain certain of its own characteristics that would be compatible with its other business systems.

Once the specifications were defined, the project moved into the second stage in which multiple phases of prototyping were conducted. As each phase of the prototype was completed, it was installed so that the members could access and evaluate it from their own offices.

The third stage was testing. Reality checks using sample orders were conducted on the relatively complete prototype to determine whether the orders were accepted and managed in an acceptable fashion. In addition, robotic software driven stress test were used to ensure that the site could handle several hundred different orders at the same time, and that it could consistently handle, over a long period of time, the thousands of orders expected each week.

The last stage began after the prototype passed all testing. In this stage, the actual site was constructed, and the implementation of the system was carried out in phases with three or four distributors being brought on-line at a time.

DMA is now in the process of presenting a seamless, state-of-the-art, cost effective and responsive national distribution of products. Their e-business solution streamlines the sales and order processes, improves order accuracy and reduces customers' order discrepancies.

6. DISCUSSION

The case studies discussed in section VI provide excellent illustrations of utilizing The Revere Group's e-business management model, the Technology Solution Lifecycle, to enable organizations to fully leverage an e-business strategy. The Revere Group, however, is not the only organization that offers an e-business management model. The purpose of this section is to provide an overview of other e-business management models from industry. Comparisons will be made to the Technology Solution Lifecycle, with an emphasis toward highlighting the common (key) ingredients from each.

This first of such models comes from the Electronic Data Systems (EDS) corporation. Founded in the late 1960's, EDS is the second largest provider of Information Technology services (second only to IBM) and employs more than 125,000 people worldwide. EDS's e-business management model is entitled IMPACT and was developed by Miles K. Davis and Margaret Anne McPhee (Davis 2001). At a high level, the IMPACT model is split into three areas (Organizational Assessment, Organizational Design, and Organizational Implementation). Each area is then split into two phases (six phases for the overall IMPACT model). Organizational Assessment's first phase is to establish the 'case for change' which begins by providing the overall context, scope, and objective for the transformation. The 'case for change' consists of determining the imperatives for change, the change vision, the path for change, and the overall business case for change. The second phase includes understanding the 'as-is' environment. This phase involves developing of an understanding the client's current environment and management practices. Three types of analyses are undertaken: business processes analyses, technology analysis, and organization analysis.

Organizational Design's two phases include designing the 'to-be' environment and the detailed planning phase. The 'to-be' environment (or IMPACT Phase 3) is the innovate phase. This phase entails the determination and documentation of the client's expectations of the future environment. In this phase, the team defines new processes, technology, and organizational elements to achieve breakthrough results in performance. To achieve this goal, EDS and the customer work in partnership envisioning the "new state.". The innovate phase includes the following activities: identify and review best-in-class business practices, benchmark the customer's current organization, processes, and technology against the best-in-class and finally reviewing state-of-the-art organization and technology enablers to support the customer's vision. A planning phase (or IMPACT Phase 4) follows the 'to-be' phase, during which a gap analysis is performed that compares current organization, process, and technology to the envisioned To-Be scenario. Implementation plans are developed ensuring the consistency of objectives and assumptions across To-Be designs, while also identifying all dependencies and resource requirements. The planning phase includes the following activities: creating integrated implementation plans, developing timelines and schedules, and quantifying investments and resources required.

Organizational Implementation includes the build-out and refinement phases. The build-out phase or alternatively called Achieve (IMPACT Phase 5) includes execution of the implementation plans. The following activities are include in this phase: construct developed environment, conducting a pilot, build and prepare any new technology needed, build and prepare organization, continue communications to all stakeholders—including constituents, where appropriate, deliver training (as required), and evaluating implementation success. The final phase (IMPACT Phase 6) is appropriately named 'evolve—refine and improve'. Organizational change, process, and technology measures that were identified during the To-Be design are evaluated. Ongoing measurement, data capture, and reporting processes are established or refined. A change control process and board may be established to capture, review, and schedule improvement activities and to package improvement activities into releases.

To conduct a proper comparison between EDS' and The Revere Group's e-business management models, one must first acknowledge the obvious organizational differences between these two companies and their targeted client base. EDS has been in business for over 30 years, employs more than 125,000 people, and as such, can target both Tier 1 (large multi-national organizations) as well as Tier 2 (middle sized organizations). The Revere Group, on the other hand, has been in business for nine years, employs 500 people, and primarily targets Tier 2 sized organizations. As a sheer result of these organizational differences, there are a number of pragmatic (yet very noteworthy) differences between EDS' IMPACT model versus the Revere Group's Technology Solution Lifecycle. For example, The Revere Group's e-business management model is functional in nature and EDS' e-business management model is more horizontal (process) driven. This is evident by a simple side-by-side comparison of the two different models (figure 5).

	IMPACT MODEL	e-SOLUTIONS LIFECYCLE
Phase 1	Establish the Case for Change	Strategy
Phase 2	Understand the As-Is Environment	Marketing
Phase 3	To-Be, The Innovate Phase	Process
Phase 4	Plan the Implementation	Build
Phase 5	Achieve	Manage
Phase 6	Evolve-Refine and Improve	Analyze

Figure 5. EDS' and The Revere Group's e-business management models

The Technology Solution Lifecycle is more geared towards defining how e-business can be integrated functionally across a mid-sized organization, with special emphasis in the Marketing and the detailed Analyze financial analysis areas. The IMPACT model is more project (or process) driven in defining how e-business should be horizontally integrated across an entire enterprise, with a special emphasis in human resource utilization and enterprise alignment areas. Again, this analysis not intended to criticize either model, but rather, it's more of a function of whom the respective e-business models are intended to serve and benefit.

Despite these differences, however, there are a greater number of significant similarities between these models that need highlighting. For example, both models place heavy emphasis on e-business strategy formulation, project planning, and quantifying financial returns from e-business investments. In fact, at a high level, both models have the following approach: e-Business Strategy Formulation, Planning, Build-Out, Manage and Re-Evaluate. In addition, both models are flexible and adaptable across multiple industries and across a variety of different types of technologies. Indeed, both companies have numerous case studies that document successful e-business applications utilizing their respective e-business management models. Both models also place special emphasis on the evolutionary nature of adapting e-business initiatives. That is, both models actively encourage the re-evaluation and re-assessment of an organization's e-business strategy (post implementation of an e-business initiative), which then begins the cycle again of incorporating e-business into an organization.

Another e-business management model in discussion comes from the International Business Machines Corporation (IBM). With revenue of $87.5 billion and total number of employees of over 300,000 in 1999, it is not only a giant in providing information technologies, more importantly, it is the world's largest provider of information technology services. IBM Global

Service is one of the major growth engines of the company, constituting almost 40% of its total revenue in 1999. "e-business" is the most explosive segment among all the services provided, in 1999, revenue from "e-business" services increased 60% as compared to the average 11% for the overall service division.

Similar to that of EDS, IBM's e-business management model is also process oriented. In particular, it consists of the following four steps:

1. Determine e-business initiatives. In this stage, the key e-business drivers confronted by the organization will be studied to form the objective of the e-business initiative and its application requirements.

2. Evaluate current e-business functionality. IBM offers a tool, called "e-business adoption cycle", to help organizations assess their existing e-business functionality, information technologies (IT) infrastructure, and problems and concerns of e-business development. The "e-business adoption cycle" indicates that companies move through six common phases (in three clusters) in their evolution to e-business: awareness and presence, pilot and adoption, and integration and transformation. A company must overcome the "security chasm" before advancing to the second cluster – conducting online transactions. Then at the later part of the cycle, it must cross the "business-value chasm" – to rethink its business strategy in integrating the web with core business processes such as customer relationship management, supply chain management, knowledge management, and operations – to realize an e-business model. In addition, this adoption cycle can be used to direct resource prioritization and allocation to achieve the e-business objectives.

3. Select an e-business operations model. Operations models are the key to IBM's e-business management. An operations model is the target environment, tied to IT investments and capabilities, that the organization must implement in order to achieve e-business objectives defined earlier. Each operations model has a unique value proposition, organization/culture, IT focus/scope, logical common function, middleware and overall infrastructure architecture. IBM identified five types of e-business operations models in a matrix form by two parameters: location of the e-business environment (external vs. internal) and primary e-business objective (new business vs. efficiency/effectiveness). In the internal environment, the *e-commerce model* increases sales and profitability by leveraging the Internet as a new distribution channel and by customer relationship management (CRM). The *e-process excellence model* focuses on improving the effectiveness

and efficiency of an organization’s internal processes. In the external e-business environment, the *extranet model* aims to provide efficiency across multiple organizations through the use of enterprise resource planning (ERP) or supply chain management (SCM) systems. By maintaining a network of suppliers, employees, distributors, retailers, and consumers, the *virtual-community model* not only achieves business efficiency, but also improves customer intimacy. Finally, the *above-the-e-line model* enables the organization to develop new products and markets through implementing new business models and business-to-consumer processes.

4. Identify service areas and implement e-business initiatives. In this phase, organizations will define the activities under the selected operations model, and associate them with the four service areas – managing transition to e-business, integration of process and infrastructure, operational performance, and expert sense and respond – offered by IBM.

Comparing with The Revere Group’s e-business management model, IBM put much more emphasis on IT infrastructure investment for conducting e-business. Each selection of e-business operations model is tied to a particular IT environment or architecture. In other words, those operations models are in fact the guidelines of IT investments to achieve e-business goals. This is understandable according to the nature of the company. Hardware sales contribute the highest percentage of total revenue, and services, software and component (OEM) technology as a whole provide more than half (in fact, nearly 60 percent) of IBM's revenue. Therefore, such a model can effectively drive the cross-sale of its software and component business. As a matter of fact, most of the successful e-business stories are associated with some deployment of IBM product, such as IBM Net.Commerce, Net.Data, DB2, and IBM RS/6000® server.

In addition, this model is different from that of The Revere Group’s in its specialization of service areas. As we said earlier, IBM has shifted its focus from creating innovative technologies to helping customers use them. Moreover, it is anticipated that sometime within the next five years, more than half of the revenues and workforce will come from services. To manage this huge business efficiently, IBM must build a knowledge pool that targets to different e-business problems systematically. Moreover, the multi-billion company also has the deep pocket to develop such specialty. Therefore, landing an operations model to specific service areas is an essential part of its model. On the other hand, the much smaller service practice of The Revere Group ($70 million vs. $38 billion of revenue) does not allow the company to develop such specialty services. Therefore, there is no such clear differentiation of service areas. Consultants are expected to work across areas. Lastly, unlike The Revere Group's model, this model does not include a final assessment of the return of e-business initiatives.

Despite those differences, it can be shown that, at a higher level, this model also follows the common procedure of: e-Business Strategy Formulation, Planning, Build-Out, and Manage, with the exception of Re-Evaluate, although the model does recommend a multiyear plan for e-business evolvement when there are multiple e-business initiatives. The commonalities are shown in the table below (figure 6):

	IBM e-BUSINESS MODEL	TECHNOLOGY SOLUTIONS LIFECYCLE
Phase 1	Determine e-business Initiative(s)	Strategy
Phase 2	Evaluate Current Functionality	
Phase 3	Select e-busines Operations Model	Marketing
		Process
Phase 4	Identify Service Areas and Implement	Build
		Manage

Figure 6. Summary of the commonalities

This chapter has focused on e-business management models. Despite this shake-out of dot-corn companies during 2000 / 2001, the key business drivers leading organizations to adopt Internet-based solutions still remain. This chapter discussed those key business drivers and illustrated how those drivers are enabling a host of new opportunities (and challenges) from the traditional operations of an organization. However, the methods to evaluate these organizations in the public market place have changed significantly. Gone are the days of evaluating new venture start-ups based on burn rates, over-inflated revenue estimates and the vita of a silicon-valley cowboy. The market has forced companies to focus, once again, on the basics: cost, quality and profitability. A critical ingredient towards successfully achieving these 'basics' is a long-term focused and profit-orientated e-business management model. One such model, The Revere Group's Technology Solution Lifecycle, was presented and explained in great detail. Four case studies were presented to illustrate the application of the Technology Solution Lifecycle e-business management model. In addition, two other e-business management models (from EDS and IBM) were discussed and compared with the Technology Solution Lifecycle. Common ingredients from each of the models were presented.

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Chapter 6

Focus on Consumers: P&G's e-Commerce Strategy

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Abstract: New opportunities arise as entire industries embrace the potential of the Internet and the World Wide Web. These opportunities can improve various facets of an organization's environment including customer management, supply-chain relations, inter-organizational partnerships, and internal operations. When developing eBusiness initiatives that capitalize on these opportunities, companies must consider the uniqueness of their industry. In this chapter, the unique characteristics of the Consumer Packaged Goods Industry are presented followed by an analysis of the potential eBusiness opportunities that arise from the Internet. Thereafter, a description of the initiatives undertaken by Proctor & Gamble, a major manufacturer within the industry, and an analysis of how these initiatives capture the uniqueness of the industry will be presented.

Key words: consumer packaged goods, e-commerce strategy, online consumer management

1. INTRODUCTION

In the fast changing world of electronic commerce, no industry has been left untouched by the impact of the Web. The Internet has caused fundamental shifts in the way consumers shop for and purchase goods and services. This shift has had a major impact on the consumer packaged goods industry (CPGI), including the major brand name manufacturers, their suppliers, distributors, retailers and advertisers. Procter and Gamble (P&G), a major CPG manufacturer and a leader in the industry launched several e-business projects to address this shift and leverage the Web to provide more benefits to consumers. These initiatives have provided mixed results with respect to the impact on P&G's fundamental business and marketing strategies. This chapter will systematically present several e-business initiatives of P&G, estimate the impact each has had on the company and the industry, and identify some useful lessons learned from this experience.

In the aftermath of the dot-com bubble burst and the slow-down in the economy, many organizations are evaluating their Internet strategies. This evaluation comes as organizations realize that the Internet is not only about, perhaps not even mostly about "dot-com" business models, but represents a technological sea of change that provides opportunities for organizations to become more efficient and effective in highly competitive business environments. Given the characteristics of the consumer packaged goods (CPG) industry, the e-business experience of P&G raises several interesting questions for academics and practitioners in business management:

1. What major opportunities does the Internet provide for the CPG industry, given its unique characteristics?
2. How did P&G's e-business initiatives measure up to the potential of the Internet?
3. What lessons can we learn from P&G's experience about developing and implementing e-business strategies?

All industries must deliberate these questions during this period of profound technological and organizational changes. But, in the CPG industry the focus turns to the impact that the technology has had on consumer's preferences and their expectations about the goods and services they consume. The presentation of this chapter is as follows. The next section presents the characteristics of the CPG industry and how the Internet can play a role in this industry. Section III discusses the e-business initiatives of Procter & Gamble, a major CPG player. This is followed by an analysis of these initiatives to evaluate them according to the questions above. We conclude with a look at the major lessons learned from these initiatives and point to some of the critical issues that need further research.

2. CPG INDUSTRY

Consumer packaged goods are the everyday use items that consumers purchase primarily from food, drug and mass merchandizing channels. Categories include food and beverages, cosmetics, skin care, hair care, feminine care, home cleaning, and detergents. The CPG industry is a $1.3 trillion industry (Krivda, 2001). The most striking feature of this industry is the wide range of consumer needs and preferences involved. The buyers can be considered fragmented in the sense that though the marketing strategies across the industry are surprisingly similar, the product attributes and the specific benefit proposition differ even within a category. A retailer has particularly important roles to fulfill in the supply chain (i.e., the aggregation of demand and supply and the final merchandising at the point of sale). Table 1 identifies some notable characteristics of the CPG industry that will shape the industry's use of the Web.

Table 1. Characteristics of CPG Industry

CHARACTERISTICS OF PRODUCTS	***CHARACTERISTICS OF INDUSTRY***
• Typically, products are low-price, low involvement item • Products are quickly, yet steadily, consumed and frequently re-purchased • The switching costs among products is low • Women are the primary purchasers • Product selection is influenced by: price, discretionary household income, consumer demographics, and product features (*Standard & Poor's*, 2000)	• Consumption is stable, hence the opportunities for influencing demand through the Internet are limited • Manufacturers depend on mass media to communicate the product value to the consumers • It can be difficult for consumers to differentiate among brands, hence the need for heavy consumer marketing • The CPG industry is known to have optimized existing systems (i.e., media management, merchandising, and inventory management)

As the characteristics suggest, it is critical to provide a very good product and channel experience to the consumer on a continual basis to ensure maximum consumer satisfaction and repeat purchase. Unlike other industries where purchases are made less frequently (i.e., the auto industry), a dissatisfied consumer does not have to wait long to change brands. Thus, marketing consumer goods involves constant feedback from consumers about their experiences with the products and requires the ability to rapidly respond to consumers' needs and preferences. CPG members continually attempt to increase the bond between their brands and consumers through such efforts as customer satisfaction and product offerings. Brands that are strong within the industry tend to develop a competitive advantage through the loyalty of its users (*Standard & Poor's,* 2000). While the manufacturers work directly with market research data to understand consumer preferences, they must rely on the information supplied by retailers to understand the demand for their products.

The product categories in CPG industry are mature and stable, making it expensive to generate revenue by increasing share. Also, most products in this industry meet basic human needs and it is not regarded as cyclic. Hence, CPG players have to find new value propositions to their consumers to keep them coming again and again. With the emergence of the Web as a new channel, consumer goods manufacturers are hoping to provide such new value propositions, for example, by providing more customized products and services to consumers at far less costs than possible through traditional channels. Finding new ways to reduce current costs through the use of Web can also help companies improve profitability in this tight market.

3. P&G E-BUSINESS INITIATIVES

Procter & Gamble (P&G), a key market player within the CPGI, was founded in 1837 in Cincinnati, Ohio. The multibillion-dollar company markets to 140 countries and employs 110,000 people worldwide. It produces over 300 brands that cross a variety of product types. Some of P&G's well-recognized brands include Tide, Scope, CoverGirl, Crest, and Pampers.

In recent years, P&G has developed a number of e-commerce initiatives to take advantage of the opportunities web technologies present. The initiatives discussed here enhance customer relations, improve transactions with supply chain members, and provide employees with access to valuable information. Table 2 summarizes the potential benefits of these initiatives.

3.1 PG.com, Brand Websites, and Online Communities

http://www.pg.com

Objectives/Purpose: P&G's Internet marketing efforts include a corporate website, numerous brand websites, online advertising campaigns, and the sponsorship of online communities. Their corporate website not only provides corporate information but also it showcases the range of P&G brands. Brand websites give information related to products and their use (e.g., stain removal tips, cleaning tips). P&G has also played an active role in the development or sponsorship of several online communities (i.e., BeingGirl.com, Women.com). These initiatives further expand the potential reach of their marketing efforts.

Service/Features: In traditional media, P&G has approached each brand as a stand-alone message. This behavior carried over to the company's initial web presence. The PG.com corporate website did not highlight brand content, rather it served as a typical corporate information website. Reviewing the website today one finds a much more consumer oriented website. Attention gets directed to brand content, a different approach from traditional media. The individual brand websites bring added value to product marketing through the use of product selectors and/or alternative uses suggestions (i.e., Pantene, Bounce), or by providing valuable information (i.e., Tide's Stain Detective). Other brand websites use games (i.e., Crest's Sparkle City game for kids) or online communities (i.e., Pampers Institute) to encourage repeat visits. See Figure 1 for a screenshot of PG.com.

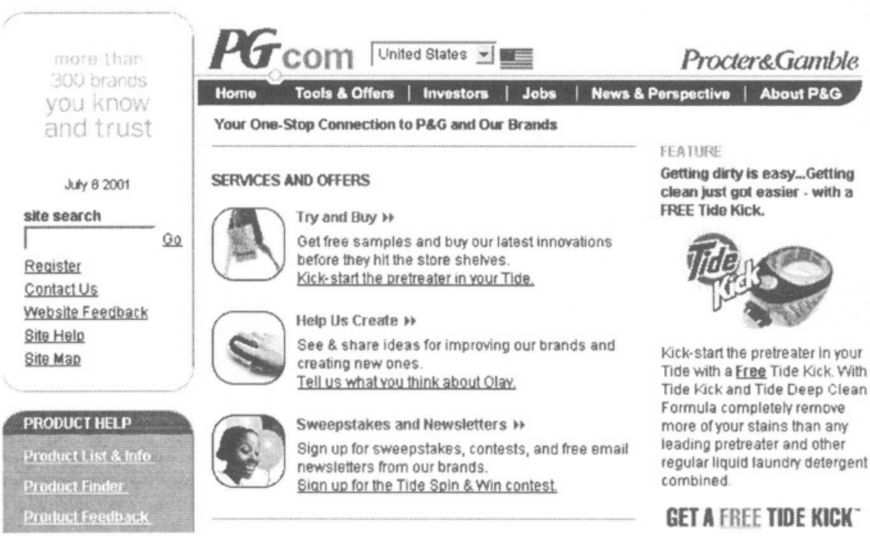

Figure 1. Screenshot of PG.com Website

Benefits to Consumer: Brand websites primarily build consumer awareness about products. In addition to discovering information about certain products, some brand websites allow users to request free samples or order coupons online. Product selectors on brand sites benefit customers by helping them choose the product style that best suits their needs. Online communities, such as the Pampers Institute, encourage the development of a community among visitors through the use of bulletin boards and chat rooms available to members. Furthermore, PG.com and brand websites provide consumers with another customer service outlet in addition to traditional customer service outlets (i.e., phone hotlines).

The internal aggregation of P&G's brand sites into pg.com provides a single window for consumers to explore P&G's offerings. They also get product information and trial offers of multiple brands from one place.

Benefits to P&G: P&G has incorporated Internet technologies in its consumer research strategies with the objective of reducing cost and time-to-market. By incorporating the use of online discussion forums and surveys, the completion of concept-testing procedures has been reduced from months to weeks with a significant reduction in the cost (Advertising Age 2000). Overall, marketing research costs have been reduced by 50-70% through these strategies (VanScoy 2000). Additionally, P&G benefits from its sponsorship relationships as well. In addition to providing an outlet for marketing brands, some websites (i.e., Bolt.com) provide P&G with profiling and segmentation data gathered from polls and forums (Promo 2000).

P&G has also used the website to launch new products, such as Physique, rather than relying on the traditional strategy of using an intensive mass media advertising campaign. Additionally, products in the beta-testing stage of product development (e.g., Crest Whitestrips) have been available to purchase through the website prior to their introduction in traditional retailing outlets (VanScoy 2000).

3.2 Reflect.com

http://www.reflect.com

Objectives/Purpose: Reflect.com, which was launched by P&G in 1999, is an online retailing website featuring cosmetics and other beauty products. Reflect.com takes advantage of the direct channel between manufacturer and consumers by allowing consumers to customize their product based on their responses to a few background and product preference questions on the website. Besides customizing the product itself, customers can select its packaging features, accents, and even name their creation. Within a few days, the customer receives her customized cosmetics, wrapped in bright tissue paper, and delivered in uniquely sized packaging. The value to the consumer is purchase of a highly personalized product designed and delivered based on her response to a few questions.

Service/Features: Reflect.com permits P&G to use its knowledge of product formulations to offer the full-range of possible formula combinations of cosmetics and hair care products that are not available in traditional Food-Drug-Mass Merchandising outlets. The Internet enables P&G to offer customized cosmetic formulations by making it easy for P&G to gather the needed information from the customer (VanScoy 2000). See Figure 2 for a screenshot of the customization process on Reflect.com.

Figure 2 Screenshot of Reflect.com Website

Benefits to Consumer: Reflect.com provides customers with valuable knowledge of cosmetic products. Not only does it assist customers by removing the guesswork from product selection, but it also goes beyond this to create a product that is right for them. To help reduce the frustrations associated with online purchasing, the website offers a "concierge service" to assist customers, if needed, during the customization and purchasing process. Additionally, Reflect.com's return policy, which states that customers who are not satisfied with their purchase can return their product for a full refund, is prominently displayed throughout the website.

Benefits to P&G: Reflect.com offers all combinations of product formulations that other P&G brands cannot make available through the limited versioning sold through traditional retailing outlets. More importantly, Reflect.com gives P&G the opportunity to have a direct sales channel with customers, which also allows P&G to take full advantage of customer relationship management opportunities. Reflect.com can develop strong relationships with these customers, while encouraging increased customer involvement. Information gathered from customers is used to develop profiles that can be used to personalize future marketing efforts. Furthermore, the direct channel encourages direct feedback from customers.

3.3 Supply Chain Initiatives

Objectives/Purpose: P&G has projects to help improve the collection and flow of information across its supply chain. The capture and flow of more accurate and timely information can help reduce the inventory in the supply chain and thus, the costs, while allowing all the players in the chain to respond more effectively to consumer needs.

Service/Features: P&G has been experimenting with an enhanced supply chain management strategy, referred to as "smart packaging." P&G hopes that their smart packaging initiative, which includes embedding microchips into product containers, will identify when, where, and what specific units of a product are sold. P&G has teamed up with Microsoft to improve point-of-sale efficiency. The proposed system will capture real-time point-of-sale data that is aggregated and processed by intelligent algorithms which then identify the products that need to be re-stocked, re-supplied, and manufactured (P&G Press Release June 2001).

Benefits to P&G: Through the smart packaging initiative, the company will be able to track each individual unit from its production through its purchase at the retail outlet. Additionally, P&G hopes that the initiative will ultimately continue into the customer's kitchen. Specific ideas include the capabilities of automatically charging a customer's bank account via the Internet when the shopper adds a product to their grocery cart and automatically reordering products via the Internet when they run low in the customer's refrigerator (VanScoy 2000). Although the data obtained through smart packaging would initially be used for inventory management, P&G hopes that the data eventually will be used throughout the entire supply chain (VanScoy 2000). Today, the supply chain as such ends at checkout and visibility does not extend into the home. Through their supply chain solution with Microsoft, P&G can integrate sales data with its own core operational and business intelligence systems (P&G Press Release June 2001).

Benefits to Supply Chain: These initiatives hope to ease the ordering process. Reordering can become more accurate and require less time than current procedures. For instance, their supply chain solution hopes to reduce inventory by 50% while improving out-of-stock retailing conditions by 25% (P&G Press Release June 2001).

3.4 Transora

http://www.transora.com

Objectives/Purpose: Transora is an online procurement website for the business-to-business consumer packaged goods industry. It is designed to "facilitate cross-industry integration, communication, and cooperation (Krivda 2001)." The consortium of CPG industry members, which currently includes over 80 companies, originated from corporate investors who pledged $250 million to fund its development (Krivda 2001). To assure a level playing field, any manufacturer can hold a maximum equity of 5%. Transora's CEO Judith Sprieser stated that the collaboration of CPG members resulted from the recognition of a common need set. CPG members realized "that tackling the next level of inefficiencies was too difficult and expensive to do alone." Thus, they pooled their money and created Transora to help them exploit the next level of efficiencies and information flow (Krivda 2001).

Service/Features: Transora's vision is to "lead the transformation of the consumer products and services industry through a global, open, standards-based, industry-led marketplace that delivers breakthrough value for all industry participants." Companies are connected through shared standards and shared transaction formats, but the business that is done through the exchange is conducted privately (Krivda 2001). Transora also provides other value-added services, including collaborative planning, forecasting and replenishment, and the ability to simplify ordering processes and to improve ordering accuracy (PR Newswire 2000).

Benefits to Supply Chain: All participants in the value chain can benefit from increased connectivity with other members, as well as enhanced automation, and improved inventory management. Suppliers using Transora have access to a large customer base and realize lower customer acquisition and service costs compared to traditional channels, while manufacturers benefit from improved customer service with retailers and wholesalers (PR Newswire 2000). In past trials, companies saved 22-25% over their typical procurement procedures for indirect materials (PR Newswire 2000). Transora's website outlines how participation can be beneficial across the various roles in the CPG industry:

- Suppliers can seamlessly integrate with manufacturers and improve collaboration, demand planning, logistics and inventory management
- Manufacturers can expand their customer base and strengthen their links to key suppliers
- Retailers can develop closer, more productive relationships with manufacturers and more responsive consumer strategies
- Industry participants and consumers can access and exchange relevant, timely information to build their community

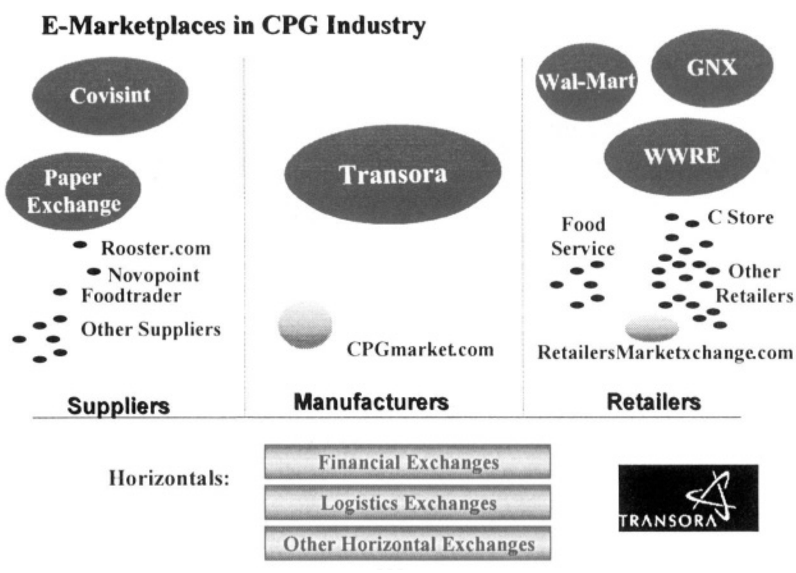

Figure 3. Transora's e-Market Structure (Source: www.transora.com)

Benefits to P&G: P&G believes a "seamless supply chain" can reduce half the costs and half the time it currently takes to transform raw materials into finished products (BtoB 2000). The combined effects of P&G's participation in Transora, as well as its other supply chain initiatives, could reduce the company's end-to-end supply chain cycle by 2-3 days (VanScoy 2000). This computes to a $1.5 billion reduction in working capital and a $100 million savings in inventory management, before considering additional sales that are currently lost when retailers are out-of-stock due to ordering inefficiencies. P&G has set a goal of taking 50% of retailer orders over the Web by the end of 2001 (BtoB 2000).

3.5 Yet2Com

http://www.yet2.com

Objectives/Purpose: Yet2.com is an electronic marketplace that provides the forum for companies and individuals to purchase, sell, license and research intellectual assets. Only a fraction of the billions of dollars spent on research and development is ever commercialized in products. Yet2.com, which was founded in February 1999 with over 50 corporate sponsors, helps companies extract value from undervalued or unused technologies by streamlining the traditionally lengthy and ineffective process of technology transfer. Similarly, it can help inventors find companies that can use their intellectual properties.

Service/Features: Although the market for intellectual properties is estimated at $105 billion, finding potential buyers for technology has been a difficult and lengthy process. Yet2.com provides an electronic global marketplace dedicated to the transfer of these assets. Owners of intellectual properties can list functional descriptions of their licensable technologies on the website, while technology seekers can use search tools to assist in locating technology that fulfill their needs. Information between owners and seekers are confidentially exchanged until both parties have qualified the other party for the transaction. Once both parties have been qualified, the negotiating occurs offline. Parties are only charged a fee (approximately 10%) when a successful agreement occurs. Present listings include over $10 billion in R&D investments. Interestingly, these sunk costs will now have a chance to be valued by the market.

Benefits to Participants: The average corporation only markets 20-30 percent of its technological assets. Through Yet2.com listings, sellers can turn these untapped assets into revenues by selling them to companies that can benefit from these properties. Even technologies that are presently marketed by a company could bring additional revenues to sellers, if they have applications for other products and industries. Additionally, both parties benefit from the reduction in costs associated with identifying companies holding or needing intellectual assets. Without the use of electronic marketplaces, companies would rely on personal networking to identify buyers or sellers for specific assets. The traditional process to market intellectual assets takes an average of 12-18 months and is often limited to those companies within their own industry. Yet2.com can significantly reduce the time it takes to identify a transaction partner. Furthermore, its members cross various industries and countries, with over a third of the listed technologies being from outside of the U.S. Overall, Yet2.com features can help companies "avoid costly R&D processes, increase speed-to-market, and maximize R&D profitability."

Benefits to P&G: P&G was one of the founding sponsors of Yet2.com. P&G includes descriptions of its intellectual properties to encourage the development of partnerships with other corporations interested in purchasing a license to use P&G patents. Most of the revenue that P&G receives from Yet2.com partnerships is pure profit, since the research and development costs involved in establishing the patented item have already been absorbed (VanScoy 2000). Both marketed products and non-marketed assets have been included. For instance, the enzyme used in Tide detergent can potentially be used as a lubricant for oil drilling and as a contact lens cleaner. P&G can also purchase other companies' intellectual properties, which may reduce the time it takes for their own product development.

3.6 Emmperative

Objectives/Purpose: The objective of Emmperative, on online marketing management company, is to aid companies with their marketing function through the use of a collaborative marketing software system. The company, which was formed from a joint venture between P&G and Accenture, provides software that allows marketers to centralize their marketing resources and collaborate their efforts across company brands and geographic locations.

Service/Features: Specific features of the software include project management tools (e.g., project trackers), project related websites (e.g., centralized file storage), and customized news delivery. As one of the active partners of this initiative, P&G is contributing its expertise in the marketing function as a reference benchmark during software development. This intellectual property is embedded in the software's marketing tools and project wizards.

Benefits to Participants: The software allows marketers to work smarter and quicker while decreasing the time-to-market for new products. Organizations adopting the software will benefit by increasing productivity in routine, administrative tasks, while improving the return on marketing investments. The software will also aid in spending decisions, as users have access to a library of marketing "best practices." The workflow templates and case studies included with the software encompass the intellectual property and experiences of P&G (Furness, 2001).

Benefits to P&G: In addition to participating as a partner in this initiative, P&G is also the initiative's largest customer. Bob Wehling, P&G's Global Marketing Officer, outlines the following specific goals of Emmperative: "to collaborate more effectively, get our learning from one end of the organization to the other end more quickly, and free our brand managers to spend more time listening to consumers and creating winning brand strategies and marketing programs."

Table 2. Benefits from P&G's e-Business Initiatives

INITIATIVE	*POTENTIAL BENEFITS*
PG.com, Brand Websites, and Online Communities	• Serves as a cost effective test-marketing vehicle by offering samples directly to consumers • Reduces product development costs • Provides an additional customer service outlet • Allows P&G to take advantage of customer relationship management – Personalizes marketing – Develops customer profiles – Increases customer involvement with the brand – Allows direct interaction with customers
Reflect.com	• Allows P&G to sell products directly to consumers • Allows P&G to offer product formulations that traditional retailing outlets can not carry • Expands businesses' potential reach to a global market • Allows P&G to take advantage of customer relationship management • Allows direct interaction with customers • Establishes a way to reach a segment that cannot be reached by mass marketing
Supply Chain Information Collection Initiatives	• Improves information sharing – Data is more timely and more accurate – Expands the accessibility of data throughout P&G and supply chain • Improves point-of-sale efficiency

INITIATIVE	POTENTIAL BENEFITS
	• Improves inventory management • Reduces ordering costs
Transora	• Reduces procurement costs • Improves access to data • Strengthens supply chain relationships • Reduces customer acquisition costs • Improves inventory management
Yet2Com	• Improves enterprise knowledge management • Reduces product development time • Allows for the sale of intellectual properties • Accelerates the transfer of intellectual assets
Emmperative	• Improves information sharing and collaboration among internal marketing units • Increases productivity of the marketing function

4. ANALYSIS OF P&G'S E-BUSINESS INITIATIVES

The widespread adoption and use of the Internet and Web technologies by consumers has created significant opportunities for innovation in the CPG industry, including the development of an interactive communication channel between the product company and the consumer. However, even for an industry leader like P&G, it is not an easy path to realize these opportunities. On the one hand, organizations ask if these opportunities represent fundamental changes in the way the industry does business. On the other hand, organizations want to know if they have exploited the opportunities fully by formulating and executing effective business strategies. The challenge is to find the right value proposition on the basis of which the consumers will interact with P&G.

Were P&G's initiatives cautious moves to find what works on the Web or did they represent a sensible portfolio of experiments when business models were still evolving for the Web? In this section we will systematically evaluate P&G's e-business initiatives and the hurdles to realizing the opportunities. These opportunities can be categorized into three groups based on their level of analysis: (1) consumer opportunities that benefit and service relations with consumers, (2) supply chain opportunities that affect the end-to-end supply chain of a business, and (3) intra-organization opportunities.

4.1 Consumer Management Opportunities

As a company of brands, P&G relies on its marketing capability to make its products visible to its consumers and communicate the product benefits. Traditionally, its interactions with consumers are limited to broadcast media packaging, and merchandising in the retail channel. The use of interactive Web media thus provides P&G an opportunity to establish direct and two-way communication with consumers for more targeted advertising and brand building. However, the use of the Web for developing new global markets may be limited, as it requires a physical presence in the market. In this section we will discuss how P&G's e-business initiatives address the Web opportunities.

4.1.1 Web advertising

The Internet allows companies to target their advertisements based on a known, or perhaps inferred, profile of the consumer who visits a Web page, thus deepening the message for that consumer. P&G embraced Internet advertising and built brand websites to attract Internet visitors to learn more about its products. However, P&G and other companies have realized the challenges of giving a compelling brand sell message in the online media. Learning how to use the interactive media in its marketing mix has required experimentation, but to date the media spending in CPG remains overwhelmingly in traditional media channels, mainly television advertising.

When television emerged as a new media in the 1950s, it quickly replaced radio as the dominant media of choice for marketing. Within five years, P&G's media budget for television advertising went from 0% to 80% (Schisgall, 1981: page 193). Similar expectations arose when Web advertising was introduced in the mid 1990s. However, even after 5 years and with penetration levels similar to that experienced by television, Web advertising is still less than 1% of the media spend in the CPG industry (Adage, 2001). One explanation is that the Web in its current form is not able to provide rich media experience to all consumers, due to limitations of devices and bandwidth. Also, the consumers' involvement online can be a dilemma for CPG advertisers. Unlike traditional media, the Web requires consumers to be active users, who tend to be less tolerant to intrusions in the form of advertisements. Overall, the CPG industry has not yet developed the right advertising model for online interactive media, such as the Web.

Another challenge for the CPG industry has been in developing a reason for consumers to return to a website, given that many of the CPG categories are not top-of-mind for consumers. P&G has initiated several features on various websites to encourage return visits and has offered special promotions to encourage brand loyalty. For example, Reflect.com has offered incentives to past customers to encourage repeat purchases and referrals. Promotions and loyalty incentives have included a free Palm Pilot with a purchase of $100 worth of cosmetics and free customized mascara for a friend. CPG led the development of television advertising but has not yet found an online model that displaces its historical reliance on the earlier medium.

Interactive content, particularly when generated by consumers offers a CPG manufacturer much less control over content than the one way broadcast environment. P&G has already faced public pressures to close chat rooms of a website after receiving complaints that it did not curtail sexually explicit conversations (Marketing Week 2000). P&G will need to develop content partners for interactive, just as it relies on others for television content. For example, P&G has partnered with Excite.com, to bring technical expertise to websites (Marketing Week 2000). "The difficulties that P&G is facing on the Web reflect both the company's struggle to connect with consumers in the 21st century and investors' new realism about the value of the Internet (Marketing Week 2000)."

4.1.2 Product customization

Although the CPG industry is 50 to 100 years up the product versioning curve, the traditional brick-and-mortar marketplace does not allow all combinations of a product to be offered in the retail store. Even when multiple versions are available, the consumer does not always know which version is right for her. The Internet can overcome the physical space limitations of the traditional marketplace, by providing companies with the possibility of customizing a product specifically to the needs of a particular consumer.

Reflect.com is a bold product customization initiative for the CPG industry. By allowing the consumer to create her own product, this initiative changes cosmetics from being a just a mundane everyday product to a more exciting product. High involvement products, such as skin care products, are good candidates for this customization, as the exact combination for a consumer may depend on several factors. Reflect.com uses the information gathered during the online customization to fine-tune its offerings (Gaffney 2001). P&G has realized that the feedback from online consumers helps in responding more effectively to changes in market needs and preferences. But, the jury is still out on the success of Reflect.com and it remains to be seen if the value proposition offered by this model is sustainable in the long-term.

4.1.3 Customer relationship management

The possibility for relationship-focused marketing through the use of interactive Web media provides several new opportunities for companies within the CPG industry. By collecting data from website visitors, corporations can develop profiles of their customers and personalize marketing efforts to the specific visitor based on the data in his/her profile, thus resulting in a stronger relationship between a company and its customers. Relationship marketing can also encourage an increase in customer involvement. Furthermore, direct interaction between the company and customers strengthens the relationship between the two entities, while providing the company with a channel to test-market its products. The Reflect.com website uses a sophisticated customer relationship management system by E.piphany (www.epiphany.com) and consumer research by P&G to refine existing products.

Although the customer relationships developed online will be stronger than that arising from broadcast media, consumers will likely support only a handful of these relationships. Hence, CPG industry members will have a difficult time breaking into that set. By contrast, broadcast media give extensive reach and economic reinforcement of basic marketing messages and the visual reinforcement that remains problematic for today’s interactive technology. Determining the effectiveness of online advertising and marketing will take time. Fifty plus years of television advertising has built a huge base of data from which to plan current media campaigns. However, there is still a lack of good tools to measure the success of interactive marketing efforts.

4.2 Supply Chain Opportunities

Supply Chain Opportunities have an influence on a large number of players within the CPG industry. The CPG industry and the associated retail channels were early leaders in moving vast volumes of data between manufacturer and retailer. The Web can offer new value in this process, but will have to show an incremental payout versus a highly automated EDI regime of long standing.

4.2.1 Information sharing

Companies can help avoid the bullwhip effect and its associated costs by sharing sales forecasts and information data with other channel members, by coordinating orders across the various retailers, and by simplifying pricing and promotional activities (Lee, Padmanabhan, and Whang 1997). Web technologies, such as B2B exchanges, encourage the sharing of timelier and more accurate information resulting in reduced inefficiencies (Corbett, Blackburn, and Van Wassenhove 1999). Landry (1998) suggests that pertinent information, such as sales goals and target costs, should flow freely among all members of the electronic channel. The experiences of other companies, such as Cisco, has shown that giving full supply chain visibility to all involved entities yields efficiency and service gains.

The flow of information among P&G's supply chain members has improved with new Web initiatives. Transora has already launched e-Procurement, data catalog, logistics optimization services and collaborative planning, forecasting and replenishment services that are benefiting participants (Krivda 2001). It has significantly altered the process of locating vendors and bidding for projects.

4.2.2 Direct sales to consumers

The Web has enabled companies to overcome some of the barriers that have previously discouraged manufacturing companies from selling their products directly to the end-consumer. By developing an online storefront, manufacturers can reach customers, regardless of their location, without the aid of distributors and retailers. Thus, online storefronts result in the development of a new distribution channel (i.e., supplier → manufacturer → consumers). By creating a distribution channel that does not include distributors and retailers, manufacturers can reduce the costs associated with getting their products to consumers by providing for themselves the value that was previously provided by those channel members.

As one of P&G's bolder e-commerce initiatives, Reflect.com has changed the company's role in the cosmetics industry from a manufacturer to a manufacturer-retailer, resulting in the creation of a new direct distribution channel. The development of this direct-to-consumer channel has resulted in a few issues for P&G. P&G has had to assure retailers that their intention with Reflect.com is not to compete with Food, Drug and Mass Merchandising outlets. According to research conducted by P&G, there is a need for distributors and retailers within this industry. Findings suggest that consumers want an aggregator for consumer product goods because of the convenience that they provide. (Ironically, Food, Drug and Mass Merchandizing outlets frequently sell their own private label consumer product goods that directly compete with P&G products.) Furthermore, the direct sale of beta-test products on PG.com is not intended to be a substitute to traditional channels of product distribution. Rather, these strategies are used to develop an interest in new products before they reach retailers (i.e., word-of-mouth referrals).

Although P&G has had success in selling directly to consumers through Reflect.com, another similar initiative did not perform as successfully. MoreThanACard.com was an innovative move to bundle everyday products as a gift to create additional value. However, the market tests showed that this bundling did not create sustained interest in the mind of the consumer. This demonstrates the inherent difficulties in selling directly to consumers in the CPG industry. We need more research to understand online consumer behavior, product packaging, and the logistics that will be most appropriate for creating a value proposition and business model to sell low involvement product directly to consumers.

Even in the limited settings so far, CPG manufacturers will need to acquire some new skills for direct to consumer fulfillment. Merchandising functions, which have long been the core competencies of retailers, would now need to be defined in an interactive setting. The manufacturer would need to develop a new set of skills to become competent in functions like customer service, as direct logistics, including the handling of returned merchandise. Channel management will require finesse as direct sales by the manufacturer to the consumer could damage existing channel relationships, even when the volume of product is modest. Clearly manufacturers must keep their relationships with traditional channel members intact, as Internet storefronts have not eliminated the need for traditional channels. In fact, the experience with the startup, online order/ home delivery services suggest that the role of the major retailers will persist for a very long time. Consumers want the convenience of retailers, particularly for consumer products and grocery items produced by CPG industry manufacturers.

4.2.3 Product development costs

Web technologies could be used as a decision-making tool that not only reduces product development costs internally for the organization, but also allows the manufacturer to coordinate decision-making among channel members to encourage faster product development and innovations through collaborations (Landry 1998). Several of P&G's e-business initiatives have taken advantage of the inter-organizational opportunities provided by the Internet to improve upon existing relations with other organizations. The reduction of product development costs have been realized through the implementation and use of these projects. For example, Yet2.com has allowed P&G to reduce product development time by providing P&G with the resources to identify and potentially purchase patented objects from other industries. P&G could also capitalize on their patented assets by selling rights to the patents to other companies.

4.2.4 Product ordering costs

Web technologies provide the medium for reducing product development and ordering costs for members of the CPG industry. Inconsistent purchasing practices cost manufacturers nearly $900 billion annually in procurement expenses (Krivda 2001). Additionally, warehouses have carried over $1 trillion in "just-in-case" inventory, as forecasting technology has shown to be inefficient (Krivda 2001). In addition to reducing these costs, Web technologies can streamline the costs associated with the ordering process by automating or eliminating steps in existing processes.

4.3 Within Organization Opportunities

Within Organization Opportunities affect the company's internal processes. Not only can Web technologies be used to enhance collaboration among departments and employees, they can be used to enhance the management of enterprise knowledge.

4.3.1 Enterprise knowledge management

Although traditional assets (e.g., factories, equipment) once were the source of wealth creation for businesses, intellectual property has become the source of wealth creation in today's economy. Intellectual property, such as knowledge bases, can benefit the entire company if it is properly stored, organized, and utilized (Turban and Aronson 1998). By capturing expertise from within the organization and providing that knowledge as information that can be used by any employees, businesses can enhance their day-to-day operations or provide added support during decision-making. Intelligent agents and Web technologies are facilitating the use and maintenance of knowledge bases (Turban and Aronson 1998). Because of the technical specialization required for enterprise knowledge management, it can be difficult for companies to hire and retaining talented information technology and knowledge workers. The demand for these highly skilled employees will continue to grow with existing and future commerce initiatives.

P&G has used the Web to implement project Emmperative to systematically collect and manage the marketing knowledge created in the entire organization. This initiative encourages collaboration among employees who would otherwise not be coordinating their efforts. Emmperative has improved employees' accessibility to corporate and other relevant marketing information through the use of a website that displays and categorizes links to all available material. Emmperative also encourages employees to seek advice and input from other P&G employees.

5. CONCLUSION

Several of P&G's e-commerce initiatives are promising primarily because they have fit the features of the CPG industry to develop a value-added product or service. However, only a few of these initiatives can be said to have taken a truly bold approach, and none has yet radically transformed P&G's operations or the CPG industry. Primarily, P&G has been more experimental in their selection of initiatives by implementing a range of applications with most being extensions of existing industry practices. The initiatives, nonetheless, take advantage of the gestalt of the Internet economy by moving toward new business arrangements and more open partnerships in implementation.

The experience of P&G and other CPG companies has shown that the Web has limitations as a marketing media for consumer products. The value added by interactive capabilities of the Web is more suited to high-involvement products. CPG marketers currently do not have a viable media model for marketing a majority of the consumer products online. As more powerful online devices and bandwidth are available to consumers, we may see better media models for online marketing of consumer products.

The CPG industry has over time optimized several of its business processes, such as media measurement and management, merchandising, and inventory management. Hence, e-business initiatives that focus mostly on improving process efficiency are likely to provide marginal benefits, unless the CPG industry is willing to undertake major transformations enabled by Web technology. Even so, the experience of Transora has shown that it is possible to reduce the operating costs significantly and, thus, improve profitability of the “low-margin” CPG industry.

An interesting aspect of P&G’s e-business strategy is the use of a portfolio approach to identify initiatives. Given the characteristics of the CPG industry and the lack of a proven model for online consumer marketing, the portfolio approach gave P&G opportunities to experiment and understand the role of the Web in various aspects of its business, such as consumer communication, product customization, procurement, and knowledge management. At the same time, this approach protected P&G from any adverse effects of failed initiatives. In addition, P&G has collaborated with outside companies on many initiatives, an indication that it has become more open in its approaches than what was customary. P&G has aligned with other companies on numerous initiatives, such as when Reflect.com brought in other investors including venture capitalists. Yet2Com also expanded beyond the common goal of protecting existing brands and markets by selling existing patents to other companies, at the risk of increasing the company’s vulnerability.

Even though Web advertising has not yielded the expected results to the sales of P&G products, an area that has benefited most from the Web is “test-marketing” (Gaffney 2001). One of the most successful of such test marketing efforts was for Crest Whitestrips, with about 12% of registered visitors making a purchase resulting in sales of $50 millions in just 3 months. Now, P&G conducts about 40% of its product tests and studies online, which is both faster and less costly than traditional test-marketing efforts. Forrester Research notes that the use of the Internet for test marketing, rather than as an advertising media, has had more impact on the sales of P&G (Gaffney 2001). In the CPG industry, being the first company to bring a new product to the marketplace is considered to be a significant advantage (Standard & Poor’s 2000). Direct interaction with consumers can improve product offerings and reduce the time needed to get a new product to the marketplace. Although P&G has realized some time reduction and cost savings by relying on their website visitors to aid in product development, P&G should do this earlier in the product development stage.

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Chapter 7

Global Non-Production Procurement at Motorola: Managing the Evolving Enterprise Infrastructure

Judith Gebauer, Dean Haacker, and Michael J. Shaw

Abstract: In this chapter, we describe the experiences at Motorola to utilize e-commerce technologies to support and streamline non-production procurement globally, in an integrated fashion. We point out successes and discuss some of the challenges and considerations that the company faces moving forward.

Non-Production Procurement (NPP) includes the goods and services that are necessary to support the daily operations of a business. These items range from office supplies to consulting services and can easily represent one-third of a company's total spend. Traditionally, NPP has lacked the efficiency that is often achieved for the procurement of production-related items.

In 1997, Motorola embarked on a project to utilize Internet technologies to reduce "renegade purchases" and to improve the leverage of its buying power. An easy-to-use, controllable procurement application allowed the company to reduce cycle times and process costs, and to improve process quality and information transparency.

As one way to overcome the remaining limits of the Internet-based electronic procurement solution, Motorola considers the use of mobile technologies. Besides further improvements of the purchasing processes, the addition of wireless access also allows for advancing the development of Motorola's own products and solutions. At this point, the focus of attention shifts from business process reengineering and system implementation to product development and feasibility considerations.

Key words: Electronic procurement, Change management, Wireless application, System evaluation, Case study

1. INTRODUCTION

Non-Production Procurement (NPP) includes all goods and services that are necessary to support the daily operations of a business but that are not directly part of the final product. These items range from office supplies to consulting services and can easily represent one-third of a company's total spend. In the past NPP has often lacked the efficiency achieved for production-oriented procurement, with the result of slow and complex procedures, poor leverage of corporate buying power and high overall costs. Similar to other large companies throughout the late 1990s, Motorola, a multi-billion dollar communications equipment and electronics manufacturer, deployed Internet technologies in order to overcome these deficiencies.

This chapter is structured as follows. After a brief overview of the shortcoming of the initial situation, we describe Motorola's vision of an improved procurement function, combining organizational and process changes as well as the use of information technology (IT). We then point out some of the challenges of developing and implementing the new, integrated system and describe how Motorola's project team addressed the challenges. An assessment of the results after system implementation shows significant improvements and cost savings but also yields some limits of the current system. The use of emerging, wireless technologies to further improve the existing system is discussed in the final part of this chapter.

2. SHORTCOMINGS OF THE INITIAL NON-PRODUCTION PROCUREMENT FUNCTION

Similar to the situation at many other large and small organizations, the procurement of non-production products and services at Motorola was considered inefficient in particular with respect to three issues: The process was mainly paper-based, poorly standardized and allowed little leverage of corporate purchasing power. The results were high overall procurement cost, and long cycle times.

1. Paper-based process. Given its cross-functional yet non-strategic nature, nobody really owned the non-production procurement function at Motorola, by itself a rather decentralized organization. As a result, the function had been somewhat neglected, which again resulted in a complex, and non-standardized conglomeration of individual procedures, which were to a large extent based on paper. In fact this

function was considered to be one of the most paper-intensive processes of the entire corporation, amounting to a yearly stack of paper documents reaching as high as 40 stories.

2. Poor leverage of corporate purchasing power. The highly decentralized nature of the procurement function also resulted in low internal visibility and insufficient information about corporate contracts or internal spending patterns. While it was in fact possible to determine the overall volume of business with a given supplier (e.g., by accessing accounting data), many times the purchasing department had no way of tracking what was ordered and by whom with in the organization. For a supplier such as Hewlett Packard with a range of products including test equipment, printers, servers, desktop computers, and workstations, such high level of aggregation was considered unsatisfactory.

   The fact that Motorola did not leverage its corporate purchasing power or utilized preferred suppliers to full extent was of particular concern. Many times purchase orders were placed ad hoc, and frequently different groups conducted negotiations with identical suppliers in parallel. For example, in the area of office supplies, Motorola used as many as 300 different suppliers for the same items (the number has since been cut down to one).

3. Multiple procedures, low level of standardization. As no single group had responsibility for the NPP process, procedures were typically established at each site independently, as well as within the different domains, such as materials, administration, distribution, and manufacturing. The result was high fragmentation, poor control, and little process optimization.

   In addition, the information technology (IT) systems to support the processes varied widely throughout the corporation, as did the level of sophistication between different organizational units. Some of the groups had in fact established quite advanced processes, supported by sophisticated IT applications. At the time of the assessment, one business unit had already been using a mainframe-based procurement system for more than ten years. The system provided its users with access to over four hundred supplier-catalogs, and supported a business process where payments were handled by receipt without invoicing. In contrast, other groups had hardly any formalized process or IT system in place.

3. VISION: A THREE-PRONGED, INTEGRATED APPROACH

With its effort to improve non-production procurement, Motorola attempted to achieve "significant cost savings by leveraging and managing the supply base, reengineering business processes, and implementing an enabling system to allow sustaining the benefits." In order to implement this vision, an integrated approach was chosen, consisting of three inter-related elements: (1) strategic sourcing and commodity management; (2) business process reengineering; (3) web-based procurement application. All three elements were considered crucial for the overall success of the initiative.

1. <u>Strategic sourcing and commodity management.</u> Although Motorola actually had a high-performance supply management organization, its focus had always been on production commodities, while non-production procurement had received comparatively less attention. A detailed analysis of the purchasing volumes, however, revealed that for some groups in the organization the non-production-spend almost equaled the production-spend.

   Consequently, Motorola envisioned a sourcing concept for non-production that was similar to the practices that were already well established in the production area. Commodity managers were appointed with the responsibility to identify opportunities to leverage transaction volume across businesses, and to negotiate favorable deals with suppliers. With a total over 50,000 suppliers, ample opportunities existed to leverage Motorola's buying power.

2. <u>Business process reengineering.</u> Corresponding to the outward-looking, strategic focus of the efforts to improve commodity management, the business process reengineering initiative focused rather inward on operations management. As such, it was responsible for analyzing business processes, for establishing business rules, for implementing them, and for benchmarking the resulting processes within and outside Motorola.

   In addition to streamlining individual buying and approval procedures, the reengineering effort also attempted to standardize the buying process across the corporation. Managing the related issues of cultural and procedural change and integrating widely heterogeneous practices turned out to be some of the biggest challenges of the project.

3. Web-based procurement application. As the third integral piece of its procurement project, Motorola decided to implement a Web-based electronic procurement solution, including an electronic catalog and online ordering functionality to be used by its workforce.

   The system would essentially facilitate and link the other two elements by providing visibility throughout the process, as well as supporting the implementation of business-specific rules and standardization efforts. Access to up-to-date data was essential for the sourcing process and could, for the first time provide detailed information about purchases, preferred suppliers, and supplier contracts. The system would also provide the basis for the reengineering of day-to-day purchasing activities and the introduction of process standards, while at the same time help increase the availability of items.

4. DEVELOPMENT AND IMPLEMENTATION ISSUES

In this section, we focus on some of the issues that Motorola faced upon the development and implementation of its electronic procurement system. The issues include strategic sourcing, catalog management, purchasing operations (the business process), system architecture, and links with the suppliers.

COMMODITY AND SUPPLIER MANAGEMENT

As one of the first steps, Motorola analyzed its buying patterns of non-production goods with the objective of identifying distinctive groups of commodities and suppliers. The results improved the understanding of the corporate wide procurement function and subsequently helped prioritize the focus areas.

First, the annual non-production spend was analyzed according to value and volume in two ways: a quantitative analysis to identify areas of opportunity in economic terms was followed by a qualitative review of the spending categories to devise different paths of action for specific commodity groups. Second, a supplier analysis was performed to prioritize the outside reach of the project.

1. Quantitative spend analysis. An analysis of Motorola's non-production spending according to number of transactions and transaction value

points to a situation similar to many other organizations (Figure 1). Eighty percent of the transactions concerned purchases under a thousand dollars. Also, the value of only a very small number of purchasing transactions reached beyond ten thousand dollars. This analysis provided valuable starting points for process improvements in particular and was termed “blue dollar (volume) opportunities” by the project team.

The second analysis helped helps identify starting points for improvements on the sourcing side and for supplier and contract management. It shows that almost half of all purchasing dollars are spend for items in the one to ten thousand dollars range, while the other groups are split fairly evenly (less than $1 thousand, $10,000 to $100,000, and above). The project team refers to the potential savings from renegotiating supplier contracts as “green dollar (value) opportunities.”

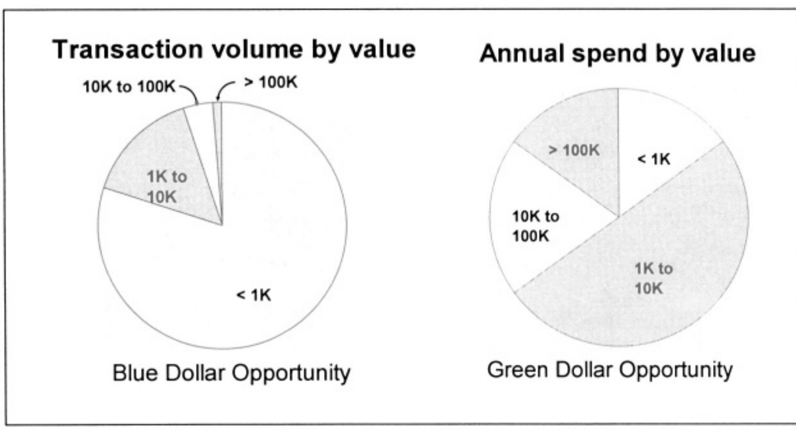

Figure 1. Blue Dollar (Transaction Volume) Opportunity and Green Dollar (Purchasing Value) Opportunity

2. Qualitative spend analysis. Additional information regarding how to set project priorities was derived by identifying different commodity groups according to their value and purchasing volume (Figure 2).

   Typically, high value calls for improvements on the sourcing side, while high frequency (volume) tends to call for an emphasis on process improvements (Table 1):

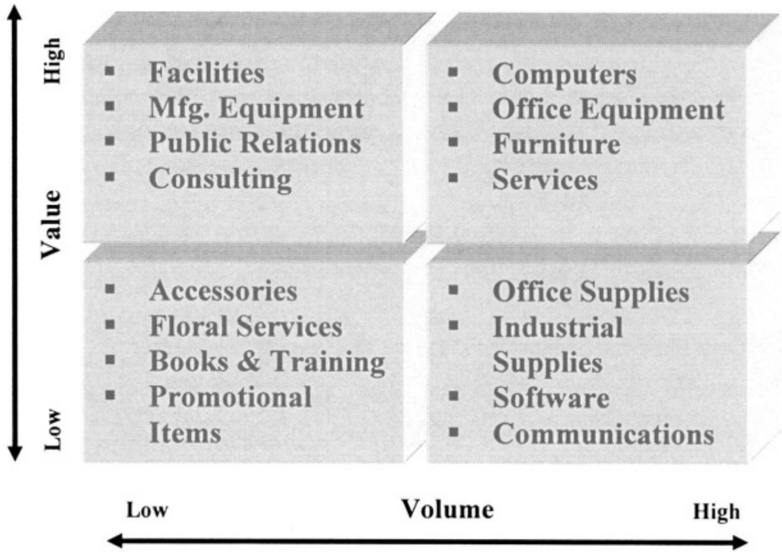

Figure 2. Buying patterns for non-production goods and services with respect to volume and value

Table 1. Project strategies for different commodity categories

Transaction	Examples	Project strategy
High value, high frequency	Computers, office equipment, furniture, services	Sweet spot for an automated procurement solution. Promises best results for a combined effort of sourcing improvement and process redesign supported by IT.
High value, low frequency	Facilities, manufacturing equipment, public relations services and consulting services	Focus on sourcing strategy to reduce product costs.
Low value, high frequency	Office supplies, industrial supplies, software, and communication services	Focus on process improvement: eliminate manual steps, and improve level of process standardization.
Low value, low frequency	Accessories, floral services, books and training services, and promotional items	Lower priority regarding process or commodity management improvement. Including this category into the electronic procurement solution nevertheless can be beneficial for motivational reasons and to provide a low-risk trial ground.

3. Supplier analysis. In parallel to standardizing its purchasing processes, Motorola's project team made an effort to streamline and globalize its supply base. For each commodity category the number of suppliers was held as small as possible. Where available (computer, office supplies), a single supplier was selected on a corporate wide, global basis. In other cases (facilities and services), national or regional suppliers were chosen. Factors to be evaluated included supplier performance in local markets, reliability, and market domination.

   Suppliers were grouped into three categories: strategic, preferred, and tactical suppliers:

   - The relationships with **strategic suppliers** are complex and mutual. In addition to buying items from these suppliers for the use in its operations, Motorola also integrates their products into the solutions that it provides to its own customers. The resulting partnerships are considered strategic because they reach beyond the mere delivery of goods and cannot easily be substituted.

   - The tier of **preferred suppliers** includes longer-term, contracted relationships, e.g., with providers of office supply. Given the relatively generic nature of the items, the relationship with these suppliers is not viewed as strategic per se. Still, a longer-term commitment is considered beneficial, as the contracts typically include a commitment to best services, delivery, price etc.

   - A fairly large number of **tactical suppliers** provide supplies ad hoc. This group might include a local hardware store providing a tool required for assembling a cellular tower "out in the field." Typically, payment is done with corporate purchasing cards. Rather than ordering an item from a contracted supplier, for convenience reasons, a more practical approach is preferred in such situations.

CATALOG MANAGEMENT

The online catalog is an essential piece of any electronic procurement solution as it provides the basic product information that enables online requisitioning by the end users. Several different options exist to set up an online catalog (see textbox below). Motorola decided to develop the online catalog under its own initiative and the commodity management team collaborated with the suppliers on how to represent the products and services that would be available to the end users. Although comparatively costly, the "do it yourself"-approach promises Motorola maximum control over its catalog content as well as regarding the purchasing information.

Catalog options:
When setting up an e-procurement solution to enable end-user requisitioning, there are different options of managing the central catalog, each with different advantages and disadvantages:

1. "Do it Yourself" – individual aggregation at the buyer side. The buying organization manages the entire catalog in line with the specifications and file format of the selected e-procurement solution (e.g., Catalog Interchange Format, CIF).

Advantages: buying organization in control (regarding updates, look & feel and user interface, ownership of purchasing data, approval rules), aggregated catalog content (e.g., searches across different catalogs are possible).

Disadvantages: catalog management efforts for the most part at the buying side (very costly/time consuming!), suppliers have to comply with CIF format (or whatever is required by the e-procurement solution).

2. Punch Out/OBI model. Catalogs hosted individually by the suppliers, can be accessed from inside the e-procurement solution

Advantages: less management effort for the buying organization, more "freedom" for the supplier (e.g., no need to comply to CIF format, individual look & feel)

Disadvantages: buying org has no control over the catalog content because catalog changes don't have to be announced by the suppliers and buying org has no easy and automated way of finding out where/when changes have occurred and approving of them. Individual catalogs are not aggregated, which means searches across different catalogs are not possible.

3. Hosted Catalog Solution. Individual multi-vendor catalogs are hosted and managed by a third party. The third party (e.g., Essential Markets) works with the suppliers to retrieve and normalize their data and presents an aggregated, customized catalog to the buying org. Suppliers submit updates and changes to the third party which runs them by the buying org before implementing them.

Advantages: buying org is presented with an aggregated view of the data, plus keeps control of the content, but without having to manage the catalog itself

Disadvantage: fees? buying org and suppliers have to manage one more vendor, immature market, sophisticated solutions not yet widely available.

Alternative: third-party aggregator model (e.g., Requisite): present buying org with individual views of a very large catalog - turned out to be expensive, as both buyers and suppliers are charged. From the buying organization's perspective this solution is possibly less beneficial than option 3 (hosted solution), because it does not offer full control and there are significant fees involved.

Besides combining the data from different suppliers into the aggregated catalog, Motorola also needed to include data from already existing systems. When the project was started, a total of about four hundred catalogs were maintained throughout the corporation. They ranged from highly functional applications on top of the legacy architectures to the utilization of supplier Web sites. The integration of existing solutions into a coherent new system and the task of getting all business units to the same level of IT-use were just as challenging from a technical perspective, as it was from a management standpoint.

Similar to many other companies, Motorola encountered a significant need to support the suppliers in their efforts to provide clean catalog data. In particular the first wave of suppliers required much “hand-holding.” The team expects these efforts to decline for future groups of suppliers as electronic commerce capability becomes more widespread and accepted standards emerge. Nevertheless, it became evident that supplier integration cannot be considered automatic.

After setting up the initial catalog, ongoing updating and management of the catalog data have to be ensured. Update cycles vary depending on a number of factors such as price dynamics of different product categories (office supplies vs. computer gear) and supplier capability. Over time, Motorola expects to turn more and more responsibility to manage the catalogs over to its suppliers, and to rely on automated update checks.

PURCHASING OPERATIONS

Besides the electronic catalog, another major component of electronic procurement systems is process automation. Based on the catalog infrastructure, a workflow system facilitates automated purchasing operations, including requisitioning, management approval, ordering, and payment (Figure 3).

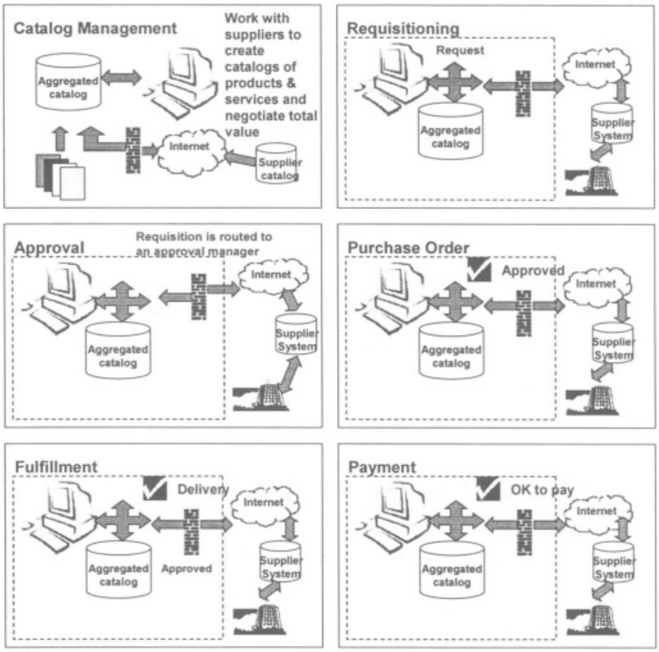

Figure 3. The e-Procurement Process

Typically, a requisition process begins with a user, virtually anyone in the company. The system enables the employee to select and order products from the aggregated catalog. In cases where an item is not included in the catalog, the user can submit a free-form request.

In addition to providing employees with a ready selection of purchasing items and thus reducing individual search costs and efforts, the project team also strives to channel more buying activities to pre-approved suppliers, and thus reduce maverick purchases, and the randomness that comes with it.

For items of frequently changing features or complex equipment that requires configuration, the approach to manage the catalog internally reaches a limit. For these cases, Motorola's project team considered a solution where the catalog is maintained at the supplier side. From within the purchasing system, requesters are routed to the supplier's website, where they configure or pick a solution, and bring this selection back into the buying process for approval (punchout/OBI-model). As pointed out above, both methods (onsite catalog management and punchout) can complement each other. The integration of different solutions is challenging, however, as it increases the complexity of the system.

Once a request for purchase is completed, it is routed automatically to the appropriate manager(s) for approval, based on a set of business rules for a particular commodity and or business unit specifics. Upon approval, a purchase order (PO) is generated and sent to the supplier. In many cases, electronic links with the supplier are in place for PO submission, including EDI, email, or other Internet methods.

In addition, a notification is sent to the accounts payable group, and possibly the receiving desk, announcing to these departments the delivery and that they can expect an invoice. In some cases, Motorola asks the supplier to provide an acknowledgement, in particular, if an item is out of stock, or other delivery performance issues are expected.

After the goods are delivered, they are marked as received, either centrally by the receiving personnel at one of Motorola's receiving docks, or by the requester on location. The receipt of delivery is subsequently sent to accounts payable for invoice matching, while the supplier is notified in cases where payment is done via electronic funds transfer (EFT).

The project team made an effort to cover as much of Motorola's purchases as possible with the electronic procurement solution. That means that in order to come to a fully automated, paperless solution, free form requests were provided for items that were not (yet) included in the central catalog.

Initially, the desktop purchasing system was run as a standalone solution and had not been integrated fully with corporate wide enterprise resource and planning (ERP) applications. The following paragraphs provide a more detailed overview of the system infrastructure.

SYSTEM ARCHITECTURE

In parallel to sketching out the ideal business process, the project team started to select a software application in December 1997. In February of 1998, a request for proposal (RFP) was issued to about a dozen companies occupying most of the market around the time. The responses to the RFP were evaluated according to functionality and their fit with Motorola's requirements, the technology that was being utilized within the solutions, and the capabilities of the vendor companies. The resulting shortlist of companies was then evaluated further based on customer references, before one vendor was selected (Ariba).

The system architecture (Figure 4) reflected Motorola's decision to standardize the procurement process throughout the corporation, and to leverage its corporate resources. The project team chose to deploy one central e-procurement system, hosted on two large Unix servers. The procurement application was integrated with two primary backend applications: human resources (HR) and accounts payable (AP).

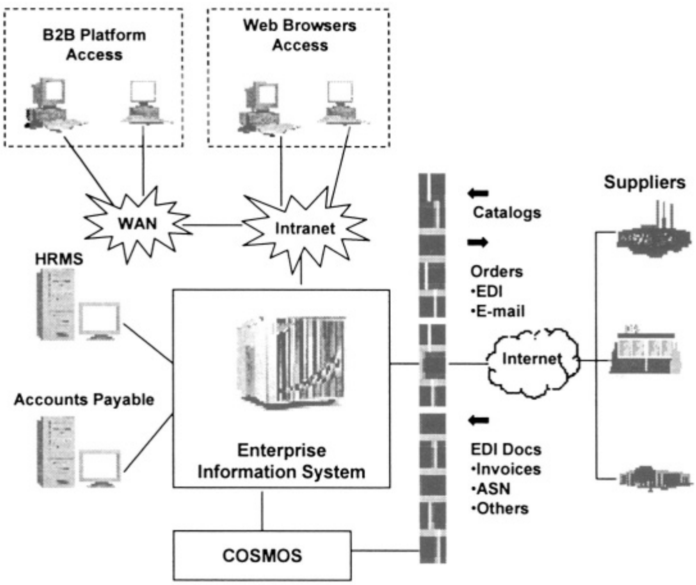

Figure 4. The Architecture of the e-Procurement System

Through an interface into the master HR system, personnel data was provided to the procurement application on a daily basis, including the individual's department number, phone number, location code, and reporting structures.

The interface with AP had to be more interactive, in comparison, and was more difficult to implement. On the one hand, accounting codes were required in the e-procurement system. On the other hand, purchasing data had to be passed to the AP system for invoice matching.

With only one instance of the procurement application worldwide, the requirements for system uptime were high, and much effort and cost was put to provide twenty-four hour availability and full back up functionality. The two central procurement servers were accessible through Motorola's intranet, and thus available to users throughout the corporation, independently from their geographical location. Access from outside the network was facilitated over a number of network connections.

In line with Motorola's vision of a corporate-wide standardized procurement process, the electronic procurement application did not allow for different process parameters and process rules for individual business units. Exceptions were implemented only in particular instances, such as in cases where legal differences between different countries had to be acknowledged.

SUPPLIER-LINKS

As with any business-to-business application, the success of an e-procurement solution depends to a great extent on the willingness of the business partners to cooperate and participate. On the one hand, suppliers provide product and process-related data. On the other hand, the ability to reach suppliers online, and to exchange purchase orders and other transaction related documents electronically, can greatly improve the benefits derived from the systems in terms of process cost and time reductions.

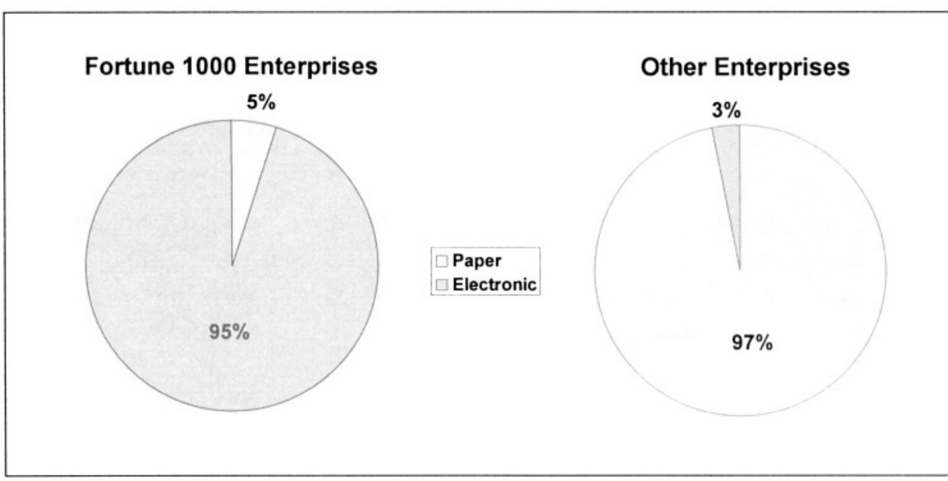

Figure 5. The Gap in EDI Adoption between Large and Small Organizations

Several possibilities exist to establish electronic links with business partners. In order to reach as many suppliers as possible electronically, in particular smaller ones, Motorola had to provide for more than the traditionally available electronic data interchange (EDI) links. EDI is often viewed as too expensive for smaller businesses without the necessary transaction volumes to offset high initial startup costs (Figure 5).

Similar to other Internet-based marketplaces and portals, Motorola put up a Web-site to serve as an interface for business partners to access their purchase orders, and then reply back with shipment notices, acknowledgements, and invoices. Named **Cosmos,** the platform aims to replace traditional paper-based interaction, including fax, as well as the need for suppliers to implement a full-grown EDI application. As this solution only requires an Internet-connection, plus access to a standard web browser, the project team hopes to have eliminated a major hurdle for suppliers to participate in the online system, and to enable a fully electronic end-to-end process. For Motorola, Cosmos allows supplier data to be fed automatically into its online procurement system.

5. CURRENT STATUS AND LESSONS LEARNED

The actual implementation of the e-procurement system at Motorola commenced in April 1999 with a pilot that included two catalogs (computers and office supplies), and a limited number of about fifty users. The pilot system was operational for orders in the U.S. shortly after a month and was soon expanded to Ireland and China, reflecting Motorola's global organization structure.

As the pilot implementation was considered successful, the project team grew the system to a total of fifteen catalogs and 4,850 users until June 2000. At the end of August 2001, 17,500 employees at 270 locations in thirteen countries used the procurement system. The total number of participating suppliers had been increased to 6,500. The aggregated catalog encompassed twenty commodity families and included 442 internally hosted catalogs with a total of 340,000 items.

The project team estimated that over 250,000 orders would be generated through the system per year, amounting to as much as $1.2 billion in transaction value, and providing the company with cost savings of $100 million.

Moving through the complete planning and implementation cycle swiftly had provided the project team with the opportunity to learn from the experiences fast, and to identify critical success factors as well as challenges for the project that could be considered in subsequent implementation cycles. Issues include management of catalog data and suppliers, flexible process engineering, data quality, interfaces with legacy systems, and cultural issues.

- **Catalog management and supplier involvement.** Both issues turned out to be very much related and critical for the entire project. The project team soon realized that it had taken too much for granted regarding the requirements to create and maintain the catalog a well as to sign up and work with the suppliers.

- **Flexible processes.** Receiving was among the processes that proved to be particularly challenging. In order to cover the various forms of receiving within the corporation, ranging from traditional manufacturing receiving to an individual purchase for a home office, and to satisfy the legal requirements at the same time, the receiving process had to be designed in a very flexible way. In particular, the handling of deliveries and payment through a central receiving dock was not sufficient.

- **Data quality.** In addition to the importance of external interfaces with suppliers to set up the catalog, the accuracy and timeliness of internal enterprise data turned out to be an issue. As part of the project, cleaning up the enterprise data proved crucial and as well as challenging due to its heterogeneous and non-integrated organization in the past.

- **Interfaces with legacy systems.** Another issue, somewhat related to the issue of data quality was the complexity of interfaces with other systems. For example, throughout the corporation, multiple accounts payable systems were being operated in the U.S., Europe, and Asia that had to be reorganized and integrated.

- **Cultural issues.** The project team had set an ambitions rollout schedule of the electronic system, according to commodity, geography, and business unit. In many cases this meant significant changes, because most of the units had been working with their own independent solution so far. In the context of the roll out, changes included a switch to the standard chart of accounts, as well as turning off systems that had been in place for a long time. In addition, tight collaboration with the local sourcing teams and purchasing experts was necessary to ensure optimal availability of all items.

The project also faced some internal resistance in particular from the mid-management levels. Assembling the local project groups and identifying a local "sponsor" was critical to ensure user adoption and to manage the resistance towards the changes. In some cases organizational adjustments had to me made to match the project objectives with management incentive structures. For example, a plant manager might resist a shift in the supply base from a regional to a national supplier, if there is a risk of performance loss as a result of this change. In cases where the plant manager is measured on the total uptime of the specific factory, such a shift will be difficult to justify, as compared to a situation where the performance is based on total supply chain cost.

6. MOVING AHEAD: THE DEVELOPMENT AND ADOPTION OF MOBILE COMMERCE TECHNOLOGY

Two years after the initial rollout of the e-procurement system and despite its impressive progress and success, the bigger part of the target user community of 50,000 employees is still out of reach for e-procurement. Consequently, the efforts continue to include new geographic areas and catalogs, in particular outside the U.S. In addition, still more efforts are necessary to decrease maverick buying, or, at least, to include more of within the electronic procurement system, and to eliminate the widespread "expense it" mindset. Corporation-internal efforts also include continuous attempts to increase the efficiency and consolidation of the different buying organizations, demonstrating once again the close inter-relationship between an IT-solution and organizational issues.

Motorola also plans on maintaining and even intensifying the close relationship with its software vendor, e.g., by utilizing the insights from implementation projects conducted elsewhere. Plans also include an increased use of online services offered on Ariba's market platform (Commerce Services Network) and a stronger shift towards the punch-out model to simplify catalog maintenance, order routing and invoicing at Motorola's end.

But there is more. Throughout the course of the project, the team identified a chance to turn a necessity into an actual business opportunity. Building upon its own core competencies, Motorola now works on the integration of e-procurement functionalities into some of its wireless products. Such a step would allow managers, for example, to perform the approval of requisitions, especially urgent ones, with a two-way pager or cell phone. The enhancement of the system with an additional way to access it will most importantly increase its availability. Further cycle time reductions and increased productivity beyond what has already been achieved with the e-procurement solution are the expected results. The project team has started to identify areas of application and we can remark that, suddenly, the task of system development to improve and automate an organizational process has been transformed into an issue of product development.

We conclude this case study with an overview of the considerations at Motorola to take the e-procurement application to the next, mobile level.

THE USE OF MOBILE TECHNOLOGY IS GROWING, BUT WHERE IS IT HEADING?

To this date, it is unclear what impact wireless technology will have on businesses processes and organizations. Although the penetration of wireless devices, including cellular phones, two-way pagers, PDA's and other handheld devices, is already quite impressive and continues to grow (see Figure 6), the number of commercial applications is still quite low, and most of the usage occurs on an individual level.

Wireless Penetration:

- An estimated 108 million mobile phones in the U S. as of the end of 2000, with another 25 million expected by the end of 2001 (source: Morgan Stanley, January 2001)
- Currently 12 million data-enabled phones available in the U S, with 112 million expected by the end of 2004 (source IDC, Phone.com, December 2000)
- 1 3 billion wireless data subscribers worldwide in next four years (source: Cahners In-Stat, September 2000)
- 18 million PDAs and mobile phones bundled with J2ME will be sold by end of calendar year 2001 (source: Sun Microsystems)
- By 2003, more than a billion cellular subscribers are expected to create a $83 billion marketplace for wireless services (source Yankee Group, February 2000)

Figure 6. Wireless Penetration

In other words, wireless devices (in particular cellular phones) are most often used for inter-personal communication, replacing a regular telephone, rather than to access information systems or to transmit data, which would be comparable to using a personal computer. A number of applications are available, though, as cellular phones and two-way pagers can be used to access stock market data and to trade assets, to check weather reports, to purchase theater tickets, or to send short messages to other phones and computers. To this date, however, and particular in the United States, the volume of data traffic over cellular devices is extremely low compared to voice traffic, and, again, for the most part concentrated on personal and consumer-oriented applications.

When it comes to business-oriented mobile applications, most organizations are still waiting for the so-called "killer-application" that would propel the use of wireless technology, similar to the way that email or the World Wide Web helped spread the Internet.

To take opportunity of technological innovations, but at the same time avoid the installation of "expensive toys", a careful match has to be performed between the requirements of a specific situation with the abilities and limits of the technology.

IDENTIFYING APPLICATION AREAS FOR MOBILE BUSINESS-TO-BUSINESS COMMERCE

Mobile devices can help increase the reach of a business application, say the procurement module within an enterprise system, as they provide an additional way of access (Figure 7). Using an Internet-enabled cellular phone or handheld device, users log into the application by using a personal ID, and then navigate through a simplified menu by using the keypad of the device (Figure 8).

Traditionally, business applications are accessed from workstations or personal computers stationed in a corporate or home office. Situations where employees are away from their desks without access to a computer or dialup connection, e.g., while traveling, typically preclude access to business applications. As a result, email-messages, notifications, and requests, e.g., to approve a purchasing requisition, are delayed until desktop access is regained. The implications in terms of cost and productivity losses can be significant and possibly ripple through larger parts of the organization. Consider the case where the purchase of a computer for a new hire is delayed because the approval manager has left for an offsite meeting and is, thus, away from his desk and out of reach. In particular in situations where an approval decision is more a matter of "being aware of a request," rather than the result of complex information processing, wireless access can be very useful to reduce cycle time and improve productivity (Figure 8).

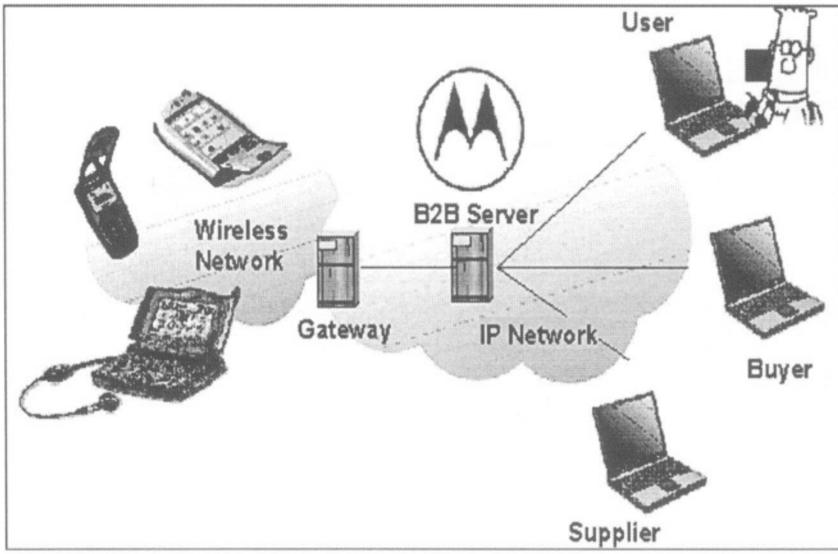

Figure 7. Infrastructure to Enable Wireless Access to Business Applications

In order to identify areas where the application of mobile technologies could enhance current business applications, two issues need to be considered in particular. First, it is important to assess the abilities and limits of the mobile devices, as they compare and relate to current electronic commerce applications. Second, the economic benefits have to be assessed and evaluated in relation with the necessary investments.

The *opportunities* provided by mobile devices, as compared to stationary computers and wired laptops include: wider reach of business applications as access is not confined to an office or desk, faster access to applications in cases where booting up a computer takes a long time, and advantages from integrating data and voice communication into one device. In addition, the simplicity of the devices and the fact that "they are not a computer," might increase acceptance where employees feel uncomfortable with using a regular desktop PC. At the same time, wireless devices are typically also cheaper than regular computers.

Limits of the technology include small screens, limited graphical functionality, and a comparatively small number of keys, all restricting the complexity of the information that can be displayed and often resulting in complicated usage procedures and deep navigation structures. Additional issues include limitations of bandwidth, of signal availability, and of on-device storage space, all restricting the amount of data that can be processed wirelessly.

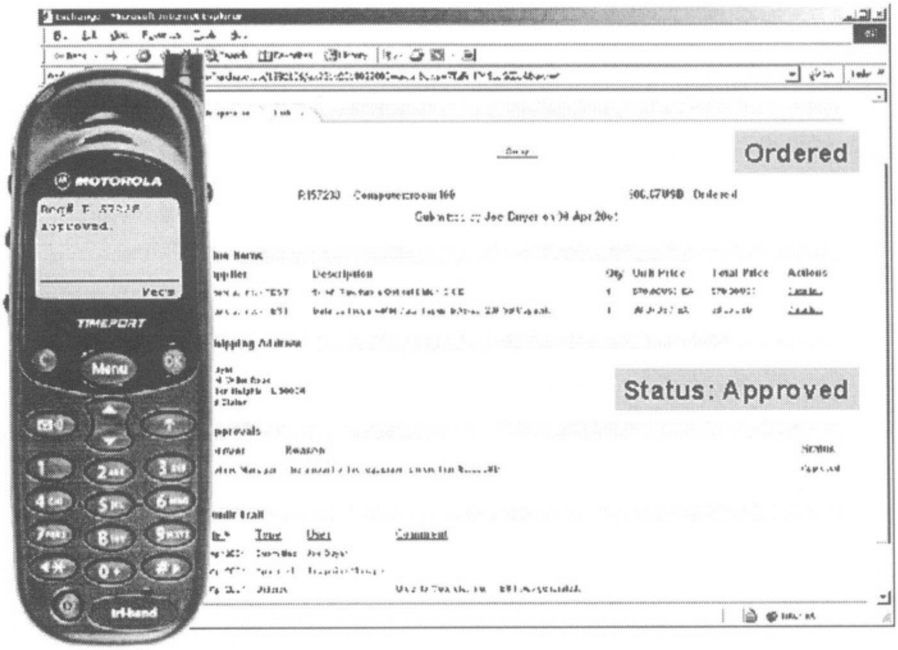

Figure 8. Extending an E-Procurement Application with Wireless Access: Approval of a Purchase Requisition

Taking into consideration the characteristics of wireless technology, Motorola identified three main *areas of application* in the context of its non-production procurement process: creation of requisitions, requisition approval, and status checks of requisitions.

All of these sub-processes are sufficiently simple and easy to perform, and often triggered by an alert or notification (read: urgent). In a next step, the team needs to perform an economic evaluation. Questions include: How many requests are delayed because a manager is traveling? What are the implications in terms of productivity losses and increased cycle time? How often do users circumvent the system in cases where they need items urgently but do not have system access? What are the cost implications of such maverick buys? How often are managers out of the office? What are the consequences on user satisfaction and system perception if users cannot easily obtain information on order status and delivery information?

After answering these questions, and quantifying the benefits, a thorough assessment of the costs required to implement the enabling infrastructure (Figure 7) would result in a sound estimate of the overall benefits and help to further improve the benefits derived from the e-procurement application. At this point, the team is promoting the new concept to the current users of the electronic procurement system and conducting trial studies to verify the expected benefits as well as to gauge user acceptance.

One of the things that can be learned from this case study when comparing it to reports of similar implementations elsewhere is that many of the benefits of an e-procurement solution are not unique to the particular situation of a company, and neither are the problems and issues. Motorola's case also demonstrates the value of an integrated approach – linking emerging technologies with the requirements of modern business strategies and processes.

Chapter 8

Supply-Chain Partnership between P&G and Wal-Mart

Michael Grean and Michael J. Shaw

Abstract: This paper describes the development of channel partnership between a manufacturer (Procter and Gamble, or P&G) and a retailer (Wal-Mart). Both major players in their industries, P&G and Wal-Mart found a way to leverage on information technology by sharing data across their mutual supply chains. The resulting channel has become more efficient because channel activities are better coordinated. There are reduced needs for inventories but greater returns by focusing on selling what the customers want. All in all, the supply chain between P&G and Wal-Mart has adopted a much better customer focus through the channel partnership. And it is *mutually* beneficial. This integration of the supply-chain information systems will become increasingly important both for enhancing business-to-business electronic commerce and for supporting the increasing volume and customization in business-to-consumer electronic commerce.

Key words: Integrated Supply Chains, Information Sharing, CRP, Channel Partnership

1. INTRODUCTION

One of the major transformations in the rapidly evolving digital economy occurs in the supply chains of both traditional and e-commerce companies. Information technology has enabled channel partners to trade goods, share information, and integrate their processes, thereby reshaping the inter-organizational dynamics and resulting in more efficient channels. Electronic integration of data and the automation of business practices has driven costs down and built sales by satisfying consumer needs.

This paper describes the development of channel partnership between a manufacturer (Procter and Gamble, or P&G) and a retailer (Wal-Mart). Both major players in their industries, P&G and Wal-Mart found a way to leverage on information technology by sharing data across their mutual supply chains (Figure 1). The resulting channel has become more efficient because channel activities are better coordinated. There are reduced needs for inventories but greater returns by focusing on selling what the customers want. All in all, the supply chain between P&G and Wal-Mart has adopted a much better customer focus through the channel partnership. And it is *mutually* beneficial.

The power of inter-organizational information systems (IOIS) is well know in the literature of information systems research. It has proven to be an effective strategic weapon. But the P&G and Wal-Mart partnership does further. To understand the impact fully, one has to think about three progressive degrees of IOIS: transactional, operational, and strategic. The strategic partnership is the most involved, with the greatest commitments from the partners and requiring the strongest trust. In this paper we will describe how P&G and Wal-Mart developed this partnership, the main initiatives adopted in the process, and how the two companies, who are at the same time competitors and partners, created values from the partnership.

In retrospect, there is a strong logic associated with how P&G and Wal-Mart created values for both through the channel partnership. That is what we would like to describe in this paper so the lessons involved can be learned and the success story can be duplicated. Yet, as described in this paper, the two companies essentially stumbled into it and then progressively built stronger collaboration as more benefits were unleashed. The partnership started with the simple desire to improve business relationships, and was gradually enhanced by sharing information and knowledge about their respective markets. This sharing in turn enabled more effective execution of such concepts as category management and continuous replenishment, which helped make the supply chain more efficient.

The remainder of the paper is organized as the following. Section 2 presents the business background behind how the two companies started building the partnership. Section 3 discusses how P&G and Wal-Mart built channel partnership and information sharing. In Sections 4, 5 and 6, the details of how the two companies implemented information sharing, continuous replenishment, and category management are discussed. Section 7 further describes the potential of using data mining to develop decision support applications from the shared data. Section 8 discusses the logic of using information technology to build channel partnership. Finally, Section 9 concludes the paper.

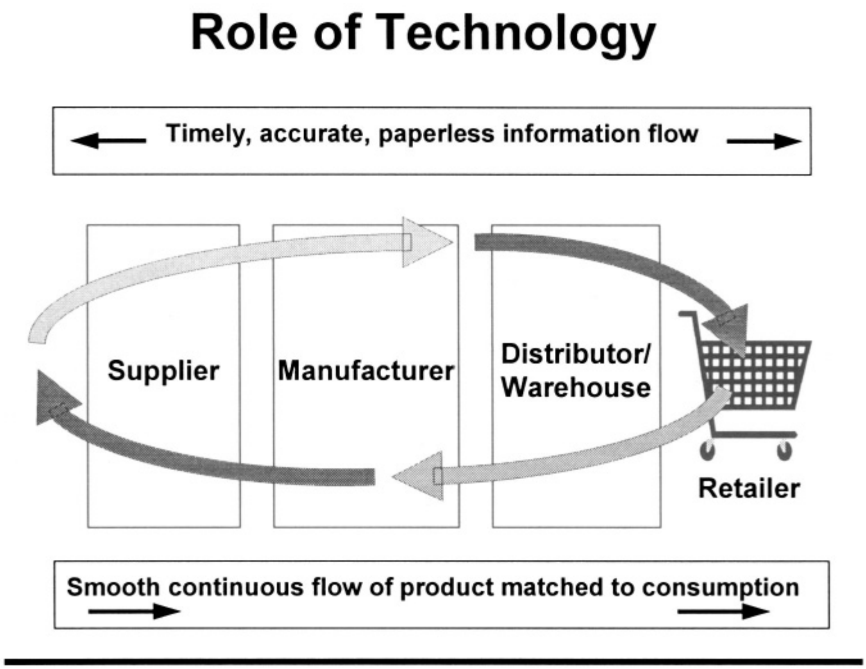

Figure 1. Role of Information Technology in Supply-Chain Integration

2. BUSINESS BACKGROUND

To fully comprehend the role that technology has played in the Procter & Gamble and Wal-Mart business relationship, an understanding of the business relationship prior to 1988 is needed. The business situation in 1988 between P&G and Wal-Mart was broken. The business itself was $375 million and growing. In spite of this, the business relationship between the two companies was poor. P & G had organized itself into 12 different internal product divisions. Each division had different sales managers that would separately and independently call on Wal-Mart. These individuals were accountable for the sales results of each division and never came together to represent P&G as a whole.

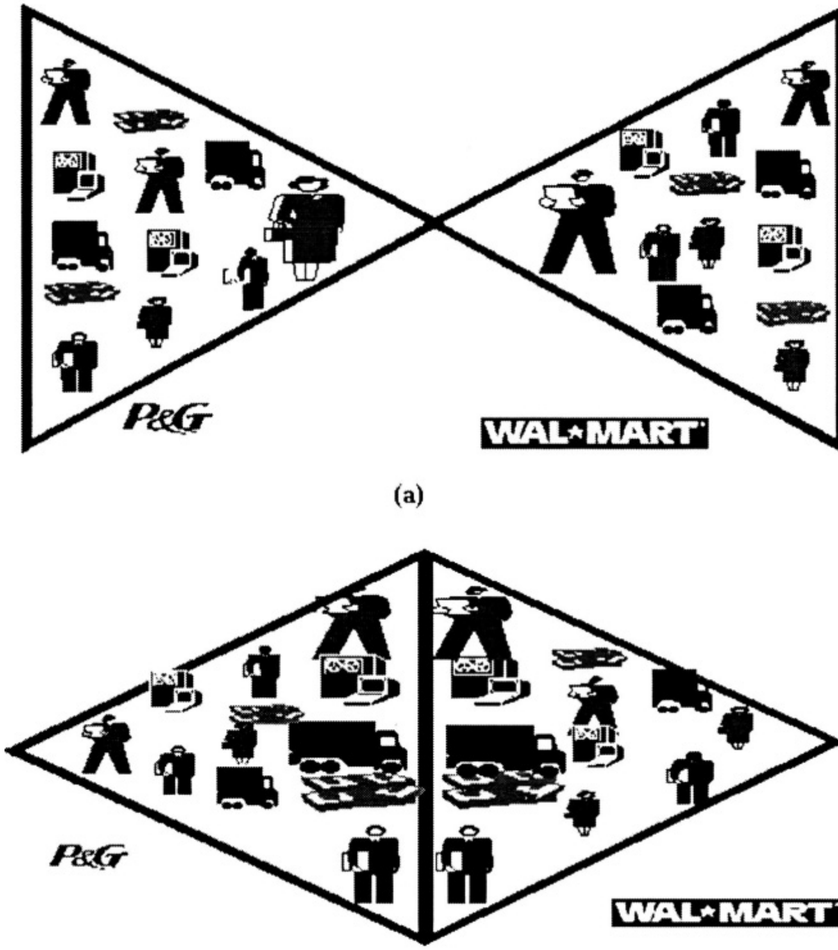

Figure 2. Working Relationship between P&G and Wal-Mart (a) before the Channel Partnership and (b) the Relationship Today.

At that time, the relationship between P&G and Wal-Mart was characterized as anything but collaborative. As a matter of fact, their relationship was adversarial, obsessed by day-to-day transactions. Furthermore, their business relationship was conducted through fragmented processes. The details of these problems are described as follows:

1. Adversarial relationship. Wal-Mart did not like doing business with P&G. P&G organizations were too complicated and inflexible.

2. Transactional focus. P&G were obsessed by day by day selling, in which success was that you got the order today - failure was that you did not. Efforts were made to push for sales irrespective of what the customer needed, or was rewarded for. There were no testing or long term planning.

3. Fragmented processes. Relationship and activities were managed by the buying and selling function only. The selling function within P&G was responsible for all customer activity. They were responsible for selling at the customer. The role that information systems played in the relationship was non-existent. The IT group typically got involved only after phone calls down the chain informed us that a technology project such as Electronic Data Interchange (EDI) was requested by the customer.

In 1985, Sam Walton called Procter and Gamble's CEO to inform him that Wal-Mart had awarded P&G their prestigious "Vendor of the Year" Award. The sales organization dealt with customers and Mr. Sam's call to the corporate office resulted in him being transferred 5-6 times. Having never reached P&G's CEO, Mr. Walton decided to give the award to another vendor.

P&G began to re-think the way it approached its customers about the same time. Our newly appointed Vice - President of Sales met with Sam Walton and discussed the P&G / Wal-Mart relationship. Sam indicated that it was a shame that two quality companies could not work together effectively. He shared that we had an extremely overcomplicated and inflexible sales organization. He stated if we thought of Wal-Mart stores as an extension of the P&G company, we would treat Wal-Mart differently. This challenge became the rallying cry for our two companies. Figure 2 describes the relationship between the two companies before and after the partnership. Today, as depicted in Figure 2 (b), the two organizations collaborate on all levels in all business functions.

Great strides have been made since the 1988 start-up of the P&G dedicated Wal-Mart team. We have grown our joint businesses from $375 Million in 1988 to over $4 Billion dollars today. Moreover, P&G and Wal-Mart have improved the profitability of both companies by using multifunctional resources to drive out costs and improve sales. We use joint scorecards to review our business and make annual plans to drive category growth for both companies. We use technology as a method to drive out costs, and openly share data to better understand our joint customer - the consumer. The P&G and Wal-Mart Team Mission Statement States: "*The mission of the Wal-Mart/P&G Business team is to achieve the long-term business objectives of both companies by building a total system partnership that leads our respective companies and industries to better serve our mutual customer - the consumer.*

Technology has played a key role with Wal-Mart in three areas:

1. Joint scorecards and measurements
2. Driving out costs through automation
3. Sharing data to better understand the consumer and drive sales

3. CHANNEL COLLABORATION AND INFORMATION PARTNERSHIP

P&G's Corporate Reporting System was developed based on the market and geographic structure used by the 12 product divisions. All sales reports were designed so P&G could track the amount of product (e.g., laundry detergent) sold in the Western part of the country, however, they did not have a system capable of reporting total product sales by customer. A system needed to be developed to track sales by customer. Once this system was developed tracking sales by customer was possible. P&G's shipment data proved helpful in understanding how much business was sold to Wal-Mart. Some of the questions Wal-Mart had were: (1) How much of the product was sold at stores last year? (2) How many customers bought P&G products? (3) What was the profitability of these products for both P&G and Wal-Mart? These were real questions that needed to be answered. The infrastructure that was needed to link P&G's data with Wal-Mart's data proved to be a critical step in understanding the consumer's needs. Wal-Mart was just coming online with a new data warehouse that allowed them to track sales of all products in each of their stores. P&G and Wal-Mart jointly developed a data highway that linked P&G data to Wal-Mart data driving down costs and sharing information to meet the consumer's needs.

The data highway concept (Figure 3) was straightforward, Wal-Mart had scanners in all of their stores to track, measure and analyze their business. Wal-Mart collected its own data then analyzed the results. P&G also had data about the consumer which was used to make product decisions. Why did she/he prefer a certain product or go to a certain store to buy diapers for her/his children? These insights from P&G about the consumer were combined with information regarding what was happening inside the store from Wal-Mart thus creating an information data highway.

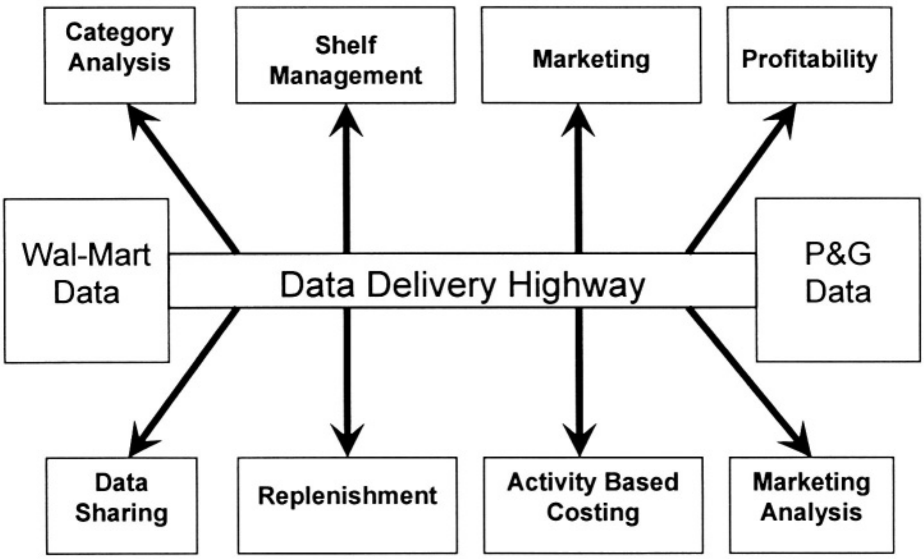

Figure 3. The Data Highway for the Manufacturing/Retailing Integration

These linkages allowed P&G to build "exit ramps" to support applications such as joint business scorecards, replenishment, EDI, customer table checking and category management. Each of these will be explained later.

JOINT BUSINESS SCORECARD

A joint common scorecard was developed that reported, as described in Figure 4: the sale of P&G products at Wal-Mart, margin and profit results, inventory turns, and other financial and logistics measurements. The integration of P&G and Wal-Mart data played a key role in delivering these scorecards. This common "language" allowed the partnership to focus on the end consumer and used combined data to measure joint progress.

Wal-Mart - Procter & Gamble U.S. Business
1998-99 Scorecard

Wal-Mart Fiscal Years - $ Millions

	Wal-Mart FYs		
	96/97	97/98	Index
Retail Sales (W-M POS Data) Wal-Mart Stores			
Gross Margin % (W-M POS Data) Wal-Mart, Inc.			
Inventory Management (Wal-Mart Stores) Store Inventory DOH Total DOH Service Levels (% Fill) In Stock Level On-Time Delivery to Whse			
Financial PO/Invoice Match Rate Deduction Rolling Balance Past Due Invoice Payment Rolling Balance Customer Pick-Up Revenue			

Figure 4. Wal-Mart Procter and Gamble 1998-99 Scorecard

DRIVING OUT COSTS THROUGH AUTOMATION

Leveraging technology to drive costs out of the supply system is another important aspect of the information systems function. The delivery of products to the end consumer involves a series of steps including raw material delivery, conversion to a finished product, transportation to a distributor or customer distribution center, transportation to the store and placement on the store shelf. The degree to which all parties involved can drive costs out of these systems result in corresponding savings that can be passed on to the consumer in the form of lower product costs.

In order to drive down costs product information is needed to move from the retailer back through the supply system. As better consumer data flowed back from the consumer to the raw material supplier, better forecasts could be anticipated and the right material put in place for finished product manufacturing.

4. INFORMATION SHARING AND CONTINUOUS REPLENISHMENT

An important strategy for managing integrated supply chains is to share information among supply-chain partners. One of the main benefits of sharing information is the reduced need for inventory. As a result, the supply chain achieves better performance in terms of financial returns, service level, and turn-around times.

With information shared among the manufacturer and the retailer, the manufacturer can use the information about the inventory level of the retailer to manage the frequency, quantity, and timing of the shipments-- instead of waiting for the retailer to place orders. This practice, referred to as continuous replenishment process (CRP), enables the manufacturer to reduce the inventory necessary and to plan the shipments more efficiently, as has been implemented by P&G and Wal-Mart.

P&G replenished Wal-Mart's inventory based on inventory data received from Wal-Mart's distribution center. This data allowed P&G to manage the inventory levels to insure that P&G products were in stock at all times. P&G used their information data highway to fundamentally change the replenishment process by linking Wal-Mart's inventory data at their distribution centers and P&G's replenished inventory based on movement of product through their DC's. P&G reduced the order cycle time (amount of time from the order generation to delivery) by 3-4 days. This process also dramatically increased inventory turns which resulted in a reduction in the inventory of the entire system.

One way to explain the benefits of information sharing andCRP is from the perspective of the so-called "bull whip effect," that is, the small fluctuation of demands tend to be progressively amplified when moved up the supply chains. There are many reasons behind this phenomenon in a multi-stage supply chain, such as the use of safety stock at each stage, the varying batch sizes, ordering frequency, and lead-times, and irregular behaviors like forward buying. In Figure 5 (a), for example, the real demand as reflected by the POS data is relatively flat, but the inventory level at the warehouse becomes very fluctuating because of such factors as batching and order lead-times.

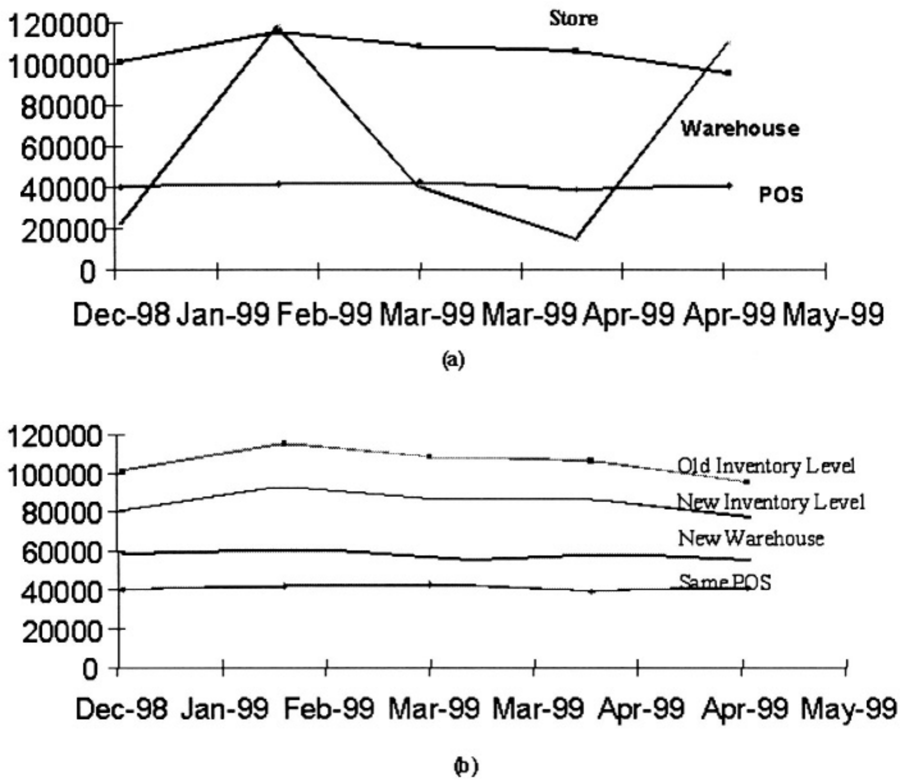

Figure 5. Inventory Levels without (a) and with Information Sharing (b).

For the same POS data, when CRP was implemented by sharing the demand data with the manufacturer, i.e., P&G, the performance is greatly improved (as shown in Figure 5 (b)). Instead of the highly fluctuating inventory level used by the warehouse in Figure 5 (a), the warehouse inventory is much reduced. Moreover, the inventory level for the retailer is also reduced. This is due to the reduced uncertainties and shorter lead-times when CRP is used. P&G executes continuous replenishment by three pieces of information: (1) actual warehouse on-hand quantity, (2) actual warehouse on-order quantity, (3) projected sales demand from the stores.

CRP has become a common practice in te retailing industry. Wal-Mart, for example, has demanded it suppliers to implement CRP. However, underlying the implementation of CRP as well as sharing information is the mutual trust among the partners. Also involved in the equation of information partnership is the bargaining power. Because of the possession of demand data and the customer information, the retailers increasingly have the bargaining power. As a result, they can demand their suppliers to implement CRP, thereby freeing them from having to place orders. Other than sharing the demand information, supply-chain partners have started to share other types of information as well.

5. ADDITIONAL BENEFITS OF INFORMATION SHARING

The role of technology was to link the supply chain by using industry standards Electronic Data Interchange (EDI) to communicate key business documents. Purchase orders, invoices, advanced shipment notification, and financial payment are just a few examples the electronic transmission of EDI. It was critical that EDI not be used to automate poor business practices. It was imperative that we streamline the business "handoffs" then use automation to drive the process. To understand the value of simplifying the business process then applying technology, the business situation below provides a concrete example.

By 1990, P&G's business relationship with Wal-Mart was headed in a positive direction. Joint sales were up, standard scorecards to track the business, and both companies were proud of the progress of the partnership. However, there continued to be issues in the area of accounts payable/receivable.

For example, P&G had developed a billing accuracy system that was used to measure how accurate P&G's invoices were against Wal-Mart's purchase orders. P&G felt that Wal-Mart's accuracy was very good, exceeding 95%. During a meeting to discuss vendor performance, the accounts payable manager of Wal-Mart stated that P&G was one of their worst vendors with the lowest purchase order to invoice match rate. Of the purchase orders sent to Wal-Mart, 15% matched invoices. Something was wrong. All purchase orders were via EDI as were all invoices. If the invoices matched, they would be paid automatically. If they did not match, both companies manually handled them. P&G believed that 95% of the invoices were accurate, Wal-Mart believed it was 15% and deductions were at an all time high.

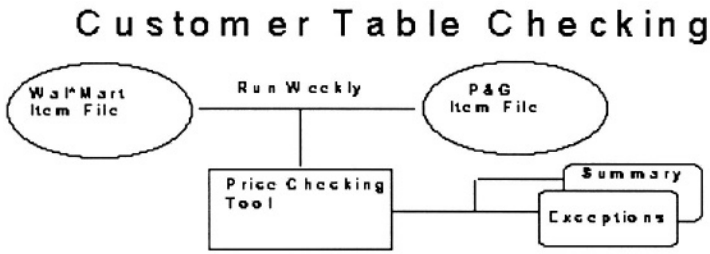

Figure 6. Customer Table Checking

To address this problem P&G placed a person from their customer service organization into Wal-Mart's accounts payable group. The person's responsibility was to track each purchase order/invoice combination and attempt to identify the problem. After a 3-week assessment, P&G found that they had different definitions of billing accuracy. P&G defined billing accuracy as being billed for a certain number of cases that were shipped to Wal-Mart. However, Wal-Mart defined billing accuracy as both the number of cases <u>*and*</u> the dollar amount of each case. For example, if P&G had a box of detergent for $25 in their item file while Wal-Mart had the same product for $25.05, the invoice sent did not match the purchase order! P&G also discovered that most purchase orders and invoices that did not match were due to different prices in the Wal-Mart and P&G system. The automation through EDI only moved bad data faster and resulted in re-working both systems. The cost of the mismatch was calculated at $50 per occurrence.

Technology played a role in identifying and correcting pricing errors. A tool was built called the Customer Table Checking Tool (Figure 6). Every Monday morning before any purchase orders were created, P&G linked into Wal-Mart's item file of P&G products and compared them to the pricing and product specifications in P&G's item file. If any of the items did not match, they were flagged as an exception and electronically corrected.

As a result, P&G's purchase order-invoice match rate went from 15% to 95%. This new system has resulted in P&G moving from one of Wal-Mart's worst vendors to one of the best. The customer service organization insured the data in both systems would be correct and EDI was used to drive down costs and improve the order cycle time. This tool has been used with P&G customers worldwide.

6. CATEGORY MANAGEMENT

Finally, using the design technology of data sharing allowed P&G and Wal-Mart's partnership to make better consumer based decisions. The key decisions made by the retailers include:

- What are you going to buy?
- Where are you going to put it (shelf location)?
- How are you going to price it?
- When should it be promoted?

Key questions for retailers can be answered by integrating data from

- Manufacturers' market data
- Retailers' internal point-of-sale systems and
- Third party market data providers such as Nielsen or IRI.

Retailers point of sale data show the results of consumer's choices thus providing the truth. It provides the platform resulting in information on what is selling and the selling price. It does not explain why nor does it provide insights into the market dynamics. In contrast, manufacturer's consumer data is helpful to understand why a product is being purchased. *P&G is a research and development company first.* Consumer needs are studied, products are then developed and manufactured to meet those needs. P&G studies consumer trends and understanding these trends provide insights that the retailer itself does not have. Finally, Third Party data providers help explain the market dynamics of a product. It provides insight into consumer trends and provides a perspective on growing consumer needs. Should a retailer be pleased with a 10% increase in sales vs. last year on a particular category? If his competition is indexing at 5% the answer is yes, if the competition is indexing an increase at 18% then the buyer is losing share in a growing category. This information is valuable in determining the markets key items not carried in their stores.

The key is the *integration* of these three data sources for making decisions, as shown in Figure 7. A joint manufacturer/retailer workstation should be used to share common data scorecards and allow for quick analysis by all parties.

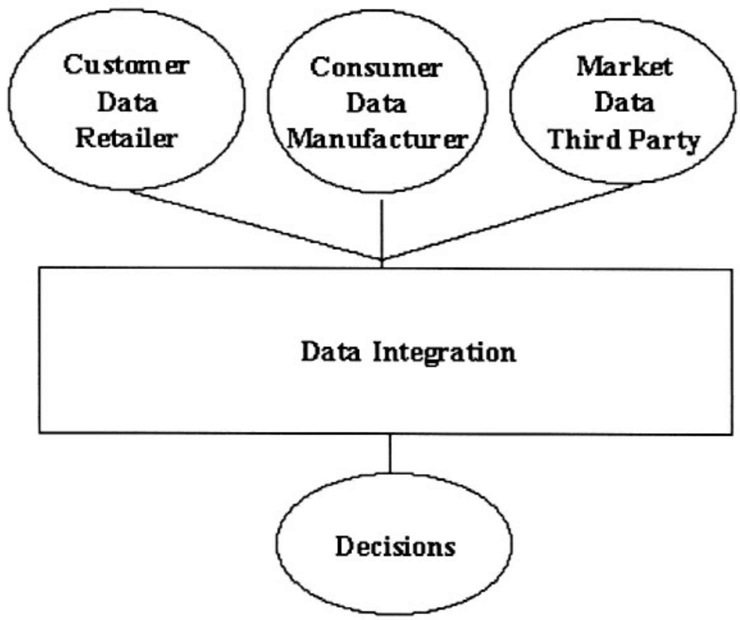

Figure 7. Category Management

Each business application between a manufacturer and a retailer should be agreed upon early if it is proprietary between the two companies or if it can be shared with other customers/suppliers. Wal-Mart, for example, now has a strategy to share data with their vendor partners. A tool has been developed called "Retail Link" that links Wal-Mart's data with their key vendor partners and carriers. P&G has re-applied their customer replenishment systems and the Customer Table Checking Tool to other customers. It is critical for both companies to come to a common point of view on the expansion of these systems. Ideally, most of the electronic linkages between manufacturers and retailers will be similar to the EDI standards that are in place today.

Wal-Mart has in its possession customer data that is greater in volume than the database of Internal Revenue Service (the federal government's tax agency of the United States). When this vast of data is shared, what is in great need is to use data mining techniques to develop actionable decision rules. For instance, simply by eliminating losers from the shelf and add more winners, the two companies can both be better off. For example, after a study of the sales data, P&G recommended to Wal-Mark to eliminate 56 items that were not sold well based on Wal-Mart's POS data. What is more, using its market data, P&G also recommended 25 products that were market winners. This simple decision based on data shared among the two companies increased the sales by 32.5%.

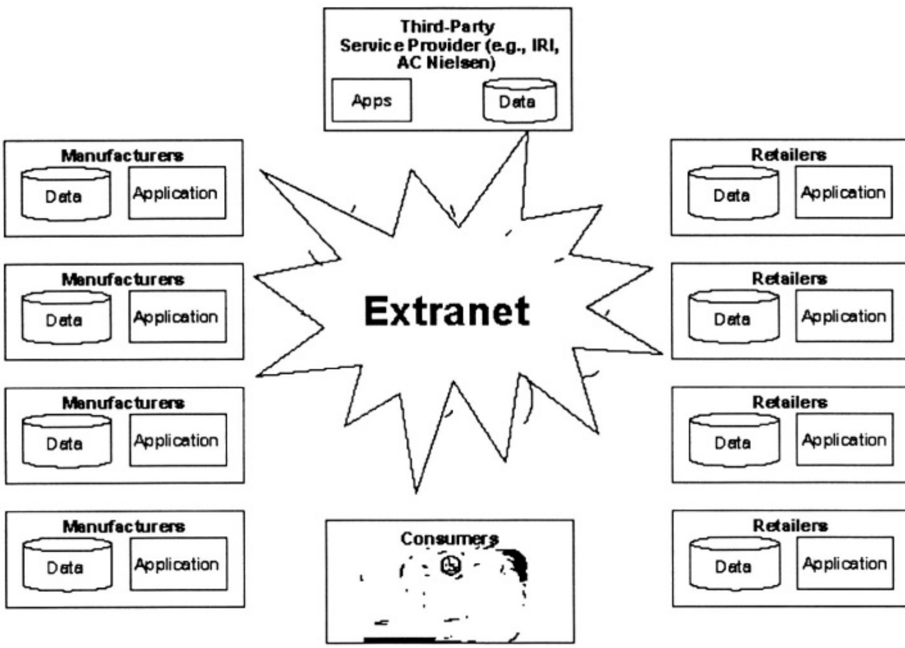

Figure 8. The Use of Extranet in the Supply Chain

Technology continues to play a role between manufacturers and suppliers. On the supply side, we have moved from EDI purchase orders and invoices to looking at *Collaborative Planning Forecasting and Replenishment* (CPFR). This industry model provides a platform for the collaboration of a joint forecast between manufacturers and suppliers that will ultimately drive the replenishment process through the entire supply chain. This may eventually lead to the elimination of purchase orders and invoices as we know them today.

Second, watch for industry standard approaches to share the demand side data similar to the standards we have in place today for EDI. Developing an Industry based approach for sharing point of sale data, market data, and consumer data for joint decision making will be a key to success. In addition, driving key third party data providers such as Nielson and IRI to provide quality data in agreed to Industry standard hierarchies will lead to better integration between joint buyer/seller workstations. The Internet will provide the technical platform to exchange information between manufacturers, retailers and third party data providers.

7. SUMMARY

Looking back over the ten-year period between Wal-Mart and P&G, information technology has created a common language, driven down costs, and provided an avenue for increased sales for the P&G and Wal-Mart partnership. Several key lessons learned are summarized in the following for understanding the role that Information Technology can play in the manufacturer/supplier relationship:

1. <u>Use Information Technology Resources</u>: Information Technology (IT) resources can play a big role in the business. IT can provide technology solutions to link suppliers and retailers. Ensure proper staffing of these resources to drive volume and reduce cost.

2. <u>Teach them the business</u>: Take time to train your IT about the business. The days of the business ignorant programmers are fading. When first brought in to the P&G team I was an Information Technology Manager, now, as a Business Manager I use technology to drive sales and reduce costs through technology.

3. <u>Focus on the consumer</u>: Use data and technology to better understand the consumer's needs. When a debate about approaches occur, ask yourself the question "What is right for the consumer, what are her/his needs?". This will help you approach the problem differently.

4. <u>Data can be information</u>: Retailer data is typically used for quick decision support, P&G data is used for analytic decision support. When merged, this data create tremendous gains for both companies. Information Technology can also be used to sift through large amounts of data and provide exceptions or out of range business parameters. Using IT to identify key outages such as low sales on a fast moving item, out of stock on a key sku etc, will provide powerful business solutions for both companies.

5. <u>Employ Industry standards</u>: Driving towards common methods of communicating business transactions and data sharing reduces cost for the entire supply chain. Just as we have standardized logistics such as pallet size, truck dimensions from a supply chain perspective, automating

business transactions will also drive down costs of the manufacturer/supplier relationship.

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Chapter 9

From the User Interface to the Consumer Interface

Melissa Cole, Robert M. O'Keefe, and Haytham Siala

Abstract: Business success requires that advances in technology be designed and applied within a human context. Too often technological advance has occurred without reference to human behaviour. While research appreciates that electronic consumers are computer users, and vice-versa, few understand exactly how this is transforming consumer behaviour. In other words, technological imagination has surpassed our knowledge of media-based consumer behaviour. This paper seeks to re-dress the balance of understanding. By (i) integrating themes in human-computer interaction (HCI) with consumer behaviour models and (ii) placing the results within a framework of relevant research issues, we present the conceptual foundations for a consumer interface.

Key words: Consumer Behaviour, Human Computer Interaction, Culturability

1. INTRODUCTION

Commercial and personal use of the Web has been increasing at an exponential rate. Revenues generated from on-line sales are expected to tip the billion-dollar scale by the turn of this century (Lohse & Spiller, 1998). Such prospects have led to the on-line application of consumer models drawn from the physical world (Wigand & Benjamin, 1998; Lohse & Spiller, 1998; Tenenbaum, 1998; Elofson & Robinson, 1998; Hoffman et al., 1995; Kannan et al., 1998; Palmer & Griffith, 1998). Typically, the focus has been to apply innovative sales and marketing techniques to cyberspace. Recently, research has noted the changing nature of commerce conducted in cyberspace, though generally from a supplier's perspective. The purchasing element of commerce - the consumers - has been largely neglected from the e-commerce agenda. Little substantial and systematic research has been conducted to understand how consumers' behaviour and associated shopping trends change in the milieu of electronic commerce.

This paper will attempt to highlight the critical factors in electronic consumer behaviour which enable existing, and potential, electronic traders to better develop their strategic plans and leverage their core activities *from a consumer perspective.* Consequently, this paper seeks to investigate how the multi-dimensional aspects inherent in traditional consumers' purchasing behaviour change in the context of electronic commerce.

The first part of the paper briefly discusses three simple consumer models: consumer behaviour, consumer decision making, and the behavioural perspective. We then discuss Human Computer Interaction (HCI) research that has looked at the Web as an interface, including some empirical work. We then seek to identify common elements between these two diverse theory's as the basis of a new consumer interface model, highlighting areas required for further investigation.

2. CONSUMER BEHAVIOUR

Wells and Prensky (1997) define consumer behaviour as the "study of consumers as they exchange something of value for a product or service that satisfies their needs." Products can be either tangible (food, beverages, cars, etc.) or intangible (talkshows, films, travelling, etc). Consumer behaviour commences from the awareness of a want, through to the search and evaluation of possible means of satisfying it, the act of purchase itself, and terminates at the post-purchase evaluation process of the purchased item (Alba et al., 1991). Post evaluation is an influential factor in re-purchase decisions (possibly mediated by the feedback process) and largely depends on a consumer's utilitarian/arbitrary judgement of the product.

Clearly there are two interdependent aspects of consumer behaviour that need to be appreciated when designing and applying new technological applications for dual use and consumption. First, the consumer purchase process (Figure 1) and second, the background characteristics which influence those purchasing activities (Figure 2).

2.1 Steps in Consumer Purchase Process

Although designed for the physical world, Wells & Prensky's (1996) model is equally applicable in the world of electronic media. It has been used to conceptualise Web-based marketing in business-to-business environments (O'Keefe & Machearn, 1998).

- *Need recognition.* Consumers must be made aware of their potential needs. Advertising (including banner ads), word of mouth and journalism all play large roles in this process.

- *Searchfor alternatives.* Internal searches invoke personal prior experience of a product. External searches in the pursuit of additional information are performed when purchasing an unfamiliar product. Sources include word of mouth (friends and family, reference groups and Usenet discussion groups), and reading material (consumer magazines and consumer reports).

- *Evaluation ofalternatives.* A unique set of criteria based on individual needs and wants is created. Each alternative is ranked and different weights are assigned according to desired product attributes.

- *Purchase decision and use ofthe product.* Actively making the purchase.

- *Evaluation ofthe consumption experience.* The judgement of a product based on its complete consumption. After sales care has a disproportionate influence at this stage and is a critical factor in product differentiation.

2.2 Consumer Background Characteristics

These characteristics describe consumer's tastes, preferences and utility. These intrinsic elements are associated with each consumer and cannot be easily altered. Amongst the many characteristics noted culture, values and reference groups are critical factors for electronic traders.

Culture and values. Culture is the character of a society that distinguishes it from other cultures. Generally defined within geographical boundaries, and represented by symbols such as national flags, culture refers to the set of values, ideas, attitudes and views held by homogeneous members of a society who together determine appropriate behaviour.

Subconsciously held, its influence on consumer perceptions and decision-making cannot be overstated. Kallman & Grillo (1996) note, however, that ethical principles overpower the perfunctory use of intuition and culturally-induced personal preferences when making decisions.

Reference groups are a consumer's panel, consisting of a set of people that impose the predetermined cultural values, attitudes, and behaviour upon their group members. Affinity groups have a strong influence on an individual's beliefs, evaluations and purchase decision processes. Reference groups may be based on family, friends, colleagues or role models. Opinion leaders are the influential members of a reference group to whom other members turn to for advice. Howard (1994) notes that homophilous opinion leaders (same age, sex, education, and social status) enhance positive attitudes in other members.

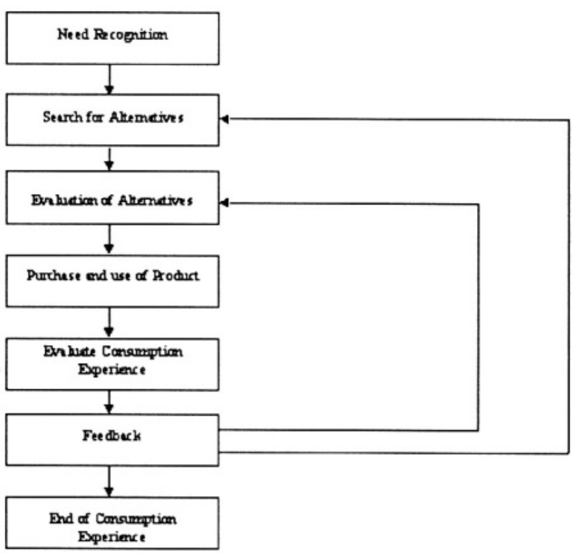

Figure 1. Steps in the consumer purchase process (Wells & Prensky 1996).

Of special interest is the relationship between reference groups and *the type of purchasing decisions* (high/low involvement) made by individual consumers (Bearden & Etzel, 1982). Involvement decisions refer to the level of cognitive effort the consumer is willing to invest when searching for product information. The greater the perceived risk (functional, financial, social and psychological) inherent in the purchase, the higher the involvement and the greater the effort in searching for information and evaluating alternatives. As Figure 3 illustrates, the stronger the brand image and the more the product is perceived as a luxury, the greater the degree of influence exerted by the reference group on shaping an individual's purchasing process.

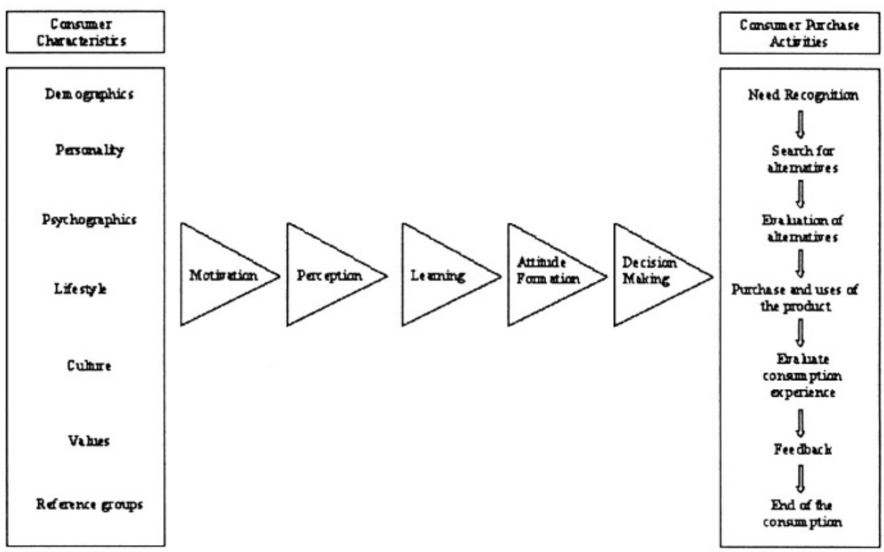

Figure 2. The impact of consumer background characteristics and behavioural processes on consumer purchase activities (Wells & Prensky, 1996).

Levels of risk can be reduced either directly via information, or indirectly, via (a) brand loyalty creating advance purchase trust in a product or (b) word of mouth (i.e., reference groups). Of note, therefore, is the development of *virtual reference groups.* Newsgroups and other electronic chatrooms on the Internet have enabled geographically dispersed individuals with identical consumer backgrounds (demographic and lifestyle) to form virtual reference groups whose members can share ideas and opinions online with others, anytime and anywhere in the world. Thus, operations such as AOL, and Web sites such as Theglobe.com, provide a hierarchy of reference groups from their entire membership down to specific chat rooms or mailing lists that congregate around specific topics.

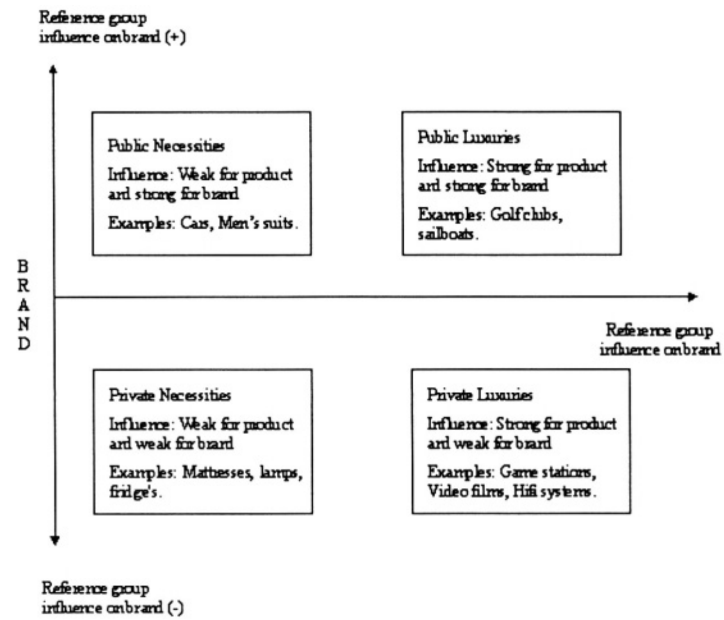

Figure 3. Effects of reference groups on product and brand purchase (Bearden & Etzel, 1982).

2.3 Cognitive Effort and the Consumer Decision Model

It is important to understand the relationship between the degree of cognitive effort required/used and consumer decision making. Consumer decision-making is classified into three cognitive levels: (1) extensive, (2) limited and (3) routine (see Figure 4 and Figure 5).

At the EPS stage, consumers are not familiar with a new product category, and so they increase their efforts searching for information about the product to form a concept (brand image) about it. Consumers then produce a set of criteria to judge the product's benefits and to identify to which category it belongs. For example, when consumers first encountered 'instant coffee' they associated it to the coffee category. They then began to distinguish it from regular coffee using particular criteria's such as *convenience* and *taste*, eventually creating a separate category: instant coffee (Howard, 1994).

Stages of Decision	Amount of Information Used	Speed of Decision
Extensive Problem Solving (EPS)	Large	Slow
Limited Problem Solving (LPS)	Medium	Medium
Routine Problem Solving (RPS)	Small	Fast

Figure 4. Characteristics of stages of decision making (Howard, 1994).

In the LPS stage, consumers start to develop a brand image. LPS involves applying existing criteria to a recurrent purchasing decision. For example, when more brands of instant coffee appeared, consumers compared it (with less cognitive effort) to the original Nescafe brand. Since consumers in this case encountered a new brand (e.g., Maxwell House), associated with a now familiar category (instant coffee), consumers sought less information. Increased savings on cognitive resources resulted in faster decision-making.

At the RPS stage, consumers have developed an evoked set of candidate brands that they consider buying. Availability and pricing become the decisive factors. RPS involves the repetition of a previous decision making process on recurrent purchase decisions. Consumer purchase behavior becomes habitual and less thoughtful, often continually buying the same product. This is *brand loyalty.* Usually, this level of decision-making is applied in frequently purchased low-involvement items such as soft drinks, toothpaste, etc. but again the situation in which the consumer finds himself determines which level of decision-making is appropriate.

It must also be noted that there is substantial empirical evidence to support the argument that (emotional) affective factors also play a significant part in consumer purchasing decisions (Howard, 1994; Ray and Batra, 1983). This topic however is beyond the scope of this study.

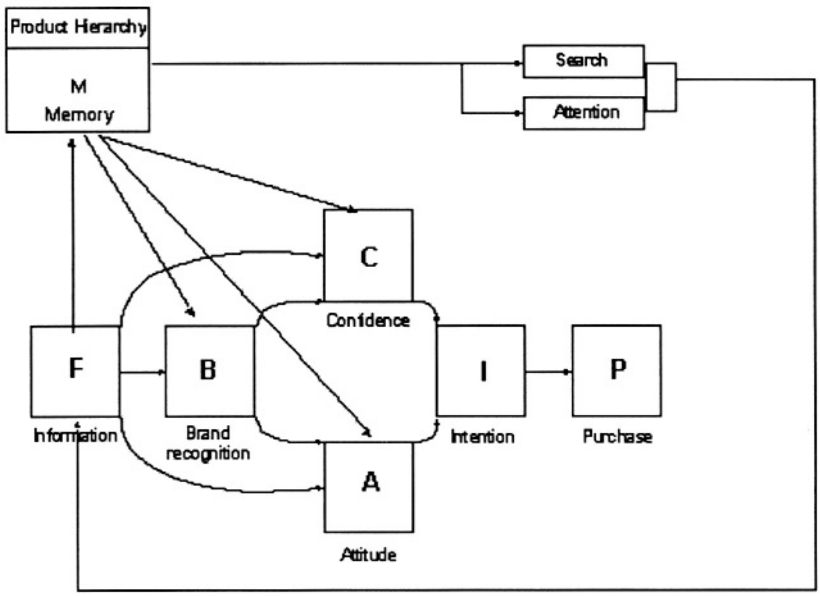

Figure 5. General theory of consumer decision making (Howard, 1994).

2.4 Behavioural Patterns and the Behaviour Perspective Model

Unlike cognitive models of consumer behaviour, BPM recognises the importance of environmental stimuli in the shaping, and maintenance of, behaviour rather than cognitive pre-dispositions that may, or may not, result in action (Foxall, 1997). Of note is the focus on time (historical learning and experience) and space (situational context). Interestingly, BPM argues that the interactions between time and space directly affect consumer behaviour in terms of influencing repeat purchases.

Foxall (1996) identifies 3 behavioural "reinforcements" that shape actual purchasing behaviour: hedonic, informational and aversive. *Hedonic reinforcement* refers to the strengthening of consumption behaviour through the generation of feelings and other sensory stimulation and aimed at an individual's innate behaviour. Web sites that incorporate elements that intrigue consumer's hedonic interests were branded as "effective" by some subjects in an experiment (Raman & Leckerby, 1998; Dholokia & Rego, 1998).

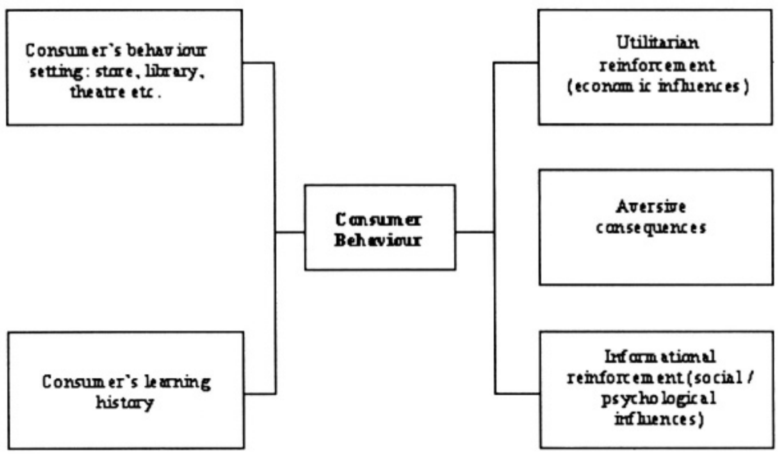

Figure 6. Summative behavioural perspective model (Foxall, 1997).

Informational reinforcements consist of either internal/private or group/public feedback on an individual's performance. It may confer social status and/or self-satisfaction, or may simply constitute a reference point denoting progress to date. This kind of reinforcement is induced verbally and has greater impact in a social setting given the existence of peer pressure. *Aversive reinforcements* refer to the post-purchase/consumption experience. A bad experience of buying and/or using a product provokes dissatisfaction (negative reinforcement) and is a powerful mitigating factor against repeat purchases of the product.

In summation consumer behaviour models can be loosely divided into two types: cognitive *(attitude-behaviour-intent paradigm)* and behavioural *(stimulus-organism-response paradigm).* Cognitive models argue that (i) it is possible to change consumer attitudes via persuasive marketing, and (ii) through such marketing a change in consumer purchasing behaviour will occur (Roper, 1966; Robertson, 1971; Pinson et al., 1973). Behaviour models argue that purchasing behaviour, especially recurrent purchases, is determined by increasing the positive reinforcements and, where possible, eliminating the negative reinforcements in the “consumer situation”.

3. HCI IN THE CONTEXT OF THE WORLD WIDE WEB

Human Computer Interaction (HCI) is defined as the area of intersection between the psychology, social science, computer science and technology disciplines (Caroll, 1997). HCI researchers analyse and design specific user-interface technologies (for example 3D pointing devices, interactive video, and the pervasive mouse & keyboards peripherals). The hallmark of the HCI agenda is its dynamic nature: it is continuously evolving as new concepts and techniques from other disciplines are incorporated.

Myers (1998) has ascribed the frenetic growth of the Web to HCI research, particularly to improvements in interface design and the use of hypertext technology. Hollan (1997) elaborated on this:

> *“It was changes at the level of the interface, making access to information systems almost anywhere only a matter of clicking on a link, that has opened the web to users and resulted in its massive impact not only on scientific activities but also on commercial and social interactions. ”*

Results from a WAMMI (Web Analysis and Measurement Inventory) questionnaire survey corroborated the hypothesis that higher user satisfaction is achieved with sites that had some explicit HCI involvement in their construction (Kirakowski et al., 1998). Imbuing software applications with social as well as human cognitive attributes was found to augment human-software interaction significantly (Nass et al., 1996; Fogg & Nass 1997; Wiedenbeck & Beck 1997; Cockburn, 1996). HCI has also entered the dimension of *virtual reality* in the form of sophisticated 3D-Visualisation of complex systems. This has successfully improved environmental stimuli (where available) for users online and consequently has interesting implications for competition between electronic traders (Hollan et al., 1997; Card et al., 1991; Eick and Joseph, 1993; Bederson et al., 1996).

Research has suggested that the incorporation of auditory elements in Web interfaces can augment the global usability of the Web. The inclusion of sound in Web-related actions (such as playing a ‘dinging’ sound when receiving a new mail message) can augment situational awareness of users thereby enhancing the usability of users per se and those from diverse cultures (Tannen, 1998; Scholtz et al., 1998). Users were found to 'relish the chance' of using a combination of speech commands and gestures in Web-specific tasks (searching, browsing, etc.). A conclusion was drawn on this issue stipulating that user interface design should encompass multi-disciplinary techniques and concepts such as speech recognition, linguistics and computer science (Czerwinski & Larson, 1998).

3.1 Culture and HCI

Barber and Badre (1998) contend that culture and usability issues intertwine and can be integrated into a single entity: *culturability*. The principal premise of culturability postulates that cultural preferences can directly affect user performance. Cultural preferences and characteristics such as colour, text *vs.* graphics and spatial orientation largely control what is deemed as "user-friendly", and therefore usability issues must adapt to a cultural context (Barber & Bader, 1998). In one study, the Asian HCI model was found to be different from the Western model. Asian users preferred 'speech-to-text' in conjunction with 'handwriting-recognizing' peripherals as their input devices in contrast to the ubiquitous Western model of mouse and keyboard (Sacher, 1998).

The similarity between travellers' finding themselves in an unfamiliar place can be applied to visitors exploring unfamiliar Web sites. Subtle things such as colour, which may be considered trivial, can attract or repel new visitors. The background colour of one site in an experiment was found to mysteriously reflect cultural constituents such as creed and faith (Bourges-Waldegg et al., 1998: pp. 298). Using Boor & Russos' (1998) colour-culture chart, one can conjecture that Chinese and Japanese visitors may find a Web page with a white background colour apprehensive because in Asian cultures the colour white represents death. The success of a global interface, it is argued, is only achievable when the interface design reflects the seized "cultural nuances of a targeted audience" (Barber & Badre, 1998); in other words, the cultural characteristics of local regions. For example, CNN explicitly uses cultural icons (e.g. national flags) and cues to attract a wider pool of visitors to its site.

Bourges-Waldegg et al. (1998) found it was important to identify shared contexts for the interface between heterogeneous cultures and Web sites. This has generally been obtained by explaining the meaning (M) of a representation (R) in its context (C). For example, Netscape's STOP sign (R) is meant to cancel (M) the downloading of a Web page (C). Kerne (1998) stressed that by identifying and taking benefit of the multi-cultural heritages of netizens on the Web, digital interactive environments will have hybrid interfaces that are more responsive to different users.

3.2 Accessibility

Alvarez et al. (1998) noted that people with sensory, motor or cognitive disabilities should not be discounted from the contemporary electronic consumer base: “internationalisation and accessibility are basic tenets of good design and development in the modern marketplace“. The ADA (Americans with Disabilities Act) enforces regulations in the United States that require developers to make their final product accessible to people with disabilities. For example, the Windows operating system has been redesigned to include interface features for people with disabilities

3.3 User Behaviour on the Web

Shih (1998) investigated how consumers behave in e-commerce differently from physical commerce. He found that by embedding a combination of audio-visual components in Web pages, the consumer perception of the advertised product or service is enhanced. According to Venkatesh (1998) cybershopping consists of elements of physical and catalog shopping, but it deprives consumers from the prominent senses of feeling and smelling, which may justify why it has not totally replaced traditional shopping.

Shih (1998) identifies telepresence and bricolage as critical success factors in an e-commerce environment (Shih, 1998). *Telepresence* is the extent to which cybertechnology can emulate and reproduce sensory data: how much a consumer believes that s/he is actually there in the computer-simulated environment. Users playing 3D games show a high degree of telepresence. For example, user’s moves and reflexes when driving a virtual car in a car-race game are identical to their moves and reflexes when driving a car in real life.

Bricolage is a means of allowing consumers to explore adverts and interact with the object of interest in a manner that best suits them. As an example, users can choose to either click or skip ad banners and hyperlinks without any obligations. This contrasts with traditional ads where intermediate TV advertisements during sport games, soaps or films compel viewers to either see the ad even if they are not interested or to alternatively switch to another channel.

3.4 Response Times

Ramsay et al. (1998) describes Web response time as the ‘crucial intersections’ of HCI and Web research. Response times of computer applications in general has been identified as a paramount issue in HCI (Schneiderman, 1992; Johansson & Aronsson, 1984) and evidence shows that longer retrieval times degenerate the psychological state of Web visitors (Kuhman, 1989; Basu et al., 1997). Torpid sites are usually caused by Web pages that are cluttered with superfluous graphics, Java applets and other resource-voracious components (O’Keefe and McEachern, 1998). In other words, slow access and downloading capabilities, often the result of visually stunning but non-essential marketing graphics merely frustrate consumers and reduce the consumption experience.

4. THE CONSUMER INTERFACE IN ELECTRONIC COMMERCE

What, then, is different about consumer behaviour in cyberspace? And what can we learn from HCI about interacting with consumers through a Web-based consumer interface?

If we juxtapose the issues and trends that are emerging in HCI against the key elements from consumer models it is possible to develop a matrix that will help businesses develop a customised consumer interface. To be effective, a customer interface requires three dimensions to be addressed: Web page design, Web site style, and Web site construction. See Figure 7

4.1 Web Page Design

Colour, graphics and text is a critical factor in attracting customers and enticing them to purchase products. Kim & Moon (1998) revealed that the composition of appropriate customer interfaces (3-dimensional clipart for example) could instil “trust” in visitors of a Web site. As previously discussed, particular cultural characteristics generate positive or negative attitudes towards Web sites. Importantly, these attitudes, which influence the purchasing decisions of consumers, are unrelated to the functional ability or service quality on offer at that Web site.

In the context of consumer behaviour, Web page design needs to appreciate how product categories require different levels of cognitive effort, since consumer models identify cognitive effort as a critical factor influencing purchasing decisions. Extensive problem solving in the form of a query or unfamiliar product, for example, requires large amounts of information and consequently high levels of cognitive effort. Web pages here would be of a non-standardised format and could include links to other sites which support the original product (by defining the product category or providing cost comparisons) or links to an interactive customer sales support centre for online clarification.

Consumer Behaviour	Page Design	Page Content	Site Construction
Brand Recognition	Image Continuity Graphics	Advertising *versus* Information	Standard *versus* Customised
Product Hierarchy	Education *versus* Marketing	Link Support - Complementary - Cost comparison	Deep *versus* Shallow
Cultural Characteristics	Colour Sensitive	Text Sensitive	Accessibility & Technical Awareness
Searcher Intent	Purchase Directed *versus* Awareness Promoted	Informative *versus* Advertising	Interactive Customer Support *versus* Novel Audio/VR
Consumption Experience	Degree of Sensory Stimulation	Degree of On-line Support	Degree of Interactivity

Figure 7. Consumer behaviour/Web interface

With limited problem solving the product category is relatively defined and a more standardised format could be followed within a product specific marketing strategy. A greater number of graphics could be used with links to supportive, but non-related sites. For example, travel agents could link to tourist information boards to promote key destinations as a lifestyle choice. Routine problem solving involves the least cognitive effort, as products are well defined and easily identifiable by consumers. Here a standardised format with clear navigational instructions, culturally common graphics and simple ordering procedures is probably the most effective design.

4.2 Web Page Content

Clearly, the content of Web page design is a critical factor influencing consumer behaviour. In order to determine which style of design (informative text or advertising text) is most commercially appropriate requires businesses to appreciate two dimensions in a consumer's purchasing process: (i) product familiarity and (ii) level of risk.

Educative versus marketing information will largely depend upon a consumer's familiarity with the product. As Figure 4.2 illustrates, an entirely new product is completely unfamiliar to consumers and lacks rival competitors. Consumption therefore requires a heavy marketing strategy to build awareness, consumer need and brand image. Conversely a new product entering an existing market faces established competitors with brand-loyal and product aware customers. To be successful, this business needs to pursue an informative strategy highlighting product differentiation (cost, quality and product attributes).

Figure 8. Information dimensions of Web page design.

Similarly, the matrix can be used to demonstrate the educative versus marketing spectrum for products ranging from luxury to routine. There is little social or financial risk associated with routine purchases. Buying a toothbrush is neither expensive nor likely to invoke derision/admiration from a consumer reference group. The degree of information content, therefore, depends upon the products attributes, target audience and marketing strategy - product differentiation or brand maintenance. Luxury products involve greater risks for potential consumers (particularly social kudos and financial cost). Consequently, consumers need greater levels of marketing with which they can justify their purchase as “acceptable” to themselves (via their personal evaluative criteria) whilst appealing to the attitudes and values of their reference group.

4.3 Web Site Construction

In terms of Web site construction it must be noted that there are two types of consumer: casual browsers and specific searchers. Aimless surfing is the general characteristic of casual browsers. Here, attention is caught primarily by novel graphics and/or alignments between personal interests and Web site purpose (unusual hobbies for example). A specific searcher, however, is looking for particular information or product(s). Attention is focused on helpful links and informative text rather than pretty pictures. A further point to note is that casual surfers may have more time and patience to look through a web site’s various levels whereas the specific searcher, it could be argued, has less patience for Web site cul-de-sac’s.

Nielsen (1997) warns that a site’s interface should not be sales-driven but should accentuate customer support and service. For example, Amazon.com deals with two sets of customers: customers looking for books and publishers looking for customers. By providing interactive services to assist people in purchasing books, Amazon.com accentuates the purchase process rather than the sales process. The set of services it provides include online reviews, a bestseller’s book chart and individual feedback on books purchased from the site. Guidelines containing lists of “do’s and don’ts” in designing Web sites are available in abundance on several Web sites (Konan, 1998; Miller, 1998; Haine, 1998).

4.4 Significance of Virtual Reference Groups

Special attention needs to be paid towards the nature, speed and power of online information exchange, with regard to virtual reference groups and online discussion rooms in determining the “consumption experience”. Consumers can purchase products internationally, consume locally and comment globally. Consequently, online information exchange wields disproportionate influence on profit levels than information traded in the real world. Mistakes committed by businesses online generate “cyber-punishments“ in terms of time (global dissemination of adverse opinion in real-time), cost (international reduction in demand) and reputation (effects linger long after virtual opinion leaders have been replaced). Interestingly, online business “mistakes” generally occur through a misunderstanding of cultural characteristics. Sales may be harmed by cultural insensitivity in Web page design and site construction.

5. TOWARDS A CONSUMER INTERFACE

In general, the above discussion suggestions that much can be learnt from models of consumer behaviour, and HCI issues can be viewed in a new light. Conversely, the fact that consumer behaviour merges into a single focus point, i.e., the Web page, may mean that electronic media models of consumer behaviour need to emerge.

For instance, consumer behaviour consists of two aspects: attitude/intention and behaviour/action, which separately influences the consumers' product selection and consumption experience. The on-line "consumer experience" integrates attitude and behaviour into a seamless whole. Web site selection also involves Web site consumption, and is the critical first step in the purchasing process.

Ease of use is perceived to be a critical success factor regarding (i) site navigation by consumers, (ii) persuading consumers to purchase products, and (iii) facilitating repeat purchases. It is clear that Web sites have to be both useable and responsive in traditional HCI terms; response speed is no doubt an important moderating factor.

6. CONCLUSIONS

An effective consumer interface consists of three separate elements: Web page design, Web page content and Web site construction. Each element uniquely interacts (individually and together) with the critical aspects of consumer behaviour (attitude - actual purchasing activity - evaluation) to determine the consumption experience. In turn, each aspect of online consumer behaviour requires different methods and techniques for successful sales and marketing, i.e., attracting new customers and/or developing brand loyalty. In applying the framework developed in this paper, electronic traders are better positioned to (i) understand the exact nature of that interaction between interface construction, consumer behaviour and online sales and marketing techniques (as per HCI developments) and (ii) develop an electronic interface which maximises sales generation potential.

Interestingly, this research notes the importance of two types of electronic users: casual browsers and specific searchers. Each user type possesses different consumer behaviour characteristics and thus requires different, possibly even mutually exclusive, selling techniques and/or interface construction. This is an area for future research.

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Chapter 10

Information Foraging in Internet-Based Selling: A System Design Value Assessment Framework

Jungpil Hahn and Robert J. Kauffman

Abstract: *Information foraging theory* provides a theoretical perspective for the study of different online consumer purchase behaviors that need to be understood to support a sound basis for the measurement of business value of the design of Web-based applications. In this chapter, we examine the extent to which online consumer purchases are effectively supported through systems design choices in Web-based applications through a series of five classical stages in consumer purchase decision-making. They include *need arousal, information search, product evaluation, purchase decision,* and *post-purchase evaluation.* We distinguish between different purchase behavior settings through a framework that identifies purchase decision-making contingencies in the context of three different consumer purchase scenarios: *convenience goods, researched goods,* and *replenishment goods.* The different types of purchase scenarios reflect distinctions in terms of the *extent of consumer involvement* in information processing and evaluation leading up to the purchase decision, and the *frequency of repeat purchases.* We then illustrate and evaluate the extent to which the framework offers insights into the evaluation of the efficacy of systems design for Internet-based selling with reference to a number of mini-cases for each of the three types of purchase scenarios. The primary means for assessing the efficacy of the Web-based support in a given setting is the extent to which the consumer is able to achieve high levels of *return on information foraging.* We also consider differences that may arise between *information goods* and *physical goods,* and the Internet-based selling of goods versus services, in general. The results of our analysis suggest a number of new design guidelines for software application development in this area, and provide an initial assessment of the extent to which information foraging theory can be leveraged as a means to understand the referents of systems value.

Key words: Business Value of IT, Consumer Purchases, Electronic Commerce, Evaluation Framework, Information Foraging Theory, Internet-Based Selling, Systems Design, Web-Based Applications

1. INTRODUCTION

Firms that sell on the Internet are especially reliant on getting people who browse a Web site to buy things. In the early days of e-commerce, most firms were overly concerned with getting visitors to their Web sites. Today, in contrast, the focus has shifted to getting people to make purchases. But the Yankee Group in a November 2000 study noted that the average conversion rate for business-to-consumer Web sites is on the order of only 1% (Patton, 2001). As a result, developing, launching and maintaining state-of-the-art electronic commerce Web sites have become critical activities related to organizational success in e-businesses. For example, today businesses that make a commitment to doing business via the Internet budget around $1-2 million yearly for Web site setup and maintenance. Leading Web sites require annual investments that are closer to $8 million (Rizzuti and Dickinson, 2000). But what value emerges from such spending? Are Web site investments effective? Or are expenditures for Web sites that support Internet-selling an example of yet another category of business software that doesn't do what it is supposed to, ultimately leaving American industry open to billions of dollars of lost value in systems investment (Levinson, 2001)?

Although e-commerce application development requires very large firm investments, the process of designing high quality Web sites for e-commerce is still more of an art than a science. Firms mostly still rely on intuition and experimentation when it comes to designing their Web sites (Wallach, 2001). This results in the lack of a clear tie to performance metrics that might otherwise be applied in the context of a firm's e-business activities that would offer guidance for e-commerce application design. This is mainly due to the lack of theory for how the design of systems for e-commerce applications should be approached.

In this chapter, we tackle the problem of e-commerce application systems design by focusing on the following research questions:

- How do we develop standard templates for purchase scenarios that occur in Internet-based selling for the purposes of assessing the business value of e-commerce applications?

- What do we need to know about consumers to create value in online retail situations?

- What do we need to know about the products that are sold to create value in online retail environments?

We believe that current theories of information-seeking in online environments, especially *information foraging theory* (Pirolli and Card, 1999), provide a useful theoretical basis for thinking about the value of systems design in Internet-based selling scenarios. Basically, in online retail, consumers not only interact with a Web-based application (i.e., the Web site), but also through it with the firm's business processes, and product and service delivery capabilities (Hoffman and Novak, 1996). Hence, we need to think more holistically about the consumer's overall experience of using the computer-mediated shopping environment and to understand how the consumer (i.e., the user), the e-commerce Web site (i.e., the medium) and the purchasing scenarios (i.e., the tasks) interact with one another. In other words, rather than scrutinizing single choice decisions, we recommend that the focus be shifted to the rich context of information-seeking behavior to understand the impact and value of e-commerce application design.

Our purpose is to provide a theoretical foundation for thinking about e-business systems design and value creation through systems design. Based on the theoretical foundation, we propose a framework for understanding the value of e-business systems design in support for online consumer purchasing behavior. Finally, we validate the value of our proposed framework through pre-empirical mini-case illustrations of current e-commerce application designs to determine if our framework is comprehensive and useful in the settings that we envision it will be applied. We first apply the framework to typical purchasing scenarios of tangible goods, and then extend the application to Internet-based purchasing of information goods and of services in order to verify whether our proposed framework covers the broad range of different categorizations of Internet-based selling situations (Kauffman and Walden, 2001; Schmid, 2001). The mini-case illustrations follow a new "grounded theory" approach that we apply to detailed business processes that occur in Internet-based selling. This approach permits us to inductively identify emergent theoretical constructs that are salient in online retail situations involving an online retailer, its product offerings and consumers. This new qualitative approach is similar to the grounded theory approach used in organizational studies (Strauss and Corbin, 1994), however, we do not strictly adhere to the original methodological guidelines. Rather, we apply the general inductive thought process to support pre-empirical analysis, framework construction and to surface key drivers for application success.

2. LITERATURE

E-commerce can be regarded as an online retail channel. The online retail channel, like any other retail formats (e.g., mail catalogs, TV shopping etc.), must overcome the problem of adoption by consumers in order to succeed. Consumers will adopt online retailers only if the utility provided by the online retailer to the consumer exceeds that provided by traditional retail formats (Alba et al., 1997). Hence, online retailers need to create value to consumers by creating online shopping environments that support the consumer's purchase needs (Keeney, 1999).

To understand the needs of the consumer, we need to first understand the information requirements of the consumer's purchasing process. A consumer's purchasing process is typically characterized as information processing consisting of five stages (Bettman, 1979; Howard and Sheth, 1969; O'Keefe and McEachern, 1998):

- *need arousal* occurs when external or internal stimuli trigger a state of heightened attention with regard to an unmet consumer need;

- active *information search* occurs when a consumers defines a set of products to consider to meet the need;

- *product evaluation* involves the formation of the consumer's attitudes toward products that are under consideration, based on perceptions about product attributes;

- actual *purchase decisions* occur once a utility-maximizing product is selected and purchased; and,

- *post-purchase evaluation* is the final step of the process, wherein a consumer's level of satisfaction (or dissatisfaction) with the performance of the product is established.

Prior research in consumer behavior in the field of marketing has investigated various factors that may affect the consumers purchasing process and behavior. Since our purpose is to present a framework for assessing the value of e-commerce systems design in the specific context of Internet-based selling, we focus our discussion on the online consumer purchasing scenarios with respect to the nature of the product that is sold. This prompts us to ask a number of intermediate questions that need to be answered along the way, including the following:

- Given the different types of product that an e-commerce site is offering, what are the typical kinds of online consumer purchase scenarios that one can expect to observe?

- Based on what is observed, how, then, should e-commerce Web sites support the consumer purchasing scenarios?

- How do the current Web sites of Internet-based sellers support (or fail to support) the consumer purchase scenarios that are observed?

Even at this relatively early stage of our research in this area, we believe that an all-encompassing solution to e-commerce Web site design probably does not exist. Instead, we expect e-commerce Web site design choices to be contingent on a variety of factors that we will shortly discuss in greater depth. However, we argue at the outset on behalf of one critical assumption for this work: that the design of an e-commerce Web site must be developed with specific consideration given to the specific product or service that is offered by the online retailer. For example, an Internet site that sells books and music CDs, such as Amazon.com (www.amazon.com), needs to have a very different Web-based interface compared to a Web site, such as BestBuy.com (www.bestbuy.com), that sells computer hardware. This is because the products and services that are offered entail very different consumer purchasing behaviors. Some products require extensive information search along with systematic product comparison, whereas the purchase of other product types may require only minimal information processing.

For the purposes of this analysis, we characterized purchase processes along two major dimensions: the *level of involvement* on the part of the consumer, and *repetitiveness of need fulfillment.* The level of involvement in the purchase process of a product has been shown to influence the dynamics of the consumer purchasing process (Celsi and Olson, 1988; Zaichkowsky, 1985). For example, high involvement purchase scenarios are associated with extended problem-solving by consumers, who conduct extended information search, do more information processing, and apply systematic rule-based product evaluation. In contrast, low involvement purchase scenarios entail routinized response behavior on the part of the consumer. Less information processing occurs, and sometimes only heuristic product evaluation (Howard, 1989). Hence, the purchase process for high involvement products typically follows all five stages of the consumer purchasing process. However, the purchase process for low involvement products may omit certain stages. We may also observe different stages of the consumer purchasing process occurring in a different order.

Typically, high involvement products are high-ticket durables (e.g., consumer electronics, automobiles, etc.) whereas low involvement products are lower-priced convenience goods. However, this distinction is not fixed. The level of involvement for a product is apt to change dynamically with time. For example, a high involvement purchase decision may lead to much lower involvement over time, especially in the case of repeated purchases. Hence, our second major factor, *repetitiveness of need fulfillment,* is included to adjust for these kinds of product purchase decision-making situations. In the case of repetitive purchases, consumers make use of their past experience of previous purchases in the current purchasing process, and this will change the extent to which one may observe behavior that is consistent with all five stages.

In view of the above discussion of how consumer purchasing behavior works, and in order to evaluate the value of e-commerce Web site designs, we need a way to understand how consumers typically interact with the design of e-commerce Web sites. *Information foraging theory* (Pirolli and Card, 1999) provides a useful theoretical perspective to enhance our understanding of the human-computer interaction that occurs when consumers use the Web site of an Internet-based seller. (For a description of the theory, see Text Box 1.)

Text Box 1. What Is Information Foraging Theory?

Information foraging theory is a general theory of human information-seeking behavior in information environments. The theory seeks to explain human information-seeking and sense-making behavior given the structure of the interface between people and a computer-based repository of information. The key assumption of information foraging theory is that the structure of the interface between the user and an information repository determines the magnitude of the costs (i.e., time, resource and opportunity costs) of different information foraging and sense-making strategies. These, then, can be weighed against the rate at which useful information is encountered. This theoretical perspective characterizes people as either selecting an information system or an information foraging strategy that maximizes their *return on information foraging* (i.e., rate of gaining valuable information). In addition, the theory gives purpose to the modification of the structure of a computer interface in the context of specific task situations, so that the result is an increase on the return on information foraging. Hence, we can compare information systems and information foraging strategies by evaluating the amount of useful information per unit cost that is obtained through each.

Information foraging theory permits the comparison of information systems by contrasting the *return on information foraging* for the different designs. The idea that user behavior in the interaction with a Web site reflects the general notions of information foraging theory has important implications for e-commerce. Since consumer purchasing behavior can be regarded as information processing, online purchasing behavior can also be characterized as information foraging. The key perspective is that a consumer forages for information that she needs to process in order to complete a purchase transaction. However, information foraging behavior will be contingent upon the purchasing task the consumer is involved in - different purchasing scenarios will entail different information requirements and hence different information foraging behaviors. Given different information foraging behaviors for different purchasing scenarios, we may anticipate what kind of information system support will increase (or decrease) the return on information foraging. Information foraging theory posits that consumers will ultimately adopt the Web sites of Internet-based seller when they offer the greatest return on information foraging for a given set of purchasing scenarios.

3. FRAMEWORK CONSTRUCTION

Based on our previous discussion of consumer behavior in online environments, we next develop a framework for evaluating the value and effectiveness of e-commerce systems design. In the upcoming sections of this chapter, we will demonstrate how the framework may be applied for both evaluation and design purposes. The purposes include:

- analyzing the effectiveness of Web site functions or for comparing different approaches to Web site design (i.e., evaluation); and,

- deriving a set of functional requirements for a Web site, given the nature of the product or service that a firm wishes to offer online (i.e., design).

Table 1 presents our basic framework of online consumer purchase behaviors.

Table 1. A Framework of Product Types and Consumer Behavior Related to Web Site Design

CONSUMER BEHAVIOR DIMENSIONS	ONLINE PURCHASING SCENARIOS		
	Convenience Goods	**Researched Goods**	**Replenishment Goods**
Need arousal	Haphazard	Pre-ordained	Event-driven
Information search	Availability / Familiarity	Extensive	Minimal
Product evaluation	Heuristic	Rule-based	Experience-based
Purchase decision	Impulsive	Cautious	Routinized
Post-purchase evaluation	Minimal	Periodic only	Recurring often

Our proposed framework is based on a typology of typical scenarios for purchasing product online: *convenience goods purchasing, researched goods purchasing* and *replenishment goods purchasing.* The major assumption underlying our framework is that different product types induce distinct purchase behaviors and, hence, the Web sites of Internet-based sellers need to provide different types of systems support to maximize the return on information foraging of the customers' purchasing scenarios. Convenience goods purchasing scenarios are casual shopping situations where a consumer may shop for a book for pleasure. Researched goods purchasing scenarios involve situations where consumers are researching extensively to buy a product that will be with her for a while. Motivations for finding the *right* product are high since the consequences of buying the wrong product will be severe. For example, buying a car can be thought of as a researched goods purchasing scenario. Finally, replenishment scenarios are habitual shopping situations where the consumer shops to restock some item. For example, shopping for groceries falls into this scenario.[1]

We start by characterizing the different types of purchase scenarios based on products types that typically induce the purchase behaviors. We characterize these product types based on dimensions that have been shown to affect consumer purchasing behaviors: *level of involvement and frequency of need fulfillment.*[2]

CONVENIENCE GOODS PURCHASES INVOLVE LOW INVOLVEMENT AND ONE -TIME PURCHASE

Convenience goods, which are characterized by low involvement and one-time purchase, are probably the most common type of products sold over the Internet. For example, books and music CDs sold online fall into this product category. From the seller's standpoint, the major problem with convenience goods is that there is a great variety in the selection of products and since most purchases are one-time purchases, it is difficult to know which specific product the consumer will want.

This is also true from the consumer's perspective. Since the consumer has never bought the same item before, it becomes very difficult for her to gauge the quality of the products in her consideration set. Furthermore, since her level of involvement is low, the consumer will not make an effort to perform a great deal of information processing. Rather, she will resort to *heuristic product evaluation* during the purchasing process. Hence, *awareness* and *familiarity* will play a more important role in the consumer's decision-making process.

For such convenience goods, the type of support provided by the Web site needs to be one of *identification support.* In other words, the Web site should try to minimize the amount of effort that a potential buyer will expend to identify products. Thus, systems support for the Web sites of Internet-based sellers of this kind of product should include intuitive and easy-to-navigate product catalogs. In addition, recommendation systems that offer association rules or collaborative filtering capabilities that present an assortment of products that the consumer may be interested in will be of significant value. They will reduce the amount of information processing that the consumer is required to do in the information search stage.

RESEARCHED GOODS INVOLVE HIGH INVOLVEMENT AND ONE -TIME PURCHASE

Researched goods are characterized by a high level of consumer involvement in the purchasing process in a single purchase situation. High-priced items such as consumer electronics and airline ticket reservations fall into this category. Since the level of involvement is high, consumers will exert asignificant amount of information processing effort in the purchase decision-making process. The consumer's product evaluation process will entail systematic rule-based procedures for filtering the consideration set of products, and for weighing attributes of alternatives. However, since the purchase of researched goods occurs only once (or very infrequently), consumers typically will not have a good representation of the purchase decision variables due to the lack of experience in the purchase of such products. In addition, for such high involvement purchases, consumers typically do not make the final purchase decision on the first occasion or at the first retail store they visit. In other words, consumers will typically shop around to make sure that their purchase decision will be satisfactory.

For such researched goods, the type of support from the Web-based retail application should focus on *decision support*. The Web site should provide not only ample information about the products (Jupiter Media Metrix, 2001), but also additional guidelines about what are the important attributes to consider in the product evaluation and actual purchase decision. Furthermore, the Web interface also needs to provide ample support for all phases of the consumer purchase process. For example, *filtering support* should be provided in order to facilitate the information search stage, *filtering and sorting functions* will be needed for the product evaluation phase and finally *product comparison functions* will be needed for the purchase decision-making.

Additionally, given that consumers will typically visit several outlets during the purchase process, it will also be beneficial to provide a memory feature so that the Web application "remembers" the consumer's consideration set. In other words, even if a consumer were to spend some effort in using a retailer's Web site to identify potential candidate products for purchase and compare several products, she will probably visit other retailers to check other brands or temporarily abandon the purchase process to think more about the purchase. When she finally decides to make the purchase, a Web site that continues with the consumer's purchasing process from where she left off will be of great value. If the site is able to remember her consideration set of products, rather than force the user to start from scratch, then the consumer's return on information foraging for that interface will be greater. This ought to lead to higher probabilities for sales transactions to take place as well.

REPLENISHMENT GOODS ARE CHARACTERIZED BY LOW INVOLVEMENT AND REPETITIVE PURCHASES

Replenishment goods are characterized by a low level of consumer involvement in repeated purchase situations. Purchases such as groceries and prescription drug refills fall into this category. Given the repetitive nature of purchase frequency, the purchasing process for this product category generally follows a routinized response pattern of purchase behavior. If consumers are satisfied with their initial purchases, they are highly likely to repurchase the same product over and over. However, it is also possible that brand switching will also frequently occur. In fact, most highly sophisticated consumer product sellers and food and merchandizing stores that sell them rely upon their knowledge of this to drive consumer to products that they benefit the most from selling.

The functional support for an online retail Web site dealing with replenishment products should focus on both *identification* and *memory.* Given the low level of involvement that consumers exhibit in such purchases, the Web site should act as the mechanism to help consumers identify potential purchase items with a minimum of effort. Consequently, recommendation systems will also be beneficial in helping consumers to identify products without forcing them into a round of significant information search. However, the Web application should also include memory capabilities so that it remembers customer purchase histories to support replenishment-driven purchasing. A key consideration is that the Web interface should not require the consumer to restart the purchase process from scratch every time she comes back.

4. FRAMEWORK APPLICATION

We next will evaluate the validity and usefulness of our framework by applying it in the context of site design practices that can be currently observed among the Web sites of leading Internet-based sellers. We apply the framework to *typical* online retail situations. Our discussion will focus on real world examples of current retail Web sites and the issues that consumers face when they use them. They include:

- how a Web site supports consumer purchase scenarios through its site features;
- what works and what does not work; and,
- how management and system design specialists can discover the key directions for improving the performance of the various categories of Web applications that support Internet-based selling.

CONVENIENCE GOODS

Since the early days of e-commerce, Amazon.com has been one of the industry leaders in the online retail sector for convenience goods. Books and music CDs are typical examples of convenience goods sold over the Internet. Amazon.com lists literally millions of convenience items for sale, including books, music CDs, and VHS and DVD titles, hence sifting through such a vast catalog to find an item of interest can be a daunting task. The problem is even more challenging for such large-scale retailers. Given the low level of involvement by consumers in the purchase of convenience items, it is unreasonable to expect that they will exert much effort when they search for and process information.

Amazon.com implements several design strategies to take care of this issue. For example, its Web site offers basic *navigation aids,* such as well-defined categories and a powerful search engine. And they include *dynamic presentation capabilities,* such as recommendations and associations. (See Figure 1.)

To accomplish what is shown in Figure 1, Amazon.com keeps track of a customer's previous purchase history and item ratings to recommend other items that the customer may be interested in through the use of *collaborative filtering techniques* (Konstan et al., 1997). This results in what Amazon calls "ListMania Lists." For each potential purchase item, Amazon.com also presents links to other related items by associating other items that other customers who have purchased the item in question have purchased, links to customer generated lists that have other items related to the item in question.[3] As a result, also most every Web page on Amazon.com not only features information about one particular product, but also lists a variety of related items.

Given the low level of involvement that consumers exhibit in the purchase of convenience goods, this design strategy makes a lot of sense.

For such products, consumers may not have a specific item in mind as they enter a virtual store. In such situations, Amazon.com's design of the navigation structure not only helps the customer to identify potentially interesting products—thus providing information search support—but also encourages exploratory browsing behavior that may lead to impulse purchases. The latter can play an important role in creating need arousal on the part of the consumer, leading to purchases that would not otherwise occur. We see that the different types of systems support at the Amazon.com site seem to support the consumers' return on information foraging for purchasing scenarios involving convenience goods.

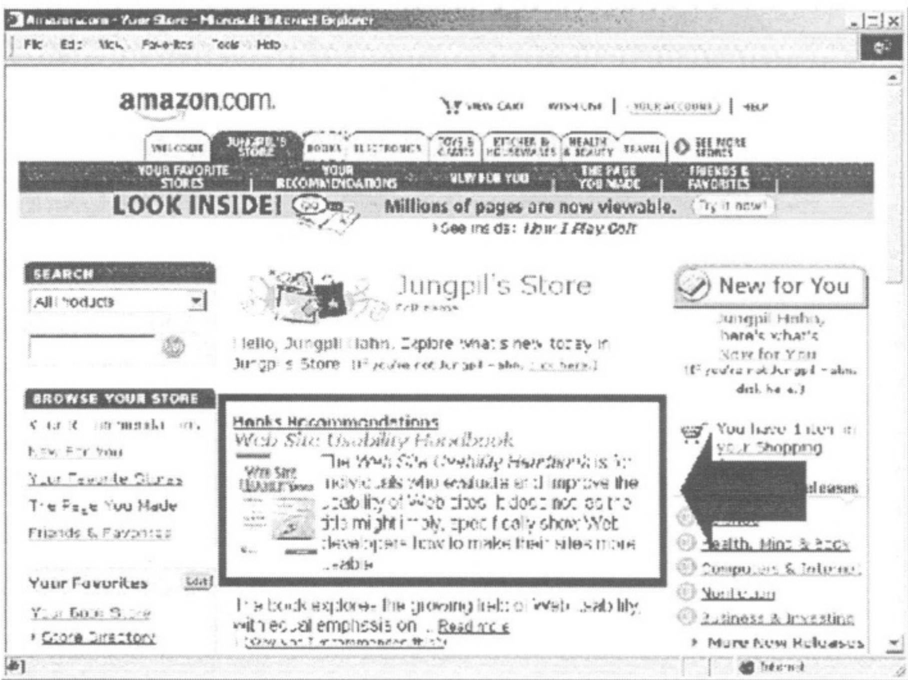

Figure 1. Personalized Recommendations at Amazon.com's Web Site (Source: www.amazon.com, October 16, 2001.)

RESEARCHED GOODS

Researched goods are characterized by a high level of involvement in the purchase process on the part of the consumer. Purchasing this kind of product requires the consumer to do a significant amount of information processing prior to making a purchase decision. We will investigate several examples of current efforts that are made by retailers to provide purchase support for various researched goods: computers, electronics and airline tickets.

Computers. BestBuy.com (www.bestbuy.com) is an online retailer of electronics. The firm is one of the leading vendors of pre-assembled computer systems in the United States, and computers, along with other consumer electronics and appliances, figure among its most important product categories. The BestBuy.com Web site has the basic drill-down categories that are typically observed among Internet-based sellers of these product categories (e.g., Computers > Desktop Computers > Notebooks). In addition to the basic product navigation structure that it offers, BestBuy.com also implements an Internet-based "Shopping Assistant," as shown in Figure 2. (See Figure 2.)

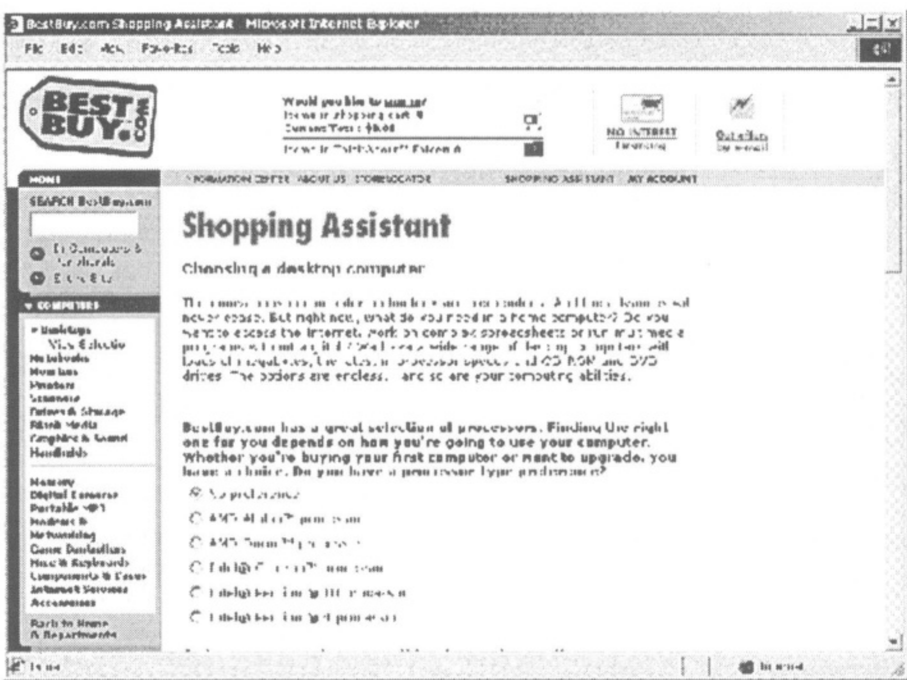

Figure 2. The Shopping Assistant at BestBuy.com
(Source: www.bestbuy.com/ShopAssist, October 18, 2001.)

This software capability on the firm's Web site takes a customer through a series of questions with detailed instructions. In the case of computers, as the figure shown, the consumer can consider systems with options on processor type or speed, RAM and hard drive capacity, devices that handle external media (such as CDRW for creating music CDs or DVD drives for watching movies), and brand preference. All of these are important at the information search stage. This helps a potential buyer to filter out products that do not fit within her preferences. BestBuy.com also provide comparison tables that compare computer systems side-by-side, along pre-defined attributes. Finally, BestBuy.com features the "ThinkAboutlT™" folder. This permits registered customers to save items to think about so that they do not have to make the final purchase decision immediately. This way, the consumer can come back at a later date and still be able to access the items she is interested in without having to browse or search through the site to find the right item.

BestBuy.com's strategy for site design fits the nature of the purchasing scenarios for the product being sold. Researched goods entail a high level of involvement on the part of the consumer. This, in turn, will require the person to conduct a significant amount of information processing prior to making a purchase decision. Various design features of BestBuy.com's site reduce the amount of information processing required. As a consequence, they also work to increase a consumer's return on information foraging for the purchase task. For example, the Shopping Assistant helps information search by filtering only the products that fit into a consumer's preference criteria, and the detailed comparison tables allows consumers to compare several products based on important decision variables.[4] Finally, given that consumers typically make the final purchase decision after visiting several retail outlets, the ThinkAboutIt folder remembers a customer's consideration set so that such multi-visit purchase decision-making can be supported.

Electronics. Amazon.com is also heavily involved in online retail of consumer electronics. What is interesting about Amazon.com is that even though it deals with both convenience goods (e.g., books, music CDs, DVDs) and also researched goods (e.g., electronics) within the same Web site, the designs of the sub-units for different product categories (convenience goods vs. researched goods) are dramatically different. For example, Amazon.com features a "Buying Guide" for the camcorder product category. But buying guides are not available for convenience goods, such as books or music CDs. (See Figure 3.)

Given that a first-time buyer of camcorders will not know all the decision variables related to the purchase of camcorders (e.g., recording media (VHS, VHS-C, SVHS, 8mm, Hi8, or DV), zoom capability, still image capability, analog vs. digital, size of viewfinder, image stabilization etc.), the Buying Guide supports the consumer at the product evaluation stage. In addition, just as BestBuy.com does for computers, Amazon.com features comparison tables that contrast selected models along the product variables as described in the Buying Guide. Again, this feature is not available for convenience goods categories, only for the products in the researched goods category.

Figure 3. Buying Guide for Camcorders at the Amazon.com Web Site
(Source: www.amazon.com/exec/obidos/tg/feature/-/148783/, October 18, 2001.)

Airline Tickets. Another product category frequently purchased online that follow researched goods purchasing scenarios are airline tickets. Longer-operating online travel agents (**OTAs**), such as Expedia.com (www.expedia.com), as well as newly-created OTAs, such as Orbitz.com (www.orbitz.com) are examples of online retailers in this category. One of the interesting things about online travel reservations is that customers have very different preference criteria. These include time in advance of purchase, Saturday night stays, departure time, and number of stops en route, among others, which all significantly alter the pricing of airline tickets (Clemons, Hann, and Hitt, forthcoming).

Both Expedia.com and Orbitz.com have the same basic interface for finding products: the search interface. Consumers enter the desired itinerary (including location, date and time of departure and arrival) and the OTA searches through available flights that match the criteria. One major difference between the sites is the extent of the search that is undertaken. Expedia.com retrieves the top five picks based on price, duration or departure and arrival time, with an option to build an itinerary based on all departing and arriving flights. Orbitz.com, though a facility that it calls "Orbot," presents all flights and provides the consumer with unique decision support functionality, such as filtering and sorting, so that consumers may experiment with various decision variables. It seems as though the extent of decision support is greater at Orbitz.com compared to Expedia.com: consumers are presented with all of the alternatives they might consider at Orbitz.com. This way, they can probe the effect on the price of the ticket as they relax various aspects of their initial ticketing preferences. In contrast, building an itinerary at Expedia.com enables the consumer to be faithful to her preferences, but she will lack significant information that might be used in decision-making: she will not be shown how her different preference settings affect the final price. (See Figure 4.)

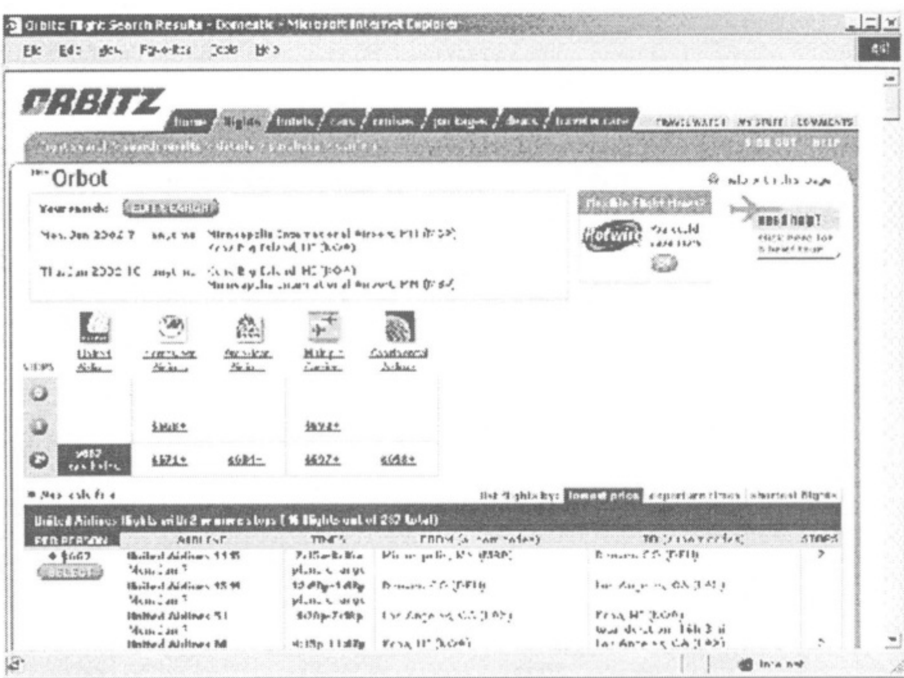

Figure 4. Product Evaluation Decision Support at Orbitz.com
(Source: Analysis done on www.orbitz.com, October 18, 2001.)

Another interesting feature that is used by OTAs is support for customization. When consumers register as customers, the sites keep track of personal and preference profiles to simplify information search and product purchase. For example, both Expedia.com and Orbitz.com keep track of airport that is closest to the registered customer's home or business address, so that the departure location is pre-loaded upon search. Expedia.com also keeps track of consumer billing information (e.g., credit card number and billing address information) so that the actual transaction process may be streamlined.

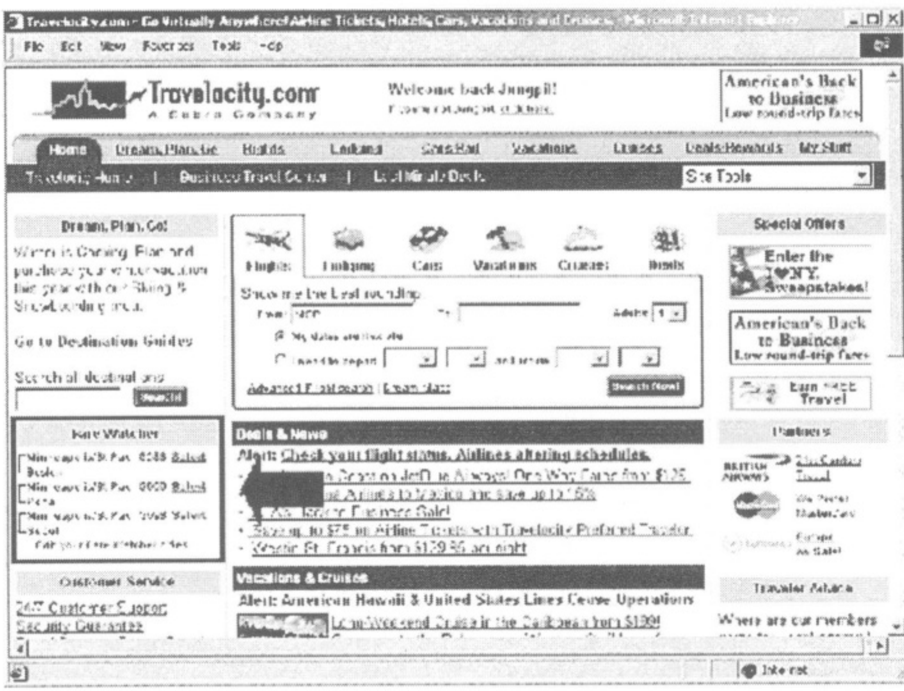

Figure 5. The Fare Watcher Capability on the Travelocity.com User Home Page
(Source: www.travelocity.com, October 20, 2001.)

We have argued that the support for purchasing scenarios for researched items needs include decision support and memory. Decision support seems to be relatively well-implemented at the OTAs that we examined, however, there is somewhat less support for memory that appears to be available. The extent of memory support is limited to pre-loading departure airports at search or pre-loading billing information at final purchase transaction. However, both Expedia.com and Orbitz.com sites do not keep track of previous searches, as BestBuy.com does with its ThinkAboutIt folder. As a result, consumers need to start each transaction from scratch with every visit they make to a Web site. Given the high level of involvement by consumers in the purchase of products that typically require several visits before a final purchase decision is made, it should be clear that the implementation of such memory capabilities would greatly enhance the support for consumer behavior that leads to sales and revenue for the Internet-based seller. This is especially important for the airline ticket category, in our view. Because of airline firm practices related to revenue yield management, prices are constantly changing and consumers may wish to make several visits to an airline reservation Web site to make sure that the price is appropriate.

One related adaptation we have seen that recognizes the extent to which changing prices and product descriptions are likely to influence consumer purchases in this context is with Travelocity.com's (www.travelocity.com) use of a "Fare Watcher." (See Figure 5.)

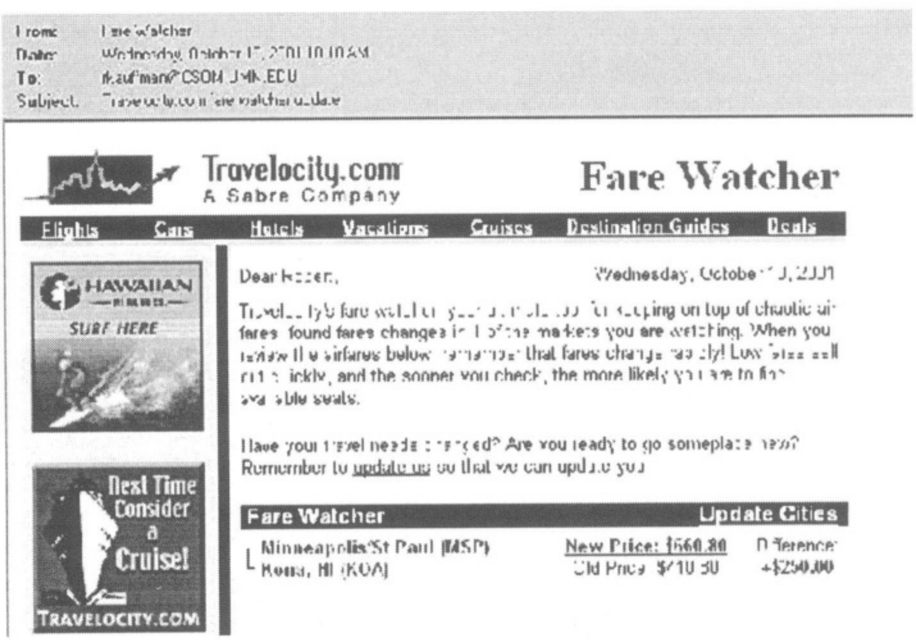

Figure 6. Broadcast Email to Provide Current Ticket Pricing on Travelocity.com for Hilo, HI (Source: Email message from Fare Watcher at www.travelocity.com, October 10, 2001.)

The Fare Watcher facility provides an at-a-glance overview of up to a set of six pre-specified city pairs for which the traveler wishes to track prices. This potentially offers *informational currency,* so long as the consumer visits the Web site. The real opportunity is to provide current information for this class of researched goods in a way that causes the consumer to visit the Travelocity Web site. The firm does this through a related capability, Fare Watcher's email broadcasts, which provide an update for the consumer when prices change based on a set of preset price change (e.g., when the fare goes down by $25, or when the fare goes up or down by $25, or when the fare goes below some criterion price set by the user—for three or six months, or indefinitely, for example). This extension into a second medium for service capability reflects careful consideration by the operator of the Travelocity Web site of the attributes of the product purchase decision that need to be considered by the traveler. (See Figure 6.)

In spite of the decision support capabilities for the purchase of airline tickets that we have illustrated, we recognize that there are far fewer high quality facilities to support consumer behavior when memory capabilities become important. For example, consumers of airline tickets are known to have different preferences when it comes to choosing the final specification of the flight arrangements that they make (Clemons et al., forthcoming). Some travelers may seek lowest prices, some gauge the "hassle factor" associated with intermediate stops en route to a destinations or the benefits associated with balanced travel durations in a flight that cannot be made without a stopover. Still others appreciate convenient arrival or departure times and the opportunity to accumulate frequent flyer miles. Even though decisionsupport for filtering such decision variables does exist, current OTAs do not make much of an effort to keep track of the decision preferences of the customers.

The extensions are relatively obvious, and probably are quite simple to implement (though the return on investment, **ROI**, may not warrant it at the moment), assuming that the OTAs are willing to make use of historical ticket purchase information that must be available in their databases. For example, additional database access could provide the basis for new functionality that may enable OTAs to keep track of a customer's previous ticket purchase history. From this, the OTA would be able to infer what decision variables the customer values most and present the results of flight searches according to these preferences, while at the same time providing the traveler with an ability to dynamically change the preferences. This is somewhat analogous to the general thrust of collaborative filtering technologies, whose data mining capabilities tend to rely more on prior observed consumer behavior as a predictor of current purchase preferences, as opposed to modeling the psychological fundamentals of product selection. Such memory support would significantly reduce the amount of effort in the purchase process, and enable the airline to figure out what the consumer wants to buy, without forcing her to specify a general set of preferences that may be imperfectly or inappropriately applied in specific product purchase setting. This kind of approach, again, will increase the consumer's return on information foraging for purchasing airline tickets.

REPLENISHMENT GOODS

SimonDelivers.com (www.simondelivers.com) is a Minneapolis, Minnesota-based online retailer of groceries. As with almost all other online retailers of replenishment goods, SimonDelivers.com's Web site features a catalog of products categories. They include such categories as fresh produce, deli items, bakery goods and dairy products. Customers can browse the categories to find items they wish to purchase, and also use a search engine that retrieves items based on their input of pre-specified keywords and synonyms of the keywords. These basic navigation aids allow customers to identify and select grocery items to purchase.

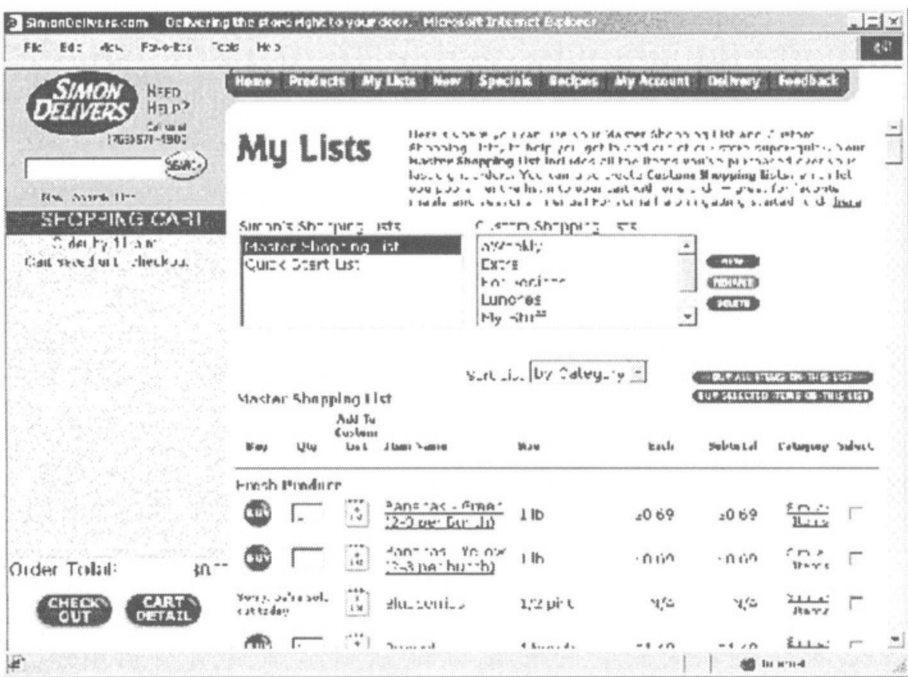

Figure 7. Personal Shopping Lists at SimonDelivers.com
(Source: www.simondelivers.com, October 15, 2001.)

In addition to the basic navigation aids, the SimonDelivers.com Web site also features specialized categories that enable customers to identify potential items to purchase. For example, the Specials section features items on sale, and these typically catch the shopper's eye and induce profitable impulse buying. The Seasonal section lists items related to seasonal events and activities (e.g., grocery items for preparing Thanksgivings dinner). The Recipes section presents the consumer with meal recipes, and offers the ability to put all (or just some) of the ingredients into the customer's virtual shopping cart. The virtual shopping cart at SimonDelivers.com also keeps track of the multiple visits that its customers make, and the contents of the cart are always saved until a checkout occurs.

Finally, a unique feature of the SimonDelivers.com web site is the "My Lists" section. (See Figure 7.)

This section lists all items that a customer has purchased over her eight last orders. Customers may also create and save Custom Shopping Lists with any number of items. All items in these lists may be put into the shopping cart with the click of a single button. For example, a customer may create her own personal Party Items List with all of the items she usually buys when she prepares to have a party at her house. So, when the opportunity to host a party occurs, she can purchase all of her pre-specified items with just a single click of the mouse.

We characterize the purchasing scenarios for replenishment goods, such as groceries, by a low level of customer involvement in repeated purchase situations. The interface support that we observe for this kind of consumer behavior seems to conform well to the predictions of our proposed framework. We previously argued that with replenishment goods, the nature of support should be focused on product identification and memory. The specialized categories (Specials, Seasonal and Recipes sections) allow consumers to browse through the site to identify items that they may need. Indeed, most consumers do not have a fixed shopping list when they contemplate purchasing groceries. Rather, grocery shoppers use the physical aisles in a store as external memory aids in lieu of written shopping lists. In addition, the support for specialized categories offers multiple ways to make information search more effective. For example, a customer may be motivated to go grocery shopping by an upcoming event (e.g., Thanksgiving dinner or a New Year's Eve party) or the everyday need to prepare dinner for the family. The Seasonal section may prompt the identification of necessary products for the upcoming event by the customer, whereas browsing through the Recipes section will help him to decide what to prepare for dinner and purchase items as part of a meaningful meal, rather than on a one-off or individual basis.

The memory features of the site also seem to readily support the repetitive nature of grocery replenishment. For example, the contents of customers' grocery carts are typically very similar across different shopping sessions—people tend to purchase the same items over and over again. The

Historical List, by keeping track of a customer's previous orders, allows the customer to swiftly fill his cart with the regular items. In addition, the contents of the current cart that are saved until checkout allows customers to fill their shopping carts intermittently, rather than having to spend a lot of time and effort in filling out orders in a single session (only to find out that he forgot to order the milk!). Customers can log onto the site regularly as the need for one or several items arises (e.g., the shopper's children drank the last of the milk) without being pressured to fill out a full order ever time he logs on. This significantly relieves the mental effort that the customer has to make, and, consistent with the theory that provides the foundation of our framework, should increase the return on information foraging for grocery purchases.

This is not to say that the SimonDelivers.com Web site is without limitations. Even though the firm provides the various specialized sections, the customer must purposefully visit those areas within the Web site in order to the appropriate identify items to purchase. Less obtrusive recommendations, as we saw with Amazon.com for books and CDs, may increase the customer's return on information foraging for this Web site.

EXTENSION OF THE PROPOSED FRAMEWORK TO OTHER PRODUCT CATEGORIZATION TERMS

In the earlier part of this section, we applied our framework to gauge the value of systems design in e-commerce retail applications for traditional product types. However, in order to ensure the applicability of the framework, we need to see if the framework still holds and offers similarly interesting insights for a broader range of Internet-based selling scenarios. In the following discussion, we extend the application of the proposed framework to Internet-based selling of information goods and also of services, as opposed to physical and tangible goods. In other words, can we also relate to the three purchasing scenarios of convenience goods, researched goods and replenishment goods when we think about buying information goods or intangible services?

Support for Internet-Based Sales of Information Goods Versus Physical Goods. Information goods are content goods such as data (e.g., a stock quote), documents (e.g., an e-book, a news article), images (e.g., maps), audio clips (e.g., audio on demand), video clips (e.g., video on demand), software applications, etc. Information goods are typically in digital format and, hence, are characterized by a near zero marginal cost of production. This is because once an information good is produced, reproduction can be freely accomplished through duplication (Shapiro and Varian, 1999). Given this property of information goods (i.e., near zero marginal costs), the literature has recognized various selling strategies, such as versioning (Shapiro and Varian, 1998) and bundling (Bakos and Brynjolfsson, 2000). Even though such strategies are important considerations of the firm given the particular cost structure of information goods production, we opt to focus on the consumption—rather than production—of information goods from the point of view of consumer purchase processes.

One of the important characteristics of information goods from the consumer behavior perspective is that most information goods are experiential as opposed to descriptive. *Descriptive goods* are those where the quality of the product can be verbally explained, whereas *experiential goods* are those that need to be consumed in order to gauge their quality. For example, it is difficult to judge the quality of a book with only information on the cover without actually having read the contents of book. This has important consequences when we consider the consumer purchase decision-making process. For example, we have argued above that one of the important stages of the consumer purchase decision making process is product evaluation where the consumer forms her attitudes toward the quality of the considered products based on her perceptions about products' attributes. However, when the product in question is an experiential good it becomes very difficult for the consumer to form accurate perceptions of the quality given that she has not had the chance to consume the good. Hence, an important information requirement or information goods, characterized by their experiential nature is the ability to try the good out. It is interesting to note that a lot of e-commerce Web sites selling information goods are practicing such free-trial strategies. For example, software companies such as ACD Systems (www.acdsystems.com) allows customers to download a trial version of their product ACDSee for limited usage so that customers may try the software before purchasing it. Similarly, EMusic (www.emusic.com) makes short second audio clips downloadable (or directly playable via Web browser plug-ins) so that customers may listen to the songs before they actually decide to purchase and download the full music clip.

In order to evaluate the robustness of our proposed framework we need to verify whether the product typology developed for purchasing scenarios (convenience vs. researched vs. replenishment goods) also apply to information goods. *Convenience goods purchasing scenarios* are characterized by low involvement and one-time purchase. The purchase of music clips (e.g., MP3 files) online fall into this product category. Again, the major problem with convenience goods, whether they are physical or informational, is that there is a great variety in the selection of products and since most purchases are one-time purchases, it is difficult to know which specific product the consumer will want. Hence, again we anticipate that e-commerce application support for such scenarios would be one of *identification.*

Researched goods purchasing scenarios are characterized by a high level of involvement in a single-purchase situation. The purchase of downloadable software falls into this category. The high level of involvement results in a great extent of information processing (e.g., information search, systematic product evaluation, etc.). Here the experiential nature of information goods becomes problematic . So decision support for product evaluation would be of great value to consumers. Since the best way to convey the quality of information goods is to have consumers actually use products, we anticipate that free trials or samples would be provided to support product evaluation.

Replenishments goods purchasing scenarios, by definition, involve multiple purchases of the same good. However, given that information goods do not perish even when they are consumed, the consumer will not engage in repeated purchase situations. For example, when a customer buys a music clip, she does not have to purchase it again when she wants to listen to it again. Hence, the replenishment good purchasing scenario may not readily apply to information goods. However, another way to think about replenishment purchasing scenarios in the context of information goods is to change the level of abstraction of the consumer need. The replenishment may be for a consumer need (e.g., to keep up to date with current news) instead of for a particular product (i.e., a particular news article). With this interpretation of replenishment, our framework can be readily applied. For example, Internet portals such as Yahoo! (www.yahoo.com) allows users to personalize information content with MyYahoo! (my.yahoo.com). The user can specify what types of news content to display (e.g., financial news, software industry related news etc.) so that whenever the user visits the Web site, only news of potential interest will be presented. Providing such personalization capabilities greatly alter the return on information foraging for the consumers. However, this can be a double -edged sword: personalization may increase the rate of gaining valuable information, but only at the increased costs of setting up the personalized site.

Internet-Based Sale of Goods Versus Services. The service marketing literature differentiates services and goods in terms of "four I's":

intangibility of services, *inseparability* of service production and consumption, *inconsistency* in output, and the inventory problem due to perishable service production capacity (Zeithaml, Parasuraman and Berry, 1985). Some of these conceptual differences may no longer apply due to changes in the nature of production, especially for e-services (i.e., services provided electronically over the Internet). For example, most e-services can provide consistency in output since the services are programmed as algorithms. As a result, the service providers are software programs instead of human customer service representatives. Additionally, given that electronic service software applications are built to synchronously handle multiple users the inventory problem dissipates in the e-commerce context.

However, the intangibility of services as well as the inseparability of service production and consumption still apply in the electronic context and should have an impact on consumer behavior in service purchasing scenarios. One of the consequences of intangibility of services is that it becomes difficult to describe the quality of the service, as was the case with information goods as experiential goods. However, since services are tailored to specific customer situations and there is a need for customer involvement in the service production process (Zeithaml et al., 1985), it also becomes difficult to produce and have available generic "trial" versions of services so that consumers may explore and gauge the quality of the service.

Does our framework as it was originally developed for traditional tangible goods also hold for Internet-based sale of services? In other words, can we expect to observe similar purchase scenarios in terms of convenience purchasing, researched purchasing and replenishment purchasing scenarios in the context of services offered online?

We have mixed feelings about this. First of all, the environment for Internet-based selling of services may induce very different consumer purchase scenarios than that for tangible or information goods. One of the underlying assumptions of our framework is that there is a great amount of information (e.g., number of products) that requires effort minimizing and return-maximizing decisions from the consumer. However, this assumption may not hold for Internet-based selling of services. It is difficult to find examples where a great amount of different services are available to the consumer where the consumer has to choose which service to use. Rather we see mainly service providers offering a handful of different variations of services at specialized e-commerce sites. As a result, the problem of information search becomes a process of searching for the e-commerce site that provides the right service and not trying to find the right service within a given site.

Since we are approaching the systems design value assessment framework from the perspective of the e-commerce firm (i.e., given a product or service that we offer, what types of purchasing behaviors are we likely to observe and how do we design the Web-based application so that return on information foraging for such scenarios within my Web site is maximized?), it becomes difficult to apply our proposed framework to issues related information search and identification of consideration sets. However, the parts of the framework related to the other stages of the consumer purchasing behavior may still apply and offer valuable insights. For example, we have argued above that pre-purchase evaluation of service quality is difficult due to the intangibility of services and inseparability of production and consumption of services. So, e-commerce sites offering services would still require various forms of decision support so that consumers may indirectly gauge the quality of the service offerings. Since it is difficult to provide customized service trials without getting the customer too involved, one way to provide quality cues is to provide guided tours of service applications. Such support would walk consumer through the process so that they can envision whether the service will prove to be valuable.

Range of Applicability and Caveats Related to the Proposed Framework. The discussion of the extension of the framework to information goods and services opens up to some interesting discussions and insights related to consumer behavior in online environments as well as the design of Internet-based selling applications. The mini-case evaluations of Internet-based selling of physical goods and the extension of the discussions to information goods suggest that the framework adequately applies to these contexts. However, the framework does not seem to fit well with Internet-based service providers.

We observe, however, that the same underlying theoretical perspective of information foraging theory still applies even to Internet-based selling of services. Given the specialized nature of service providers, the consumer's information search process for services becomes mainly a search for the e-commerce site that provides the right service rather than a search for a particular service within a site. Hence, consumers can be seen to forage for information within a broader context: the Internet as a whole.

Figure 8. Mortgage Loan Service Purchase Support Capabilities at E-Loan.com (Source: www.eloan.com, October 25, 2001.)

One practical solution that seems to have emerged is various forms of *service intermediaries.* Consumers in search of particular services can now go to service directories which not only provide links to the actual service providers, but also decision support in finding the right service provider. An example of this can be seen among digital mortgage brokers, such as E-Loan (www.eloan.com) in the United States and The Mortgage Centre (www.mortgagecentre.com) in Canada. (See Figures 8 and 9.) E-Loan provides a constellation of decision support tools, as well as direct links to mortgage lenders. In the spirit of broader-based search support for services, E-Loan offers the E-Loan Marketplace, which acts as an aggregator for a variety of home service and product-related providers, through a series of partnership arrangements with other providers. (See Figure 10.) Such intermediary services are of great value to consumers since they increase the return on information foraging for services.

Figure 9. Mortgage Provider Rate Competition Search Support at The MortgageCenter.com (Source: www.mortgagecentre.com, October 25, 2001.)

In sum, we believe that the framework, although not directly applicable to all contexts, does provide insights into the value of e-commerce systems to the consumer. We are currently working towards more refinements in the framework so that a more direct application to the multiple scenarios of Internet-based selling is possible.

5. CONCLUSIONS AND MANAGERIAL RECOMMENDATIONS

The purpose of this chapter was to provide a theoretical foundation for thinking about assessing the value of systems design in the Internet-based selling context. Attaining a deep understanding of e-commerce and e-business is a complex endeavor, and the state-of-the-art in research has only scratched the surface of what managers really need to know. Our current research is a small step in this long journey for knowledge. E-commerce application design is still in its early stages, and so it is only natural that intuition and experimentation are the primary tools that are being used. We hope that through this chapter we have provided a more principled way of approaching e-commerce systems design for Internet-based selling.

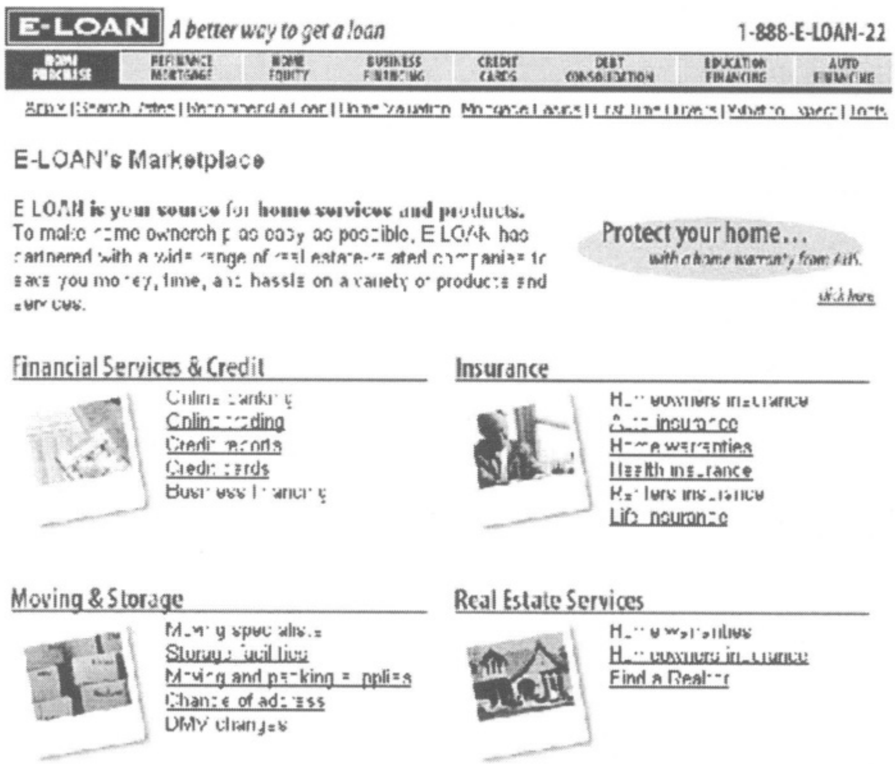

Figure 10. Provider Aggregation Across Related Home Services at E-Loan.com (Source:www.eloan.com/s/show/homeservices?linksrc=market&sid=UK_9Ykoictf84JPNZnVdAy6r2VE, October 25, 2001.)

CONTRIBUTIONS OF THE RESEARCH

This chapter offers three primary contributions to research that aims to provide a better understanding of how Web sites should be designed to support Internet-based selling. *First,* we offer a new interpretive framework for the analysis of the efficacy of design choices in Web applications that support Internet-based selling. Our framework brings to the foreground the importance of e-commerce application design and its implications on the return on information foraging activities conducted by the online consumer in Internet-based purchasing scenarios. This allows us to assess the value of various e-commerce application design choices based on the extent to which the application should support online consumer behavior. *Second,* we identify the rationale for considering online purchasing scenarios as a basis for the analysis of Internet-based selling systems support design choices. The nature of the product being sold online affects consumer behavior in online purchasing scenarios. We identify the important product characteristics (i.e., level of consumer involvement and repetitiveness of need fulfillment) that affect the various stages of the consumers' purchasing process. Based on the information requirements of typical consumer purchase scenarios for different product types, our framework allows us to identify the how e-commerce applications can support the various stages in the consumer purchasing process by virtue of their design. *Third,* we show a preliminary proof-of-concept test for the robustness of the proposed framework through its application to a set of mini-cases that involve the different product types in different product settings, through the analysis of design features in terms of the support that is offered by a Web site across the five stages of the purchase decision-making process. The mini-case analyses provide insight into what types of application support are effective (or ineffective) and also into the types of improvements that could be applied to various Internet-based selling scenarios. *Fourth,* we discuss the bases for the extension of the present framework to other related settings, including information goods versus physical goods, and goods, in general, relative to services. Although we recognize the importance of refining our framework to consider these additional kinds of Internet-based selling situations, we note that our work in these areas has only begun.

FIVE KEY FINDINGS FOR THE MANAGERIAL AUDIENCE

The primary managerial audiences for the results and recommendations that we offer in this chapter are senior managers of Internet-based selling operations, senior managers of software development, and software development project managers. Across these three responsibility levels within the firm, managers should recognize the importance of making sense of the normative guidance that our proposed framework and analysis offer. They include five key findings, as follows:

- **Purchasing scenarios determines the nature of the appropriate design elements for a Web site in Internet-based selling.** Consumer behavior theory posits that the nature of consumer need changes the information requirements in the consumer purchasing processes. Hence, different purchase scenarios for different product (e.g., convenience vs. researched vs. replenishment goods) have different sets of information requirements that need to be the focus of systems design activities.

- **Software support to enhance the sale of convenience goods on the Internet must focus on techniques that increase the consumer's ability to identify what they will purchase.** Convenience goods are characterized by a low level of customer involvement. Hence, consumers will not exert extensive information processing for such goods. The nature of software support for e-commerce applications dealing with such convenience goods should therefore be *identification.* The e-commerce application should try to minimize the amount of effort the potential buyer will expend in identifying the products that matches her purchase needs.

- **Support for the sale of researched goods on the Internet requires Web site design to emphasize capabilities that enhance consumer analysis and comparison, and consumer interaction memory re lative to the purchase task and product selection set.** Since researched goods are characterized by a high level of customer involvement in the purchase process, the consumer will exert a significant amount of information processing effort (e.g., more extensive information search and systematic rule-based product evaluation) in multi-session purchasing scenarios. Thus, software support for such products should help consumers to correctly evaluate the considered products so that the consumer will be comfortable that she has made the right final purchase decision. In addition, e-commerce applications need to recognize that consumers will revisit a Web site multiple times before making the final purchase decision. Thus, the site should remember the consumers' decision state and variables so as to reduce the amount of effort required to reactivate the purchase process.

- **Replenishment goods purchases on the Internet are best supported with Web site designs that emphasize the provision of tools and facilities that support identification and memory.** The consumer behavior with respect to replenishment goods follows a routinized response behavior due to the repetitive and frequent nature of purchasing. The consumer's satisfaction with the initial purchase of a product will be the key determinant of repurchase. At the same time, brand switching is also likely to frequently occur. So online retailers should facilitate the identification of previously purchased products, as well as alternative products that match the consumer's needs.

- **To conceptualize the effectiveness of the design of a Web site that supports Internet-based selling, managers should recognize the importance of the customer's return on information foraging as a**

driver of its ultimate business value. As we have argued for the various purchasing scenarios, the nature of e-commerce application support ultimately converges to how the e-commerce application design can support the consumer purchasing process. The goal is to minimize extraneous effort on the part of the consumer while at the same time maximize the amount of valuable information required for consumers to make purchase decisions.

DIRECTIONS FOR FUTURE RESEARCH

Research related to effective systems design for e-commerce and value assessment of e-commerce applications is still in its infancy. Further research in this area is greatly needed to deepen our understanding of the impact of systems design on online consumer behavior, as well as to provide senior managers in e-businesses useful guidelines for managing their online operations. We end the chapter by discussing some of the directions for future research, both in terms of additional theoretical development as well as empirical extensions to this work.

Theory. In terms of additional theoretical development, further research is needed to refine the underlying theoretical perspectives. *First,* the consumer behavior component of our framework was used at a very high level of abstraction. We considered the major dimensions affecting the various stages in the consumer purchase processes, however, the other dimensions relevant to Internet-based selling scenarios may also prove to be important in differentiating various consumer purchase behaviors. For example, whether the e-commerce site deals with specific brands or is an intermediary dealing with a variety of brands would also induce different consumer purchase processes. We have observed some caveats in applying the framework to Internet-based selling of information goods and of general services. Additional theoretical dimensions need to be included so that the robustness of the framework is ensured across a wider range of e-business scenarios.

Second, our framework applied information foraging theory in a very descriptive manner. The original theory comprises very detailed models of information seeking behaviors in terms of *information patch models* that deal with how information seekers allocate time and effort when foraging for information across and within Web sites, *information scent models* that treat how information seekers assess the value of information from proximal cues, and finally *information diet models* that frame how information seekers decide to pursue information items. The framework could be extended to apply the details of the information foraging models to provide insights into the optimal design given various purchasing scenarios. *Finally,* the proposed framework is currently useful in providing interpretive insights into the value assessment of systems design for e-commerce. Further research from the business value of information technology perspective are required in order to provide a more sound basis for senior manager decision making. The development of formal metrics for the assessment of business value of systems design would prove to be valuable in this regard.

Empirical Analysis. In terms of empirical extensions to this work, there are a lot of areas where empirical investigation can be valuable. *First,* an important area for empirical investigation concerns the measurement of return on information foraging. Even though the notion of return on information foraging is conceptually intuitive, we need to devise ways in which this construct can be empirically measured. *Second,* one of the fundamental hypotheses of information foraging theory is that information seekers will adopt information access systems that yield the greatest return on information foraging. In other words, in the e-commerce context, consumers will ultimately adopt and migrate to Web sites that provide designs that maximize the return on information foraging for consumer purchase behaviors.

However, this assertion is yet to be empirically validated. A further extension to this hypothesis is that Web application designs that maximize return on information foraging can thus be a source of switching costs and consequently competitive advantage. It would be fruitful to investigate whether the adoption of online retail formats follow these prescribed patterns. In empirical terms, we need to link the immediate impact of systems design (i.e., return on information foraging) to business value. Ultimately, we would like to estimate the business value of systems design activities. Can we anticipate changes in consumer behavior due to design changes? Can we measure the impact of behavioral change on business performance? Will the change in systems design lead to greater adoption, more frequent use, greater purchase quantities, etc?

We would like to end with a final note emphasizing the importance of interdisciplinary research in this area. Theoretical perspectives from marketing (consumer behavior), human-computer interaction (information foraging) and information systems (business value of information technology) were all were brought together in the construction of our proposed initial framework. Indeed, the Internet and e-commerce is a rich domain where multiple theoretical perspectives are required to paint a convincing picture. We call for researchers to join forces across disciplinary boundaries and develop shared perspectives to contribute new insights.

Notes:

1. A particular product type may fall into different scenarios. For example, the purchase of a book can be regarded as being a convenience good purchasing scenario if the consumer is looking for a book for personal entertainment, however, it may be regarded as being a researched good purchasing scenario if the goal of acquiring the book is for precise reference. A professor trying to purchase a book to use as a textbook for her class will want to know exactly what the book is about before adopting it. She will want to know what topics are covered in what depth, what topics are not covered, the quality of presentation, etc. Hence, the purchase process will be a researched good purchasing scenario instead of a convenience good purchasing scenarios. Even though the focus of our discussion is on purchasing scenarios, the discussion will be centered on product types. This is because it is easier to relate to products types to infer the typical scenarios involved with the product.
2. We are not implying that these are the only dimensions of products that affect consumer behavior. Other factors of interest may include whether the e-commerce site deals with specific brands or is an intermediary dealing with a variety of brands, whether the e-commerce site deals with products or services and so forth. We only include two dimensions of level of involvement and frequency of need fulfillment for parsimony, since these dimensions have been shown to be major differentiators of various consumer behavior processes.
3. More information on "Listmania Lists" can be found at www.amazon.com/exec/obidos/tg/browse/-/542566/.
4. However, this support for product evaluation is somewhat limited in that consumers must mentally perform comparisons. Unfortunately, the comparison tables do not include decision support aids such as sorting or filtering.

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Chapter 11

Initiatives for Building e-Loyalty: A Proposed Framework and Research Issues

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Abstract: The purpose of this paper is to examine how online retailers can create loyalty among consumers. Despite growth in sales, Internet retailers are finding consumer loyalty to be an elusive goal. The recent spate of failures among online retailers suggests that engendering consumer loyalty is difficult. Lacking personal relationships between sales associates and customers, many Internet retailers are seeking technical solutions to the problem of building loyalty. Examples include designing user-friendly Web sites, incorporating personalization and customization software, building secure transaction platforms, incorporating privacy features, providing search functions, creating communities, and instituting online loyalty programs. This paper examines how the "investments" of online retailers affect consumer e-loyalty, explores their relative importance in creating e-loyalty, and investigates how they relate to or interact with traditional relational variables such as trust, satisfaction and value. It also presents a conceptual framework for research on e-loyalty and identifies key research questions for studying e-loyalty.

Key words: Consumer loyalty; Internet retailers.

1. INTRODUCTION

In a span of just five years, the Internet has emerged as an important channel for retailing. As of February 2001, the number of active Internet users had increased by 6.6% over the previous year, while the number of individuals with access to the Internet had risen 5.6% (Nielsen/Net Ratings, 2001). The total number of minutes spent online increased by 51%, with in-home usage increasing more than in-office usage. In 2001, the number of people online is expected to increase by an additional 13% (Jupiter Media Metrix, 2001). Among Internet users, online shopping has become a key activity.

Despite impressive growth in the sales of e-retailers and the enormous popularity of online shopping, e-tail profits have been elusive. Guided by the industry maxim that it is more profitable to maintain loyal customers than to attract new customers, e-retailers are refocusing their marketing efforts from customer acquisition to customer retention. They are seeking desperately to engender *e-loyalty,* with the related goals of capturing lifetime customers and achieving long-term profits.

The spate of closings among online retailers in 2001 suggests that engendering consumer loyalty is difficult. Industry sources report disloyalty is "rampant" among Internet shoppers, who are " roaming disloyally " from one site to the next. In any retail format, building customer loyalty is important. However, in the online environment it is critical, because many of the inertial elements that captivate consumers in a "brick and mortar" retail environment are absent. Online consumers are mere "clicks" away from shopping bots, which allow them to compare prices, and the Web sites of numerous competing retailers. Thus, online consumers may be more easily distracted than off-line consumers. However, e-loyalty is worth pursuing because e-loyal consumers visit the Web sites of their favorite retailers more often, spend more time shopping, and spend more money than those who are disloyal. Thus, e-retailers are focusing on ways to establish "dialogues" with online customers that may lead to relationships, customer retention, and loyalty (Harvard Management Communication Letter, 2000).

E-loyalty, which means establishing a long-term relationship with an online customer, involves the difficult task of "humanizing digital loyalty" (Reid Smith, p. 21). How does an e-tailer achieve a relationship through a machine? In order to engender such a relationship, companies have adopted numerous technical solutions, such as improving Web site design, setting up secure transaction platforms and privacy features, creating chat rooms, and incorporating personalization and customization software. They are embarking on initiatives such as Customer Relationship Management (CRM), online communities, permission marketing, and privacy management.

This paper has two purposes. First, it describes the benefits of e-loyalty, and discusses the different "investments," including technical solutions and technology-based initiatives, that e-retailers are making to build e-loyalty. It examines, in light of extant research on loyalty, the potential of such solutions and initiatives to create e-loyalty. Second, it presents a conceptual framework for e-loyalty in which the antecedents of e-loyalty are linked to traditional relational variables such as trust, commitment and value. Key research questions are identified, the answers to which may give insight into the process of creating e-loyalty.

2. E-LOYALTY

E-loyalty can be defined as a customer's commitment to, and intention to repatronize an online business. The concept of loyalty has two dimensions – attitudinal loyalty and behavioral loyalty (Dick and Basu, 1994; Dorsett, Durand and Kannan 2000). Attitudinally, e-loyalty can be defined as the strength of the online customer's commitment to an online business, how positively the customer feels about it, and the strength of the customer's intention to repurchase. On the behavioral side, e-loyalty can be defined by the actual frequency and volume (cumulative sales) of the customer's purchases, and by the extent of positive word of mouth he or she generates. The results of research show that e-loyalty translates to more time spent at a Web site (Lake 2000), presumably leading to higher cumulative sales.

In the early days of the Internet, companies were concerned mostly with acquiring customers. However, the cost of acquiring new customers is higher than the cost of retaining them. Thus, loyal customers are more profitable than newly acquired customers; as their cumulative sales volume rises, the cost of serving loyal customers falls (Reichheld, 1996). When considering the benefits of retention, it is also important to note that Web customers tend to consolidate their purchases at one site (Reichheld and Shefter, 2000).

Recent studies provide compelling evidence regarding the importance of e-loyalty. Many e-retailers are currently spending more on customer acquisition than they are likely to make from the customer. Less than 5% visitors to e-tailer Web sites purchase, yet companies spend an average of $250 on marketing and advertising to acquire a customer. In addition, two-thirds of first time visitors never return to the Web site. A study of online apparel, groceries, and electronics shoppers by Mainspring Communications Inc. and Bain & Co. found that e-retailers have to retain a customer for at least twelve months to break even and that online grocers have to retain shoppers for eighteen months to recoup the $80 customer-acquisition cost. However, repeat customers spend more over time, and refer significantly more people to a Web site (Lehman, 2000b). Thus, loyal customers offer benefits beyond their own purchases. The online "click of mouse" referral travels faster than traditional word of mouth, as customers can email links instantaneously to an unlimited number of friends. Loyal customers also help reduce selling costs, as well as the cost of help-desk and support staff, because referred customers tend to rely on the friend who referred them for help in using Web sites (Reichheld and Shefter, 2000).

Another significant advantage to customer retention lies in the fact that a large segment of online customers seek convenience, not price. This segment has a strong incentive to repeatedly visit a Web site, because returning to a familiar site is easier than finding a new one. Another large segment of shoppers is motivated to purchase by brand and seeks long-term relationships with their favorite Web sites. Reichheld and Shefter (2000) indicate that many "loyalists" find sites through referrals. On the other hand, cherry-picking, price-sensitive customers are attracted to sites by advertising (banner ads) and promotional discounts. The key question is what types of Web technologies, if any, help create and reinforce e-loyalty.

3. WEB TECHNOLOGY INVESTMENTS

E-retailers are experimenting with technology-based initiatives as a strategy to engender online customer loyalty. These initiatives are directed toward personalizing and customizing the shopping experience, implementing loyalty programs, establishing online communities, and managing customer privacy.

PERSONALIZATION AND CUSTOMIZATION

The assumption behind personalizing and customizing the shopping experience is that, in the new economy, the relationship between the e-retailer and the customer matters as much as the product being sold. Thus, technological innovations matter only if they are consistent with the best interest of customers.

Personalization and customization initiatives focus on using technology to create value for customers. Successful e-retailers target these initiatives at their most profitable customers. The goal is to develop loyalty by creating value and earning the trust of *selected* customers for whom they can deliver superior performance (Reichheld and Shefter 2000). Some e-retailers are using technological tools such as data mining to identify their top customers and create value for them through personalization and customization. For example, in services retailing, Chase routinely analyzes its website transactions, as well as its ATM, phone, and teller transactions, to target 3.5 million customers who may some day be millionaires (Rafter 2000).

Although, the terms "personalization" and "customization" are used interchangeably, they are distinctly different. Customization involves targeting customers as part of a group or segment. Marketing communication and offerings are customized, in that they target a segment with which the customer identifies. Personalization, on the other hand, involves one-on-one, direct marketing, which is based on collaborative filtering or preference data collected directly from the customer. By combining rules-based data (mass customization) with collaborative filtering (personalization), customer needs can be anticipated quite effectively (Reid Smith, 14).

The prevailing wisdom regarding personalization is that online retailers can use their extensive customer knowledge to establish loyalty-based customer relationships. Customers benefit from a personalized experience, and develop an "emotional attachment" to a Web site. This creates "stickiness," which results in repeat visits. A good example of personalization is Hallmark.com's date reminder service, which allows users to create a list of birthdays and anniversaries and receive prompts to send cards (Clarkson, 2000). By personalizing the online shopping experience, the e-retailer exceeds customer expectations, leading to e-loyalty.

On the flip side, there is some skepticism about the ability of technological initiatives to foster personalization. Relationships are built with people, not machines (Billington, 1996). Most attempts to gain loyalty by personalizing and customizing the shopping experience are based on technological gimmicks, which are mere proxies for a personal touch. Ultimately, such "tricks" lack the intimacy required for establishing a relationship with a customer (Barlow, 2000b). These attempts may also infringe on customer's privacy rights, leading to distrust and not loyalty.

LOYALTY PROGRAMS

Loyalty programs are both barriers to customer switching and rewards to customers for frequent shopping and high purchase volume (Dowling and Uncles 1997). As customers transact with an e-retailer, their switching costs increase, making it harder for them to defect. Empirical evidence suggests that "hoppers" are happy to return to a site if they are offered incentives

(Lake, 2000). Some suggest a “freebie” culture pervades online shopping, because the Internet was originally a “commercial free initiative.” Thus, customers expect to be offered incentives for shopping on the Web (Sindell 2000). However, while discounts, incentive programs, and points attract customers to a site, they do not translate into loyalty. At best, they keep customers coming back in the short-run, with no long-term commitment. Simply put, "short-term loyalty can be bought (but) long-term loyalty must be earned" (Reid Smith 2000). Loyalty programs may encourage “adverse selection”, attracting to a Web site the least profitable, most deal-prone customers.

Recent surveys suggest that many online loyalty programs do not create e-loyalty. A report by Jupiter shows that 75% of online shoppers participate in some type of a loyalty program, but few (22 %) find it a motivator to increase purchases. Rather, they value easy returns (40 %), customer service (37 %), and product selection (37 %) Jupiter Media Metrix 2000; Meehan 2000).

Traditional online loyalty programs are proving ineffective, because customers enroll to avoid leaving “freebies” on the table. Loyalty programs work best when they address both rational and emotional components of loyalty – in other in words, "reward and recognition". Most loyalty programs have ignored recognition, while reward has been addressed superficially, with little regard to perceived value. Customer loyalty to a program does not depend on points, if customers are all treated the same. Rather, it is depends on unique and differentiated products or levels of service that make consumers feel “special”. Consumers should receive tangible value for being loyal, whether by priority service, personalized offers, or e-mail updates. E-retailers should not rely on incentive programs to drive loyalty. Rather, they must add value to their service or face losing customers to competitors (Jupiter Media Metrix, 2000).

ONLINE COMMUNITIES

Many analysts argue that to create e-loyalty, e-retailers should build online communities, generally citing the example of E-bay and how it has benefited from the network effect (Shook, 2000). While little is known about how to translate communities into loyalty, an examination of some successful efforts proves useful. One good example is the online community created by Amazon.com, through its reader reviews and interest groups. Customers share product reviews, engage in discussion forums, and compare notes on experiences with products. Participants return to the site because they have come to depend on its information and services (Mitchell, 2000). Moreover, they enjoy helping other consumers by sharing their own information. In such communities, customers create value for each other. Participating customers benefit from being recognized as a member of the community, and from the satisfaction of having contributed time and effort to a communal cause. The positive affect engendered by the community may enhance perceptions of the e-retailer, and create conditions for e-loyalty.

The ability to create, sustain and leverage an online community is a significant and powerful marketing tool for an e-retailer. An online community is a valuable source of "viral marketing;" a few simple "clicks and strokes" allow customers to send "...e-mail referrals and shared benefit offers to dozens, even hundreds of acquaintances" (Barlow, 2000a). However, the e-retailer cannot control this process. An e-retailer may create a chat room in which customers exchange information on their experiences, but the company cannot control whether this information is positive or negative. On the one hand, an e-retailer's willingness to make itself vulnerable to negative comments may enhance customer trust. On the other hand, any attempt to stifle or control comments may lead to distrust. In this sense, an online community can be a double-edged sword that has to be managed carefully to yield the intended effect. Given that building an online community is expensive, it is imperative that there is a critical mass of customers to "seed" the community, and that it fits into the e-retailer's overall business plan (Bertagnoli, 2001).

PRIVACY MANAGEMENT

The main issue in achieving customer retention and loyalty is trust (Janoff, 2000). In an online environment, gaining the customer's trust is difficult because there is no human contact, and there is no physical store presence. In an online shopping environment, customers have to take a "leap of faith," by relying on images and promises. When customers trust an online retailer, they are more likely to share personal information. This, in turn, allows the e-retailer to personalize its service, which should reinforces trust and create value for the customer. An example is Amazon.com, which dominates the online book industry because it is perceived as trustworthy. Customers allow Amazon to store sensitive personal information and credit card numbers. In exchange, Amazon allows them to purchase with "one-click." Many customers return because they both trust Amazon and perceive that it offers them the benefit of convenience (Reichheld and Shefter, 2000). This leads to the important question of how online retailers can engender trust in *new* customers. Online privacy management is the answer.

In general, customers are skeptical about providing personal information to online retailers. In fact, only one of every 25 consumers is willing to provide feedback to online businesses. While this low rate may reflect consumers' time pressure or perceptions of inconvenience, it may also reflect distrust of e-retailers. One way for e-retailers to develop trust is to make privacy a priority, allowing consumers to control how much information they share. This means explaining up front how their personal data is gathered and used. Technology-based "opt-in" programs allow consumers to give permission to e-retailers to use their personal information (Blackshaw, 2000). Most e-retailers also have privacy and security statements that create trust by promising customers that their personal information is protected.

Targeted permission-based email marketing seems to be highly effective in bringing customers back to a site, giving e-retailers a chance to build loyalty (Elliott 2001). By giving permission to an e-retailer to send them information, customers ensure that they no longer receive "junk". This creates the perception that the e-retailer cares enough to avoid indiscriminately targeting consumers. A study by IMT research found that, while customers hate "spam" or unsolicited mail, they don't mind receiving mail from opt-in or permission-based programs. In addition to creating trust, a benefit to an e-retailer of permission-based marketing is that it doesn't waste time with customers who do not want a relationship with the company.

Thus, privacy management and practices affect loyalty by building trust. Privacy management is an indication to the consumer that the e-retailer cares enough to treat with them respect, give them special status, and recognize that they are individuals who have privacy needs. To the extent that e-retailers can use technology to personalize service while safeguarding customer privacy, they can build trust, which is essential to e-loyalty.

OTHER TECHNOLOGIES

Other online technologies focus on creating a "holistic experience" for customers as they shop at an e-retailer's site. The central tenet of "experience engineering" (Carbone 2001) as applied to e-retailing is to adopt technologies that "humanize" the customer's online experience with the e-retailer. Chatting online with customers is an example of such an initiative. E-retailers, such as Land's End, reckon that training service representatives to chat with customers while they browse through web pages will yield dividends. Such "conversations," which take place via a pop-up window, allow the e-retailer to "push pages" to its customers (Pressman 2000).

Technologies that improve customer e-service are at the top of experience management tools. Web site design and site navigation can play a critical role in enhancing the ease with which customers interact with Web sites. Technologies that quicken responses to customer inquiries and complaints, speed turnaround of orders, and deliver "real time" offerings provide "holistic" experiences for customers. Intangible, experience-based attributes of websites create value for customers and build e-loyalty. In the next section, a conceptual framework for understanding e-loyalty is presented. This framework explains how investments in technology create the above technological investments relate to customers' perceptions of relationship and, in turn, to customer loyalty.

4. A FRAMEWORK FOR E-LOYALTY

Loyalty is the desire of the customer to continue a valued relationship (Moorman, Zaltman and Deshpande 1992, p. 316). As defined in Section 2, "true" loyalty has two components – attitude and behavior. The problem with which online retailers must contend is that true consumer loyalty is best developed and maintained through personal relationships between sales associates and customers. The challenge, then, is to personalize the retail offering in a medium that is essentially impersonal. Technology-based initiatives such as personalization, customization, online communities, and privacy management are attempts by e-retailers to build relationships with their customers. The framework for e-loyalty models these technological initiatives as possible antecedents to the development of a loyal relationship.

Extant studies show that these may not be the only antecedents for loyalty. Some consumer surveys indicate that in addition to privacy, both information and user-friendliness (Donthu and Garcia 1997; Ernst & Young 2000, Fram and Grady 1995; Hoffman, Novak and Peralta 1999) are characteristics of online retailers that engender loyalty. In a recent survey of 1,000 online shoppers, both convenience factors (service, delivery, and ease of shopping) and price were rated as important drivers of e-loyalty (Wagner and Rydstrom 2000). Based on extensive focus group studies, Zeithaml, Parasuraman and Malhotra (2000) identified eleven dimensions of e-service quality that may affect customer loyalty to an e-retailer. These dimensions include reliability, responsiveness, quick access, flexibility, site aesthetics and ease of navigation, price information, and assurance/trust. In other survey-based research, privacy and assurance of security were identified as factors reducing perceived risk in online shopping (Frels and Kannan 2001).

In fact, shoppers indicated that they would be willing to pay a significant amount to ensure online privacy and security.

THE FRAMEWORK

The framework for e-loyalty is presented in Figure 1. E-relationship investments are related to e-relationship equity, which, in turn, determines e-loyalty outcomes. The e-relationship investments, which are derived from social exchange theory (Foa and Foa 1974, 1976, 1980), are characterized as *particularistic* or *generalized.* Particularistic investments meet individual customer needs for personalization, customization, community, and privacy. *Generalized* investments, which include navigation, information, price, and fulfillment, are closer to commodities. Relationship equity is composed of three characteristics of ongoing relationships: trust, value, and commitment (see Morgan and Hunt 1994; Holbrook 1994, 1999). E-relationship outcomes include behavioral intentions and actual behavior. Behavioral intentions include repeat purchase intention (RPI), willingness to share personal information (WSI), and intention to spread positive word-of-mouth (WOM). Actual behavior includes repeat purchase frequency and amount (RPB), cumulative sales (CS) to the customer, and retailer's share of customer sales (SCS).

E-RELATIONSHIP INVESTMENTS

In modeling the e-relationship investments, we have been guided by social exchange theory, which suggests that relationships develop when partners to an exchange perceive that they are gaining valuable resources, through relationship investments by their partners (Foa and Foa 1974, 1976, 1980). In an exchange relationship, resources can be classified by level of perceived *particularism,* the extent to which an exchange partner believes a resource is personalized to meets his or her needs. Resources high in particularism are those that are perceived by the individual to closely match his or her unique needs. Resources low in particularism are those that individuals view as commodities, meeting the needs of most consumers. In this paper, these are called *generalized* resources.

In the context of the framework, characteristics of online retailers that consumers should perceive to be high in particularism include personalization and customization, communalism, and privacy. As seen in the last section, personalization and customization initiatives seek to treat the customer as an "individual" with very specific needs. These initiatives could be perceived by customers as an effort by the e-retailer to understand the customer as an individual. In the same vein, privacy management practices seek to treat customers' privacy with respect, as something of value to the customer, and not as an information commodity. The community feature may be perceived by the customer as outlet for providing feedback that may be valuable to other customers. The customer may, in turn, receive useful information from others. The presence of the community feature may signal that the e-retailer values customers' comments and interactions, is interested in contributing to the good of others, and is willing to make itself vulnerable, which is a precursor to trust. While the community feature is available to all customers, it is up to the customer to tailor it to his or her individual needs. The construct of empathy may include investments by the e-retailer creating flexibility to meet customers' special needs. For example, special status may be accorded to customers through "preferred customer" programs.

Characteristics considered to be low in particularism include navigation, information, price, and fulfillment. These are resources that benefit all customers and form the basis for developing the resources of high particularism. A good navigation system allows customers to find what they want quickly and easily (Zeithaml, Parasuraman, and Malhotra 2000). Information includes data on products, services, prices, delivery, and order status, which enhances the customer's shopping experience. Prices are evaluated relative to competitors, which affects customers' perceptions of value. Finally, fulfillment includes reliable on-time delivery of products, and meeting the expectations for responsiveness and fulfillment.

The e-relationship investments map well with the "core" of the retail offering (low particularism) and the "extended" offering (high particularism) proposed by Berry (1995). Because the core of the retail offering is designed to meet the customer's basic shopping needs, we posit that characteristics low in particularism are necessary conditions for the characteristics of high particularism to have their intended effect. That is, if some of characteristics of low particularism are missing, they cannot be compensated for by characteristics of high particularism. The characteristics of low particularism may well dominate characteristics of high particularism, which is an open issue for research.

E-RELATIONSHIP EQUITY

The framework suggests that the immediate impact of the e-relationship investments is on "e-relationship equity," which is composed of the latent constructs of trust, value and commitment. In a conventional channel, these constructs are affected by interpersonal relationships and are pre-cursors to customer behavioral intentions (Garbarino and Johnson 1999). Thus, we expect that e-relationship investments will build e-loyalty through their effect on these latent intervening constructs.

In research on marketing relationships, the effects of trust, commitment, and value have been studied either in isolation from one another, or in pairs. There appears to have been no research in which all three relationship variables have been included in a single model. In a consumer context, the mediating effect of trust on consumer commitment has been established in the venue of entertainment (Garbarino and Johnson 1999). While perceived value has been studied extensively in the pricing literature (e.g., Monroe 1990), it has emerged only recently as a variable of interest in relationship marketing. As in the case of commitment, perceived value has been treated primarily as an outcome variable (Bolton, Smith and Wagner 2000). Considering our review of the relevant literatures, we expect trust and perceived value to mediate the effect of the online retailers' "investments" on consumers' commitment. Commitment should, in turn, mediate the effect of trust and perceived value on e-loyalty outcomes. An argument could be made that the e-relationship investment variables may impact perceived value directly, which in turn, may affect trust and commitment. This is an alternative path that could provide an equally justifiable model. Regardless, our central argument here is that trust, perceived value and commitment are "equity" constructs that are necessary antecedents to e-loyalty.

E-LOYALTY OUTCOMES

Our framework suggests a set of variables that capture the two components of "true" loyalty -- attitudinal loyalty and behavioral loyalty. The conditions of high trust, high perceived value, and greater commitment will lead to strong positive word of mouth (WOM), a strong desire to share more personal and preference information with the e-retailer (WSI), and a strong repeat purchase intention (RPI). All these outcome variables capture the attitudinal component of loyalty. The behavioral variables measure whether customers follow through on their intentions, through repeat purchase behavior (RPI), cumulative sales (CS) at the e-retailer, and the e-retailer share of the category spending (SCS) by the customer. The behavioral measures are important because they allow e-retailers to target the seemingly "loyal" customer, determine whether that customer is "truly" loyal, and calculate customer lifetime value. This is important because, in the short run, many marketing actions can create conditions of spurious loyalty – short term promotions, price cuts and freebies may create high behavioral loyalty without the attitudinal component. Positive word of mouth and strong willingness to share information are unlikely to develop without attitudinal loyalty, which, along with behavioral measures, presents a litmus test of "true" loyalty.

RELATED ISSUES

Our framework of e-loyalty provides a useful platform for examining research questions that focus on how relationship investments and equity contribute to building e-loyalty and stimulate other desirable relationship outcomes. The first issue of importance to e-retailers is the relative importance of e-relationship investments – the investments of low particularism that make up the "core" offerings of e-retailers vs. the investments of high particularism that make up the "extended" offerings. Are the core offerings sufficient, in and of themselves, to build relationship equity and e-loyalty? If not, which of the highly particularistic investments are most important? The answer is likely to vary by product category and industry; nevertheless, data collected based on the framework may provide valuable insights. We posit that e-retailer investments in resources of low particularism are necessary conditions for investments in high particularism to have any impact on equity. This proposition could be tested against the alternative that investments in highly particularitic resources may compensate for the absence (or failure) of some core offerings. It is also conceivable that the levels of core offerings could moderate the impact of high particularism on relationship equity and outcomes. Our framework provides the basis to test such competing hypotheses in specific e-retailing contexts.

Another related issue is the impact of loyalty programs on relationship equity and outcome. Loyalty programs generally suffer from the adverse selection problem. The framework may give insight into how to design loyalty programs that affect "true" loyalty. In a well-designed loyalty program, members of the loyalty program should exhibit significantly different outcomes as compared to those not in the loyalty program. Also, the outcome measurements of members who self-select loyalty programs may provide a clue as to how well a program works in minimizing the adverse selection problem.

The framework can also be used to understand the process of building e-loyalty, which is critical in determining when and how a customer should be targeted for relationship-building efforts. While investments in personalization and customization should have a positive effect on equity, it may be necessary for a customer to perceive a significant level of equity before sharing information about his or her needs and preferences. It is also possible that personalization and customization initiatives should be implemented only after investments in core offerings have successfully begun the process of creating relationship equity.

Many e-retailers are trying to use positive word of mouth to create value for customers. For example, Amazon.com has an initiative called "Share with a Friend," which allows the customer to recommend the product he or she has purchased to another friend. If the friend purchases the recommended product, he or she receives a discount. Moreover, the customer who recommended the product earns credit towards future purchases. Such reciprocal schemes leverage the outcome variable (WOM) to create higher perceived value (reinforcing loop) for the customer. A key question is, at what point in a customer relationship should this be offered? Analysis based on the e-loyalty framework could offer insight.

It is clear from our framework that e-loyalty reinforces itself. Cross-sectional studies over several discrete time frames could provide insight into the nature and strength of such reinforcement. It could also provide insights into how changes in relationship investments affect e-loyalty.

5. CONCLUSIONS

Sales of e-retailers are growing. However, profitability remains elusive because of low "e-loyalty" among consumers. One impediment to building e-loyalty is that machines, rather than people, mediate interaction between customers and retailers. The challenge to online retailers is to identify technological initiatives that are effective in building relationships with their customers. While many e-retailers are experimenting with such technology, the outcome of their efforts may be "spurious" loyalty -- that is, short-run repurchase behavior, with no long-term commitment to continue. Research is needed to determine how effective e-retailers' technology-based personalization and customization initiatives are in building true customer e-loyalty.

In the proposed framework, e-loyalty is presented as a process. The process begins with a set of relationship investments by the e-retailer that is offered to the target customer. These investments are evaluated by the customer, and contribute to the development of relationship equity, which stabilizes the relationship and drives it forward to the set of outcomes that comprise e-loyalty. Customers express e-loyalty through both behavioral intentions and actual behavior. The behavior of the customer can be observed by the e-retailer, and provides feedback for enhancing the mix of relationship investments.

The goal of the proposed framework is to generate ideas for future research on e-loyalty. From a scholarly perspective, the framework raises a variety of questions dealing with the moderating effects of particularistic investments on the e-retailer's "core" investments. It also raises questions about the mediating effects of equity variables, such as trust, value, and commitment on the development of e-loyalty. From a managerial point of view, the framework should help managers identify which investments are most effective in establishing relationship equity, and ultimately, creating "e-loyalty" among their online customers.

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Chapter 12

Web-based Recommendation Systems for Personalized e-Commerce Shopping

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Abstract: In an e-commerce environment, personalization has taken on an important role in improving service levels, and fostering customer loyalty. In addition, the recommendation systems techniques that support many personalization systems are capable of customizing the recommendation of products and the display of advertisements to the individual level. This chapter provides a review of the major recommendation approaches used in web-based personalization, and their associated techniques. Broadly, these recommendation systems can be classified into demographics-based, collaborative-filtering-based, association-based, and content-based recommendation approaches.

Key words: Personalization, Recommender System, Electronic Commerce, Content-based Recommendations, Collaborative Filtering Recommendations, Association-based Recommendations, Demographics-based Recommendations

1. INTRODUCTION

Personalization of the e-commerce shopping experience holds great promise for improving customer service, increasing both customer satisfaction and the efficiency of the customer interaction, and engendering customer loyalty to a particular e-commerce site. At the same time, the manner in which the information necessary for customization is obtained remains an important issue for many customers (Personalization Consortium, 2000). In this chapter we explore existing recommendation systems that support e-commerce personalization, with particular attention to their data requirements and the extent to which the data may be obtained unobtrusively from the customer.

Personalization of a web site in general involves any action that tailors the web experience to make it more responsive to a particular user or set of users (Cingil et al., 2000, Mobasher et al., 2000). For example, a portal may offer the ability for a user to define the content provided, the layout of the pages, and perhaps even the structure of the site itself, based on explicit choices made by the user (Mulvenna et al., 2000). At e-commerce sites in particular, personalization involves the provision of content and services to customers in an attempt to meet their specific wants or needs absent an explicit request (Mulvenna et al., 2000, Adomavicius and Tuzhilin, 2001). In the e-commerce setting, the personalization of content becomes much more involved, expanding not only to include personalized product recommendations and advertisement displays, but also the storage and retrieval of personal information necessary to support efficient order processing and customer communication. The personalization of communication processes may even extend to include user preferences for push, pull or passive delivery of information and recommendations (Shafer et al., 2001).

A critical distinction between personalization approaches involves the degree to which a customer is required to explicitly reveal preferences or personal information, as opposed to having them indirectly determined, typically by analysis of browsing and purchase patterns and other information revealed through observable behaviors. Mulvenna et al. (2000) characterize three types of personalization systems: checkbox, Collaborative Filtering, and observational. These illustrate the full range of levels of explicit customer participation in providing personalization data. The checkbox type, wherein a customer explicitly reveals preferences, is at one end of the spectrum, and observational systems are at the other end. Collaborative Filtering, along with a number of other techniques suitable for personalization, are between the two extremes, with their position depending, to a large degree, on the type of recommendation needed and the details of the implementation.

Amazon.com is widely regarded as a leader in the implementation of personalization for e-commerce. Amazon's founder and C.E.O. Jeff Bezos is fond of saying, as he did at the PC Expo in 2000, "If we want to have 20 million customers, then we want to have 20 million stores" (Ferranti, 2000). Amazon offers an extensive set of personalization features, ranging from product reviews to wish lists and trusted friend lists that a user may establish, to 'quick pick,' 'new for you,' and other sets of recommendations offered based on past purchase patterns. A number of these are voluntary –

anyone can write, read and rate product reviews or setting up a trusted friends list allows the user to view recommendations of those on the list. Other features are driven by a recommendation engine, which works primarily with purchase pattern data collected for all purchases, to deliver recommendations based on the purchases of 'similar' customers.

The purchase data used in personalization is regarded as a key corporate asset, and Amazon is one of the only e-commerce companies that has managed to leverage this customer data by tying it in with its supply chain (Eads, 2000). However, the collection and use of this data does raise some privacy issues. For example, Amazon has faced inquiry from the Federal Trade Commission over the use of the personal data it collects (Wolverton, 2000). Amazon also created a stir by appearing at least to experiment with personalized pricing schemes (Regan, 2000). Bezos takes pains though to point out that Amazon does not request demographic information, and that any paid recommendations placed on the site would be clearly identified as such (InfoWorld, 2000). Also, the data is, for the most part, collected in an observational manner, which wins praise from usability experts (e.g. Nielsen, 1998) for minimizing the work imposed on the user, a problem, for example, with the checkbox approach.

The terms personalization and recommendation systems are often used interchangeably, and indeed there is a large overlap between the two concepts. In the e-commerce arena, personalization encompasses all but a few recommendation techniques – excluding only those that make no use of personal information. For example, Amazon also offers best-seller lists, which are a way of offering recommendations that is not at all personalized (aside from recording the decision to view it). There are also significant personalization opportunities that are not specifically related to personalizing the recommendation of products or advertisements, for example, the automatic retention of shipping and billing information that underlies Amazon's patented one-click check-out system. However, the true complexity and expense comes in the area of overlap between the two, where methods such as Collaborative Filtering are implemented to provide personalized recommendations. It is in the selection and implementation of recommendation systems that the issue of data requirements and possible strategies for data acquisition come into play. In the remainder of this chapter, we classify the various recommendation systems in use in personalization systems, and present detailed descriptions of the models that underlie them.

2. RECOMMENDATION SYSTEMS FOR PERSONALIZATION

Many recommendation systems have been employed as methods for e-commerce personalization. Based on the type of data required, the extent to which that data can be acquired observationally (i.e., indirectly or unobtrusively), and the techniques used to arrive at recommendation decisions, we classify existing recommendation systems into the following types:

1. *Demographics-based:* This approach recommends items to a user based on the preferences of other users with similar demographics. Unlike other recommendation approaches in which recommendations are made at the item level, a demographics-based recommendation system typically generates recommendations at the more general category level. As such, this approach involves learning and reasoning with relationships between user demographics and expressed category preferences, where the expressed category preferences of a user are derived from individual user preferences stated previously and the category hierarchies of items.

2. *Collaborative filtering:* The collaborative filtering recommendation approach is also called social filtering or the user-to-user correlation recommendation approach. A collaborative filtering system identifies users whose tastes are similar to those of a given user and recommends items they have liked (Balabanovic and Shoham, 1997). Users of a collaborative filtering system share their opinions regarding items that they consume so that other users of the system can better decide which items to consume (Herlocker et al., 1999). With this method, user preferences are the sole input to recommendation decisions.

3. *Association-based:* The association-based recommendation approach relies on user preferences to identify items frequently found in association with items which a user has chosen, or for which a user has expressed interest in the past (Schafer et al., 2001). Item-associations can take the form, for example, of a set of items that have been rated as similar to a particular item, or of co-occurrence of items that users often preferred or purchased in common. Such item-associations, once identified, can then be employed to recommend items to users. For instance, the prediction of the preference score of an active user on an item can be based on the active user's preference scores over similar items.

4. *Content-based:* The content-based recommendation approach rests on the notion that the features of items can be useful in recommending items. It conforms to content-based information filtering that assumes that the degree of relevance (to a particular user) of an item can be determined by its content (represented by its features) (Alspector et al., 1998). The content-based recommendation approach tries to recommend items similar to those a given user has liked in the past (Balabanovic and Shoham, 1997; Herlocker et al., 1999). Thus, the features of items and a user's own preferences are the only factors influencing recommendation decisions for the user with this approach.

Table 1. Characteristics of Different Recommendation Approaches

Recommendation Approach	Information Used	Degree of Observational Information Acquisition
Demographics-based	User demographics, individual user preferences, and features of items (specifically, category hierarchy of items)	Low, direct revelation of demographic information required
Collaborative Filtering	User preferences	Mixed, user preferences can be observational or explicit
Association-based	User preferences	Mixed, user preferences can be observational or explicit
Content-based	Features of items and individual user preferences	Mixed to High, most information required relates to products, purchase history required.

Table 1 summarizes the characteristics of each recommendation approach, arranged in increasing order of degree to which observational techniques may be used in obtaining the data required. The type of recommendations may consist of a set of items from among those that have not explicitly been rated or chosen by an active user u_a. Accordingly, two types of recommendation decisions can be:

- *Prediction:* Prediction expresses the predicted preference for item $i_j \notin I_{u_a}$ for an active user u_a. This predicted value is within the same scale as for the user preferences (Sarwar et al., 2001).

- *Top-N recommendation:* It is a list of N items, $I_r \subset I$, that the active user u_a will like the most. The recommended list must be on items not already rated or chosen by u_a, i.e., $I_r \cap I_{u_a} = \emptyset$ (Sarwar et al., 2001).

3. DEMOGRAPHICS-BASED RECOMMENDATION APPROACH

The demographics-based recommendation approach recommends items to a user based on the preferences of others whose demographics are similar to those of the user. A demographics-based recommendation system typically generates recommendations at the category level, rather than the individual item level, in order to deliver more generalized recommendations and to address sparsity and synonym problems. Hence, this approach involves learning and reasoning with relationships between user demographics and expressed category preferences, where the expressed category preferences of a user are derived from previously-stated individual user preferences and the category hierarchies of items. The demographics-based recommendation approach can be applied, for example, to deliver personalized advertisements on Internet storefronts (Kim et al., 2001).

3.1 Process of Demographics-based Recommendation Approach

As shown in Figure 1, the process of a demographics-based recommendation system typically can be decomposed into the following phases:

1. Data Transformation: Generate a set of training examples each of whose input attributes are the demographics of a user and decisions outcomes are category preferences of the user.

2. Category Preference Model Learning: Automatically induce the preference model for each category based on the training examples pertaining to the category.

3. Recommendation Generation: Given the demographic data of a user, generate recommendations by performing reasoning on the category preference models induced previously.

As mentioned, the data transformation phase generates a set of training examples for subsequent learning of the category preference model and generation of recommendations. Input attributes of a training example are the demographic descriptions of a user that potentially affect his/her category preferences. Given the demographic data of a user, the generation of input attribute values for a user is quite straightforward. However, if individual user preferences were expressed at the item level, the generation of a user’s category preferences requires a transformation based on the category hierarchies of items. Several transformation methods have been proposed for deriving category preferences of users (Kim et al., 2001). We first assume that the user preferences are binary measures (e.g., like/dislike, purchased or not) where favorable preferences (e.g., like and purchased) are denoted as 1 while unfavorable preferences are denoted as 0. The described transformation methods can easily be modified for numerically-scaled user preferences.

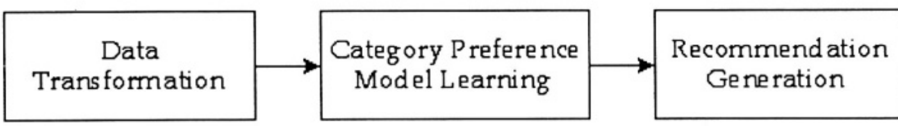

Figure 1. Process of Demographics-based Recommendation Approach

1. Counting-based (frequency threshold) method: This method uses the frequency of favorite preferences of a user on all items in a category to decide whether the user prefers the category or not. Let p_{ai} be the binary preference score of the user a on the item i, C_j be the category j, cp_{ai} be the derived binary preference score of the user a on the category j, and w be the pre-specified frequency threshold. The counting-based method is as follows:

$$cp_{aj} = \begin{cases} 1 & \text{if } \sum_{i \in C_j} p_{ai} \geq w \\ 0 & \text{otherwise} \end{cases}$$

2. Expected-value-based method: This method takes into account the number of items in each category and determines whether a user prefers a category based on the expected value, as follows:

$$cp_{aj} = \begin{cases} 1 & \text{if } \sum_{i \in C_j} p_{ai} \geq \alpha \left(\sum_j \sum_{i \in C_j} p_{ai} \times \dfrac{N_j}{\sum_j N_j} \right) \\ 0 & \text{otherwise} \end{cases}$$

where α is a multiplier for the expected value and N_j is the number of items in the category j.

3. Statistics-based method: This method sets a threshold based on such statistical values as mean and median. For example,

$$cp_{aj} = \begin{cases} 1 & \text{if } \sum_{i \in C_j} p_{ai} \geq \alpha \left(\dfrac{\sum_j \sum_{i \in C_j} p_{ai}}{C} \right) \\ 0 & \text{otherwise} \end{cases}$$

where C is the number of categories.

For a main category, the category preference of a user can be derived from his/her preferences on its subcategories. For example, a user is considered to prefer a main category j if he/she prefers any subcategory of j or a certain percentage of the subcategories of j.

After the data transformation, each user corresponds to a training example with a binary preference decision on each category. Subsequently, the category preference learning phase is initiated to induce a preference model for each category based on all the training examples pertaining to the category. As with the user profile learning phase in the content-based recommendation approach, a decision tree induction algorithm, a decision rule induction algorithm, or a backpropagation neural network can be employed for the learning task. Accordingly, for each category in the category hierarchy, a classification model is constructed to capture the relationships between user demographics and preferences of the category. Once a set of category preference models is induced, recommendations can be generated for an active user.

In this approach, both types of recommendations are possible since recommendations are generated using user demographics, the category to which a target item belongs, and the category preference models relevant to the target item. Given the demographic data of an active user and the category to which a target item belongs, the prediction of whether the active user will prefer the target item can be made by reasoning on the category preference models relevant to the target item. To produce the top-N recommendation for the active user, the preference prediction on each category is first obtained. Since inductive learning algorithms described above are capable of estimating prediction accuracy, the top-N items with the highest prediction accuracy are then included in the recommendation list.

3.2 Summary

The demographics-based recommendation approach recommends items to a user based on the preferences of other users whose demographics are similar to that of the user. Since it relies on individual user preferences and user demographics to arrive at recommendation decisions, personalized recommendations can be achieved. The demographics-based approach typically produces recommendations at the category level. Thus, the effect of the sparsity and synonym problems on recommendation accuracy can be reduced. Finally, online scalability is improved with the demographics-based approach because the category preference models can be constructed off-line and the resulting models are small in size and efficient in reasoning.

The demographics-based approach may encounter some limitations. Though the demographics-based approach may be able to achieve high-quality recommendations at the category level, its recommendation accuracy may suffer at the item level. Moreover, potential applications of the demographics-based approach may represent another source of limitation. User demographics cannot be assumed to be available, complete, and reliable. In some e-commerce settings, the acquisition and update of user demographic data raises serious privacy issues, and can be quite difficult.

4. COLLABORATIVE FILTERING RECOMMENDATION APPROACH

The collaborative filtering recommendation approach is a commonly-used method, and differs from the demographic approach. Rather than recommending items based on user preferences and similar demographic profiles across users, the collaborative filtering approach recommends items based on the similarity of opinions across users. Typically, by computing the similarity of users, a set of "nearest neighbor" users whose known preferences correlate significantly with a given user are found. Preferences for unseen items are predicted for the user based on a combination of the preferences known from the nearest neighbors. Thus, in this approach, users share their preferences regarding each item that they consume so that other users of the system can better decide which items to consume (Herlocker et al., 1999). The collaborative filtering approach is the most successful and widely adopted recommendation technique to date. Examples of collaborative filtering systems include GroupLens (Resnick et al., 1994; Konstan et al., 1997), the Bellcore video recommender (Hill et al., 1995), and Ringo (Shardanand and Maes, 1995). Amazon.com also uses a form of collaborative filtering technology, though the specifics of their implementation are not published.

As mentioned, the collaborative filtering approach utilizes user preferences to generate recommendations. Several different techniques have been proposed for collaborative filtering recommendations, including neighborhood-based, Bayesian networks (Breese et al., 1998), singular value decomposition with neural net classification (Billsus and Pazzani, 1998), and induction rule learning (Basu et al., 1998). Due to space limitation, we will only review the neighborhood-based collaborative filtering techniques since they are the most prevalent algorithms used in collaborative filtering for recommendation. As shown in Figure 2, the process of a typical neighborhood-based collaborative filtering system can be divided into three phases (Sarwar et al., 2000):

1. Dimension Reduction: Transform the original user preference matrix into a lower dimensional space to address the sparsity and scalability problems.

2. Neighborhood Formation: For an active user, compute the similarities between all other users and the active user and to form a proximity-based neighborhood with a number of like-minded users for the active user.

3. Recommendation Generation: Generate recommendations based on the preferences of the set of nearest neighbors of the active user.

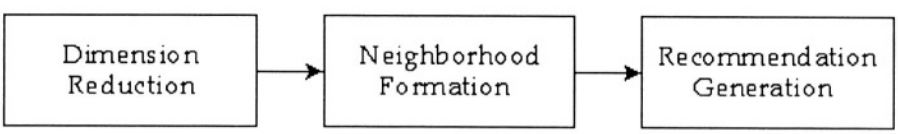

Figure 2. Process of Collaborative Filtering Recommendation Approach

4.1 Dimension Reduction

The dimension reduction phase transforms the original user preference matrix into a lower dimensional space to address the sparsity and scalability problem often encountered in collaborative filtering recommendation scenarios. The original representation of the input data to a collaborative filtering system is an $n \times m$ user preference matrix, where n is the number of users and m is the number of items. This representation may potentially pose sparsity and scalability problems for collaborative filtering systems (Sarwar et al., 2000). In practice, when a large set of items are available, users may have rated or chosen a very low percentage of items, resulting in a very sparse user preference matrix. As a consequence, a collaborative filtering recommendation system may be unable to make any recommendations for a particular user. On the other hand, a collaborative filtering recommendation system requires the user similarity computation that grows with n and m, and thus, suffers serious scalability problem.

To overcome the described problems associated with the original representation, the sparse matrix can be transformed into a lower dimensional representation using the Latent Semantic Indexing (LSI) method (Sarwar et al., 2000). Essentially, this approach uses a truncated singular value decomposition to obtain a rank-d approximation of the original $n \times m$ user preference matrix. This reduced representation alleviates the sparsity problem as all the entries in the $n \times d$ matrix are nonzero, which means that all n customers now have their preferences on the d meta-items. Moreover, the performance on computing user similarities and its scalability are improved dramatically as $d \ll m$ (Sarwar et al., 2000).

4.2 Neighborhood Formation

The goal of neighborhood formation is to find, for an active user u_a, an ordered list of l users $N = \{n_1, n_2, \ldots, n_l\}$ such that $u_a \notin N$ and $sim(u_a, n_i) \geq sim(u_a, n_j)$ for $i < j$. This phase is in fact the model-building process for the collaborative filtering recommendation approach. Several different similarity measures have been proposed (Shardanand and Maes, 1995; Herlocker et al, 1999; Sarwar et al., 2000), including

- *Pearson correlation coefficient:* The Pearson correlation coefficient is the most commonly used similarity measure in collaborative filtering recommendation systems. It is derived from a linear regression model. The similarity between an active user u_a and another user u_b using the Pearson correlation coefficient is calculated as:

$$sim(u_a, u_b) = \frac{\sum_i^m (p_{ai} - \bar{p}_a)(p_{bi} - \bar{p}_b)}{\sqrt{\sum_i^m (p_{ai} - \bar{p}_a)^2} \sqrt{\sum_i^m (p_{bi} - \bar{p}_b)^2}}$$

where p_{ai} represents the preference score of the user u_a on item i,
$\bar{p}_a$ is the average preference score of the user u_a, and
m is the number of items or meta-items in the reduced representation.

- *Constrained Pearson correlation coefficient:* The constrained Pearson correlation coefficient takes the positivity and negativity of preferences into account (Shardanand and Maes, 1995). A preference score below the midpoint of the scaling scheme (e.g., 4 in a 7-point rating scale) is considered as negative, while a preference score above the midpoint is positive. Accordingly, the constrained Pearson correlation coefficient is used so that only when both users have rated an item positively or both negatively, the correlation coefficient between them will increase. The similarity between an active user u_a and another user u_b using the constrained Pearson correlation coefficient is given as:

$$sim(u_a,u_b)=\frac{\sum_i^m (p_{ai}-mp)(p_{bi}-mp)}{\sqrt{\sum_i^m (p_{ai}-mp)^2}\sqrt{\sum_i^m (p_{bi}-mp)^2}}$$

where mp is the midpoint of the rating scale.

- *Spearman rank correlation coefficient:* The Spearman rank correlation coefficient, a nonparametric method, computes a measure of correlation between ranks instead of actual preference scores:

$$sim(u_a,u_b)=\frac{\sum_i^m (rank_{ai}-\overline{rank_a})(rank_{bi}-\overline{rank_b})}{\sqrt{\sum_i^m (rank_{ai}-\overline{rank_a})^2}\sqrt{\sum_i^m (rank_{bi}-\overline{rank_b})^2}}$$

- *Cosine similarity:* Two users u_a and u_b are considered as two vectors in the m dimensional item-space or in the d dimensional meta-item-space in the reduced representation. The similarity between them is measured by computing the cosine of the angle between the two vectors, which is given by:

$$sim(u_a,u_b)=cos(\vec{a},\vec{b})=\frac{\vec{a}\cdot\vec{b}}{\|\vec{a}\|_2\|\vec{b}\|_2}=\frac{\sum_i^m p_{ai}\cdot p_{bi}}{\sqrt{\sum_i^m p_{ai}^{\ 2}}\sqrt{\sum_i^m p_{bi}^{\ 2}}}$$

- *Mean-squared difference:* The mean-squared difference, introduced in Ringo (Shardanand and Maes, 1995), measures the dissimilarity between an active user u_a and another user u_b as:

$$dissim(u_a,u_b)=\overline{\sum_i^m (p_{ai}-p_{bi})^2}$$

According to an empirical evaluation study conducted by Herlocker et al. (1999), the Pearson correlation coefficient, whose performance was similar to that of the Spearman correlation coefficient, outperformed the cosine similarity and the mean-squared difference. Shardanand and Maes (1995) empirically evaluated different similarity measures (including Pearson correlation coefficient, constrained Pearson correlation coefficient and mean-squared difference) and suggest that the constrained Pearson correlation coefficient achieved the best performance in terms of the tradeoff between the prediction accuracy and the number of target values that can be predicted. On the other hand, the mean-squared difference outperformed its counterparts in prediction accuracy, but it produced fewer predictions than others did.

After the $n \times n$ similarity matrix is computed for n users using a desired similarity measure, the next task is to actually form the neighborhood for the active user. There are several schemes for neighborhood selection (Herlocker et al, 1999; Sarwar et al., 2000), including:

- *Weight thresholding:* This scheme, used by Shardanand and Maes (1995), is to set an absolute correlation threshold, where all neighbors of the active user with absolute correlations greater than the given threshold are selected.

- *Center-based best-k neighbors:* It forms a neighborhood of a pre-specified size k, for the active user, by simply selecting the k nearest users.

- *Aggregate-based best-k neighbors:* The aggregate-based best-k neighbors scheme, proposed by Sarwar et al. (2000), forms a neighborhood of size k for the active user u_a by first selecting the closest neighbor to u_a. The rest k-1 neighbors are selected as follows. Let, at a certain point there are j neighbors in the neighborhood N, where $j < k$. The centroid of the current neighborhood is then determined as

  $\vec{C} = \frac{1}{j}\sum_{\vec{V} \in N} \vec{V}$. A user w, such that $w \notin N$ is selected as the j+1-st neighbor only if w is closest to the centroid $\vec{C}$. Subsequently, the centroid is recomputed for $j+1$ neighbors and the process continues until $|N| = k$. Essentially, this scheme allows the nearest neighbors to affect the formation of the neighborhood and can be beneficial for very sparse data sets (Sarwar et al., 2000).

4.3 Recommendation Generation

After the nearest neighbors of the active user are identified, subsequent recommendations can be generated. Since the collaborative filtering process is initiated for a particular user, the collaborative filtering recommendation approach is typically for prediction and top-*N* recommendation decisions. To estimate the predicted preference score on the item $i_j \notin I_{u_a}$ for an active user u_a, the following methods can be employed:

1. *Weighted average:* To combine all the neighbors' preference scores on the item i_j into a prediction, the weighted average method is to compute a weighted average of the preference scores, using the correlations as the weights. This basic weighted average method, as used in Ringo (Shardanand and Maes, 1995), makes an assumption that all users rate on approximately the same distribution.

2. *Deviation-from-mean:* The method, taken by GroupLens (Resnick et al., 1994; Konstan et al., 1997), is based on the assumption that users' preference score distribution may center on different points. To account for the differences in means, the average deviation of a neighbor's preference score from that neighbor's mean preference score is first computed, where the mean preference score is taken over all items that the neighbor has rated. The average deviation from the mean computed across all neighbors is then converted into the active user's preference score distribution by adding it to the active user's mean preference score. Using the deviation-from-mean method, the predicted preference score of the active user u_a on the item i is calculated as:

$$p_{ai} = \bar{p}_a + \frac{\sum_{u=1}^{k}(p_{ui} - \bar{p}_u)\cdot sim(u_a, u_u)}{\sum_{u=l}^{k} sim(u_a, u_u)}$$

3. *Z-score average:* To take into account the situation where the spread of users' preference score distributions may be different, the z-score average method was proposed by Herlocker et al. (1999) by extending the deviation-from-mean method. In this method, neighbors' preference scores on the item i are converted to z-scores and a weighted average of the z-scores are derived as the predicted preference score of the active user u_a on the item i:

$$p_{ai} = \bar{p}_a + \frac{\sum_{u=1}^{k} \frac{(p_{ui} - \bar{p}_u)}{\sigma_u} sim(u_a, u_u)}{\sum_{u=1}^{k} sim(u_a, u_u)}$$

An empirical evaluation study conducted by Herlocker et al. (1999) showed that the deviation-from-mean method performed significantly better than the weighted average method. However, the z-score average method did not perform significantly better than the deviation-from-mean method, suggesting that differences in spread between users' preference score distributions might have no effect on prediction accuracy.

To produce the top-*N* recommendation for the active user u_a, the predicted preference score on each item that has not explicitly been rated or chosen by u_a is derived first. Afterward, the top *N* items with the highest predicted preference score are included in the recommendation list.

4.4 Summary

By using other users' opinions the collaborative filtering approach can be employed to recommend items whose content is not easily analyzed by automated feature extraction techniques. This approach is also capable of recommending items on the basis of quality and taste. Furthermore, since other users' opinions influence what is recommended, the approach is able to provide serendipitous recommendations to a user (i.e., recommend items that are dissimilar to those the user has liked before); thus avoiding the over-specialization problem associated to the content-based recommendation approach.

However, in addition to sparsity and scalability problems, the collaborative filtering approach incurs other problems. Items that have not been rated or chosen by a sufficient number of users cannot be effectively recommended. Thus, the collaborative filtering approach potentially tends to recommend popular items (Mooney and Roy, 2000). On the other hand, although newly available items are frequently of particular interest to users, it is impossible for the collaborative filtering approach to recommend those items that no one has yet rated or chosen (Balabanovic and Shoham, 1997; Condliff et al., 1999; Mooney and Roy, 2000). Furthermore, for a user whose tastes are unusual compared to the rest of the population, there will not be any other users who are particularly similar, leading to poor recommendations (Condliff et al., 1999). Finally, different items may be highly similar in their features. The collaborative filtering approach cannot find this latent association and treats these items differently (i.e., the synonym problem). Thus, the lack of access to the content of the items prevents similar users from being matched unless they have rated the exact same items (Sarwar et al., 2000).

5. ASSOCIATION-BASED RECOMMENDATION APPROACH

The association-based recommendation approach relies on user preferences to identify items frequently associated with those items in which a user has expressed interest in the past (Schafer et al., 2001). Depending on the technique used for such association discovery, item-associations can be classified into two types: item-correlations and association rules.

5.1 Item-Correlation Techniques for Recommendations

Taking user preferences as input, an item-correlation technique searches for a set of items that have been rated as similar to a target item. Assume the set of k most similar items to be $\{i_1, i_2, \ldots, i_k\}$ and their corresponding similarities to be $\{s_{i1}, s_{i2}, \ldots, s_{ik}\}$. Once the set of similar items are identified, the prediction of the preference score of an active user on the target item is then computed by taking a weighted average of the active user's preference scores on these similar items (Schafer et al., 2001). Based on this process, an item-correlation technique for recommendations consists of two main phases: *similarity computation* and *recommendation generation.*

To determine the similarity between two items i and j, the users who have rated both of these items (called co-rated users) are first selected and a similarity method is then applied to determine the similarity measure between items i and j. Different similarity measures have been proposed, using such methods as cosine similarity, Pearson correlation similarity and adjusted-cosine similarity (Sarwar et al., 2001). In the cosine similarity method, two items are thought of as two vectors in the p dimensional user-space (where p is the number of co-rated users). As with the cosine similarity measure discussed in Section 4, the similarity between two items is measured by computing the cosine of the angle between these two vectors. Similarly, the Pearson correlation coefficient measures the similarity between two items i and j based on the set of co-rated users U, as follows:

$$sim(i,j) = \frac{\sum_{u \in U}(p_{ui} - \bar{p}_i)(p_{uj} - \bar{p}_j)}{\sqrt{\sum_{u \in U}(p_{ui} - \bar{p}_i)^2}\sqrt{\sum_{u \in U}(p_{uj} - \bar{p}_j)^2}}$$

where p_{ui} denotes the preference score of the user u on the item i, and $\bar{p}_i$ is the average preference score of the i-th item over the set of co-rated users U.

The cosine similarity does not take into account the differences in rating scale between different users. Accordingly, the adjusted cosine similarity standardizes a user's preference score by his/her average and measures the similarity between items i and j as:

$$sim(i,j) = \frac{\sum_{u \in U}(p_{ui} - \bar{p}_u)(p_{uj} - \bar{p}_u)}{\sqrt{\sum_{u \in U}(p_{ui} - \bar{p}_u)^2}\sqrt{\sum_{u \in U}(p_{uj} - \bar{p}_u)^2}}$$

where $\bar{p}_u$ is the average of the u-th user's preference scores.

Once the set of similar items are identified for a target item using a similarity measure, the next phase is to combine preference scores of the active user on the set of similar items to arrive at a predicted preference score on the target item. The weighted average method is typically employed for deriving the prediction. In a manner similar to that discussed in Section 4, the weighted average method tries to capture how the active user rates similar items. It computes the prediction on the target item for the active user by taking the weighted average of the preference scores given by the active user on the items similar to the target item, using the item similarities as the weights (Sarwar et al., 2001).

To produce the top-N recommendation for the active user by an item-correlation technique, the predicted preference score on each item for which a preference score has not been given by the active user is derived as discussed previously. Subsequently, the top N items with the highest predicted preference score are included in the recommendation list.

5.2 Association Rule Techniques for Recommendations

The association rule discovery technique represents another alternative to the association-based recommendation approach (Sarwar et al., 2000). It finds interesting co-occurrences of items in a set of transactions. Formally, the association-rule mining problem is defined as follows (Agrawal et al., 1993; Agrawal and Srikant, 1994). Let $I = \{i_1, i_2, \ldots, i_m\}$ be a set of items. Let D be a set of transactions, where each transaction T is a set of items such that $T \subseteq I$. In the recommendation context, each transaction corresponds to a user and contains a set of items that the user liked or purchased. An association rule is an implication of the form $X \Rightarrow Y$, where $X \subset I$, $Y \subset I$, and $X \cap Y = \emptyset$. The association rule $X \Rightarrow Y$ holds in D with confidence c if $c\%$ of transactions in D that contain X also contain Y. The rule $X \Rightarrow Y$ has a support s in D if $s\%$ of transactions in D contains $X \cup Y$. Given a set of transactions D, the problem of mining association rules is to generate all association rules that have support and confidence greater than the user-specified minimum *support* and minimum *confidence*. To efficiently find all association rules satisfying the user-specified minimum support and minimum confidence, the Apriori algorithm proposed by Agrawal and Srikant (1994) is often employed.

As mentioned, the association rule discovery technique concerns mainly the co-occurrence of items in a set of transactions. Thus, the user preferences need to be transformed into the described representation of transactions. If the user preference on an item is a binary measure, the transformation can be straightforward. An item i will be included in the transaction of a user a only if p_{ai} is 1. However, if the user preference is on a numerical scale, the decision of whether an item will be included in a user's transaction can be based on a pre-specified threshold, a mean-based method, or other methods. For example, given a threshold α, an item i will be included in the transaction of a user a if $p_{ai} \geq \alpha$; otherwise, it will not be shown in the transaction. Likewise, in a mean-based method, an item i will be included in the transaction of a user a if $p_{ai} \geq \bar{p}_a$, where $\bar{p}_a$ is the average preference score of the user a. Other transformation methods can be developed to reflect the nature of user preferences and the target recommendation problem.

To recommend the top-N items to an active user based on the set of association rules discovered, we first find the association rules that are supported by the active user (i.e., association rules whose left-hand-side items appear entirely in the transaction of the active user). Let I_p be the set of unique items that are suggested by the right-hand-side of the association rules selected and are not shown in the transaction of the active user. Afterward, those items in I_p are sorted based on the confidence of the selected association rules. If a particular item is recommended by multiple association rules, the highest confidence is used. Finally, the top$N$ items are chosen as the recommended set for the active user.

5.3 Summary

The association-based recommendation approach recommends items to users based on the correlations or associations between items. Since it takes the user preferences as its source input information, personalized recommendations can be achieved. Like collaborative filtering, the association-based approach is capable of recommending items on quality and taste. Also, because the correlations or associations between items are relatively static, item similarity or association rules can be pre-computed to improve the online scalability of an association-based recommendation technique (Sarwar et al., 2001).

On the other hand, the association-based recommendation approach encounters problems similar to the collaborative filtering recommendation approach. When a large set of items are available, users may have rated or chosen a very low percentage of items, resulting in sparsity problems. As a result, items rated or chosen by a limited number of users cannot be effectively recommended. Finally, the synonymy problem (i.e., different items may be highly similar in their features) cannot be addressed in the association-based recommendation approach.

6. CONTENT-BASED RECOMMENDATION APPROACH

For a give user, content-based recommendation systems recommend items similar to those the user has liked in the past (Balabanovic and Shoham, 1997; Herlocker et al., 1999). The content-based approach automatically learns and adaptively updates the profile of each user. Given a user profile, items are recommended for the user based on a comparison between item feature weights and those of the user profile. If a user rates an item differently than a recommendation system suggested, the user profile can be updated accordingly. This process is also known as *relevance feedback*. The content-based recommendation approach has its roots in content-based information filtering, and has proven to be effective in recommending textual documents. Examples of the content-based recommendation systems include Syskill & Webert for recommending Web pages (Pazzani et al., 1996), NewsWeeder for recommending news-group messages (Lang, 1995), and InformationFinder for recommending textual documents (Krulwich and Burkey, 1996).

Assume the set of items that a user has rated or chosen to be the training set with respect to the given user. As shown in Figure 3, the phases involved in a content-based system generally include:

1. Feature Extraction and Selection: Extract and select relevant features for all items in the collection.

2. Representation: Represent each item with the feature set determined in the previous phase.

3. User Profile Learning: Automatically learn or adaptively update the user profile model for each user based on the training examples pertinent to the user.

4. Recommendation Generation: Generate recommendations by performing reasoning on the corresponding user profile model.

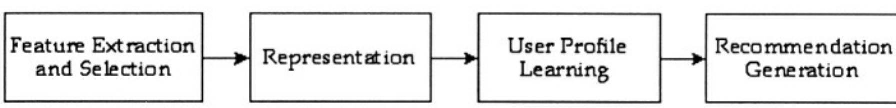

Figure 3. Process of Content-based Recommendation Approach

6.1 Feature Extraction and Selection

The feature extraction and selection phase is undertaken to determine a set of features that will be used for representing individual items. If items involve extrinsic features, they need to be specified by domain experts. For example, Alspector et al. (1998) developed variants of content-based recommendation systems for movie selection based on such features as category (e.g., comedy, drama, etc.), MAPP rating, Maltin rating, Academy Award, length, origin, and director of movies. However, if intrinsic features are involved, extraction of features by analyzing the content of items is required. An automatic feature extraction mechanism is only available for limited domains. In the domain consisting of textual documents, the most effective domain of the content-based recommendation approach, the text portion of the documents is parsed to produce a list of features (typically consisting of nouns or noun phrases) none of which is a number, part of a proper name, or belongs to a pre-defined list of stop words.

After feature specification (for extrinsic features) or extraction (for intrinsic features), feature selection is initiated to choose a small subset of features that (ideally) is necessary and sufficient to describe the target concept (Piramuthu, 1998). The feature selection process not only improves learning efficiency but also has the potential to increase learning effectiveness (Dumais et al., 1998). Various feature selection methods have been proposed, using such techniques as statistical analysis, genetic algorithms, rough sets theory, and so on. For example, in statistical analysis, forward and backward stepwise multiple regression are widely used to select features. In forward stepwise multiple regression, analysis proceeds by adding features to a subset until the addition of a new feature no longer results in an improvement in the explained variance. The backward stepwise multiple regression starts with the full set of features and seeks to eliminate features with the smallest contribution to R^2 value (Kittler, 1975). Siedlecki and Sklansky (1989) adopted genetic algorithms for feature selection by encoding the initial set of f features as f-element bit string with 1 and 0 representing the presence and absence respectively of features in the set, with classification accuracy employed as the fitness function. Modrzejewski (1993) proposed a rough set-based feature selection method to determine the degree of dependency of sets of attributes for selecting binary features. Features resulting in a minimal preset decision tree, with minimal length of all paths from root to leaves, are selected. For interested readers, a summary of and empirical comparisons on various feature selection methods can be found in (Piramuthu, 1998).

However, in the case of recommending textual documents, hundreds or thousands of features can be extracted, and the feature selection methods described above may become computationally infeasible. Thus, most feature selection methods developed for textual documents adopt an evaluation function that is applied to features independently. A feature selection metric score is then assigned to each feature under consideration. The top k features with the highest feature selection metric score are selected as features for representing documents, where k is a predefined number of features to select. Several evaluation functions for feature selection have been proposed, including TF (within-document term frequency), TF×IDF (within-document term frequency × inverse document frequency), correlation coefficient, mutual information, and a χ^2 metric (Dumais et al., 1998; Lam and Ho, 1998; Lewis and Ringuette, 1994; Ng et al., 1997).

6.2 Representation

In the representation phase, each item is represented in terms of features selected in the previous phase. Each item in the training set is labeled to indicate its preference (dependent variable) by a particular user and assigned a value for each feature (independent variable) selected. The task of representing an item's extrinsic features is straightforward and is essentially achieved during the feature extraction and selection phase. Feature-values of an item originally supplied by domain experts are used. On the other hand, to represent a textual document by a set of previously extract and selected intrinsic features, a binary value (e.g., indicating whether the feature appears in the document) or a numerical value (e.g., frequency in the document being processed) is assigned to each feature. Different document representation schemes have been proposed, including binary, TF, IDF and TF×IDF (Yang and Chute, 1994).

6.3 User Profile Learning

For each user, the purpose of this phase is to construct a user profile model for establishing the relationship between preference scores (dependent variable) and feature-values (independent variables) from the training examples pertinent to the user. The learning implementation can draw on statistical, inductive learning, and Bayesian probability methods. For example, Alspector et al. (1998) adopted the statistical method (specifically, a multiple linear regression model) and inductive learning algorithm (specifically, CART) for movie recommendations. Mooney and Roy (2000) used the Bayesian probability method for learning user profiles in order to obtain book recommendations.

A multiple linear regression model is based on the most natural assumption of a linear influence of each of the features involved on the preferences. Thus, it takes the form of:

$$p_{im} = \sum_{j=1}^{k} w_j f_{mj} + b$$

where p_{im} denotes the preference score of the user i on the item m,

w_j is the coefficient associated with the feature j,

f_{mj} is the value of the jth feature for the item m, and

b represents the bias.

Creation of such a user profile model for each user is essentially equivalent to a multiple linear regression on the set of features and its solution can be obtained using the least-squares technique (Alspector et al., 1998).

To address the potential nonlinear dependencies between individual features, inductive learning algorithms have been adopted for learning user profiles in the content-based recommendation approach. In this inductive learning framework, preference scores on items in the training set can be treated as a continuous decision or a discrete class membership, while the features of the item are attributes potentially affecting the decision. Consequently, a decision tree induction algorithm (e.g., ID3 (Quinlan, 1986) or its descendant C4.5 (Quinlan, 1993), CHAID (Kass, 1980), or CART (Breiman et al., 1984)), a decision rule induction algorithm (e.g., CN2 (Clark and Niblett, 1989)), or a backpropagation neural network (Rumelhart et al., 1986) can be employed to address the target learning task.

6.4 Recommendation Generation

Once user profile models are induced, recommendations can be generated. Since the features of items and a user's past preferences are the only factors influencing recommendation decisions, all three types of recommendations can be made. To estimate the predicted preference score on item $i_j \notin I_{u_a}$ for an active user u_a, the item is first represented with the features selected previously. Subsequently, the reasoning on the user profile model (e.g., a regression model, a decision tree, a set of decision rules, or a trained backpropagation neural network) corresponding to the active user is performed to predict the preference score of u_a on the item i_j. To produce the *top-N* recommendation for the active user u_a, the predicted preference score on each item that has not explicitly been rated or chosen by u_a is obtained as described previously. Afterward, the top N items with the highest predicted preference score are included in the recommendation list.

6.5 Summary

The content-based approach recommends, for a given user, items similar to those the user has liked in the past. Since individualized user profiles are induced, personalized recommendations can be achieved. Due to the relevance feedback process, a content-based recommendation system can adaptively update the profile of each user. As mentioned, items are recommended based on features of items rather than on the preferences of other users. This allows for the possibility of providing explanations that list content features that caused an item to be recommended, potentially giving readers confidence in the system's recommendations and insight into their own preferences (Mooney and Roy, 2000)

However, the content-based recommendation approach has several shortcomings. In many domains, the items are not amenable to any useful feature extraction methods (e.g., movies, music albums, and videos). For such domains, the efforts of domain experts to specify for extrinsic features and to assign feature-values for each item are unavoidable, thus limiting the applicability of content-based recommendation approach. Furthermore, over-specialization is another problem associated with this approach. When the system can only recommend items scoring highly against a user's profile, the user is restricted to seeing items similar to those the user has liked in the past (Balabanovic and Shoham, 1997).

7. CONCLUSIONS

In an e-commerce environment, web-based personalization has proven to have great potential for improving transaction efficiency, providing suitable custom product recommendations, and engendering customer loyalty. This chapter classified the major approaches and described the techniques associated with the implementation of recommendation systems for web-based personalization. However, the techniques covered in this chapter are by no means exhaustive. For example, collaborative filtering recommendation systems using Bayesian networks, neural networks and inductive learning algorithms were not covered. Various hybrid recommendation techniques that seek to seamlessly integrate different recommendation approaches are not reviewed in detail. As users demand higher-quality recommendations and as e-commerce expands into the wireless environment (the so-called mobile commerce or M-commerce), recommendation and personalization approaches will continue to evolve and new techniques will be devised, incorporating an ever richer set of data sources, such as real-time geographic location.

Note

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Chapter 13

A Survey on the Industry Sponsored e-Marketplaces

Hsin-Lu Chang, Stella Ying Shen, Christoph Schlueter-Langdon, and Michael J. Shaw

Abstract: This chapter starts with an overview of the various types of B2B e-marketplace, followed by two detailed industry-sponsored marketplaces (ISM) case studies. The critical system components and successful factors of the ISM are identified with the focus on five areas: aggregation, integration, trust, security, and collaboration. This chapter also analyses the direct economic benefits that an ISM brings to its owners. Specifically, three revenue sources are explored: transaction fees, software subscription fees, and membership fees. At last, We conclude this chapter by identifying some IT-related research issues evolved from the survey and providing our view of the future of e-marketplace.

Key words: Electronic marketplaces, Transora, Covinsint

1. INTRODUCTION

As we look at today's economy, we see an emerging trend that market leaders in the same industry are joining forces to create Web-based electronic marketplaces (e-marketplaces) to serve the needs of buyers and sellers in a particular market. We call this emerging market form an *Industry-Sponsored Marketplace* (ISM). They can be designed to alter the linear structure of a supply chain between suppliers, manufacturers and retailers to resemble a network of information sharing and transaction linkages in order to increase transparency and release efficiency gains. Moreover, as the Internet is ubiquitous, ISMs allow buyers and sellers to reach each other across any part of the world with ease. However, what really differentiates ISM from other third-party e-marketplaces is their superior familiarity with the conditions of the industry and its environment. Jointly owned by the largest industry players, ISMs have the advantage of leveraging the financial resources, industry knowledge, and purchasing power of the participants, thus providing gains to all of them. The benefits are multi-folded. Suppliers gain access to a much larger customer base and reduce customer acquisition cost; manufacturers benefit from improved customer service with retailers and wholesalers; and retailers and wholesalers can simplify their ordering process and improve order accuracy.

However, ISMs also face challenges. First, it is a difficult process to achieve consensus among co-owners. As rivals, they struggle to collaborate in the ISM while competing fiercely for customers. They are not willing to reveal sensitive or proprietary information. Second, standardizing documentation and synchronizing business processes and routines, such as for ordering and invoicing, across tens or even hundreds of different information systems is a daunting task. Lastly, ISMs often raise anti-trust concerns. Obtaining approval from the Federal Trade Committee (FTC) and in some cases, foreign regulatory authorities, and going through an inspection process can take a long time and divert management attention.

To obtain the greatest benefit from ISM, investing companies must determine which arrangements can contribute the most to the member companies' performance. As a result, we need to understand how particular industry characteristics influence the way economic value can be created and captured. While many companies have launched private exchanges to interact with regular customers and suppliers in a tightly controlled environment, it is also interesting to note how companies conduct business-to-business (B2B) e-commerce through ISM.

We will start this chapter with an overview of the various types of B2B e-marketplace, followed by two detailed ISM case studies. Then we further explore the critical success factors and the economic value of the ISM. We conclude this chapter by identifying some IT-related research issues evolved from the survey and providing our view of the future of e-marketplace.

2. OVERVIEW OF E-MARKETPLACES

We define B2B e-marketplace as an Internet-enabled governance structure that facilitates the exchange of information, goods, services, and payments among *multiple* business buyers and sellers and at a *dynamic* price determined in accordance with the rules of the markets. Depending on the ownership structure, we further classify them into three categories: private, public and industry-sponsored marketplaces (ISM). As their names imply, private e-marketplaces are initiated and owned by a single buyer or seller, such as Wal-Mart's RetailLink; public e-marketplaces are owned by a third-party, acting as a liaison between the buyers and the sellers in the same vertical industry or across different industries; and ISMs are usually jointly created by major players in a particular industry to serve their needs in that vertical.

ROLES AND TRENDS OF E-MARKETPLACES

The traditional and most fundamental role of the e-marketplace is transaction fulfillment. An e-marketplace acts as a third person and a central market space, maintaining relationships with multiple buyers and sellers, enabling them to buy and sell from each other at a dynamic price and without tedious search and negotiation procedures.

Increasingly, e-marketplace builders and participants are coming to realize that an e-marketplace can be more valuable to them if it addresses issues beyond a simple purchase transactions. Those emerging roles include:

- *Business intelligence:* Working as a third-party, e-marketplaces help buyers collect and analyse necessary information, especially for the purchase of complex products and services. Sometimes they can identify qualified suppliers for buyers according to their requirements. An e-marketplace can also be a source of industry information, allowing members, either for free or at a fee, to access white papers, market analyses, production reports and forecasts, latest industry news, regulatory information.

- *Supply chain management:* Traditionally, the supply chain was linear, with each node of the chain coordinating or sharing information with its direct upstream and downstream neighbours only. Demand information can easily be skewed along the way from consumers back to retailers, distributors, and to manufacturers; inventory is piled up at each node while consumers still cannot get what they want in time—a phenomenon known as “the bull-whip effect”. B2B e-marketplaces can be designed to create a supply chain in which all parties are connected at the same time to facilitate real-time collaboration in various areas such forecasting, and scheduling and planning. This networked information sharing structure can greatly improve efficiency along the entire supply chain.

- *New product development:* Because the e-marketplace is a common platform that can be virtually linked to any party, it can be used to facilitate product design collaboration and knowledge sharing so that companies can better utilize all the available resources and expedite the new product development process.

- *Standards development:* In order to release efficiency gains e-marketplaces are building information systems that take advantage of information technology standards. Often a particular implementation can emerge as a standard if key players adopt it. Furthermore, use of information technology standards can require the synchronization of business processes. This in turn can lead to the creation of standardized business procedures and routines and further increase the efficiency of interaction in the industry.

- *Solution provider:* E-marketplaces are using the Internet to bundle products with related information and services, creating integrated solutions to solve member companies' particular business problems. Some examples of such solutions are new business opportunity identification, system integration and troubleshooting, and product or process recommendations. These solutions help members improve their business efficiency and effectiveness, at the same time, increase liquidity in the marketplace and consequently, improve the financial performance of the marketplace.

Yet, most B2B e-marketplaces to date are still focused purely on on-line exchanges and auctions. They suffer from, more or less, the fierce market competition, drying trading volume, and conflicts between suppliers and buyers. It is reported that only a few-perhaps 10 percent, of them will see worthwhile profits. The surviving e-marketplaces will shift from traditional trading-based business model toward a wide variety of innovative and highly specialized new models. Those trends are illustrated in Figure 1.

At the early stage of the marketplace development, most trading services are built based upon a competitive bidding process, in which the supplier who offers the lowest price always wins the bid. This model has serious flaws. First, the model is based on an over simplified assumption that price is the most important factor for selling or buying decisions. Without taking account of the buyer-seller relationships, the model can be easily duplicated by competing marketplaces and customer loyalty is in jeopardy. That's why public exchanges providing simple transactions usually have trouble in attracting large buyers.

Second, those trading services, especially reverse auctions, deliver little benefits to sellers. While suppliers can access new customers and gain transaction efficiency, they are also forced to compete mainly on price, putting pressure on their margins. Therefore, large suppliers, who already enjoy a broad customer base, are not particularly interested in those public exchanges either.

The recent folding of several popular B2B e-marketplaces indicates that transaction fees may not be a sufficient source of income. In order to add revenue streams and improve margins B2B e-markets have to provide comprehensive services and strengthen customer relationships to increase life time value. As private e-markets have a more specific focus, they usually are limited in scale and scope in offering industry-wide solutions. Public exchanges on the other hand, are often constrained by limited access to funding, which makes it difficult to pursue a long term agenda and from third parties, thus often having problems to make long-term decisions and move ahead quickly.

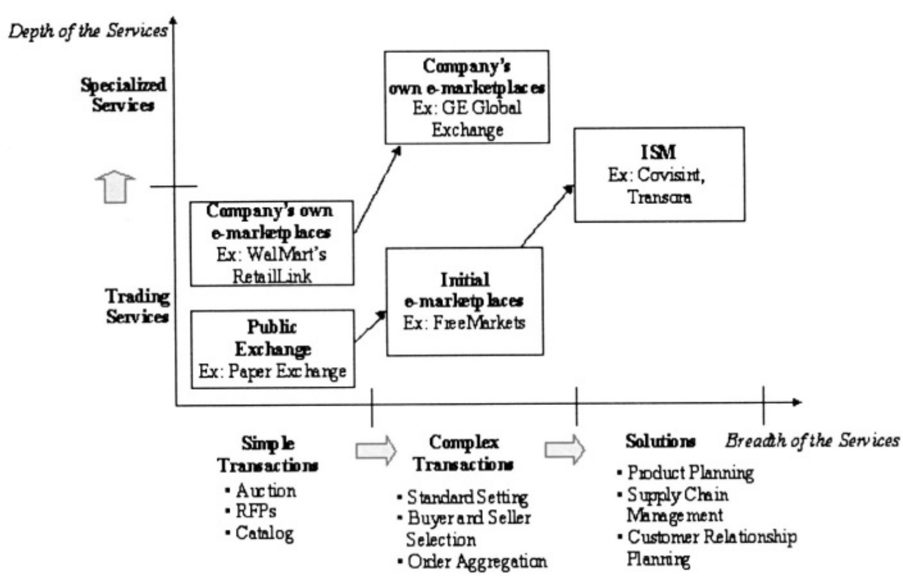

Figure 1. The Trends of E-Marketplace: Movement Toward ISM

It has been noted that the traditional rules still apply to the electronic market: find the market focus and provide specialized services. As a result, e-marketplaces are moving toward offering complex transactions and specialized services. ISMs are in a better position. On the one hand, they have a clear industry focus, so they can easily offer services targeting a specific market segment. On the other hand, they have a better chance to promote industry standards, which make the offerings of complicated services, such as collaborative planning, become possible. Therefore, ISMs have a high potential to occupy the center of the B2B territory, acting as central hubs that connect multiple suppliers, buyers, and other specialist companies.

THE CHARACTERISTICS OF ISM

When we look at the industries where ISMs evolve and operate, we find that ISMs usually share four common characteristics:

1. Supplier market is more fragmented than the buyer market
   ISMs usually evolve from industries where the supplier market is more fragmented than the buyer market (Figure 2-1). Typical examples are the traditional manufacturing industries, such as automobile, aerospace, paper, and machinery, in which several major manufacturers procure a substantial percentage of the overall materials and parts in the industry from numerous suppliers. In such an industry setting, an ISM enables buyers to reach multiple tiers of suppliers at the same time and at minimum additional cost – something that were impossible before.

2. Materials are undifferentiated/ Buyers have low switch costs
   The materials, components, and parts sold through ISMs are somewhat standardized although they are required by different buyers. Nevertheless, the related business processes, such as ordering, fulfillment, invoicing, and payment can be very different among buyers. To make things worse, buyers and sellers may use all sorts of different information systems and follow different way of documentation. In this case, an ISM is expected to set up some industry-wide standards to enhance industry cooperation and coordination (Figure 2-2).

3. Similar but complicated supply chain
   Buyers in ISMs usually have similar but complicated supply chains, extending from multiple tiers of suppliers to vast number of distributors, and dealers. Historically, this complexity has created a lot of inefficiencies, such as excessive inventories. However, their similarly structured supply chains enable the ISM to integrate their respective e-business applications, thus streamlining the whole supply chain,

establishing efficiency from product development, procurement, to customer service (Figure 2-2).

4. Buyers' products are highly differentiated/ have high brand awareness
   As we said before, the buyers of ISMs are usually rivals in the industry. They cooperate in the e-marketplace on procurement and cost cutting, while at the same time, they compete head-to-head for customers through product differentiation. While ISMs are expected to help raise the operation efficiency of the whole buyers' group, individual member has to build its own brand awareness and competitive advantage through product differentiation. As a result, those industry competitors are willing to share some proprietary information to some extent to achieve cost savings and collaboration in the marketplace (Figure 2-3).

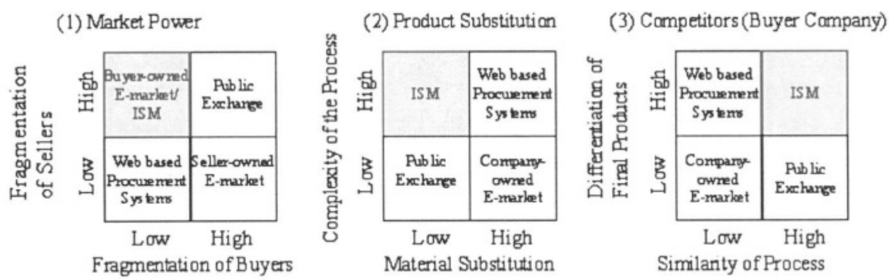

Figure 2. Characteristics of ISM

Deriving from those characteristics, ISMs enjoy some advantages over other types of e-marketplaces, particularly in terms of:
- leveraging resources and power
- creating a critical mass
- building industry standards, and
- sharing economic benefits among participants

Same as other e-marketplaces, ISMs are especially attractive to buyers. With large buying corporation as their sponsors, ISMs have the deep pockets for marketplace development, and all the development costs can be shared among several big players. On the other hand, big buyers represent built-in reservoirs of talent and knowledge, allowing the design and implementation of the marketplace to be well tailored to meet buyers' needs.

There has been a lot of talk on the critical size of the marketplace. Here "critical mass" refers to both the necessary trade volume and number of participants for a market to survive. Unlike third-party marketplaces, ISMs can usually reach a critical mass from the beginning. The fact that ISMs are mostly initiated by industry leaders ensures adequate trade volume, and consequently, market efficiency. Later on, a lot more small partners will be attracted to join. This process creates a virtuous cycle, allowing the exchanges to grow quickly. Therefore, compared to other marketplaces, ISMs usually have a better chance to be profitable.

Created by industry consortia, the ISM is a channel for participants to cooperate with each other in developing and promoting various standards for content, technology, and business processes. The standards will greatly simplify the communications among various buyers and suppliers even though the individual process can be extremely complicated. Moreover, the establishment of those standards is the foundation of any cooperation and collaboration effort.

Since the ISM is developed primarily by market leaders who have already built deep relationships with their upstream and downstream companies, it serves as a single connection or entry point to the industry. On the one hand, customers only need to build one connection to the ISM and then the transaction can be forwarded to all other connected suppliers, retailers, and exchanges. With the ISM in the central, the economics is shared by all the members in the extended enterprises. On the other hand, the open and transparent architecture offers the connected customers with transaction support and variety of value-added services to meet individual needs.

3. CASES – EXAMPLES OF INDUSTRY-SPONSORED E-MARKETPLACES

Case #1: Covisint

Automakers were among the pioneers of the second industrial revolution. The moving assembly line introduce by Henry Ford at the beginning of the 20^{th} century became an icon of the industrial age and its economics of mass production. However, the emergence of powerful computers, sophisticated software applications and databases, and broadband communications networks is increasingly challenging the industry's modus operandi. In the emerging information age car manufacturers can no longer afford to "build any car as long as it is black". They have to become more customer-oriented and be able to allow for customisation while maintaining scale advantages to keep products affordable for consumers. Hence the industry is shifting from mass production to mass customisation enabled by enhanced IS capabilities.

Automakers have been trying for some time to buy electronically in order to reduce procurement costs. In 1995, Automotive Network eXchange (ANX) was launched as a private pipeline for suppliers to link with automakers and with each other. In November 1999, Ford's Auto-Xchange and GM's TradeXchange were established. However, the multitude of proprietary exchange systems created problems: Suppliers had to firstly, decide to which extent to make investments that could not be redeployed from specific uses and users without a significant loss of productive value, and secondly, spend scarce capital to duplicate investments in buyer-specific inter-organizational IS; buyers faced difficulties in exerting bargaining power over the suppliers.

Started in February 2000 by Ford, General Motors, DaimlerChrysler, and later joined by Nissan, Renault, and Peugeot, Covisint is the automakers' solution to resolve those challenges and release efficiency gains in the industry. By linking the individual firms' procurement networks, it creates a single global Web portal for auto parts supply.

VALUE PROPOSITION

Unlike a pure transaction exchange, Covisint is more concerned with streamlining, realigning, and integrating supply chains in the global automotive industry. It provides services in four fields: procurement, supply chain management, collaborative product development, and a series of value added services to enhance corporate procurement, supply chain management and product development functions, such as consulting, training, management decision tools, etc. In addition, it provides a set of community services, such as industry news and expert advice.

Covisint's services can be beneficial in many ways. From an IT investment and maintenance cost perspective, it promises great savings by creating an open IT platform based on industry standards to support the e-marketplace. From a business process management perspective, it could save operations cost through the synchronization of order and material flows and collaborative product development.

1. *Create an e-marketplace supported by an open platform based on industry standards*
   As a technology solution for the whole auto industry, Covisint strives to provide an integrated, secure, and open platform for all participants. It is XML-based, and allows its users to work in either a hosted (usually for smaller organizations) or non-hosted environment. In a non-hosted environment, companies will be able to integrate their existing IT infrastructure with Covisint's. These companies, depending on their individual requirements, determine the appropriate level of integration. Use of an open architecture allows for the exchange to be accessible beyond the 1st tier suppliers to the ones far upstream in the supply chain.

   In addition, Covisint works with the AIAG (Automotive Industry Action Group), VDA, Galia, JAMA (Japan Automobile Manufacturers Association, Inc.) and other forums to help develop and operationalize business standards for the whole industry. By using those standards and developing common business processes, Covisint claims to be able to help participants save up to 90% of the total costs of transaction, in which the buyers and sellers split the savings equally.

2. *Achieve supply chain collaboration or synchronization*
   Covisint simplifies the communication and transaction process by using one portal to connect all participants—manufacturers, suppliers, partners, and dealers along the whole supply chain, reducing overall inventory and cycle time. Goldman Sachs estimated that there is $123 billion worth of inventory from steel mill to driveway. This excess inventory is expected to be cut due to the more integrated supply chain planning. Moreover, with the various supply chain management tools, the exchange expects to enhance companies' ability in identifying production constraint faster and offering more informed resolutions. Ultimately, once the trust relationship is built, the exchange expects to become a channel for supply chain partners to share customer order, production and inventory information, and consequently making collaborative forecasting and production planning decisions.

3. *Enable collaborative product development*
   As it is claimed by the exchange, Covisint provides a set of functionality in product development information sharing, interactive development and collaborative product design, thus allowing collaborative product development among manufacturers and suppliers. It is estimated that with these functionality, the average vehicle development process will be cut from the current 42 months to 12-18 months. It is important to

note that the impact of faster development process is two-fold. On the one hand, the shortened process can translate into enormous savings in the cost of research and development, which usually constitutes a very significant portion of the total cost of the final product. On the other hand, the shortened process also means faster time-to-market. The exchange is expected to significantly compress the existing 60-65 day order-to-delivery cycle, and eventually to establish direct inputs into the planning process for customers, that is, to build-to-order.

Case #2: Transora

For years, the consumer packaged good (CPG) industry has been in the brand-centric business, where globalization and consolidation of retailers enabled the big CPG companies to lock-in retailers via heavy investment on EDI development. The manufacturers have been holding the most valuable information and communication was in one direction, from manufacturers, retailers, to customers. However, the Internet changed this traditional channel communication to a more open and collaborative manner. One big change is the emergence of retail e-marketplaces, such as Wal-Mart's RetailLink, which can be seen as a way for retailers to aggregate their buying power, increasing their competitive positioning as opposed to big CPG manufacturers, streamlining the supply chain from the retailer side, and eventually decreasing the total procurement costs and inventory costs.

To face the emergence of retail e-marketplace, the manufacturers have an industrial pressure to adopt the same strategy. As a result, Transora was developed as an ISM in consumer packaged good (CPG) industry. Its participants consist of 56 consumer products companies, including the big names such as Kraft Foods, Procter & Gamble, Nabisco, and Pepsi Bottling Group to build unified standards among multiple item-catalogues and strong capital support.

VALUE PROPOSITION

Transora offers four types of service that support business activities along the entire value chain: supply chain optimization, procurement, consumer services, and retail service (Figure 3). Although optimizing the efficiency of each node in the supply chain is an important mission in Transora, its focus is on offering additional value in exchange-to-exchange integration, retailers' order management, and consumer's promotion management, particularly:

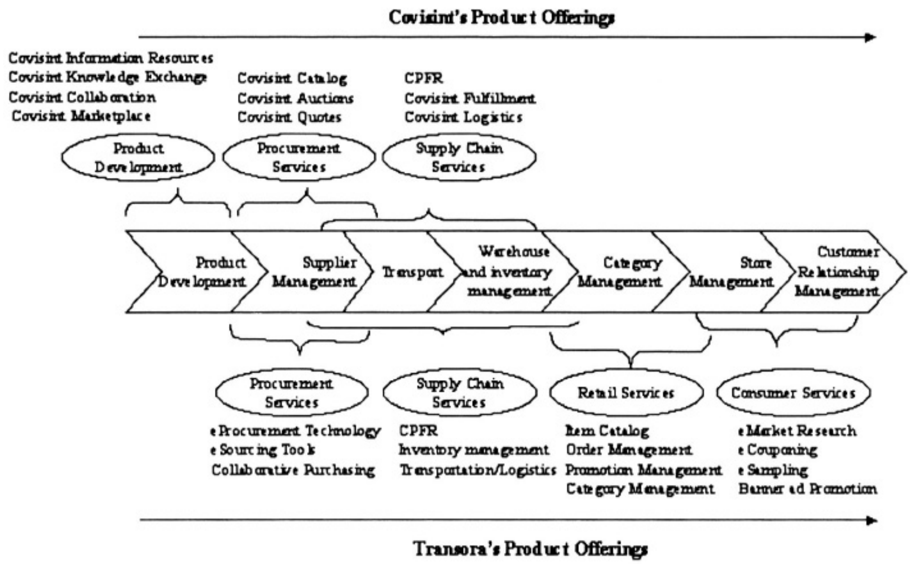

Figure 3. The Summary of Covisint and Transora's Product Offerings

1. *Support Exchange-to-Exchange (E2E) interoperability*
   Transora adopted Global Commerce Internet protocol, the first global standards for B2B e-commerce in the CPG industry, to set basic rules for data access and security, message content and the flow of information between trading partners around the world. The same standard will also be used by World-wide Retailer Exchange (WWRE), CPGmarket.com and Global Net Xchange (GNX). As a result, buyers and sellers can use the same formats to describe products, send and receive electronic purchase orders and transact with other businesses over the Internet.

   In addition, in January 2001, Transora and GlobalNetXchange (GNX) announced plans to create a joint venture with the working name of Megahub. Megahub aims to facilitate the transfer of purchase orders and other data between marketplaces. Via Megahub, the members of different exchanges can use different technologies to communicate with one another. This will enable participants to connect once, with Transora, and utilize the services of several exchanges without the difficulty and expense of building more connections.

   Transora's technology architecture is designed to support the requirements of different trading partners: suppliers, buyers, alliance partners, and other exchanges (see figure 4). Data can be either automatically exchanged via middleware at buyer and seller sites, or be manually entered and retrieved via buyer and seller's Web browser. All data input will be examined by Transora's security firewall.

In the integration layer, participants can take the form of a simple, browser-based mechanism, or choose either hosted (participant out-sources applications to Transora) or not-hosted (participant retains application in house) solutions.

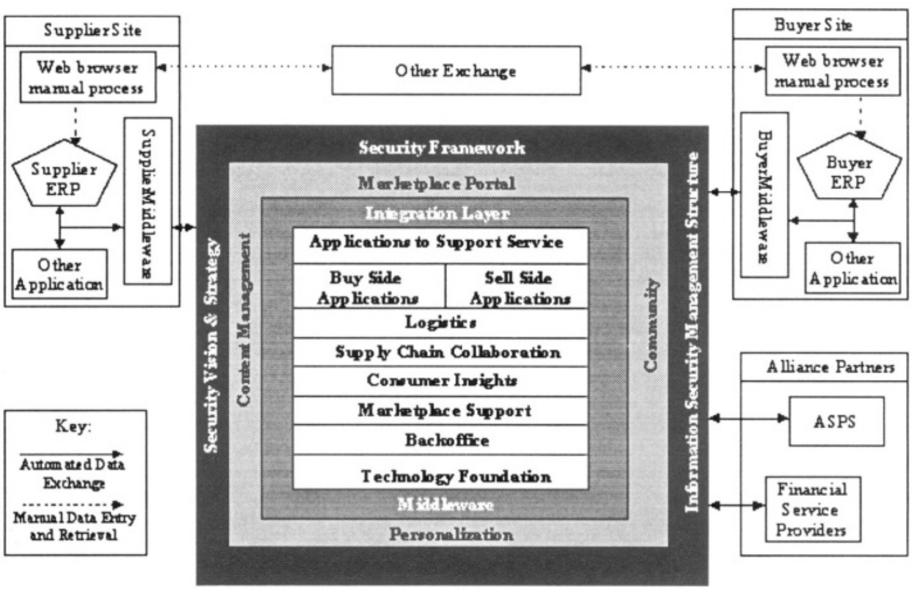

Figure 4. Technology Architecture of Transora

2. *Synchronize cataloge services*
   Data synchronization is the foundation for collaboration, enabling the next level of industry value creation – improved order accuracy and reduced data management effort and cost. However, item information can be listed very differently across multiple supplier catalogs. Transora intends to resolve this problem via a global agreement with UCCnet. This agreement will enable all participants to have a global item standard, while ensuring industry validation through UCCnet's Global Registry Services. These standards will make suppliers and manufacturers to store their product information in one place and also expedite processes like order management and promotions management for retailers.

3. *Enable online promotions*
   Transora uses consumer profiles and responses to past promotions to structure future offers and tailor communications. This one-to-one marketing technique is expected to increase coupon redemption rates up to 20% versus 2% for traditional coupons, while reducing coupon management costs and product samples distribution costs.

4. CRITICAL SUCCESS FACTORS FOR IMPLEMENTING ISMS

The success of an ISM depends not only on its design, but also on the implementation strategies. Therefore, we will analyse the critical success factors from these two perspectives.

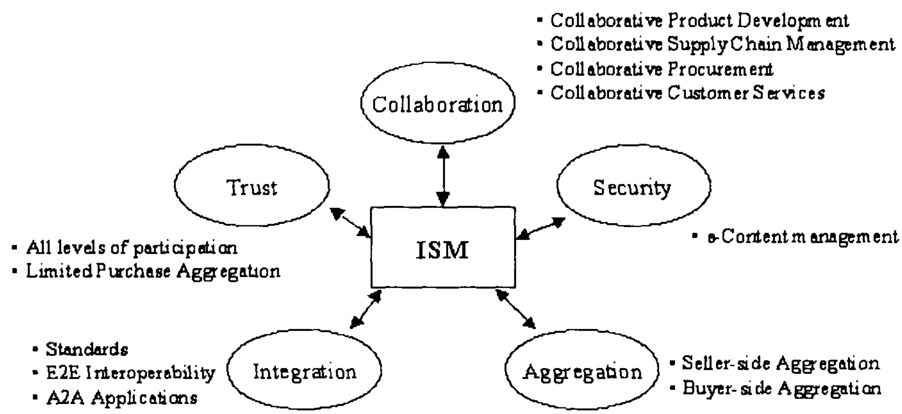

Figure 5. Five Mechanisms of ISM

ISMs must be carefully designed to facilitate potential capabilities and avoid possible pitfalls. Particularly, we identify five mechanisms that ISMs must embrace (Figure 5).

COLLABORATION MECHANISM

Many suppliers are reluctant to joint the exchange because of concerns over product branding and fears of being pressured into unrealistically low prices. This missing link can be improved by collaboration functionality.

The collaboration functionality can be applied in four areas: (1) collaborative product development, (2) collaborative supply chain management (or CPFR), (3) collaborative procurement, and (4) collaborative customer services.

In industries with high product volume and less product complexity, such as consumer packaged goods, the primary need for increased collaboration revolves around managing inventory levels along the supply chain. This can be addressed via CPFR tools designed to manage the high-volume movement of the goods by improving the allocation of inventory at all points in the distribution network.

The automotive industry is a hybrid. The final products are relatively complex and the individual sales volume of each manufacturer is relatively high, leading to more comprehensive collaboration requirements. Thus, in addition to CPFR, collaborative product development is important for the complicated products. Companies with shorter and cheaper new product introduction cycle have a competitive advantage in the market.

Collaborative procurement tool provides a central, online repository of sourcing documentation, allowing a single buyer to communicate with many potential sellers in order to obtain, organize and analyze large number of quotes in an efficient manner. Once the sellers receive the inquiry from the buyer, they review the material off-line, prepare a response, and then submit their proposals to the buyer using the tool. The buyer then makes its decision based on the responses. This procurement information sharing process gives great support for buyers to select suppliers, decreasing the total contract negotiation time.

Collaborative customer service is a collaborative effort established for marketplace customers to share their experiences of new technologies and investigate electronic procurement and e-marketplace opportunities. For example, Covisint created a customer advisory council to better understand the needs and concerns of suppliers, and incorporate their inputs throughout the development of the exchange. This council facilitates real-time information sharing between OEMs and suppliers, thus further increasing procurement efficiency.

SECURITY MECHANISM

The buyers have a lot of concerns to join the ISM. First, they are afraid that they may lose their competitive advantage by leaking some sensitive information to their rivals through the marketplace. In addition, they fear that their individual interest will be compromised by the leadership committee, who usually are comprised of rivals with conflicting interests.

As a result, it is necessary for ISM to provide individual participant a secured and private environment, enabling buyers and sellers manage their own content at their respective extranet. For example, Covisint utilizes Documentum's 4i eBusiness Platform to partition its eContent repository, allowing customers to post images, streaming media, fulfilling other more sophisticated tasks, and managing associated content workflows over the Internet in a private and highly secured fashion.

AGGREGATION MECHANISM

Aggregation is a significant mechanism of ISM. ISMs are more advantageous in aggregating trade because of their joint ownership of major market players. Taking Covisint as an example, the new addition of French manufacturer PSA Peugeot Citroen represents 25.6 billion purchasing volume in the European market, letting alone the purchasing needs from other five OEMs.

The aggregation capability can be built at either the buyer-side or the supplier-side. Currently, both Transora and Covisint are focused on aggregating suppliers by offering Web-based cataloging services. They provide suppliers with a wide variety of tools to create individual or community online catalogs, manage content, track and manage orders, and report status.

INTEGRATION MECHANISM

In general, there are two types of integration: Exchange to Exchange (E2E) and Application to Application (A2A).

Covisint focuses on A2A integration. It selected the Mercator Enterprise Broker to transport electronic customer documents from one system to another, thus integrating multiple applications, legacy systems, databases and data warehouses across the entire enterprise system. It also gives users the flexibility of accepting multiple messaging formats and data transport languages from both new and legacy technologies. This A2A integration is essentially enabled by ebXML. The ebXML 1.0 standard was designed to be the online, easy-to-translate equivalent of EDI. The approved specifications include a technical architecture, business process specification schema, registry services, and messaging.

Transora also implements A2A connection to some extent. Customers can choose to connect to the market using internal, exchange-supported or ASP (Application service provider) services. However, compared with Convisint, Transora puts in more effort to support E2E interoperability. Through E2E integration, Transora is able to connect the existing multiple e-marketplaces in the CPG industry and provide customers with a single entry point. The integration is made through the joint venture with GlobalNetXchange (GNX). This joint venture (Megahub) is developed upon multiple industry standards, such as the global item and location registry standards from UCCnet and the Global Commerce Internet Protocol.

TRUST MECHANISM

The joint ownership of an ISM makes it susceptible for monopolistic behaviors, such as collusion or price-fixing. Therefore, ISM must be carefully designed and planned to address antitrust and other legal issues. Any decision regarding the exclusion of certain markets or certain players from participating in an e-marketplace could cause unnecessary legal headaches.

Covisint set up a very good sample for other ISMs in handling government anti-trust investigations:

- Assurance of participation from all supply chain players
  Covisint emphasized that the e-marketplace will be accessible to all of the 30,000 automotive suppliers, addressing a key area of concern of the federal regulators.
- Clear guidelines for aggregate purchasing
  Covisint made it clear that it will not aggregate the purchase of one OEM with that of another. Moreover, they will not offer aggregated purchasing services for any automotive-specific parts or materials. Aggregation of purchases of non-automotive specific parts (such as office supplies, cleaning supplies, etc.) will always be conducted in accordance with the applicable business laws.

CRITICAL STRATEGIES

Based on the survey of Covisint and Transora, we summarize the critical implementation strategies below:

1. The ISM must constantly develop and offer the right products and services

The ISM must have a clear and feasible value proposition. There must be a focus on trading partner integration. Besides, the ISM should be very flexible. There is a constant need in the companies for re-engineering and reorganization. The ISM must make an effort to be more efficient and always be open to implementing a new plan.

2. The ISM must take a hybrid approach to embed private exchange into its architecture

In addition to participating in public marketplaces, many companies are launching private exchanges that allow them to interact with regular customers and suppliers in a tightly controlled environment. It is predicted that the majority of Fortune 1000 companies will use a combination of private and public exchanges to conduct business transactions over the Web.

Public exchanges are particularly efficient in buying and selling operating materials, such as maintenance, repair and operations (MRO) items. However, manufacturing-specific goods and materials are usually purchased systematically from a group of suppliers with whom buyers already have set up the relationships and procedures through private exchanges. As a result, it is necessary for ISMs to embed those private exchanges into their architecture, allowing big corporate buyers to do business privately on the site with their preferred suppliers. In the future, it is expected that some shared-services network will emerge to enable efficient product life-cycle collaboration among the trading partners and facilitate private collaborations on the public network, blurring the distinction between public and private marketplaces.

3. The ISM must strive to attract large suppliers

As we have noted before, large suppliers are reluctant to join ISMs because of the high pressure of reducing prices and the very limited benefits from transaction cost savings. To attract those large suppliers, ISMs should support the existing EDI communications, and emphasize the “cost savings” by providing alternative services.

4. The ISM must shift its revenue model from the transaction fee model to the flat subscription fee model

The transaction fee model has been widely used by B2B e-marketplaces. The model works because the marketplaces can greatly reduce the search cost for transactions between very fragmented buyers and sellers or across different industries. However, ISMs are industry-specific. The reduction of search cost will not be significant since most of the buyer-supplier relationships are already established. Hence, the transaction-based model is not appropriate in this environment.

Collecting flat subscription-fee on monthly or annual basis is a better model for two reasons. First, it is simple and straightforward, thus member companies can better budgeting and evaluating the return on investment. In addition, sellers and buyers in the ISMs usually demand more value-added services, such as logistics, collaboration, and financing rather than simple matching. Thus, *the flat subscription fee model based on the usage of services makes more sense for ISMs than the transaction fee model based on volume of transactions.*

5. The ISM must focus on collaborative services rather than trading functions

The trading function has become a commodity in e-marketplaces. Although it is still a very important service, the winners are the ones that can offer collaborative capability to the participants. As a result, it is necessary for ISMs to achieve A2A or E2E integration in order to facilitate seamless information sharing.

The ultimate goal for an ISM is to build a collaborative commerce network that consists of not only the main players in the industry but also small-sized buyers and sellers. Thus, any network participant can choose to collaborate with each other in designing, manufacturing, and distributing the products.

5. THE ECONOMIC VALUE OF ISM

Like any businesses, the success of an ISM comes from a solid business model that specifies appropriate value proposition of the e-marketplace and related revenue generation mechanisms. Learning what are the economic values, specifically revenue sources, that an ISM offers, and how the particular industrial characteristics influence the realization of those values provides us with some insights for the design and formulation of good business models.

The total value-created will be shared between buyers and sellers of the ISM, constituting buyer and seller surplus. More specifically, such surplus is the difference between the value of participating in the ISM and the operating costs and risks of joining the ISM. The profitability of an ISM is determined by its revenue and development costs.

There are three major sources of revenue for an ISM: (1) transaction fee, (2) software subscription fee, and (3) membership fee. In the rest of this section, we will discuss each revenue source and the industrial factors affecting its generation in detail.

TRANSACTION REVENUE

Transaction fee is the money collected by the e-marketplaces to host online transactions. In practice, it can be a fixed fee per transaction or a percentage of the total amount of each transaction, and it is collected from the buyers, sellers, or both.

It is obvious that the amount of transaction revenue that an ISM is able to generate depends solely on the transaction volume of the market. However, transaction volume can vary greatly in different e-marketplaces, mainly for two reasons: the collective purchasing volume of the buyers, and the degree of participation of the suppliers. ISMs are known to be very good at the former, because they are usually created by the biggest buyers in the industry. Nevertheless, encouraging suppliers to participate is not that simple. There are several industry and market forces that work together to influence the suppliers' decisions. As shown in Figure 7, we identified three such factors.

1. *Supplier power.* We call the suppliers' ability to determine product price and conditions as their power. It can be shown that when the suppliers' market is fragmented with low sales volume of each supplier while the buyers' market is concentrated with very high purchase volume of each buyer, the individual supplier has low power. In this case, it will be relatively easy for those giant buyers to demand small suppliers to participate. In fact, this is what we have seen in the auto industry.

2. *Ability to transfer transaction volume to profitability.* Like most of the e-marketplaces, ISMs put a lot of pressure on suppliers to compete against each other on price. However, simply lowering price does not translate into higher transaction volume or profitability in the long term. Suppliers who can maintain profitability are those that leverage the capabilities of the ISM to strengthen the buyer relationship, provide unique, customized products and services, thus offsetting the effect of the reduced search cost and decrease buyers' sensitivity to price.

3. *Supplier perceived benefit.* The most effective way to persuade suppliers to participate is to demonstrate the potential benefit of joining the ISM. In other words, the supplier's decision is highly influenced by the benefit they perceive, such as reduced operation time, reduced operation costs, and improved product quality.

SOFTWARE SUBSCRIPTION

Software subscription fee is the money charged to members for using particular service applications in the electronic market. Depending on the individual price structure of the ISM, it can be a one-time fee or pay-as-you-go. As a result, the amount of subscription revenue changes with the number of services provided by the ISM and the usage rate of the services.

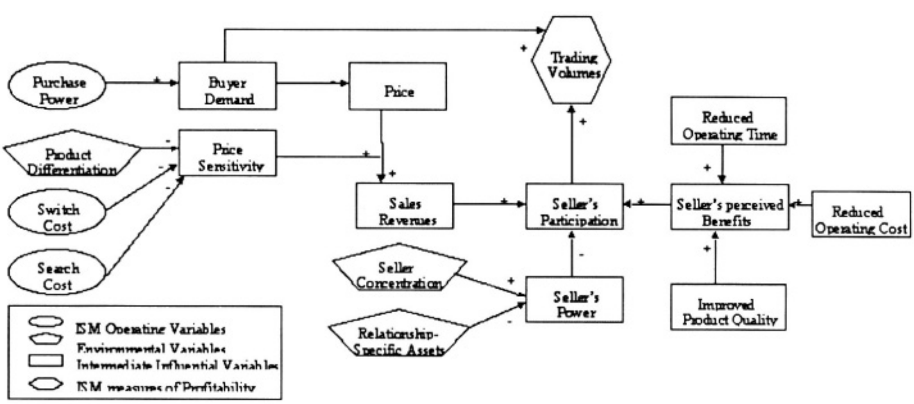

Figure 6. The analysis of influential factors on transaction revenue

1. *Number of Services.* From a glance, we may think that the more services provided, the larger revenue can be collected. However, if we think from the cost perspective, this is not always the case. Developing a service application is a capital-intensive process. Moreover, a substantial proportion of the average total development cost is fixed. In other words,

no matter how many buyers and sellers participate and use the service, there is an expensive minimum cost that must be paid up-front in order to start the particular service. Since ISMs usually have a considerable number of participants, and thus, a larger base to spread the fixed cost, it is often cost effective for them to offer more services. Nevertheless, in-depth cost-benefit analysis still needs to be conducted before the ISM making any decision in terms of offering new services.

It is important to note that there are limits to the economies of scale and its resulting benefit for an ISM. Particularly, from the buyers' perspective, having a large number of buyers in the ISM may even create a "diseconomies of scale". Two possible causes are discussed below:

2. *Bureaucracy effects.* In general, the complexity of monitor and communications increases as the number of buyers in the ISM goes up. Moreover, as the ISM is led by a management committee, it faces further difficulties in setting goals and performing specific tasks as desired. As a result, it is critical for ISM to provide tools to facilitate advanced communication and decision-making.

3. *Conflicting interest.* As the buyer group is consisted of industry rivals, it is inevitable that their objectives and interests will be in conflict with each other. Therefore, ISMs have to been very cautious in developing services to meet their common interests. As we noted earlier, one alternative is to embed existing private exchanges into their architecture.

4. *Usage of services.* To make this model work, it is essential for the ISM to stimulate the usage of its services. However, marketplace customers will choose to use a particular service only when they can perceive benefits from adopting the service, and the cost of system integration is reasonable. As we have analyzed the seller's perceived benefits in the previous section, we will discuss the integration cost here and the buyer's perceived benefits in the next section.

5. *Integration costs.* The integration cost is influenced by three environmental factors:
   - Concentration of the buyers: When the buyer market is concentrated with only a few big players, the number of systems to be integrated is relatively small, and hence the integration effort is less complex, resulting lower cost.
   - Investment of relationship-specific assets: Very often, in order to carry out transactions with big buyers, suppliers are forced to make a

substantial commitment in technologies. Those technologies can vary greatly; some of them are even proprietary. Thus, the more investment of such relationship-specific assets, the less flexible for a buyer or seller to switch to another technology, and hence the higher cost of integration.

- Complexity of the process: A complex business process often involves multiple stages with each stage precisely integrated to each other. This implies that more effort must be invested on integration because even a small error can break down the whole process chain, thus becoming very costly.

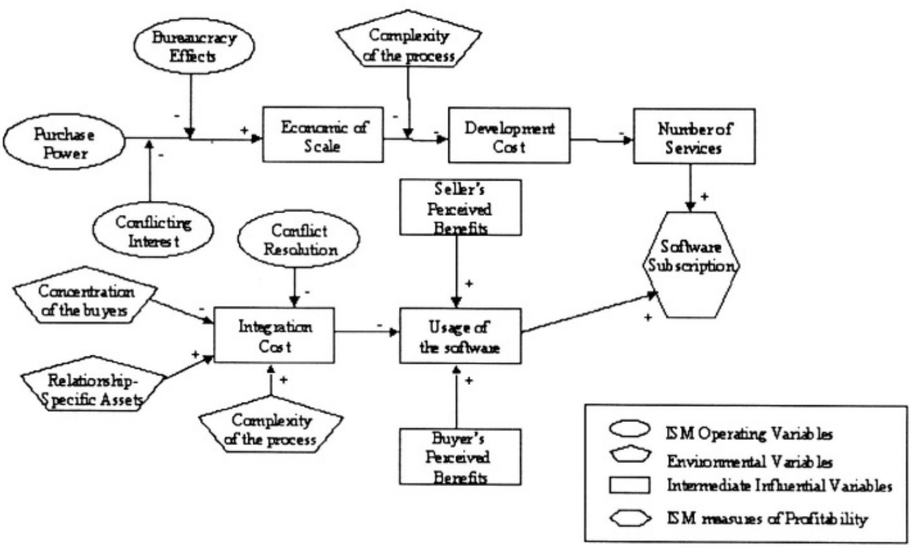

Figure 7. The Analysis of Influential Factors on Software Subscription

To increase the software subscription, ISM needs to design the mechanisms to control its operating variables and correspond to the environment at the same time. Then, with improved coordination, communication, and security capabilities, ISMs will enable buyers to gain scale economies with less bureaucracy effects or conflicts. In addition, advanced communication facilitates efficient problem solving and conflict resolution, resulting lower cost of integration.

MEMBER SUBSCRIPTION

Member subscription is a flat fee charged to buyers and sellers for being listed in the marketplace. Obviously, the entire subscription revenue is determined by the number of members in the ISM. As the seller participation has been discussed in the previous section, in this section, we will focus on buyer participation and its associated influential factors.

Different from sellers, buyers are usually the initiators of ISMs. However, because of the competing nature among them, a buyer will join force with its competitors only when it foresees substantial efficiency gains from the ISM without jeopardizing its competitive advantage in the market of final products.

We postulate the sources of competitive advantage into two categories: cost advantage and benefit advantage. A firm that is able to offer products at a lower cost is considered to have a cost advantage. However, benefit advantage is created through product differentiation. A firm with a benefit advantage is able to provide consumers with a higher surplus while at the same time, retaining a higher profit margin than that of its rivals. We find that, under different conditions, joining the ISM will bring the buyers with different degrees of cost or benefit advantages, resulting different levels of incentive of participation. Those factors are summarized as follows:

Factors influencing Buyer's Cost Advantage

- *Cost Structure of Buyers:* Compared to their high-cost counterparts, low-cost buyers have less incentive to join an ISM. As a result, in an industry where there are very different cost structures, it is more difficult for buyers to achieve consensus to form an ISM.

- *Product Differentiation:* When the buyer's product is highly differentiated and with few substitute, it will be less affected by the rival's cost reduction, even if its competitor is a cost leader.

- *Price:* Through aggregating buyers or suppliers, ISMs increase the competition among sellers, resulting lower procured product prices and cost advantage for the whole buyer industry.

- *Economies of scale:* ISM's aggregated purchasing power assists buyers to reach minimum efficient scale to build the exchange. This increases the cost advantage for participating buyers to form exchange together instead of building by their own.

- *Network externalities:* Buyers can greatly reduce their costs of searching and coordinating with various suppliers through the supplier network enabled by the ISM.

In summary, although the buyers in the ISM can enjoy cost reductions from various sources, such as price cuts, economic of scale, and network externalities, they also incur a considerable capital investment preventing them from switching to other alternatives. For big buyers who are already enjoying large discounts, participating in an ISM may not bring much cost advantage but hurt their relationships with suppliers. Moreover, as the ISM is designed to increase the operating efficiency for the whole industry, participating buyers still need to differentiate themselves through other means.

Factors influencing Buyer's Benefit Advantage

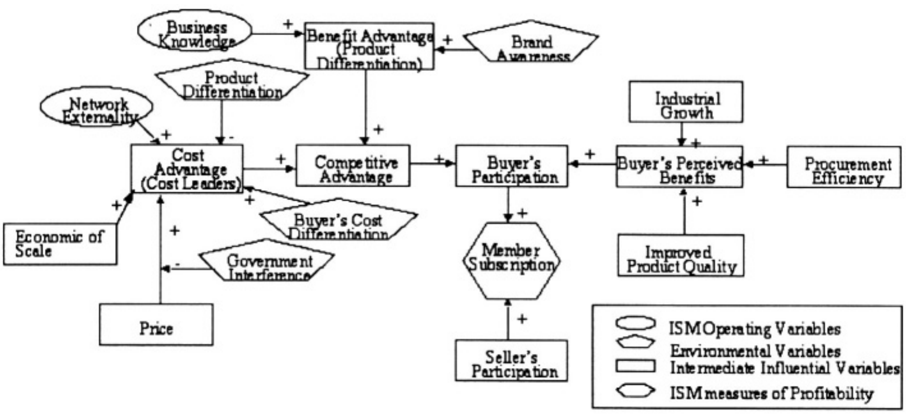

Figure 8. The Analysis of Influential Factors on Member Subscription

Each of the following tends to affect the benefit advantage of buyers after participating in the ISM:

- *Business knowledge:* ISM allows buyers to access and share a common pool of talent in the industry, including technological know-how, thus increasing the potential benefit advantage applied to the whole industry.
- *Brand Awareness:* Brand name and reputation are still valuable assets for a specific buyer in creating benefit advantage and differentiation.

EXAMPLE – THE ECONOMIC VALUE OF TRANSORA

For Transora, the economic value behind its arrangement can be evaluated from its own performance and the value it brings to its customers. From the discussion above, transaction revenue is one performance index for ISM. The calculation shows that Transora is expected to collect over 350 million in transaction revenue from its investors, who represent more than half of the total sales of global consumer products industry (Figure 9). This calculation is conservative since it is based on the current customer base, which only accounts for 25% of its initial installed base. The number should be a lot bigger when all of the investors use Transora for their B2B commerce. In addition, this calculation is based on the average e-marketplace adoption rate (4.7%) in the U.S., the actual result in CPG industry could be quite different.

The perceived participant's benefits can be evaluated via the error reduction, the cost reduction, and the improved quality. If we only looked at the manufacturers' side, Transora is expected to bring 7 billion to 45 billion benefits in total to the manufacturers (Figure 10). The realization of benefits depends on the adoption level of those manufacturers in terms of type of services they use and the frequency and consistency of their use. On the other hand, the company's scale and the level of efficiency in their current operations are also influential to the realization of benefits. The calculation captures the cost savings for regular manufacturers that participate in Transora. We use the cost data measured in sales percentage from Herbert W. Davis and Company (www.hwdco.com) to benchmark the total cost savings in different cost entry. The result may be biased because the data expresses the average cost occurred across multiple industries not specialized in CPG industry. As a result, some numbers may be higher or lower because of different operations in CPG industry.

Current Performance of Transora

- Number of total manufacturers 56
- Initial capital investment 250M
- Number of active users per total members (acquisition effectiveness) 25%
- Total sales revenue (half of the industry) 600B
- Software development cost 180M
- Average transaction fee per dollar of transaction 5%
- Number of employees 250

Expected transaction revenue
600B *25%* 5%*4.7%= 353M

Overall E-market Performance (Forrester Research)

- Percentage of U.S. industry sales going through e-market (Adoption of E-market) 4.7%

Figure 9. The Expected Transaction Revenue in Transora[1]

Some benefits are not captured in this calculation. For example, the calculation does not depict the reduced switch cost of suppliers because of more open infrastructure implemented in Transora. It also does not capture

[1] Please refer to www.transora.com for the predicted percentages

the benefits from economic of scale that can be realized as a result of increasing density of collaboration. By collaborating with a critical mass of its trading partners for a particular product category, a manufacturer can drive operational efficiencies across the supply chain.

Figure 11 outlines the tangible and intangible costs by transacting through Transora. Besides paying the transaction fee and membership fee, the participating manufacturers also need to pay software subscription fee, which is based on what type of services and how frequent the service is used. The integration cost varies from companies to companies. Transora provides three level of integration. Manufacturers can use Transora's services simply via Web-based browser, through Transora hosted environment, or from Transora's preferred integrators. Type of services and complexity of the participant's internal systems can also influence the total integration costs. For example, based on Transora's estimation, to operate CPFR application within a company's firewall, 4-6 full-time technical support personnel are needed for large manufacturers.

Perceived Benefits

• Error reduction	
Forecast accuracy improvement	10-40%
Inventory accuracy improvement	5-15%
• Reduced operating cost	
Inventory reduction	30-70%
Instock improvement	1-4%
Catalog production cost	20-35%
Customer acquisition cost (Promotion cost)	18%
Distribution cost	50%-90%
• Improved quality	
Sales growth	2-25%
Service level improvement	0.5-2%

Expected cost reduction (in million)

• Error reduction:	
0.06*14*[(4,6)*(0.1,0.4)+(4,6)*(0.05-0.15)]	0.51-2.78
• Operating cost reduction	
Inventory reduction: 150,000*2.03%*(0.3,0.7)	913.5-2,131.5
Instock improvement: 150,000*2.39%*(0.01-0.04)	35.85-143.40
Catalog production cost: 150,000*0.76%*(0.2-0.35)	228.00-399.00
Customer acquisition cost: 6,000*0.5*0.18	54
Distribution cost 150,000*3.54%*(0.5-0.9)	2,655-4,779
• Improved quality	
Sales growth: 150,000*(0.02-0.25)	3,000-37,500
Service level improvement 150,000*0.85%*(0.05-0.02)	6.375-25.5
Total perceived benefits (Manufacturers)	**6.89B-45.03B**

Overall average cost for all entries across industries (2000 survey from www.hwdco.com)

	% of Sales
Transportation	3.54%
Warehousing	2.39%
Order Entry	0.76%
Administration	0.85%
Inventory carrying	2.03%

Additional benefits (value not captured above)

- Reduced switch and search cost
- Improved conflict resolution
- Economic of scale
- Network externality
- Business knowledge

Estimated hosting support requirement for collaboration (from Transora)

Large manufacturer	4-6

Figure 10. Manufacturers' Perceived benefits for transacting through Transora[2]

[2] Please refer the predicted percentage from www.transora.com

The revenue, perceived benefits, and perceived costs listed here are intended to give a general idea to realize the economic values behind the industry-sponsored exchange. All data are retrieved from Transora's news release and general industry survey. As a result, actual benefits or revenues will, of course, vary.

Perceived Tangible Costs	Perceived Intangible Costs
▪ Transaction fee & Membership fee ▪ Software subscription fee Type of services Frequency and consistency of the use ▪ Integration cost Type of services Level of integration: (1) simple, browser-based (2) hosted integration (3) non-hosted integration Complexity of the participant's internal systems	▪ Bureaucracy effects ▪ Conflicting interests ▪ Government interference ▪ Reduced buyer's power to control the relationship with suppliers

Figure 7. Perceived Costs for transacting through Transora

6. IS-RELATED RESEARCH ISSUES

As some of the e-marketplaces pioneers have failed and as many survivors struggle to generate positive cash flows despite rapid growth, potential e-marketplace users and investors have become less enthusiastic and more cautious in making decisions as to build or join an e-marketplace. Questions such as, "what are the costs and benefits of an e-marketplace", "what types of services have to be provided by an e-marketplace and how to design service attributes", "what are the strategies for managing and implementing an e-marketplace", and "how should I deal with my suppliers, distributors and competitors in the new environment" need to be answered before taking any action.

As e-marketplaces are becoming more popular there is a growing need for industry executives and researchers to develop methods and adapt theory in order to more rigorously evaluate the impact of e-marketplaces at different levels.

Some of the research directions include:

Firstly, what is the impact of IT innovation and new IT standards such as Web services on information systems capabilities required to support e-marketplaces? Answers are very important as they affect, for example, operations and service delivery cost, and choice of service attributes of an e-marketplace.

Secondly, what is the impact of e-marketplaces on business performance? For example, is change limited to a buyer-side cost reduction of one input or are buyers and sellers changing their business strategy through outsourcing, divestures, and electronic integration to transform an entire industry segment or industry?

And thirdly, how to manage interaction effects, such as how strategic behaviour affects the emergence of IT standards and new IS capabilities and, therefore, potentially new e-marketplace business models? Answers are crucial to e-marketplace operators and investors to better allocate research and development funds, and to develop more effective and efficient standardization strategies as well as market penetration campaigns.

IS AND BUSINESS IMPACT OF E-MARKETPLACES

Like other IT innovation in the past, the impact of e-marketplaces is transformational. To account for the impact fully, considerations have to be given on multiple levels. Bakos, for example, suggests five levels or categories of units of analysis (1987):

– The individual end user of the e-marketplace;
– The division or business unit within the firm;
– The firm within an industry;
– The industry within an economy;
– The whole economy.

Current IS research is focused on market making mechanisms, such as the matching of buyers and suppliers, the facilitation of transactions, and its institutional governance (Bakos 1998, Baura et al., 1997). However, very few insights are available on how e-marketplaces affect financial performance and intermediate variables such as customer involvement, satisfaction, and retention.

There will be major shifts in the strategic relations between the participants of e-marketplaces, as competitors in the same industry use the joint e-marketplace to collaborate (especially in dealing with their suppliers). Economic arrangements involved in making the e-marketplaces work require the support of an effective information infrastructure. There will also be tensions in the relations among the e-marketplace participants, in terms of what to share and what not to share with their fellow participants. The implication is that the participants have to be able to collaborate to make the industry-wide supply chains efficient, while still be able differentiate their products, order fulfilment, and customer services.

IS DESIGN AND MARKET POTENTIAL OF E-MARKETPLACES

The IS literature reveals how some IT innovation affects IS capabilities (e.g., EDI) and how IS design can affect user acceptance and successful organizational outcomes (Davis et al. 1989, Banker and Kauffman 1991, Vessey and Galletta 1991, Goodhue 1995, Subramanian and Zarnich 1996, Dekleva and Drehmer 1997). However, e-market makers, investors and potential entrants face a constant stream of IT innovation. On one hand, new IT and IT standards are being introduced frequently (e.g., CORBA). On the other hand, even old IT can emerge as a new standard (e.g., UDDI and SOAP with Web services). Therefore, IS research has to constantly monitor new IT and its impact on IS capabilities. This may include the adaptation of existing IS research constructs (e.g., IS integration and IS flexibility) or even the development of new constructs. Availability of IS capabilities is important because it triggers what can be provided in terms of service attributes and how costly. Services attributes and cost in turn, determine the maximum market potential of a service offering. While advertising strategy shape actual diffusion into the market potential, which is extensively studied in the marketing field.

IS STRATEGY AND ORGANIZATIONAL TRANSFORMATION

Enterprises have been, according to the business press and trade journals, “blown to bits”. They have been virtualized, modularized and unbundled and reconfigured using e-markets for years. Dell Computer Corporation’s modus operandi would typify this trend for many industries. However, so far, very little of this has been observed with other companies. For most enterprises, despite having made huge investments in business process automation and systems integration and often-painful organizational redesign, Dell’s success has remained elusive.

Although e-marketplaces can allow for more business networks as opposed to linear interaction, many organizations are struggling to create positive effects across relationships in channels and supply chains. Often the move to a network with more partners and more frequent and deeper interaction has only added complexity and cost.

While most research of relationships in IS and in other management science disciplines has been at a dyadic level, effects across relationships such as the creation of relational value—defined as the rent generating capacity of relationships embedded in a business network—has only been locked at recently. Therefore, from the perspective of a business executive and IS researcher it is important to understand the role of IS capabilities in the creation of relational value.

There is no question that information technology is the enabler of emergent e-marketplaces by providing the necessary connectivity, common platform, information sharing, modular processes, standard protocol, and coordination. What is less clear is how the e-marketplaces will evolve and in what form. It is a classic example of the interplay between IT, strategy, organizational transformations, and inter-organizational dynamics. The boundaries between enterprise-level and inter-organizational activities are blurring. As a result, supply-chain and e-market relationships are converging in the ongoing development of e-marketplaces.

7. CONCLUSION

Most practitioners, industry observers and researchers believe that the long-term prospects of B2B e-commerce are positive. Nevertheless, in the short term many observers suggest struggle.

On one hand, e-market makers are running out of cash. Since the burst of the so called Internet bubble in 2000 less venture capital funding is available and equity investors are more cautious, which puts pressure on e-market makers to generate enough cash to sustain operations and fund business expansion.

On the other hand, the business may already be too crowded. In the chemical industry alone, for example, there are over 15 similar e-marketplaces chasing the same customers and transactions. This leaves all competitors with too few volumes. Forrester Research found that 95% of the

50 e-marketplaces that it had surveyed in 1999 were conducting fewer than 10,000 transactions a month, which is less than a decent-sized grocery store handles in a week . Many observers, therefore, agree that few of the existing e-marketplaces stand a chance to create the necessary liquidity to survive and that the industry will face a period of consolidation.

So the question is: "who can survive the current e-business turmoil and harvest benefits in the future?"

We conclude that ISMs are better positioned to successfully navigate today's struggle and consolidation. Built by big players and focused on a particular industry, ISMs already have the industry knowledge, insights, and expertise that would take third-party e-marketplaces some time and effort to develop. Hence, they are better prepared to offer value-added services, such as supply chain decision support and management advise, to supplement revenue from transactions. As a result, ISMs would also be a less risky and, therefore, more attractive choice for new investors, which in turn could lower cost of capital and, therefore, cost of operations, service delivery, and business expansion. However, there is one caveat with the ISM model—potential conflict of interest among its owners. As the joint owners of ISMs are usually rivals in the industry, cooperating in the ISM while competing in the market—cooptition—can be a difficult task.

We identified the essential system components and critical strategies for the success of an ISM, which are not necessarily limited to ISMs. For any type of e-marketplaces to be successful, information systems have to be designed and implemented to allow for: aggregation, integration, trust, security, and collaboration.

We also analyzed the direct economic benefits that an ISM can generate for its owners. Specifically, we looked at three sources of revenue: transaction fees, software subscription fees, and membership fees. Additional sources of revenue that we didn't analyse in detail include advertising and consulting fees. The actual revenue mix will depend on the level of buyers' purchasing power, supplier participation, and IT capabilities of participants. And needless to say, that multiple sources of revenue appear to be more desirable than reliance on a single stream.

[3] "E-Marketplace Vision Collides With Reality - B-To-B E-Commerce Has Turned Business Models Upside Down, But the Frenzy Seems to be Cooling Down," *InformationWeek,* June 12, 2000

Finally, we used our analysis to identify emerging IS research issues whose investigation would also be of tremendous value to business executives and IT experts.

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Chapter 14

Trading Financial Derivatives on the Web - An Approach Towards Automating Negotiations on OTC Markets

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Abstract: Derivative instruments have become increasingly important to financial institutions, institutional investors, traders and private individuals throughout the world, both as risk-management tools and as a source of revenue. The volume of over-the-counter (OTC) traded derivatives has increased enormously over the past decade, because institutional investors have often had a need for special derivative products, which are not traded on organized exchanges. An important feature of OTC trading is the bargaining on multiple attributes of a contract such as price, strike price and contract maturity. Negotiation on multiple attributes of a deal is currently not supported by electronic trading floors. In this paper we describe an approach of how to automate the multi-attribute multilateral negotiations using a Web-based trading system. First, we will give an overview of various approaches to supporting or automating negotiations on multiple attributes. Then we will introduce multi-attribute auctions, an extension of single-sided auction theory and analyze preliminary game-theoretic results. Finally, we will show a Web-based electronic trading system for OTC derivatives, based on multi-attribute auctions.

Key words: Financial Derivatives, Multi-Attribute Auctions, OTC Trading, Electronic Exchanges, Microeconomic Engineering

1. INTRODUCTION

Trading in futures and options has evolved wherever business risks have increased as a consequence of industrialization and these risks have needed to be hedged. Derivatives transactions make it possible to spread risk over several parties. Futures and options contracts are in some respects comparable to the insurance business: One party is the insurer, the other party the insured. As compensation for the security afforded by the futures transaction, the party seeking coverage - the insured - renounces a share of his/her potential profit in favor of the party who assumes the risk - the insurer. Financial derivative instruments comprise a wide variety of financial contracts and securities, including forwards, options, futures, swaps and warrants. Banks, securities firms, or other financial institutions are intermediaries who principally enable end-users to enter into derivative contracts.

Derivative contracts are traded on organized exchanges and through over-the-counter (OTC) transactions. Of course, only a selected set of standardized options and futures can be traded on an organized exchange. The special needs of institutional investors have led to the creation of many new types of derivative products, which are not traded on an exchange, but by way of bargaining on OTC markets. This segment has grown enormously over the past decade. As a consequence, there are several new approaches to establishing electronic exchanges for OTC derivatives, in order to make OTC trading more efficient. On those exchanges buyers specify exactly the various attributes of the product they want to procure. Then conventional single-sided auctions are used to automate negotiations on the price. Compared to the bargaining process in traditional OTC markets, participants lose several degrees of freedom during negotiations. In this paper we introduce multi-attribute auctions, an approach to automating OTC negotiations on multiple attributes of a contract.

In the next section a description of the state-of-the-practice of trading with financial derivatives shall be given. Section 3 introduces various approaches ranging from different academic disciplines to support or automate negotiations on multiple attributes. Section 4 gives a general overview of auction theory. Based on this we shall describe preliminary game-theoretic results in the field of multi-attribute auctions and give an overview of alternative research approaches in section 5. In section 6 we describe the details of a Web-based trading system implementing multi-attribute auction mechanisms. Finally, in section 7 we conclude with a summary of preliminary experimental results which we gathered from a series of laboratory experiments with this trading system.

2. TRADING OF FINANCIAL DERIVATIVES

Exchange-traded derivatives (i.e., futures and listed options) are standardized derivative instruments that are listed and traded on an organized exchange. Contract specifications of exchange-traded derivatives are typically standardized, whereas OTC contracts are individually tailored to the needs of the participants in the transaction and frequently specify instruments, commodities and/or maturities that are not offered on any exchange. Exchange-traded derivatives are standardized to such characteristics as the type of underlying, unit of trading, price basis, contract maturity and delivery terms. Standardization is a feature of exchange-traded derivative instruments enabling market participants to learn the relevant characteristics of an instrument based on its description or identification number or symbol. Liquidity is a direct consequence of standardization and makes it possible to readily trade derivative instruments on exchanges. It is the standardization of contract specifications and the associated liquidity that are fundamental differences in distinguishing exchange-traded derivatives from most OTC contracts. Besides, on organized exchanges a clearing house intervenes between the purchaser and the seller. It guarantees fulfillment of the contract and releases the contracting parties from the credit risk of the counterparty.

Nowadays, most organized futures and option exchanges are based on electronic trading systems. An *electronic trading system* is an electronically interconnected, computer-based securities trading network, commonly providing price quotations, order routing and automatic order matching. Participants can trade options and forwards anonymously from a computer terminal and query the latest market information. There is no exchange floor for such markets, traders can operate from offices anywhere in the world where access to the trading system is provided. Electronic trading allows for increased efficiency in order handling, especially when there is a large number of small orders.

Traditionally, trading in OTC derivatives is not bound to an organizational structure in that supply and demand are concentrated on a centralized trading floor (McLaughlin 1998). Prices are not determined by auction but by way of bargaining. Investors have special preferences based on their market expectations and their portfolio and negotiate with financial intermediaries on attributes such as the type of underlying, the unit of trading, price basis, the contract maturity and the delivery terms. The volume of OTC transactions has increased enormously over the past decade. Institutional investors especially have the need for special derivative products. As a result, financial engineers have created a large variety of OTC-traded derivative products ranging from equity forward contracts to exotic Bermuda and Barrier options. Traditional OTC transactions, however, have several disadvantages. Bilateral negotiations with banks or investment brokers are conducted over the phone, leading to high transaction costs for a deal. In contrast to electronic exchanges, investors lose their anonymity and also have to bear the contracting risk.

New approaches are trying to establish efficient, electronic trading systems for OTC derivatives. For example, in 1993 U.S. options exchanges began with the development of Flexible EXchange® Options (FLEX Options), an electronic trading system for the trading of index options. Equity FLEX Options (E-FLEX Options) has broadened the concept to encompass listed equity options. Equity FLEXible Exchange Options provide the opportunity to customize key contract terms, including the expiration date, exercise style and strike price of an equity option. Then prices are determined anonymously, using single-sided auction mechanisms. Thus, options and futures can be designed to fit an investor's own investment strategies and goals. Both systems have been designed to extend investor access to customized derivative products. They are used at NASDAQ, the American Stock Exchange (AMEX), the Chicago Board Options Exchange (CBOE) and the Pacific Stock Exchange (PSE).

In contrast to conventional options trading, Equity FLEX quotes are generated only in response to a Request For Quote (RFQ), rather than from an order. No FLEX option series, new or established, is continuously quoted. Each RFQ is assigned a "Request Response Time", from 2 to 20 minutes after receipt of the RFQ. This is the period of time designated for responses — bids and offers may be submitted and modified by exchange members on behalf of customers during this time. At the end, the best bid and offer is reported to the submitting member who may accept all or part of the bid, seek to improve the BBO, or reject the entire BBO. The submitting member is not obliged to accept the BBO. Details of quotes, as well as information on completed trades, including execution price and size are made available to vendors. The issuer and guarantor of all option contracts on this exchange is a professional clearing house.

While systems like this combine many advantages of OTC trading and electronic exchanges, the deployed auction mechanisms automate only negotiations on the price. In contrast, participants on an OTC market have the possibility to also bargain on several attributes of a contract such as strike price, style, contract maturity or contract size. This gives a participant many more degrees of freedom during the negotiation and has the potential to achieve a better deal for both parties. In this paper we focus on approaches to supporting multi-attribute negotiations on an OTC market for financial derivatives. The next section describes other approaches to supporting negotiations electronically and we then concentrate on auction theory and multi-attribute auctions.

3. NSS AND DAI

Over the past decade, there have been several approaches to supporting or automating one-to-one bargaining on multiple attributes, ranging from negotiation support systems (NSS) to intelligent agents which bargain on the details and finally close the deal without further user interaction (Beam et al. 1999). NSS is a special form of decision support systems, which assist human negotiators in making a deal. The various literature places a relatively strong emphasis on human factors such as behavioral characteristics, cognitive differences and negotiation theories with most of these approaches focusing on one-to-one negotiations on single as well as multiple attributes. While NSS can often make negotiations more productive than would be possible without them, they require constant human input, and both the initial problem setup and all final decisions are left to the human negotiators. NSS has seen commercial use in purchasing (Foroughi 1995; Perkins et al. 1996) and in operations management (Alty et al. 1994). Recently, they have also been used over the Internet with notable success in international applications where cultural barriers play a crucial role (Kersten and Noronha 1998).

Several approaches from the Distributed Artificial Intelligence (DAI) field have been trying to achieve automated negotiation. It typically requires programming computer agents to negotiate with each other. In systems such as ADEPT (Alty et al. 1994; Sierra et al. 1997), bargaining automated agents are programmed with rules-of-thumb distilled from intuitions about good behavioural practice in human negotiations. Another good example of agent-supported bilateral bargaining is Kasbah (Chavez and Maes 1996). Kasbah is a marketplace for negotiating the purchase and sale of goods using intelligent software agents. Software agents in Kasbah receive their complete strategies through a World Wide Web form from the users who specify the way in which the acceptable price can change over time. A follow-up project called Tete-a-Tete focuses more on multi-attribute negotiations (Moukas et al. 1999). The danger is that software agents are badly exploited by new agents that have been programmed to take advantage of the weaknesses of other agents. Rosenschein and Zlotkin (1994) and Binmore and Vulkan (1999) emphasize the advantages of using game theory to predict the outcome of agent-based negotiations. Game theory has often been criticized for its “hyper-rational” view of human behavior, however, in the context of agent negotiations, such hyper-rationality may be an appropriate model (Varian 1995). Currently, much promising research is being carried out in the field of agent-based one-to-one negotiations, however, the applicability of these models has not been widely deployed in commercial settings.

In the following sections we will focus on auction mechanisms, following the standard view among economists that an auction is an effective way of resolving the one-to-many negotiation problem. The section gives a brief summary of the most commonly used auction schemes and describes the basic theoretical concepts. Based on this we introduce multi-attribute auctions as a potential economic mechanism for the trading of OTC derivatives.

4. AUCTIONS – AN OVERVIEW

An economic environment consists of individual economic agents together with an institution through which the agents interact. Any environment where agents have limited resources and a preference over outcomes can be modeled as a resource allocation problem. *Auctions* have been defined as "a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from the market participants" (McAfee and McMillan 1987). In an auction a bid taker offers an object to two or more potential bidders who send bids indicating a willingness to pay for the object (Milgrom and Weber 1982). Oral or open-cry auctions reveal price quotes and require public and adjustable bids. After a certain time has elapsed the auction clears, meaning it matches buyers and sellers and determines the price. In the case of an English auction the winner is the remaining participant bidding the highest price. In a Dutch auction the price at which an item is offered for sale starts from a high level and declines steadily until one of the buyers stops the clock and buys the item at that price. This auction is often used in Holland in the sale of flowers. Sealed-bid auctions do not reveal price quotes and require private, committed bids. The highest bidder acquires the object and pays the seller his own bid price in a first-price sealed-bid auction and pays the second highest bid price in a second-price or Vickrey auction. There have also been several authors who have investigated these single-sided auctions in the context of procurement, where the buyer accepts bids from multiple suppliers.

Double auctions admit multiple buyers and multiple sellers at once. The continuous double auction (CDA) matches bids in the order received. When a new buy bid is processed, the auction checks whether the offered price would match the lowest (i.e. best) existing sell bid and vice versa. On detection of a match, the auction clears at the price of the existing bid, and generates a new price quote. The CDA is a common mechanism for organized exchanges, such as stock and commodity markets. A periodic version of the double auction termed a call market or clearing-house instead collects bids over a specified interval of time, then clears the market at expiration of the bidding interval (see a detailed description of double auction mechanisms in (Wurman et al. 1998).

Game theory and economic mechanism design try to design negotiation protocols that are able to allocate resources efficiently. Game theory has been a particularly productive area of auction theory. There is a solid theoretical foundation for single-unit, single-sided auctions. The most thoroughly researched auction model is the *symmetric independent private values (SIPV)* model. In this model all bidders are symmetric/indistinguishable and all bidders have a private valuation for the item which is independent and identically distributed. The bidders are risk neutral and so is the seller. Consequently, the bidders' behavior can be modeled as a non-cooperative game under the assumption of incomplete information. In keeping with standard terminology, we define the buyer's reservation price (or valuation) as the maximum price he is willing to pay for the item. Economists have tried find whether the auctions achieve the same equilibrium price or if we can rank the different auction schemes in any order. SIPV assumes strategic equivalence between the Dutch auction and the first price sealed-bid auction as well as the English auction and the Vickrey auction. Strategic equivalence between the Dutch auction and the first price sealed-bid auction is intuitive to many people. The bidder has to decide in advance what to bid or at which price to shout "Mine". In an English auction the bidders have a dominant strategy of bidding up to their private valuation. In the Vickrey auction the dominant strategy is to bid the true valuation v. Bidding below v reduces the chance of winning the item with no increase in profit since the second-highest price is paid and bidding above v and winning as a result of the higher bid results in losses. The dominant bidding strategy in both cases does not depend on the number of bidders, risk attitudes or the distribution from which private values are drawn. Thus, English and Vickrey auction converge to a dominant equilibrium. The surprising outcome of the SIPV model is that with risk neutral bidders and the number of bidders $n \to \infty$, all four auction schemes are payoff equivalent. This is also known as the *revenue equivalence theorem.* Economic experiments in this field, however, could not find evidence for revenue equivalence (see Kagel, 1995 for a summary of experiments in this field).

Another approach to analyzing single-sided auctions is the *common value model.* It states that the customer's valuation of the item depends additionally on at least one common objective variable, such as resale value or amount of oil in the tract in the case of oil lease auctions. The common variable introduces statistical dependence to bidders' valuations of the object which, in turn, allows a bidder to infer information from other bidders' bids. Many auctions involve some common value element, where the value of the item is not known or unsure during the auction. A frequently observed phenomenon in these auctions is the so called winner's curse, where the winner bids more than the item's true value and suffers a loss. The main lesson learned from the common value model is that bidders should shade their bids, as the auction always selects the bidder as the winner who has received the most optimistic estimate of the item's value.

Most auction theory deals with indivisible goods. For single-unit auctions, a bid simply indicates whether it is to buy or sell and at what price. A *multi-unit* bid generalizes this by specifying a set of price-quantity pairs. The first-price auction has two multi-unit generalizations – discriminatory auction in which the bidders who bid the highest prices pay their bid, and uniform-price auction in which all successful bidders pay the lowest accepted bid. The theory of multi-unit auctions, however, is not well developed. Auction theory is a complex economic subject and only brief treatment can be given here. Following Vickrey's (1961) pioneering article, auction theory quickly progressed between 1975 and 1985. Surveys by Milgrom and Weber (1982) and McAfee and McMillan (1987) provide adequate summaries of most of the results. A more theoretical treatment is given by Wolfstetter (1996), and a strategic analysis with a game-theoretic perspective by Wilson (1992).

5. MULTI-ATTRIBUTE AUCTIONS

Over the past few years much research has been carried out to extend the framework of auctions, such as combinatorial auctions or multi-stage auctions. Combinatorial auctions are an approach to achieving efficient allocations in cases where bidders place bids on combinations of goods. These bids allow us to express dependencies and complementarities between goods (Sandholm 1999, Rothkopf and Pekec 1998). Multi-stage auctions describe an auction process that is divided into several stages (Engelbrecht-Wiggans 1989). In this section we introduce multi-attribute auctions, a special case of procurement auctions. This auction schema is an interesting candidate for the automation of OTC markets.

5.1 Preliminary Game-theoretic Results

Several authors have investigated tenders and procurement auctions (Vickrey 1961, Dasgupta and Spulber 1989). These auctions are mostly deployed in governmental or corporate procurement, where a bid taker wants to procure goods or services. The philosophy behind tenders and procurement auctions is that the true value of a service contract or franchise is unknown to the procurer so that bargains will often favor the incumbent contractor. Laffont and Tirole (1993) describe many of the issues involved in procurement auctions ranging from the costs of setting up the tender to evaluating the bids in such a process. They also mention the need that auction theory must be generalized to “multidimensional bidding”.

The literature on auction theory has mostly focused on the analysis of auctions of a well-defined object or contract so that the price to be paid is the unique strategic dimension. The auctioning of procurement contracts does not usually meet this assumption (Branco 1997). In procurement auctions, bidders often describe very different kinds of goods and services in their bids. A good example is the procurement of large food retailers (Bichler et al. 1999). The suppliers in the market consist of large companies as well as a large number of small and medium sized enterprises such as bakeries and breweries. Buyers are a small number of large food retailers who aggregate demand and distribute it to the end consumer. Purchasing managers have their own preferences for product quality, price, terms of payment and delivery and they look for the offer that best satisfies these preferences. The overall utility of a deal for the buyer contains not only the price of the item but a combination of the different attributes. Conventional procurement auctions only automate negotiations on the price. It would be comfortable to have a mechanism that takes multiple attributes of a contract into account when allocating it to a bidder. In other words, the mechanism should automate multilateral negotiations on multiple attributes of a deal. Some authors call this a multidimensional auction. We will call these mechanisms "multi-attribute auction", as the term "multidimensional auction" is also used by researchers investigating combinatorial auctions.

Little theoretical work has been done in this field so far (see Koppius (1998) for a summary). Thiel (1988) used consumer theory and analyzed situations, in which the procurer decides on a budget of the project which becomes known to all agents, and does not value any savings. In these cases the problem of designing optimal multidimensional auctions will be equivalent to the design of unidimensional auctions. However, the assumption of a preset budget is not true in many procurement situations. Cripps and Ireland (1994) introduced a model where bid takers set threshold levels for quality and price and analyze three evaluation schemes. First, they assume a scheme where price bids are only accepted after quality plans have been submitted and approved. In a second scheme they consider a price auction first and then quality plans are submitted in the order of the level of price bids. The first plan to qualify on quality is then accepted. Finally they investigate joint submission of a price and a quality plan, where the allocation is made to the highest priced plan satisfying the quality threshold. The quality test is conducted by the buyer under the assumption that objectively better projects have a greater probability of being accepted. The schemes produce essentially the same results. The paper, however, leaves open a complete characterization of optimal mechanisms.

A thorough analysis of the design of multi-attribute auctions has been provided by Che (1993). Che studied design competition in government procurement by a model of two-dimensional auctions, where firms bid on price and quality. He focuses on an optimal mechanism in cases where bids are evaluated by a scoring rule designed by the procurer. Each bid contains a quality, q, and a price, p, and quantity in this model is normalized to one. The buyer in this model derives a utility from a contract comprising q and p:

$$U(q, p) = V(q) - p,$$

where V is the individual utility function of quality. On the other hand a winning firm earns profits from a contract (q, p):

$$\pi_i (q, p) = p - c(q, \theta_i)$$

In the cost function c the unit cost is expressed as θ which is private information. θ is assumed to be independently and identically distributed. Losing firms earn zero profits and trade always takes place, even with a very high θ.

Che investigates what an optimal auction in this case should look like. Myerson (1981) observed that in the search for optimal auctions one may restrict attention, without loss of generality, to incentive compatible, direct auctions. This insight applies to the *revelation principle* which has been useful in many areas of modern economics. An auction is called *direct* if each bidder is only asked to report his valuation to the seller and the auction rules select the winner and bidders' payments. A direct auction is *incentive compatible* if honest reporting of valuations is a Nash-equilibrium. A particularly strong and strategically simple case is an auction where truth telling is a *dominant strategy*. This is a desirable feature because an agent's decision depends only on its local information and it gains no advantage by expending effort to model other agents (Wolfstetter 1996). Vickrey (1961) showed that a second-price, sealed-bid auction is incentive compatible for the buyers, in that neither bidding higher nor bidding lower than the true valuation is beneficial. In Che's model, an optimal multi-attribute auction selects the firm with the lowest θ. The winning firm is induced to choose quality q which maximizes $V(q)$ considering the costs.

Che considers three auction rules: In a so-called "first-score" auction – a simple generalization of the first-price auction, each firm submits a sealed bid and, upon winning, produces the offered quality at the offered price. In other auction rules, labeled "second-score" and "second-preferred-offer" auctions, the winner is required to match the highest rejected score in the contract. The second-score auction differs from the second-preferred-offer auction in that the latter requires the winner to match the exact quality-price combination of the highest rejected bid while the former has no such constraint. A contract is awarded to the firm whose bid achieves the highest score in a scoring rule $S = S(q, p)$.

In the model it can be shown, that the equilibrium in the first-score auction is reduced to the equilibrium in the first price auction if the quality is fixed. The Vickrey auction intuition also applies for the second-score auction: If a firm with type θ bids a higher score than the one based on θ, it would risk winning at negative profits without increasing its profit conditional on winning. If the firm bids a lower score, it would forgo some opportunity of winning at positive profits. Similarly, one can show that in a second-preferred-offer auction, each firm will bid a score that will earn the firm zero profit. However, in the second-preferred-offer auction a winning firm has no control over the quality in the final contract.

Another important question analyzed by Che (1993) tries to discover the *optimal scoring rule* for the buyer. He showed that if the scoring function underrewards quality compared to his utility function, first- and second-score auctions implement an *optimal mechanism.* This is true, because the true utility function fails to internalize the informational costs associated with increasing quality. Che also shows that if the buyer's scoring function reflects the buyer's preference ordering, i.e. equals his utility function, all three auction schemes yield the same expected utility to the buyer – a *two-dimensional extension of the revenue equivalence theorem.*

The costs in Che's model are assumed to be independent across firms. In the context of procurement auctions one might expect the costs of the several bidders not to be independent. Branco (1997) derives an optimal auction mechanism for the case when the bidding firms' costs are correlated, but the initial information of firms is independent. He shows that when the quality of the item is an issue, the existence of correlations among the costs has significant effects on the design of optimal multi-attribute auctions. Under these conditions the multi-attribute auctions analyzed by Che are not optimal. Branco also discusses the implementation of the optimal outcome through mechanisms based on multidimensional auctions. In his model the optimal quality is a function of the firm's efficiency which depends on parameters not known to the firm at the time of the auction. This is true, because in the correlated-costs model, the optimal quality to be provided is a function of all the bidders' parameters. Therefore, unlike in the independent-cost model of Che, optimal quality cannot be achieved just through the bidding process. As a result, the procurer has to use a two-stage mechanism: a first-score or second-score auction, followed by a stage of bargaining over quality between the procurer and the winner of the first stage. Branco shows that the two-stage first-score auction and the two-stage second-score auction implement the optimal mechanism.

5.2 Alternative Research Approaches

Game theoretic analysis, in particular mechanism design theory, is one approach to learning about multi-attribute auctions. The analysis by Che (1993) and Branco (1997) particularly provide many valuable results about optimal multi-attribute auctions as well as optimal scoring functions under different assumptions. However, the game theoretic analysis conducted so far still leaves a number of questions open. It is unclear, how we can find a buyer's utility function, in order to derive an optimal scoring function. Moreover, we want to determine whether the game-theoretic results hold in different economic environments and how different parameter settings in a scoring function influence the outcome. Finally, we need to learn whether the results are stable in the case of more than two negotiable attributes of a deal.

Game theory in general does not adequately address many issues of auction design. It was recognized as incomplete, requiring empirical evidence (Friedman and Sunder 1994). Many researchers criticized the results, as game theory often assumes perfect information, identically perceived, on all sides of the bargaining table, when real-life bargaining situations often deal with imperfect information which is perceived differently by the different parties. Furthermore, game theory often assumes perfect rationality of all players, when in reality players are either at times not wholly rational or must work under constraints of time and/or bounded computational ability. A common complaint of game-theoretic models is their exponential complexity. Friedman and Rust (1993) claim that "even the world's top game theorists are unable to explicitly solve any but the simplest dynamic games."

We have taken a more heuristic approach and proposed a set of multi-attribute auction mechanisms. In contrast to previous game-theoretic analyses, we do not only analyze first-score and second-score sealed-bid auctions, but also multi-attribute open-cry auctions (e.g. a generalization of the English auction). We use *laboratory experiments* and *computer simulations* to evaluate these mechanisms. The computer simulation should help us analyze the stability and optimality of these various design parameters. Computational methods are very helpful, because the complexity of multiple attributes together with the various auction schemes and parameters make it difficult to solve the problem analytically. Besides, we use laboratory experiments to test game-theoretic results, to learn about the deployment of multi-attribute auctions in a particular application domain and to see how users can cope with the new mechanism.

Over the past two decades, experimental economics has become an important source of data for economists. For economic mechanism design it is useful to study new institutions in the laboratory before introducing them in the field. Laboratory experimentation can facilitate the interplay between the evolution and modification of proposed new exchange institutions. Experimenters can repeat testing to understand and improve the features of the institutional rules being examined. When analyzing institutions like auctions or one-on-one bargaining the experimental literature is particularly large. Previous experimental observations of the outcomes of various types of auctions mostly examined game theoretic hypothesis such as the revenue equivalence theorem (see Kagel, 1995; Kumar & Feldman, 1998 for an overview).

Laboratory results are joint outcomes of the characteristics of individual subjects, the laboratory institution, and the environment (Friedman & Sunder, 1994: pp. 57). Some institutions, such as the double auction, powerfully influence individual behavior so that the final outcomes are relatively insensitive to the characteristics and behavior of individuals. Due to the complexity of bidding in multi-attribute auctions, we think that laboratory experiments are even more valuable than experiments with classic auction schemes. We believe, the final outcomes of multi-attribute auctions are more sensitive to a subject's personal characteristics and the environment provided by the implementation (e.g. user interface design issues).

6. A WEB-BASED TRADING SYSTEM

In this section we describe a Web-based trading system implementing multi-attribute auctions. This implementation has forced us to solve several practical problems in the context of multi-attribute auctions and serves as a test bed for our laboratory experiments. The system consists of a trading server, a buyer client and a bidder client. To our knowledge this is the first implementation of multi-attribute auctions on the Internet. In the following we describe the most important issues of the implementation. We start out with a description of the overall functionality and the auction schemes deployed in the trading system. Then we will show how we elicit the buyer's utility function and how the participants on the market can provide bids on-line.

6.1 The Institution

In this section we describe the Web-based trading system and give a formal description of the three single sided auction schemes implemented by the trading server. The server-side implementation comprises several CGI programs, accessing an Oracle8 database. Clients are implemented as Java applets. The implementation is very generic and can be used to trade various types of goods and services. Here, however, we concentrate on the trading of OTC derivatives. In our experimental analysis a buyer wanted to procure a call option and subjects provide bids containing a strike price and implied volatility. The implied volatility indicates the volatility implied by a certain option price. Many traders on OTC markets quote an option's market price in terms of implied volatility. This helps measure the goodness of a certain option price independent of the strike price.

In a first step, the buyer on such a market has to define his scoring function in the buyer client (see section 6.2). The buyer sends this scoring function in the form of an XML-formatted request for bids (RFB) to the trading server. For the communication between clients and server we use the Web's ubiquitous Hypertext Transfer Protocol (HTTP). This trading server parses the RFB, retains all important data in a database and forwards the RFB to appropriate suppliers via e-mail. Suppliers use the bidder client to download the RFB from the database and compile an XML-formatted bid which is sent to the trading server. Finally, the trading server calculates the winning bid and closes the deal. The trading server implements three alternative auction schemes. We deployed a multi-attribute generalization of the first-price sealed bid, the second-price sealed-bid and the English auction, all of which compute the winning bid in the following way:

A bid received on the trading server can be described as a vector Q of n relevant attributes indexed by i. We have a set B of bids and index the m bids by j. A vector $\mathbf{x}_j = (x^1_j \ldots x^n_j)$ can be specified, where x^i_j is the level of attribute i in bid b_j. In the case of an additive scoringfunction $S(\mathbf{x}_j)$ the buyer evaluates each relevant attribute x^i_j through a scoring function $S_i(x^i_j)$. Let's assume for reasons of simplicity that the additive scoring function corresponds to the buyer's true utility function $U(\mathbf{x}_j)$. Then the individual scoring function S: $Q \rightarrow R$, translates the value of an attribute into "utility units". The overall utility $S(\mathbf{x}_j)$ for a bid b_j is then given by the sum of all individual scorings of the attributes. For a bid b_j that has values $x^1_j \ldots x^n_j$ on the n relevant attributes, the overall utility for a bid is given by

$$S(\mathbf{x}_j) = \sum_{i=1}^{n} S_i(x^i_j)$$

The next section gives a detailed description of how a buyer determines his scoring function for a certain item. A reasonable objective in allocating the deal to the suppliers is to allocate them in a way that maximizes utility for the buyer, i.e. to the supplier providing the bid with the highest overall utility for the buyer. This function $max\ S(\mathbf{x}_j)$ (and $1 < j < m$) gives us the utility of the winning bid and can be determined through various auction schemes.

In a first-score sealed bid auction the winner gets a contract awarded containing the attributes $\mathbf{x}_j$ of the winning bid. Alternatives with the same overall utility are indifferent. In these cases the first bid is the winning bid. The multi-attribute English auction (also first-score open-cry auction) works in the same way, however, all bids are made available to the participants during an auction period. In a second-score sealed-bid auction, we take the overall utility achieved by the second highest bid S_{max-1} and transform the gap to the highest overall utility $(S_{max} - S_{max-1})$ into implied volatility. Consequently, the winning bidder can charge a higher option price. This is similar to the procedure described as second-score auction by Che (1993). In the first-score and second-score sealed bid schemes, the auction closes after a certain pre-announced deadline. In a multi-attribute English auction, bids are made public and the auction closes after a certain elapse time, in which nobody submits a bid. For several practical reasons we have not implemented a multi-attribute generalization of the Dutch auction.

6.2 Eliciting the Buyer's Utility Function

Eliciting the buyers' preferences is one of the key problems that need to be addressed by the graphical user interface of the applet. The need to get "true" data in an appropriate form from the user poses both psychological and theoretical problems in creating a suitable interface. In our case, a buyer specifies his preferences using a Java applet which can be downloaded over the Web (see *Figure 1*). We then need to map the buyer's preferences, as input by the applet, into coherent utility functions. For this task, we use conventional decision analysis techniques.

Multi-objective decision analysis prescribes theories for quantitatively analyzing important decisions involving multiple, interdependent objectives. Decision analysis techniques such as the Multi-attribute Utility Theory (MAUT) (Clemen 1996; Keeny and Raiffa 1993), the Analytic Hierarchy Process (AHP) (Saaty 1980) and conjoint analysis (Backhaus et al. 1996) are used in a broad range of software packages for decision makers and can also be used to determine the utility function of a buyer(Bichler et al. 1998). For the evaluation of bids, the implied volatility is important, but so is its strike price. It is important to determine the relationship and trade-off between them.

The essence of decision analysis is to break decisions down into small pieces that a user can deal with individually and then recombine logically. In our current implementation we use MAUT and deploy an additive utility function. An additive utility function is easy to implement and intuitive to use for the buyer. The additivity assumption implies that attributes are preferentially independent and there are no interaction effects (e.g., two attributes may be substitutes for one another, or high achievement in all attributes might be worth more than the sum of individual successes). This precondition is not always given and it depends largely on the type of item traded as well as the type of utility function one has to deploy. In our case we assume preferential independence of the strike price, implied volatility and style.

The additive utility function is composed of two different kinds of elements, scores on individual attribute scales (also called individual utility functions) and weights for these attributes. The assessment of the individual utility functions and weights is a core issue, when using MAUT. The buyer evaluates each relevant attribute value of a bid x'_j through an individual utilityfunction $S(x'_j)$ and indicates its relative importance value by a weight w_i. All the weights are positive and add up to 1. Individual utility functions provide a means to measuring accomplishment of the fundamental objectives. Some of the individual utility functions are easily defined. If minimizing implied volatility is an objective, then we can, for example, define a linear function of the implied volatility that assigns values between 1 and 0, with some highest acceptable values for the implied volatility providing zero utility and zero implied volatility providing a utility of 1. We call this type of proportional scores a "continuous attribute". The individual utility $S(x'_j)$ of a continuous attribute can then be computed by:

$$S(x'_j) = (x'_j \text{ -worst value}) \,/\, (\text{best value} - \text{worst value})$$

Another way to assess utilities, particularly appropriate for attributes that are not naturally quantitative, is to assess them on the basis of some ratio comparison. We call this type of attribute "discrete attribute". Suppose that the buyer in our scenario provides four different strike (1300, 1320, 1340, 1360) prices to choose from for the bidder. Clearly, this is not something that is easily measurable on a meaningful proportional scale. Using a ratio scale, the buyer might conclude that 1320 is twice as good as a strike price of 1360 and so on. In the applet the buyer assigns a number of points between 0 an 100 to each possible alternative. In this way, for example, the buyer might assign 94 points to 1300, 86 points to 1320, 70 points to 1340, and 44 points to a strike price of 1360. Now, we scale these assessments so that they range from 0 for the worst alternative to 1 for the best alternative. This can be achieved by solving two equations simultaneously to compute the constants *a* and *b*:

$$0 = a + b(44)$$
$$1 = a + b(94)$$

This results in utilities of 1 for a strike price of 1300, 0.84 for 1320, 0.52 for 1340, and 0 for 1360. Using these two types of individual utility functions for continuous and discrete attributes, the overall utility for a bid is given by the sum of all weighted utilities of the attribute values. For a bid that has values x^1_j ... x^n_j on the *n* attributes, the overall utility for a bid is then given by

$$S(\mathbf{x}_j) = \sum_{i=1}^{n} w_i S_i(x^i_j)$$

This procedure can readily be implemented into a software system. *Figure 1* shows a screenshot of the Java applet we use in our implementation on the buyer side. The user interface consists of several areas. In the upper area the buyer supplies a unique identifier which he gets upon registration through a WWW form. In the text field above the buyer can specify a parameter file for a certain product traded on the marketplace. Thus, it is very easy to adapt the applet to any other kind of application domain by simply changing the parameter file. In this case we trade calls on the ATX. Below we find a list of relevant attributes for the auction. The negotiable attributes are the strike price and the implied volatility. “Duration”, i.e. contract maturity and “Style” are fixed in advance. In the lower left panel users can define the individual utility functions for the negotiable attributes which can be either continuous or discrete functions as described above. The utility of the strike price shown in the screenshot is determined in a discrete form. From the input of the buyer the applet compiles a Request for Bids (RFB) in XML format and sends the RFB via HTTP to an electronic brokerage service. The RFB contains the bidder ID, the product description and the parameters for the additive utility function. The brokerage service parses the RFB, retains all important data in a database and informs potential bidders via e-mail.

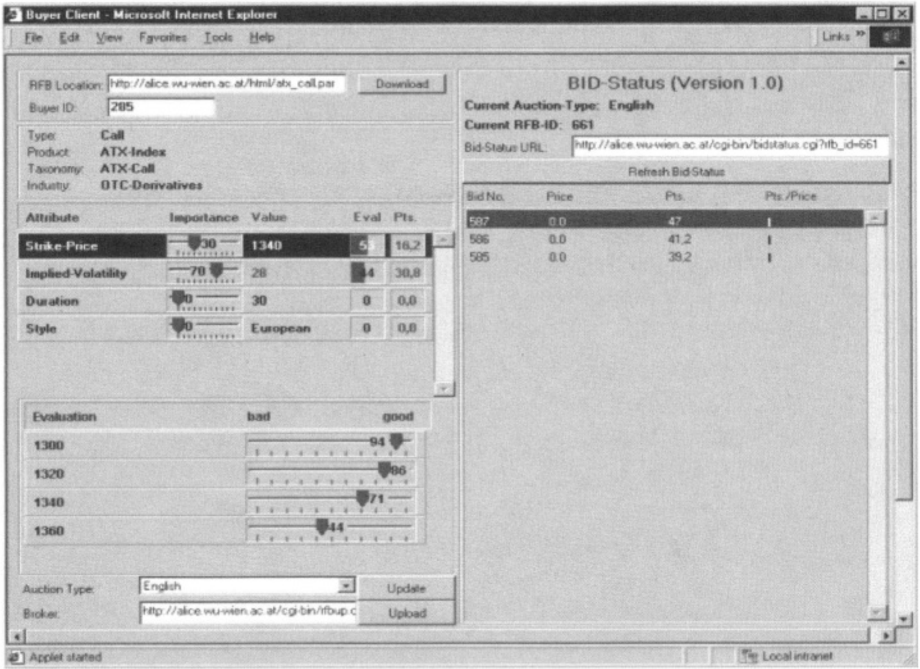

Figure 1. Buyer Client

After the auction begins the buyer can query a list of bids submitted on the right hand side of the applet, ranked by overall utility (third column). By clicking on a certain bid the buyer can see the details of every bid in the form of green numbers on the left-hand side of the applet.

6.3 Providing Bids

Bidders download the RFB from the URL they received via e-mail to their bidder client (see *Figure 2*). This Java applet allows us to enter parameters for all negotiable attributes and to upload an XML-formatted bid via HTTP to the brokerage service. Bidders also have to register via a Web form, in order to get a bidder ID. The applet shows important parameters contained in the RFB and allows us to enter values for the negotiable attributes. In the case of a discrete attribute (e.g. the strike price) the bidder can select a value from a drop down listbox. The numbers in brackets give information about the utility of each value. In the case of continuous attributes the bidder can enter a number in a text field. The numbers must be within a certain range depicted right beside the text field. "+--" means that the individual utility function is downward sloping or in other words, the lower the implied volatility is in a bid, the more utility points are achieved. The "Calculate Util" button on the lower left corner of the applet can be used by the bidder to compute the utilities achieved with different attribute values. In the case of an open cry auction (e.g. an English auction) the brokerage service reveals information about the bids submitted so far on the right hand side of the applet.

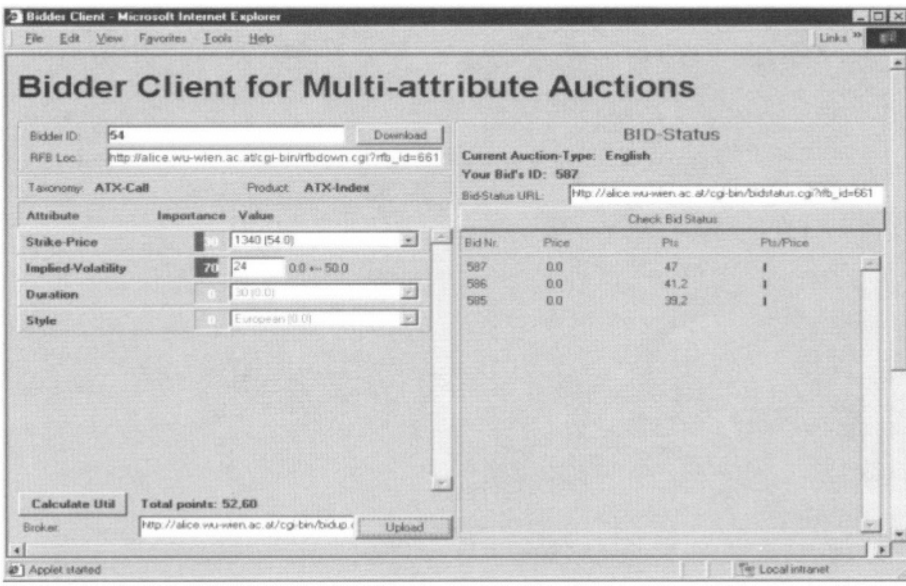

Figure 2. Bidder Client

For bidders it is not always easy to determine the appropriate values of the strike price and implied volatility of a bid. The values depend on a bidder's portfolio, the market expectation and risk attitude. Therefore, we provide the bidders with an additional decision aid in the form of an Excel spreadsheet, calculating the implied volatility based on a certain strike price, risk attitude and market expectation. This auxiliary tool reduces the complexity of bidding for the subjects enormously and also less experienced subjects can provide reasonable bids after one or two dry runs. In the case of more than two negotiable variables, it is particularly important to provide a bidder with appropriate decision support on the client side.

7. CONCLUSIONS

The Web application is also an excellent medium for conducting economic experiments. In May and October 1999 we have conducted laboratory experiments with 64 MBA students at the Vienna University of Economics and Business Administration. From the experiments we gathered several promising results. After half an hour of introduction and one or two dry runs the students could cope quite well with the software and were able to place reasonable bids. In each session we conducted conventional single-attribute and multi-attribute auction trials and found that based on the same scoring function, the utility scores achieved in multi-attribute auctions were on average 5.39 % higher than in single-attribute auctions. We also measured the efficiency of single-attribute and multi-attribute auctions and could not find a significant difference. Information feedback and preference elicitation are important future research issues. An auctioneer can reveal various degrees of information about a buyer's preferences or about other bidders bids. Currently, there is little knowledge about how this information impacts the bidder's strategic behaviour. In addition, we are working on solid preference elicitation methods, in order to derive a scoring model, which adequately describes the buyer's true preferences.

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Chapter 15

The Dynamics of the Electronic Market: An Evolutionary Game Approach

Sulin Ba, Andrew B. Whinston and Han Zhang

Abstract: The capabilities afforded by network technologies have facilitated the growth of electronic commerce. However, online frauds pose serious challenges to the further adoption of the electronic market. In order to promote trust and reduce transaction risks, various trusted third parties have emerged and new models have been proposed. Will people use the trusted third parties while conducting online transactions? How will the electronic market evolve? This research attempts to identify the different equilibria of the electronic market using an evolutionary game theoretic approach and to explore the best strategy to do transactions in the electronic market. Also, the work provides a theoretical justification to the emergence and necessity of trusted third parties for electronic transactions.

Key words: Electronic Market, Trusted Third Party, Market Evolution, Evolutionary Game Theory, Evolutionarily Stable Strategy

1. INTRODUCTION

Commercial activities on the World Wide Web in the past several years have greatly stimulated the growth of electronic commerce. Ordering books online, booking airline tickets from online travel agents such as Travelocity (www.travelocity.com), or bidding for various merchandise at auction sites such as eBay (www.ebay.com) are becoming more and more popular. According to the Boston Consulting Group, consumers spent $10 billion buying goods and services online in 1998. Starting from basically zero in 1995, total electronic commerce is estimated at some $102 billion for 1998, and is predicted to reach $330 billion in 2001-02 and $1 trillion in 2003-05 (OECD Report 1999).

Greater choices, lower prices, better customer service, and cost-effective delivery channels (especially for digital products) are among the unparalleled potential advantages the new business channel – the electronic market – has to offer. In the thriving electronic marketplace, however, fraud has become one of the biggest risks that could severely cripple the further development of electronic commerce. According to the Internet Fraud Watch, operated by the National Consumers League, Internet fraud is on the rise. Complaints have increased 600 percent since 1997 (http://www.fraud.org/internet/9923stat.htm). In 1998 only, there were nearly 8000 reports on Internet fraud. In the online auction market especially, cheating and misrepresentation are prevalent. Online auction fraud has increased to an alarming 68 percent of the total Internet fraud reported in 1998. The Federal Trade Commission even sought to bar a Lake Worth, Fla., man from participating in online auctions again because he placed goods for sale on various auction sites, but didn't deliver them to auction winners (Andrews, 1998). A Wall Street Journal's reporter surfs the online auction sites with five art experts and finds many counterfeit products (The Wall Street Journal, March 5, 1999). Obviously, with the growth of electronic markets and electronic transactions, online frauds are also rising at an alarming speed, posing serious threats to the further adoption of the electronic market. How to promote trust for efficient online exchange of products and services when individuals have short run temptations to cheat? This is a major challenge in the electronic market.

In the conventional marketplace, a set of social, economic, and legal systems provides the basis for protecting business activities. There are many means to solve business disagreements. Fraud is punishable by law. Nonpayment is remediable through small claims courts. Disagreements can be resolved by formal and informal arbitration. These are social systems that have worked in the conventional market. Unfortunately, the social, economic, and legal system has not yet caught up with the growth of electronic commerce. For instance, the Uniform Commercial Code (which defines U.S. law about business transactions) has not been extended to electronic commerce. The face-to-face resolutions to different problems in conventional face-to-face transactions do not work in a decentralized electronic environment. There is a need for web-based solutions to the web-based problems.

Recognizing the potential damaging effect of online fraud on electronic commerce, many researchers have begun to look into the role of various formal or informal mechanisms to encourage trustworthiness and reduce risks in the electronic market. Friedman and Resnick (1999) notice that on the Internet it is easy for someone to obtain a new identity, therefore this introduces opportunities to misbehave without paying reputational consequences. They argue that entry fees and pseudonym commitments may be two techniques for limiting name changes, thus limiting opportunities to misbehave. Kollock (1999) examines when and how groups are able to manage the risks of trade when they do not have access to external enforcement mechanisms and explores the emergence of endogenous solutions to the problems of risky trade in the electronic market. Ba et al. (1999) spell out a design of a trusted third party (TTP) to deal with the broad issue of information asymmetry and to encourage and maintain trustworthiness that is vital to the growth of electronic commerce. Through a game theoretical model, they have demonstrated that with the help of TTP - an extralegal economic incentive mechanism - the most profitable course for anyone wishing to do business online is to be honest.

Undoubtedly, electronic commerce is still in an embryonic stage, and the market dynamics are still changing. However, it is certain that more and more people and businesses will try to utilize the new form of commerce; and it is also certain that more frauds will occur to take advantage of the impersonal nature of electronic transactions. Then the inevitable questions we face are: How will the electronic market evolve? Will individuals continue their electronic transactions without the extra protection provided by extralegal systems such as TTPs, as how most of the transactions are done today, or will people use the services of TTPs to manage their online transaction risks? In this paper, we use an evolutionary game approach to compare electronic transactions with and without the TTPs and to demonstrate that using TTP's service to do online transactions is an evolutionarily stable strategy (ESS); and people will gradually adopt this strategy in the electronic marketplace. To the best of our knowledge, this is the first attempt to use evolutionary game theory to analyze the evolution of electronic markets.

The rest of the paper is organized as follows. In section 2, we briefly review currently available mechanisms that are geared toward promoting trust in the electronic market. Section 3 describes a transaction game with two different strategies: electronic transactions through a TTP and electronic transactions without a TTP. Then in section 4, we identify which strategy is evolutionarily stable and use replicator dynamics to demonstrate how online market participants choose between the two strategies. Section 5 discusses the evolution of the electronic market and concludes the paper.

2. TRUSTED THIRD PARTIES FOR THE ELECTRONIC MARKET

In a traditional face-to-face business environment, eye contact, handshake, and chat help develop basic trust between trading partners. However, such an interpersonal realm does not exist in the electronic market. With the global open Internet being the primary carrier of electronic commerce transactions, web sites can be counterfeited, identities can be forged, and the nature of transactions can be altered. Since the inception of commercial activities on the Internet, information asymmetry, which means that both parties do not have the same information (Akerlof, 1970), has been perceived by some to be a significant barrier to the extensive acceptance of the electronic market (Choi et al., 1997).

Among the many aspects of information asymmetry, two are closely related to online fraud: one being the identity of online trading parties, the other the product quality uncertainty. As manifested by the famous New Yorker cartoon that "on the Internet, no one knows you are a dog," online trading parties can easily remain anonymous or change their identities. For example, in the auction market where numerous individuals participate in transactions, it is very hard to bind one identity to one trader. Most of the auction sites identify sellers or bidders by email addresses, which can be easily obtained without monetary cost from multiple sources.

Information asymmetry with respect to product quality uncertainty means that transacting parties do not have the same information about the product quality. In the traditional business setting, people get to know the quality of products by looking, touching, and feeling. But when bidders view a product listing at an online auction site, for example, they don't have ready or easy access to information regarding the true quality of the product. Recognizing the difficulty of verifying user identity and guaranteeing product quality, eBay excuses itself from the responsibility in its User Agreement: "Because user authentication on the Internet is difficult, eBay cannot and does not confirm each user's purported identity." Also, the company claims that they "have no control over the quality, safety or legality of the items advertised, the truth or accuracy of the listings."[1] Without a doubt, the two aspects of information asymmetry expose electronic market participants to more risks and fraudulent transactions. More generally, due to the existence of information asymmetry, the competitive market outcomes can no longer be guaranteed to be Pareto efficient.[2] Thus, there is a need to use non-market corrective behavior to improve economic outcomes.

Recognizing the problems, several remedies have been proposed as a form of trusted third parties to promote trust and address the information asymmetry problem:

- Feedback systems: These are extensively used in online auction businesses. Auction participants can use feedback systems to publicly rate their satisfaction towards their trading partners. Specifically, the feedback system is a measure of a user's reputation in an auction community. The auctioneers encourage all users to check their trading partners' rating before transactions and leave feedback about their trading partners after their transactions. In essence, the system tries to use one's reputation as a deterrent for cheating behaviors. That is, if one develops a bad reputation, other auction participants may not transact with the person anymore.
- Certification Authority: Certification authorities (CAs) (such as VeriSign and GTE CyberTrust) recently emerged to serve as one form of trusted third party (TTP). They authenticate the identity of each trading party in a transaction by issuing digital certificates based on public key cryptography and digital signatures[3]. A certificate is a digitally signed statement by a CA that binds the identity of an individual or organization to a public key. More specifically, a certificate contains, among other information, the certificate holder's name, the certificate holder's public key, and other personal information that can uniquely identify the certificate holder. By digitally signing a certificate, a CA binds the identity of the certificate holder to the public key contained in the certificate, and thus vouches for the identity of the public key holder. As an important element of the extralegal mechanisms, CAs play an important role in electronic commerce in terms of authenticating players, attesting to certain facts about the players, and minimizing concerns arising from the fact that the online market is a faceless world.
- Escrow Services: An escrow service such as i-Escrow (www.iescrow.com) or TradeSafe (www.tradesafe.com) acts as a trusted third party in a transaction, providing safe methods to transfer items and payments to both parties. First, the escrow company collects payment for the merchandise from the buyer. When the payment clears, the seller is notified to ship the item. Second, the buyer notifies the escrow company when the merchandise is received and is satisfactory. Finally, the escrow company will then release the payment to the seller.

The above mentioned mechanisms are aimed at minimizing risks involved in online transactions. Although each model has limitations (Ba and Zhang, 1999), they do, to a certain degree, help reduce fraud. For example, the reputation effect embedded in eBay's Feedback Forum has been reported as an incentive for auction participants to maintain and improve on their ratings (Kollock, 1999), which means that the participants will try to behave in a trustworthy manner.

In addition to the above systems that are already in use, Ba et al. (1999) outline an extralegal mechanism – a trusted third party – that addresses some of the limitations with those systems. Their model not only authenticates the identity of trading agents by issuing digital certificates, but also disseminating information about agents' behaviors. Specifically, the digital certificate issued by a TTP serves not only as authentication of the certificate holder, but also as a reputation indicator. Anyone who holds a valid digital certificate should be regarded as a reputable agent. If a certificate holder is reported to have cheated in the market, the TTP will investigate the case and ask the cheater to pay a fine. However, the TTP is not a legal institution that could enforce rules, thus paying fines adjudicated by the TTP is voluntary. If the cheater pays the fine, he will keep his digital certificate and others will still treat him as an honest agent in the future; otherwise, his digital certificate will be revoked by the issuing TTP. Without the digital certificate, he risks being regarded not trustworthy and may lose his business in the long run. Using a game theoretical approach, Ba et al. demonstrates that the proposed TTP model is an effective mechanism to promote trust in the electronic market. This model provides the extra protection that the online market participants cannot change their identities easily and their reputation history is tied to a fixed identify that will follow them no matter which online market they choose to participate in.

The questions are: will people use TTPs' services in their electronic transactions? If they are already conducting transactions without using TTPs, what will be the main form of electronic transactions in the future? In this paper, we use an evolutionary game theoretic approach to answer these questions.

3. THE BASIC MODEL

Evolutionary game theory is a particularly attractive approach to studying the evolvement of the electronic market. In the fast-paced, global, dynamic electronic market, business parties may change their partners often, and many transactions may be one-time deals in a faceless environment. For example, the consumer-to-consumer auction sites such as eBay (www.ebay.com) and Yahoo!Auction (Auctions.yahoo.com) provide a matching place where people can choose to buy or sell a wide variety of merchandise. This kind of random matching fits well with the dynamics that evolutionary game theory studies. Evolutionary game theory assumes that individuals are repeatedly drawn at random from a large population to interact.

One may argue that random matching is not always the case in the electronic market. This is true to some extent. For example, customers may trust Amazon.com and repeatedly order books from Amazon.com. However, taking into account the whole global electronic market, random matching is the more appropriate case in general. In a virtual marketplace, for instance, customers often use search engines to pursue a better deal for their car insurance, airline tickets, digital CDs and so on from a large selection of vendors. Also, as one important component of the electronic market, the online auction markets are more appropriately characterized by random matching. Therefore, when we discuss why people might adopt a certain strategy and what transaction strategies will thrive in the electronic market, the evolutionary game theory is very appropriate.

Another advantage to using evolutionary game theory is that we do not need to assume that economic agents are rational.[4] In noncooperative game theory, the following two assumptions are very important: 1) maximization - every economic player is rational based on his clear understanding of the world; and 2) consistency - the player's understanding and expectations of other players' behavior are correct (Mailath, 1998). However, these two assumptions have been challenged repeatedly since noncooperative game theorists cannot provide compelling justification for these two assumptions. Evolutionary game theory, instead, assumes that the game is played over and over again by biologically or socially conditioned players who are randomly drawn from large populations. Strategies in an evolutionary game model emerge from a trial-and-error learning process in which players find that some strategies perform better than others. The agents may do very little reasoning in the course of this learning process. Instead, "they simply take actions, sometimes with great contemplation and sometimes with no thought at all" (Samuelson, 1997). Their behavior is driven by rules of thumb, social norms, conventions, analogies with similar situations and the like. In games that are played recurrently, players will adjust their behavior, rejecting choices that appear to give low payoffs in favor of choices that give high payoffs. The result is a process of experimenting and finding something that seems to work, a process in which strategies that bring high payoffs tend to crowd out strategies that do not.

Most importantly, evolutionary game theory seeks to answer the following two basic questions: 1. Do agents play Nash equilibrium? 2. Given that agents play Nash equilibrium, which equilibrium do they play? (Mailath, 1998). In the electronic market, we may find several Nash equilibrium strategies, but evolutionary game theory can help answer which Nash equilibrium economic agents will play if they face multiple equilibria in the electronic market. This is the most important point we attempt to make in this research.

Suppose in the global electronic market, economic agents (players) randomly match with each other and play a two-person game. Since a player can sometimes be a buyer and other times a seller, we model the game as a symmetric game. Based on the TTP model proposed by Ba et al. (1999), we assume that each player has two strategies available for each business transaction: electronic transaction without going through a TTP, and electronic transaction through a TTP. If players query the TTP before their online transactions, they get to know their trading partners' previous behavior and reputation. That helps them reduce their exposure to risk. The TTPs help mitigate the risk problems by tying a player's reputation to each transaction that he engages in. Business agents need to maintain and protect their reputation if they want to continue their business in the global electronic market. By obtaining a digital certificate from a TTP, buyers and sellers, to some extent, get a guarantee about the quality of their transactions. But buyers and sellers that do not use the services of TTPs may be cheated. For example, they may end up with counterfeit products or products that do not match up the proclaimed quality. Therefore, in our model, the final average payoff a (after deducting the fees to use the services of TTPs) for electronic transactions through a TTP is higher than the average payoff a' for electronic transactions without a TTP: $a > a'$.

Let ETTP denote electronic transactions through a TTP, and ET electronic transactions without using the services of a TTP. If both economic agents have two strategies, then we have the following table with the respective payoff for each strategy.[5]

Table 1. Payoff to a player following the row strategy against a player following the column strategy: $a > a' > 0$

		Player 2 ET	Player 2 ETTP
Player 1	ET	a', a'	a', a'
	ETTP	a', a'	a, a

A fundamental concept in evolutionary game theory is that of an evolutionarily stable strategy (ESS), which can withstand the pressures of mutation and selection. In other words, if an ESS is established in a population, and if a small proportion of the population adopts some mutant behavior, then the process of selection arising out of differing rates of reproduction will eliminate the latter (Maynard Smith and Price, 1973; Maynard Smith, 1982). That is, An ESS is a Nash equilibrium[6] satisfying an additional stability property. That is, an ESS should be able to withstand the pressures of mutation and selection once it becomes established in a population (Maynard Smith and Price, 1973; Maynard Smith, 1982).

Mathematically, the set of pure strategies is denoted $K = \{1,2,...,k\}$ and the associated mixed-strategy set $\Delta = \{x \in R_+^k : \sum_{i \in K} x_i = 1\}$. Suppose that a small group of mutants appears in a large population of individuals, all of whom are programmed to play the same (mixed or pure) incumbent strategy $x \in \Delta$. Suppose also that the mutants all are programmed to play some other (pure or mixed) mutant strategy $y \in \Delta$. The payoff to strategy $x \in \Delta$ is $u(x,y)$ when played against $y \in \Delta$. A strategy $x \in \Delta$ is evolutionarily stable if and only if it meets the following two conditions (Maynard Smith, 1982; Weibull, 1995):

$$u(y,x) \le u(x,x) \quad \forall y,$$

$$u(y,x) = u(x,x) \Rightarrow u(y,y) < u(x,y) \quad \forall y \ne x.$$

The first condition is a Nash equilibrium requirement and the second one is a stability requirement which ensures that the ESS x can repel mutants such as y. If the conditions fail, then the strategy y is said to be able to invade x.

4. ELECTRONIC MARKET TRANSACTIONS: TTP VS. NON-TTP

Obviously, there are two Nash equilibria in this game: (*ET, ET*) and (*ETTP, ETTP*). Which equilibrium will the players play? The model shows that the payoff (a ,a) for the strategy set (*ETTP, ETTP*) is higher than the payoff (a', a') for the strategy (*ET, ET*). In terms of the electronic market, now that both (*ET, ET*) and (*ETTP, ETTP*) are Nash equilibria, then which equilibrium will players play eventually? We use an evolutionary game theory approach to study the selection process of the equilibrium.

4.1 Pure Evolutionarily Stable Strategy

As we described before, there are two pure strategies available to each agent in the market for almost every transaction he is engaged in. This transaction game happens more and more frequently, given the emergence of more online businesses and the easy availability of Internet access. Some agents may choose one strategy while others choose a different one. As agents conduct more and more transactions using any of the two available strategies, they learn to select the one that performs the best based on their experiences. The strategy that gives a higher payoff than any other strategies and is also stable is an ESS. Stability ensures that the ESS strategy can repel mutants.

Theorem 1: In the electronic marketplace, ETTP is an evolutionarily stable strategy.

Proof:

In the following part, we will check if pure strategy ET and/or ETTP are ESS according to the two conditions listed in Section 3.

i) Is x = (1,0)an ESS?[7]
If $x = (1,0)$, then $u(x,x) = a'$. No matter what y is, $u(y,x) \leq u(x,x)$ because $a' \geq Co(a',a')$ (Convex hull of a',a'). Therefore, Condition 1 is satisfied, and $x = (1,0)$ is a Nash equilibrium strategy. Suppose $y = (0,1)$, then $u(y,x) = u(x,x) = a'$. However, $u(y,y) = a$, and $u(x,y) = a'$, but $a > a'$, so $u(y, y) > u(x, y)$, then Condition 2 is not satisfied. Therefore, $x = (1,0)$ is a Nash equilibrium strategy but not an ESS.

ii) Is $x = (0,1)$ an ESS?

If $x = (0,1)$, then $u(x,x) = a$. No matter what y is, $u(y,x) \leq u(x,x)$ because $a \geq Co(a', a)$. Therefore, Condition 1 is satisfied. Obviously, Condition 2 is also satisfied, because we cannot find a $y \in \Delta$ so that $u(y,x) = u(x,x)$. Therefore $x = (0,1)$ is an ESS.

Our proof shows that with the payoff structure $a > a' > 0$, ETTP is an ESS. In other words, in such a social or economic environment, individuals who try to use ETTP do better than those individuals who stick to other strategies. Currently, most people do their electronic transactions using ET, so ET can be treated as an incumbent strategy. However, some market participants may discover that using the service of TTP has more benefits. Therefore, they begin to do electronic business transactions based on the services of TTP. For instance, by using TTP's service, they get to know their trading partners' reputation, thus they can decide what strategy they will take in their online transactions. If those individuals who try ETTP are worse off than those individuals who stick to the status quo strategy ET, then individuals who use ET have no incentive to modify their strategy and those who try ETTP will return to the incumbent strategy. However, with the service of TTP, ETTP is a better strategy that leads to a higher payoff. So, sooner or later, the mutant strategy ETTP will successfully invade ET and force ET out of the market. The individuals who currently use ET will eventually change their strategy to ETTP.

We can use the replicator dynamics (Samuelson 1997, Weibull 1995) to explore the dynamic properties of ESS, therefore to demonstrate the conversion from ET to ETTP under the payoff structure $a > a' > 0$. The replicator dynamics is to build a dynamic model of the process by which the proportions of different strategies in a population change.

Suppose economic agents (buyers or sellers) only adopt pure strategies $i \in K = \{ET, ETTP\}$ in a symmetric two player game with mixed strategy simplex Δ and payoff function u. At any point t in time, let $N_i(t) \geq 0$ be the number of traders who are currently playing pure strategy $i \in K$ and let $N(t) = \sum_{i \in K} N_i(t) > 0$ be the total population. We assume that the total population remains constant: $N = \sum_{i \in K} N_i(t)$ for all t.

We define $x_i(t)$ as the proportion of the population adopting strategy i at time t, so $x_i(t) = N_i(t)/N$. The associated population state at time t is then $x(t) = (x_1(t) \ldots x_k(t))$.[8] The replicator dynamics means that certain pure strategy may be copied overtime, then this will lead to a certain population dynamics in continuous time. That is, the replicator dynamics illustrates that the population share of a pure strategy i, $x_i(t)$, will increase if this strategy does better than the average strategies.

Let $g_i(t)$ be the growth rate of the population playing strategy i ($g_i(t) < 1$ implies a shrinking population, $g_i(t) > 1$ is a growing population). Therefore,

$$N_i(t+1) = g_i(t) N_i(t)$$

Now we assume that the growth of the population playing strategy i is proportional to the payoff $u(i,x)$. For convenience of writing, we use $u(t)$ to represent the average payoff in the population, where

$$\bar{u}(t) = \sum_{i \in K} x_i u(i,x)$$

Then we define $g_i(t)$ as:

$$g_i(t) = \frac{u(i,x)}{\bar{u}(t)} \cdot \frac{N}{\sum_{i \in K} \frac{u(i,x)}{\bar{u}(t)} N_i(t)} = \frac{u(i,x)}{\bar{u}(t)} \cdot \alpha$$

with $\alpha = \dfrac{N}{\sum_{i \in K} \frac{u(i,x)}{\bar{u}(t)} \cdot N_i(t)}$

Populations with a low payoff $(u(x) < u(t))$ will thus have a slower growth rate than populations with a high payoff $(u(x) > u(t))$. Moreover, for two populations i and j, their relative growth rate is given by:

$$\frac{g_i(t)}{g_j(t)} = \frac{u(i,x)}{u(j,x)}$$

The results show that if strategy i has a higher payoff than strategy j, the ratio between the two population shares will increase. In our model, suppose i is ETTP, and j is ET, if the ratio $\frac{g_i(t)}{g_j(t)}$ increases, then more traders will change their strategy to use ETTP.

The following theorem gives a more rigorous account of what will happen in the electronic market.

Theorem 2: As long as there is certain population playing ETTP at the beginning, the population will eventually all play ETTP.

Proof:

At any time t, we assume $N_{ETTP}(t) = p(t)N$, and $N_{ET}(t) = (1 - p(t))N$. Also, let $p(1) = p$ such that $0 < p < 1$. We have:

$$g_{ET}(t) = \beta(t)u(ET, x(t)) = \beta(t)\{[1 - p(t)]u(ET, ET) + p(t)u(ET, ETTP)\} = \beta(t)a'$$

$$g_{ETTP}(t) = \beta(t)u(ETTP, x(t)) = \beta(t)\{[1 - p(t)]u(ETTP, ET) + p(t)u(ETTP, ETTP)\}$$
$$= \beta(t)[a' + (a - a')p(t)]$$

in which $\beta(t)$ is a constant that conserves N.

Then,

$$p(t+1)=\frac{[a'+(a-a')p(t)]p(t)}{[a'+(a-a')p(t)]p(t)+a'[1-p(t)]}$$
$$=\frac{(a-a')p^2(t)+a'p(t)}{(a-a')p^2(t)+a'}$$
$$=p(t)+p^2(t)\frac{(a-a')[1-p(t)]}{a'+(a-a')p^2(t)}$$

and,

$$1-p(t+1)=\left[1-\frac{(a-a')p^2(t)}{a'+(a-a')p^2(t)}\right][1-p(t)]\text{, and}$$

$$1\geq....\geq p(t+1)\geq p(t)\geq...\geq p(1)=p>0$$

Because $1-\dfrac{(a-a')x}{a'+(a-a')x}=\dfrac{a'}{a'+(a-a')x}$ is a decreasing function of x, we have:

$$1-p(t+1)\leq\frac{a'}{a'+(a-a')p^2}[1-p(t)]$$
$$\leq\left[\frac{a'}{a'+(a-a')p^2}\right]^2[1-p(t-1)]$$
$$\leq....$$
$$\leq\left[\frac{a'}{a'+(a-a')p^2}\right]^t(1-p)$$

Therefore, $\lim\limits_{t\to\infty}[1-p(t)]=0$ and $\lim\limits_{t\to\infty}p(t)=1$. So, people will eventually all play ETTP as long as certain number of people adopt the ETTP strategy at the beginning.

The conversion from ET to ETTP basically is a learning process. At the beginning, only a small group of population may try to use ETTP. The services of Trusted Third Party help them get higher payoffs in the electronic market. Gradually, more and more people will get to know the benefits of using the services of TTP and begin to adopt the ETTP strategy. Eventually, all the people will adopt the highest payoff strategy, ETTP, under the payoff structure $a > a' > 0$. The replicator dynamics and theorem 2 demonstrate that the strategy that is successful this period will be adopted by a larger proportion of the population in the future.

4.2 Mixed Evolutionarily Stable Strategy

Up to this point, we have assumed that players make their choices with certainty. That is, they choose one of the two strategies. However, often times a player may randomize when faced with a choice. This kind of randomization gives rise to what is called a mixed strategy. Then the questions is, under the current payoff structure, is there a mixed ESS?

Suppose x is a mixed strategy defined as "play ET with probability p , and ETTP with probability $1-p$," that is, $x = (p, 1-p)$. Is there a value of p such that x is an ESS? Using the theorem proved by Bishop & Cannings (1978), which states:

If x is a mixed ESS which includes, with non-zero probability, the pure strategies $A, B, C, \ldots,$ then

$$u(A,x) = u(B,x) = u(C,x) = \ldots = u(x,x)$$

Therefore, if there exists a value for p that makes x an ESS, we can find it by solving the following equation

$$u(ET,x) = u(ETTP,x) = u(x,x)$$

That is,

$$\begin{aligned}
&p \cdot u(ET,ET) + (1-p) \cdot (ET,ETTP) \\
&= p \cdot u(ETTP,ET) + (1-p) \cdot (ETTP,ETTP) \\
&\Rightarrow pa' + (1-p)a' = pa' + (1-p)a \\
&\Rightarrow a = a'
\end{aligned}$$

This is contradictory to the assumption $a>a'$. Therefore, there is no mixed strategy x that is an ESS. In other words, in the electronic market, ETTP is the only evolutionarily stable strategy.

5. THE MARKET EVOLUTION AND CONCLUDING REMARKS

The journey of electronic commerce has just started. To fully reach the potential of the electronic market, proper social, legal, and/or economical mechanisms should be set up to minimize transaction risks and to encourage consumer confidence in online transactions. This kind of mechanism will change people's strategies in conducting online business.

Ba et al. (1999)'s proposed TTP is one ideal type of institutions that can promote trust in the electronic market. Based on the proposed TTP, we use an evolutionary game theoretic approach to analyze the electronic marketplace, and demonstrate that electronic transaction through a TTP (*ETTP*) is an evolutionarily stable strategy. With the services of TTP, people can learn about their trading partners' reputation before they conduct transactions. Currently, very few TTPs exist in the electronic market, so many market participants only use the *ET* strategy to do their transactions. However, as more people are involved in online transactions, more people may be getting scammed. With the exposure to various online transaction frauds, people are getting more concerned about their online transactions. Under the circumstances, there is an increasing need for trusted third parties. At this time, using ET could be considered the incumbent strategy. As more people start to use *ETTP,* the advantages of using the services of TTP may be reported in the media, may be discussed in the news groups, or spread through word of mouth. Therefore, when people realize that ETTP is a better strategy leading to a higher payoff, people will finally abandon the ET strategy, and adopt ETTP in their online transactions.

In addition to providing a theoretical analysis to how the electronic market will evolve, this research also has strong, practical implications for online businesses. The main purpose of the TTPs is to protect market participants from opportunistic behaviors. Many online businesses, without a strong brand name, may fall victim to the (perceived) risks inherent in the electronic market. Market participants therefore may be hesitant to conduct transactions with them. Using the services of a TTP, these businesses can increase their chance of survival and attract more transactions. An excellent example for the argument is Amazon.com's zShops services. Acting like a

TTP, Amazon.com leases its reputation and marketplace to small merchants that can use Amazon.com's zShops as a platform to reach more customers. Transactions with these merchants will get Amazon.com's A-to-z guarantee that is designed to make sure the merchandise listed by the seller is described accurately, and the merchandise is sent to the buyer in a timely fashion after the buyer pays. In case of fraud, consumers will be covered up to $250 of the final closing price of the item. This type of transactions will be an ETTP strategy. In terms of the game we described in Section 3, people may choose ET strategy to directly do transaction on a merchant's online storefront (the merchant could be an individual or a small company), or choose ETTP to buy through Amazon.com's zShops. Suppose the merchant cheats the buyer and disappears, then the benefit to using Amazon.com's zShop is that the buyer may be compensated by the A-to-z guarantee. Although Amazon.com's guarantee has a lot of restrictions, this is one method to promote trust in the electronic market. Our analyses shed light on the strategies small businesses should take to conduct online transactions.

In short, trusted third parties in the electronic marketplace are still growing. These TTPs will perform functions that include digital certificate services, electronic notaries, product and quality evaluation services and so on. All of these TTPs will promote trust and ensure the integrity of the market, and help the electronic market evolve into an efficient marketplace.

Notes

1. Directed quoted from eBay's User Agreement: http://pages.ebay.com/help/basics/f-agreement.html
2. A Pareto efficient allocation is one for which each agent is as well off as possible, given the utilities of the other agents (Varian 1992).
3. Please refer to Schneier (1994), Ford and Baum (1997), and Garfinkel and Spafford (1997) for a thorough description of the public-key cryptography and digital signatures.
4. It is worth noting that perfect rationality in information systems (IS) research from an economics perspective has often been criticized by traditional IS research that has a behavioral focus. Using evolutionary game theory, we think our assumptions about economic agents are more realistic.
5. According to Ba et al (1999), if both players adopt ETTP, then both are reputable players; if only one player adopts ETTP, and the other doesn't, then no one can know the other's previous behavior and reputation.
6. If there is a set of strategies with the property that no player can benefit by changing his strategy while the other players keep their strategies unchanged, then that set of strategies and the corresponding payoffs constitute the Nash Equilibrium.

7. $x = (1,0)$ means that the probability to play the first strategy ET is 1, and the probability to play the second strategy ETTP is 0. Therefore, $x = (1,0)$ represents the pure strategy ET. Likewise, $x = (0,1)$ represents the pure strategy ETTP.
8. Obviously, $x(t)$ is a member of the mixed-strategy simplex, and we often interpret $x(t)$ as a mixed strategy. Therefore, a population state is identical with a mixed strategy.

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Chapter 16

A Strategic Analysis of Exchange Based B2B Networks

Kerem Tomak and Mu Xia

Abstract: This paper aims to propose a novel approach to look at the formation of network of firms. We propose an economic model of strategic relationships among firms. The model treats firms as nodes in a network and analyses the equilibrium network structure. It recognizes the cost of setting up and maintaining relationship between firms. Unlike the previous research that analyses B2B networks *after* they are established, we look at the dynamics of how they come into existence and where they can be expected to converge. The paper provides conditions under which an exchange-based B2B is preferred to a peer-to-peer network. It also indicates the importance of asset specificity in the strategic network formation.

Key words: Network of firms; Exchange-based B2B; Asset specificity.

The past several years have witnessed the emergence of various business models, successful or unsuccessful, which created a lot of excitement about the technology underlying electronic business. As systems and businesses matured, firms within and across industries started to use Internet in places where they believed efficiency gains would be maximal. One particular area in which we have seen exponential increase is business-to-business (B2B) electronic commerce (EC). Several analysts forecast B2B EC to reach a level of billions of dollars by 2005. Jupiter Research reports that B2B Net Market infrastructure spending in the US will grow from $2.1 billion in 2000 to $80.9 billion by 2005. A report by the Gartner Group estimates the value of B2B e-commerce to reach $7.3 trillion by 2004.

At the center of the hype were the business-to-business exchanges, often set up by third parties that aim to aggregate demand and supply and provide transaction and value-added services to buyers and sellers. During the past two years, a large number of B2B markets have been created. In one account, there were more than 700 e-marketplaces (Emarketer, 2000). According to a Forbes article (Patsuris, 2000), in the United States there are more than 500 B2B independent markets that were funded by at least $5 million, and by 2003 there will be 2000.

In spite of this and similar forecasts, over the last couple of years, we saw a dramatic revision of the numbers, followed by a shakeout of the B2B markets. For example, the Gartner Group revised their forecast of worldwide B-to-B Internet commerce to $5.9 trillion by 2004. While there are still more than 300 e-marketplaces in operation in North America (Digimarkets, 2001), most of them are operating at losses or have very limited participation from the members.

Although practitioners and researchers offer different explanations for why the marketplaces went under in such a dramatic fashion, they do agree on several key points. Among them the most important is the reluctance of participation when the new business model may cast a negative impact onto their existing way of doing business. In particular, suppliers stay away from independent marketplaces because they do not want their products to be traded as commodities, as most independent marketplaces only distinguish products by specifications, and fall prey to pure price competition. Buyers whose specific demands for which the market cannot be replied upon and for which relationship with suppliers is important to ensure availability and quality of supply do not want to pressure the suppliers to join the marketplaces, in order to maintain the strategic relationship. Adding to consideration the high cost of joining marketplaces (entry fee plus transaction fee), it is not difficult to understand why independent marketplaces with the current aggregation model did not fare well with the suppliers and the buyers.

A conclusion one can clearly deduct from these observations and forecasts is that the B2B EC is in a constant flux. In the initial stages of B2B EC, independent exchanges were forecasted by a majority of the analysts to be the most successful B2B model. Today, we are witnessing the move towards privately owned, exchange based B2B networks (ex. Walmart's private exchange) or consortia backed exchanges (ex. Covisint), although there are independent exchanges that are relatively successful (ex. RetailExchange.com). EDI is still widely used by large corporations and Web-EDI is taking its place among small and medium scale enterprises.

Most of these transactions are currently handled over private or neutral third party exchanges and traditional value added networks and EDI systems integrated with the Internet. Recently, several authors suggested peer-to-peer (P2P) networks for B2B solutions (e.g. McAfee, 2000, Parameswaran et al., 2001) due to their decentralized information management potential. The compelling reason behind such an application of P2P technology is the decentralized structure that will help companies everywhere to locate trading partners on the fly and complete transactions swiftly, securely and efficiently without the need for any central aggregator or facilitator.

In this paper we provide answers to the following research questions:

- How do trading networks form in electronic B2B environments?
- What network types can be expected to form in the long run?

We start by discussing the value proposition of electronic marketplaces. We then provide an economic modelling approach that may advance our understanding of which electronic structures constitute potential convergence points and hence sustainable business models for B2B marketplaces.

1. VALUE PROPOSITION OF ELECTRONIC MARKETPLACES

B2B trade is extremely complex involving countless transactions along the supply chain. Demand triggered by a customer may generate hundreds of B2B transactions that occur before the purchase is completed. Furthermore, each transaction typically involves multiple parties beyond the buyer and the seller including providers of insurance, inspection, escrow, credit, warehousing and transportation. The main goal of business automation is not only to give an electronic form to existing business processes and relationships but also, more importantly, to help firms lay a foundation for establishing new relationships much more efficiently.

There are several distinctive economic characteristics of electronic markets (Bakos, 1991). If we regard both a purchasing firm and an individual customer as the consumer, electronic markets can reduce the costs of obtaining information about the prices and product offerings of alternative suppliers as well as suppliers' costs of communicating information about their prices and product characteristics to additional customers. Benefits of participating in an electronic market increase as the number of individual member firms increases, commonly known as the network externality effect (Katz and Shapiro, 1985). If being a member of an electronic market requires a significant investment from their participants and hence becomes a strategic relationship, resulting switching costs may be too high.

Beyond these characteristics shared by both the consumer and business-oriented electronic markets, there are features specific to B2B transactions that distinguish B2B from B2C markets. One such characteristic is *asset specificity*. It refers to the relative lack of transferability of assets intended for use in a given transaction to other uses. Highly specific assets represent sunk costs that have relatively little value beyond their use in the context of a specific transaction. High asset specificity requires strong contracts or internalization to protect the company from the threat of rivalry. This has a fundamental impact on the form of the electronic marketplace that is sustainable in the long run. One would expect, for example, that a company purchasing highly specific assets for production will not trade over a third party owned (neutral) marketplace. A recent study by Kauffman and Mohtadi (2002), addresses the problem of incentive alignment for B2B e-procurement technology investments that permit inventory coordination and operating cost control. They find that larger firms tend to adopt costlier, but more certain procurement technologies such as proprietary EDI. Smaller firms, on the other hand, tend to adopt less costly procurement solutions that entail greater supply uncertainties, such as open B2B procurement platforms like exchange based B2B networks. In a related paper, Tomak (2000) describes conditions under which firms may choose to join a B2B marketplace.

There is little empirical work in the area of B2B marketplaces on the Internet. One reason for this may be the limited availability of the data pertaining to the inner workings of such digital platforms. Most of the firms operating such marketplaces keep the data confidential due to the nature of the relationships among the trading parties.

Garicano and Kaplan (2000) posit that the key impact of B2B EC is to change the costs of transaction via changing/improving processes, the nature of the marketplace, decisions, the degree of information incompleteness and the ability to commit. They find little evidence that informational asymmetries are more important in the electronic marketplace they study than the existing physical ones. However, generalization of their conclusions to all types of B2B marketplaces is questionable due to the characteristics and size of the sample used in the study.

We approach the B2B structures as networks of relationships among participating companies. Due to the nature of trade along the supply chain, each participating member actually establishes a close relationship with the rest and makes complementary EC investments. Although not presented in this paper, our approach establishes a framework in which one can test the sensitivity of the network forms to the existence of informational asymmetries. There is research under way by the authors of this paper which looks at the impact of information asymmetry on the incentives to join exchange based B2B networks.

INTERMEDIATED VS. PEER-TO-PEER NETWORKS

Exchange based B2B models are in essence a collection of centrally managed client-server networks which are highly integrated in order to make the transactions among them as flawless and fast as possible. As McAfee (2000) also points out, these exchanges have two main roles: aggregation and facilitation. Their aggregation role is fulfilled by bringing a group of dispersed trading partners under the umbrella of a virtual marketplace. They also facilitate transactions by providing the necessary software tools and protocols. Hence, an exchange-based B2B network can be imagined as a star-like structure as in Figure 2.

In P2P networks however, the client-server relationship is partially if not completely abandoned. Napster's technology still centrally manages the directory and user information but the actual files reside on separate locations. Gnutella further decentralizes the network structure by treating users as independent nodes among which the information needs to be transacted. P2P networking is a way of sharing of computer resources and services by direct exchange between systems. These resources and services include the exchange of information, CPU time, data storage, and file transfer. Peer-to-peer computing takes advantage of existing desktop computing power and networking connectivity, allowing clients to leverage their collective power to benefit the entire network. In a peer-to-peer architecture, computers that have traditionally been used solely as clients communicate directly among themselves and can act as both clients and servers, assuming whatever role is most efficient for the network. This reduces the load on servers and allows them to perform specialized services (such as billing, etc.) more effectively (for details see for example, Intel P2P Working Group http://www.peer-to-peerwg.org/whatis/index.html or Parameswaran et al. (2001)). A P2P network can then be pictured as a wheel-like network such as the one in Figure 2.

2. A MODEL OF B2B RELATIONSHIPS

Aside from the operations management literature, there is a limited number of papers in the IS literature addressing economic problems related to B2B marketplaces. An excellent survey in the B2B as well as the B2C area listing a large body of literature in the economics of IS area can be found in Kauffman and Walden (2001). Dai and Kauffman (2001) also explore several online business models and the adoption of purchasing firms. They posit that private aggregating and negotiating mechanisms are being adopted for large quantity business supply purchases and public market mechanisms are more often adopted when firms face uncertain and high variance demand. Their study provides support to our assessment of the linkage between asset specificity and the B2B network structure.

Nault and Dexter (2000) look at the investments to integrate electronic marketplaces in the buying and selling infrastructure of firms from a strategic point of view and suggest that a pure strategy Nash equilibrium in investments is not assured in such environments. Based on their models of information sharing, Seidmann and Sundararajan (1997) classify different forms of relationships between independent – yet virtually integrated – companies. Four primary types of such relationships include EDI, vendor managed inventory, continuous replenishment, and category management. They also show how retailers and other buyers can successfully contract to end up with more value through sharing information.

In a related paper, Yu and Chaturvedi (2001) study the problem of what the structure of the B2B marketplace will be. They base their model on Gehrig's (1996) paper which takes the number of participants in a particular network structure set *exogenously,* similar to the existing research in this area. Furthermore, marketplaces in an industry are treated as islands which consist of a number of firms set ex-ante. A major difference between our work and theirs is that we take the network type as a side result of the equilibrium of a game that is played among the participants in a market rather than assume it to be set already, exogenously.

In this paper, we use game theory as our main tool for modelling. There are mainly two branches of game theory which study strategic interactions among individuals or groups. Cooperative game theory, unlike its non-cooperative counterpart, allows for the existence of enforceable binding agreements and also for side payments. Hence, fair allocation of costs or revenues becomes the main problem. In the context of our problem setting, this approach can be used to address questions such as "How can profits from a consortia-backed B2B marketplace be shared among the participants? What is a fair and envy-free allocation to all the participants so that proper incentives for membership to the B2B marketplace can be given to all the suppliers and manufacturers in the industry?" One approach in the cooperative framework concentrates on the costs of forming social and economic relationships (Haller, 2000). An excellent survey of this literature can be found in Borm (1994).

A large portion of the papers in the intersection of OM and IS literature, including this paper, use non-cooperative game theory. Unlike the cooperative version, enforceable binding agreements are assumed not to be possible. Individual incentives and strategic interactions become the center of attention. Non-cooperative games take players as individual decision makers who base their decisions on opportunistic strategies that lead to desired outcomes. This approach is more suitable for the type of problems that involve individual firm decision making under uncertain B2B liquidity and potential for opportunistic use of the trade platform. Several trade structures may also result from the relationships between suppliers and manufacturers. Examples include vertical integration, markets and network forms. Kranton and Minehart (2000) apply the model proposed by Jackson and Wolinsky (1996) to a buyer-seller network structure and compare economic welfare of such a network with vertical integration. They find that networks can yield greater social welfare than vertically integrated firms when there are large idiosyncratic shocks in demand. They also show that individual firms have the incentive to form the network structure. An application of their findings to the B2B networks suggest that formation of industrial networks are to the benefit of all parties involved especially when the industry operates under high uncertainty, but third party ownership may curtail this activity.

Figure 1 below shows an example of a graph that represents a supply chain structure. The direction of the arrow implies that there is a link in that direction to the node it points to from the node it originates. Furthermore, the direction indicates the path of information flow. Most of the communication that takes place on the B2B networks is bi-directional. However, there are examples, such as electronic catalogs that suppliers or manufacturers use to inform their customers about their product offerings and prices, in which the direction of information on the B2B platform is one-way. By two-way communication, we mean that data is transferred from an origin to a destination and back as in a proprietary network setup like an EDI system. In our example, suppliers 1,2 and 3 do not have any connections with the rest of the network structure as there is no arrow pointing outwards from them to the next node they are connected to while it is possible for the rest of the network to link to them. This situation may arise if the supplier is small and the only way they can attract customers is via putting ads on specialized catalogs and expect the customers to visit them. Hence these suppliers can be envisioned to lack technology based links to the subcontractor or simply have chosen not to link to the subcontractor since it may be too costly to them. The burden of maintaining the link is on the subcontractor. On the other hand, Suppliers 4 and 8 have at least an EDI connection with their trading partners to allow for two-way communication among themselves. In order to keep the exposition simple, we assume that the links are bi-directional.

We let $N = \{1,...,n\} \quad n \geq 3$ represent the set of players with locations at the nodes of a graph *before* the graph is formed. We assume that the reason why the links are formed is the gains from information sharing by doing so. A typical supply chain information flow is a good example for this setup. A strategy of a player $i \in N$ is a vector $s_i = \{s_{i,1}, s_{i,2}, ..., s_{i,i-1}, s_{i,i+1}, ..., s_{i,n}\}$ where $s_{i,j} = 0$ if i does not have a link with j and $s_{i,j} = 1$ otherwise. The set of all strategies of player i is given by Σ_i. In this setting, a link $s_{i,j}$ is represented by an edge starting at j with the arrowhead pointing at i. For example, in Figure 1, $s_{s3,cs} = s_{s2,cs} = s_{s1,cs} = 1$.

Literature on non-cooperative strategic network formation, such as the one we just depicted, deals with the flow of information from one agent to another and looks at issues such as information transmission with unreliable links.

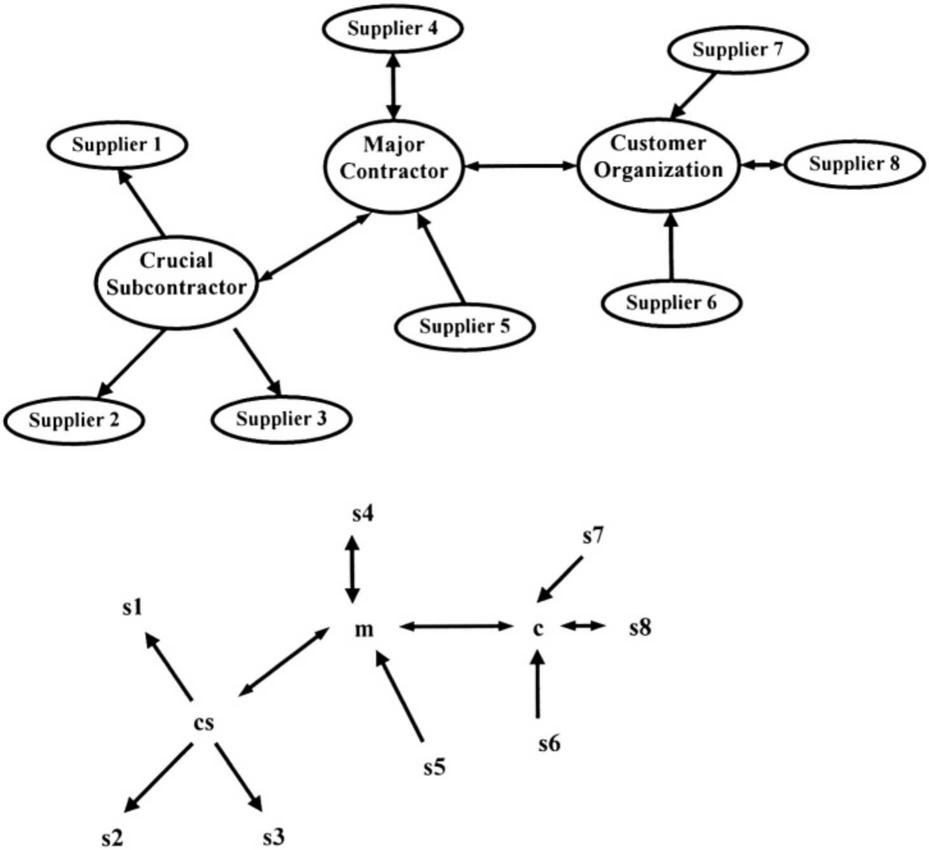

Figure 1. A supply chain network structure and its graph form. Any supply chain relationship can be reduced to its graph form and represented as a stage in a finite horizon dynamic network game.

We now define $L_i = \{k \in N | s_{i,k} = 1\}$ as the set of players with whom i maintains a link. It is also important to find out all players whose information i accesses either through a link or through a sequence of links with an intermediary in between. Let such a set be given by

$$\overline{L}_i = \left\{ k \in N \middle| \begin{array}{l} \text{either } s_{i,k} = 1 \text{ or there exists } j_l \in N(l = 1,\ldots,m) \\ \text{such that } s_{i,j_1} = s_{j_1,j_2} = \ldots = s_{j_m,k} = 1 \end{array} \right\}$$

Finally, the payoff to each player is given by

$$\Pi_i = \left|\overline{L}_i\right| - \left|L_i\right|c$$

where $\left|\overline{L}_i\right|$ measures the benefit that a player i receives from his/her links and $\left|L_i\right|c$ measures the cost associated with maintaining them with $c > 0$ being the cost to each player of forming the link. This particular setup of the profit function implies that the benefit to the player increases by the number of links he/she forms with other firms. Using this approach, we are able to account for the network externality effect that is inherent in most of the network forms, especially in B2B relationships (see for example, Dai and Kauffman, (2001)). However this benefit is weighed by the cost of actually maintaining the links. Hence the more the number of links, the better; including the indirect ones, net of costs of establishing the direct links. Finally, we assume that Π_i is strictly increasing in $\left|\overline{L}_i\right|$ and strictly decreasing in $\left|L_i\right|$. This assumption implies that increasing the number of links to other firms adds to the profits of the firm. It also implies that increasing the number of links that needs to be maintained by the firm himself/herself adds to the cost and hence decreases the profits.

Given this formulation, these links can be approached in two ways. One can take the links as one of EDI or B2B marketplace link types with their associated costs or take them as the aggregate cost of establishing a relationship between a buyer and a supplier. In this paper, we take the latter approach. Furthermore, there may be several forms of network structures. The most common ones are star or wheel networks given in Figure 2 below. Star networks can be interpreted as public or private networks with the center formed by either a firm, a third party or a consortium. Wheel network structures can be interpreted as peer-to-peer (P2P) networks. A network structure is Nash if no individual link owner benefits by deviating from the existing network structure he/she belongs to by severing his/her link or by adding another link.

The uniqueness of this approach comes from the treatment of the evolution of network forms in the B2B context. We let the B2B relationships form endogenously as opposed to the previous approaches in the IS literature, which assume that networks are formed a priori or investment in networks is considered to be over a pre-designed network structure (Nault and Dexter, 2000).

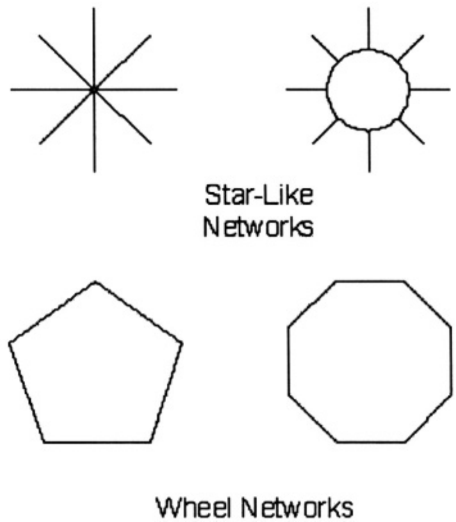

Figure 2. Star like networks mainly represent exchange based B2B and wheel networks correspond to peer-to-peer structures

If all the players in the game described above try to maximize their individual payoffs, resulting equilibrium is described by the following Proposition.

Proposition 1: *Starting with a random network structure between buyers and sellers, let them decide on whether to maintain or sever a link from their set of links. If this process converges to a state where none of the parties involved would rather change their existing links, resulting exchange-based B2B (private or public) network will take the form of a star-like Nash network.*

This Proposition implies that if the firms act selfishly and form their links with each other on the basis of increasing their information sharing capabilities, an exchange-based B2B network structure can be supported in steady state. Once it is formed, no firm would have any incentives to deviate to other networks or connect to each other directly. One can easily envision such conglomerate exchanges emerging in every industry which values sharing information along different supply chain architectures. eBay is an excellent example in the value chain side. With 100,000 trading partners and one billion transactions processed annually, GE Global eXchange Services (GXS) is a good example of such a conglomerate in the B2B side.

The cost to the seller and buyer are different when they form links with each other or through a marketplace due to the asset specificity of the processes each gets involved in. Let c_b be the cost to the buyer firms for forming a link with the suppliers. For both the buyer and the seller, cost of a link with a marketplace is given by c_m. For the suppliers, direct link cost is assumed to be c_s. We rewrite the payoff function to incorporate these changes as follows

$$\Pi_{i,b} = \left|\overline{L}_i\right| - \left|L^D{}_i\right| c_b - c_m \left|L^M{}_i\right|$$

$$\Pi_{i,b} = \left|\overline{L}_i\right| - \left|L^D{}_i\right| c_b - c_m \left|L^M{}_i\right|$$

Here, $|L^M{}_i|$ corresponds to the number of marketplaces that the buyer (supplier) firm establishes a link with and $|L^D{}_i|$ is the number of direct links to the buyers (suppliers). In order to understand how asset specificity plays an important role, let the cost of the link be directly proportional to the cost of acquiring the product. The more assets specific the production process is, the more the cost of the link to the marketplace for the buyer. This is because of the fact that the risk a buyer incurs by going to the marketplace for highly asset specific processes is quite high. Assumption on the payoff function implies that as $|L^D{}_i|$ increases, profit falls. Hence, we expect that $|L^D{}_i|$ decreases and $|L^M{}_i|$ tends to zero for highly asset specific processes of the buyer. Similar observation holds for the suppliers.

Proposition 2: *High asset specificity leads to a wheel-like Nash network at the steady state whereas low asset specificity results in a star-like Nash network.*

This is a rather insightful result since it suggests that peer-to-peer networks have more of a chance to succeed in establishing connections among trading partners for highly asset specific processes, whereas exchange based B2B networks play more of a role in facilitating transactions for low asset specific tasks.

3. DISCUSSION AND CONCLUSION

Motivated by the recent business model transformations in exchange based B2B network structures, our research focused on the endogenous formation of B2B relationships. In particular, we studied the strategic choice of a buyer or seller, of linking to a marketplace or participating in a peer-to-peer network. Although our model is representative of the establishment of actual B2B exchanges, we recognize that the results are limited to the setting we consider. In our model, links are formed because of the gains from information sharing. Although this assumption is necessary to provide focus to our study, in reality, there may be many reasons why links are formed. A link to a marketplace for procuring indirect materials such as office supplies does not have any strategic context other than cutting costs of such an activity. Another restriction comes from the homogeneity of costs among the buyers and sellers. Obviously, costs of establishing B2B links vary for different suppliers of heterogeneous sizes. The assumption of two-way communication channel does not play a significant role in our model although assuming one instead of two-directional links would change the nature of the equilibrium network structure (see Bala and Goyal, 2000).

Our results show the significance of letting the B2B network relationships form endogenously as opposed to exogenously. Previous literature has predominantly assumed the network structure given which limited our understanding of how exchanges and trade networks form. We contribute to the existing literature by introducing a complementary view of B2B exchanges and networks. In the context of non-cooperative relationships, it is important to look at a similar game with either heterogeneous players and/or informational asymmetries among them. This extension will make the model more realistic and lead to testable hypothesis if relevant data can be found in the future. In order to study consortia-backed exchanges, one needs to look at cooperative rather than non-cooperative settings. This route would help us understand and devise revenue sharing models for B2B exchanges as well as link the network forms in equilibrium with concepts such as fairness and governance. Another promising extension if the study of the impact of upstream cooperation and downstream competition – such as the case of Covisint exchange – on the sustainability of exchange based B2B network form.

Note

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Technical Appendix

Proposition 1: *Starting with a random network structure between buyers and sellers, let them decide on whether to maintain or sever a link from their set of links. If this process converges to a state where none of the parties involved would rather change their existing links, resulting exchange-based B2B (private or public) network will take the form of a star-like Nash network.*

Proof: We will provide a sketch of the proof. For details, see Bala and Goyal, (2000). Let $f(k) = \left|\overline{L}_i\right|, g(k) = \left|L_i\right|$. Note first that due to the assumption on the payoff structure,

$$f(n) - g(n-1)c > \max_{x\in[0,n-2]}\{f(x+1) - g(x)c\}. \tag{*}$$

To show that this implies the equilibrium network structure is a star-like Nash network, we start by assuming that the initial random network is such that every pair in the network is connected either directly or indirectly to each other in at most one way and that it is Nash. This implies that there is only one path between every pair in the network and deleting a link would isolate at least one player in the network. Furthermore, there is a unique path for each pair in the network. Multiple paths are not allowed. Now, let i and j be firms such that $s_{i,j} = 1$. We claim that $\max\{s_{j,j'}, s_{j',j}\} = 0$ for any $j' \notin \{i, j\}$. If this did not hold, then i can delete his/her link with j and form one with j' and receive the same payoff, which contradicts the Nash assumption of the initial network. Hence, any agent with whom i is directly linked, cannot have any other links. Since, by assumption, every player is linked to each other in a unique way, i must be the center of a star.

To show the convergence, let each player move sequentially and decide on whether to keep an existing link, build one or sever it. Note that if the resulting network is not empty, it must be that each player is uniquely linked to each other. As (*) holds, a firm's best response is to form links with all the others and hence a star-network is formed.

Proposition 2: *High asset specificity leads to a wheel-like Nash network at the steady state whereas low asset specificity results in a star-like Nash network.*

Proof: As $\left|L^M{}_i\right|$ tends to zero for highly asset specific processes by the argument given prior to the Proposition, the payoff function for the buyer reduces to

$$\Pi_{i,b} = \left|\overline{L_i}\right| - \left|L^D{}_i\right| c_b$$

Let $c_b > c_s$ and $f(k) = \left|\overline{L_i}\right|$, $g(k) = \left|L_i\right|$. Then for the buyer, due to high asset specificity,

$$f(n) - g(1)c_b > f(n) - g(n)c_b.$$

But since $f(n) - g(1)c_s > f(n) - g(1)c_b$ it is also beneficial for the seller to establish a unique direct link with the buyer. Since each firm values linking to as many firms as possible but prefers only direct links with his/her immediate neighbor, a wheel type network arises in equilibrium.

If the process has low asset specificity, $c_b = c_s$ and the payoff function for the buyer is

$$\Pi_{i,b} = \left|\overline{L_i}\right| - \left|L^D{}_i\right| c_b - \left|L^M{}_i\right| c_m .$$

If $c_b = c_s$, by Proposition 1, the equilibrium network is of star type. If $c_m \neq c_b$, then either $\left|L^M{}_i\right|$ or $\left|L^D{}_i\right|$ tend to 0 and again, by Proposition 1, we have a star-like Nash network as the equilibrium of the game.

Table 3. Notation Used in the Paper

$N = \{1,...,n\} \quad n \geq 3$	set of players with locations at the nodes of a graph
$s_i = \{s_{i,1}, s_{i,2},..., s_{i,i-1}, s_{i,i+1},..., s_{i,n}\}$	Strategy of player i where $s_{i,j} = 0$ if i does not have a link with j and $s_{i,j} = 1$ otherwise
Σ_i	Set of all strategies of player i
L_i	Set of players with whom i maintains a link
$\overline{L}_i$	Set of all players whose information i has access to either through a link or through a sequence of links via an intermediary
$c > 0$	the cost to each player of forming the link
$\lvert L^M{}_i \rvert$	Number of links that firm i establishes with exchange based B2B networks
$\lvert L^D{}_i \rvert$	Number of direct links that firm i establishes with buyers
c_s	Cost to the supplier firms for forming a link with the buyers.
c_b	Cost to the buyer firms for forming a link with the suppliers.
c_m	Cost of a link with a marketplace

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Chapter 17

Product Hardware Complexity and Its Impact on Inventory and Customer On-Time Delivery

Grace Y. Lin, Richard Breitwieser, Feng Cheng, John Eagen and Markus Ettl

Abstract: This paper studies the impact of hardware complexity reduction on supply chain inventory against various customer on-time delivery alternatives and manufacturing environments. Different methods of hardware complexity reduction are proposed, and their impacts on total supply chain inventory and customer serviceability are quantified. An analytical inventory optimization scheme taking into account multi-stage supply networks, product structure, forecast accuracy, lead-time variability, and supplier reliability is used to determine optimal inventory levels in a stochastic modeling environment. The analysis is based on a business case for an IBM midrange computer family consisting of more than two hundred models and upgrades with hundreds of features. We investigate different hardware complexity reduction strategies, including low usage feature reduction, low volume feature reduction, and feature substitution, as well as quick response and postponement mechanisms. Our computational results show that in a fabrication-fulfillment center environment, implementing a hardware complexity reduction mechanism results in significantly higher inventory savings than in an integrated manufacturing environment. The results presented in this paper were used to implement hardware complexity reduction in IBM's midrange computer division.

Key words: Inventory, Modelling, Postponement, Supply Chain Management

1. INTRODUCTION

The rapid advances in information technology have brought the computer manufacturing industry many unprecedented challenges in its production and distribution processes. Constant price wars among computer manufacturers have resulted in very thin profit margins. Customers are demanding faster and more reliable services. Those challenges are compounded by the increased complexity of the business environment. Products are distributed through a variety of channels, ranging from traditional sales methods to direct marketing and e-commerce, placing a tremendous strain on legacy processes and I/T applications. Product development cycles have been reduced to less than twelve months while the number of features and part numbers to be managed continue to increase.

Because cost reduction is absolutely critical for computer manufacturers to survive, supply chain management becomes an important issue of which every player in this marketplace must have awareness. As part of the effort to improve customer serviceability and to reduce manufacturing costs, the US computer manufacturing industry has shifted its main focus from improving assembly and plant operations to establishing supply chain efficiency and integration. Companies have addressed these challenges in different ways: first, by reconfiguring the distribution network and the physical flow of inventory, including raw materials, work-in-process, and finished goods; secondly, by improving the efficiency and flexibility of the operating processes governing supply chain management; and lastly, by using advanced information technology to enhance business processes and to establish effective and efficient information exchanges between supply chain partners.

Supply chain reengineering efforts have focused on improvements reflected in key operational metrics: on-time shipments, on-time delivery, responsiveness, cycle time reduction, and inventory turnover. Improvements are dependent on the integration of supply chain considerations early in the product development cycle when design methodologies and practices can be changed. To effectively integrate product design and development with manufacturing and distribution processes, with the goal to build products faster and to deliver them to the marketplace quicker, manufacturers have adopted a broad range of strategies and mechanisms. These include design of simplified product structures through modularization and parts commonality, standardized building blocks that can be used on a plug-in basis in multiple products‘ product customization at the most efficient point in the supply chain, e.g., through postponement or operations re-sequencing‘ suitable for channel assembly‘ and quick response distribution models.

In addition to quick response and postponement, which are among the most beneficial mechanisms to reduce costs and manage risk in high-technology supply networks, this paper focuses on two strategies for hardware complexity reduction: *feature reduction* and *feature elimination.* In a computational study, we quantify the impacts of feature reduction and feature elimination on inventory and customer serviceability using manufacturing data from a family of IBM midrange computers. We show how these strategies help to control inventory and improve on-time delivery performance. We will also focus on how to configure the supply chain relative to the product structure to integrate product design and supply chain processes.

Implementing these business decisions increasingly depends on coordinated and reliable information exchanges between supply chain partners, including suppliers, manufacturing, assembly, and distribution channels. To conduct the computational study, we utilize a multi-stage inventory optimization scheme that allows such business decisions to be analyzed enterprise-wide. The inventory optimization scheme takes into account product structure, lead-time variability, supplier reliability, and forecasted demands, and determines optimal inventory levels to support a predefined delivery time commitment. It operates by utilizing a set of manufacturing data across the enterprise. The data collection is accomplished through a number of database applications that were implemented to extract, manipulate, and reconcile manufacturing data from corporate databases and local site data sources.

The paper is organized as follows: in Section 2, a brief review of the related literature is provided. A discussion of product hardware complexity follows in Section 3. Section 4 describes the analytical optimization scheme used to determine inventory levels in multi-stage supply networks. This method is used in our computational study. In Sections 5 and 6, data issues, modeling assumptions, and manufacturing environment settings are discussed. In Sections 7 through 9, the effects of quick response, feature elimination, feature substitution, and postponement are presented, and the benefits of the various concepts are illustrated. Section 10 concludes with a summary and directions for future work.

2. RELATED LITERATURE

While it has been recognized that hardware complexity reduction and the use of standardized building blocks helps to reduce costs and improve customer delivery performance, most studies on the benefits of such mechanisms are based on qualitative assessments. There have been few analytical studies, with most results pertaining to the well-known properties of risk-pooling.

Sauer (1984) and Gerchak and Henig (1986) investigated the quantitative impact of common parts on components stock in a single-period, unconstrained profit maximization model. Baker, Magazine, and Nuttle (1986) proposed a simple multi-product model with one common component and independent uniformly distributed demand. They concluded that the introduction of parts commonality reduces the total inventory required to meet a specified service level. Gerchak, Magazine, and Gamble (1988) extended the results of Baker et al. (1986) to allow general demand distributions. Grotzinger, Srinivasan, Akella, and Bollapragada (1993) extended the analysis for assembly-to-forecast systems with general product structure, multiple time periods, and independent product demand. An allocation policy was developed to incorporate risk pooling by minimizing the expected excess finished-goods inventory subject to service level requirements.

A simulation study based on computer-generated demand distributions was conducted to show the inventory reduction that can be achieved by the allocation policy. Collier (1982), Ashton and Ashton (1985), Benton and Srivastava (1993), and Bartezzaghi and Verganti (1995) utilized simulations to obtain quantitative results for parts commonality in multi-product, multi-stage manufacturing environments. Strategies for postponement, or delayed differentiation, were studied, among others, by Lee (1996), Garg and Lee (1996), Garg and Tang (1997), Garg and Lee (1998), Brown, Lee and Petrarkian (1998), and Aviv and Federgruen (1998). Most of these studies were aimed at obtaining analytical insights into product design using simple models with a limited number of products. Swaminathan and Tayur (1998) utilize stochastic programming to address common parts, postponement, and operations resequencing in the context of managing product variety in large-scale supply networks. Kruger (1997) characterized the various stochastic events influencing a company's shipment and inventory performance, focusing on minimizing on-hand inventory and optimizing supplier response time.

Ettl, Feigin, Lin, and Yao (1998) and Ettl and Lin (1999) studied multi-stage inventory systems operated via a base-stock policy. They developed a model to compute the optimal base-stock levels in large-scale supply chains based on predefined service level requirements. We apply this technique in our computational study because it allows us to generate effective solutions for industry-size problems, as well as to provide computational insights.

Related models were described in Lee and Billington (1993), Andersson, Axsaeter, and Marklund (1998) and Graves, Kletter, and Hetzel (1998).

3. MANAGING PRODUCT COMPLEXITY

In the computer industry, a wide range of feature offerings allows customers more choices, and hence may generate more demands. However, it also increases the complexity of the product structure. It is important to evaluate the tradeoff between the benefit and the cost associated with product complexity. In this paper, two approaches for hardware complexity reduction are considered: feature elimination and feature substitution. Feature elimination means that a particular feature is no longer offered, and, therefore, demand for this feature is lost. Feature substitution means that a particular feature is no longer offered, but demand for this feature is filled by a feature with similar functionality. Feature offerings with low demand, low volume, or low usage are potential candidates for elimination or substitution.

The benefits from feature elimination and feature substitution can be realized in a number of ways. First, fewer part numbers will be maintained in inventory, and inventory carrying costs will be reduced as a result. By removing low usage parts, the risk of scrapping obsolete parts is also reduced. Secondly, procurement costs will be lowered because of better economies of scale. With a higher level of parts commonality, manufacturers may take advantage of volume discounts from suppliers. Also, inventory management will become simplified with less unique components. Less physical storage space is required on factory floors and in warehouses. And finally, administrative and overhead costs associated with procurement will be reduced. There will be fewer transactions going through planning and ERP systems.

In addition to the benefits identified above, managing hardware complexity also helps to reduce the amount of inventory needed as safety stock in an uncertain demand environment. The risk pooling effect of parts commonality can be illustrated by means of the following simple analysis: suppose d_1 and d_2 are the demands for two different parts (or features) in a period. Assume they are normally distributed. Let

$$d_1 \sim Nor(\mu_1, \sigma_1) \quad \text{and} \quad d_2 \sim Nor(\mu_2, \sigma_2).$$

We calculate the safety stocks required being $s_1 = k\sigma_1$ and $s_2 = k\sigma_2$, where k is the safety factor determined by the serviceability requirement. The total amount of safety stock will be

$$s = s_1 + s_2 k(\sigma_1 + \sigma_2).$$

Suppose $\sigma_1 \le \sigma_2$ and let $p = \sigma_2 / \sigma_1$. Then, $s = k(1 + p)\sigma_1$. However, if the two parts are substitutable, only one type of parts is required. Assume the demands d_1 and d_2 are independent, and denote d as the consolidated demand for the common part. We have

$$d \sim Nor(\mu, \sigma),$$

where,

$$\mu = \mu_1 + \mu_2 \text{ and } \sigma = \sqrt{\sigma_1^2 + \sigma_2^2}$$

The total amount of safety stock becomes

$$s' = k\sigma = k\sqrt{\sigma_1^2 + \sigma_2^2} = k\sqrt{1 + p^2}\,\sigma_1$$

Comparing s' and s, we have

$$\frac{s'}{s} = \frac{\sqrt{1 + p^2}}{1 + p} = \sqrt{1 - \frac{2p}{(1 + p)^2}},$$

It is easy to see that

$$\frac{\sqrt{2}}{2} \le \frac{s'}{s} \le 1$$

which means that the total amount of safety stock will be reduced when consolidating demands d_1 and d_2. The maximum relative savings is

$0.29 = 1 - \sqrt{2}/2$ when the two demands have the same variability. In a similar fashion, we can extend this analysis to include multiple items. The maximum savings for the *n* item case is

$$1 - \frac{1}{\sqrt{n}}$$

Any real manufacturing system, however, will be far more complex than the simple cases described above. First, the demands for components and subassemblies are the result of an MRP explosion based on the bills-of-materials. Secondly, factors like the manufacturing lead times, transit times, material handling delay times, as well as the production and inventory procurement policies, affect the amount of safety stock required to achieve a certain level of serviceability to customers. Assessing the impact of all these factors on the inventory and the serviceability through a closed-form mathematical expression is no longer feasible.

4. INVENTORY OPTIMIZATION IN MULTI-STAGE SUPPLY NETWORKS

To numerically evaluate strategies for hardware complexity reduction in a multi-stage supply network, we apply the analytical inventory optimization scheme described in Ettl, Feigin, Lin, and Yao (1998) and Ettl and Lin (1999). The method determines optimal inventory levels from a constrained nonlinear programming formulation, taking into account forecast accuracy, lead-time variability, supplier reliability, and customer service level targets. The idea is to estimate the actual lead time of each product at a stocking location based on upstream parts availability. Each stocking location, of buffer, is modeled as a queuing system controlled by a base-stock policy. The analysis is based on decomposition, analyzing each stocking location individually, and capturing the interactions among different stocking locations through their actual lead times.

Each stocking location is modeled by a queue with batch Poisson arrivals and infinite servers with service times following a general distribution, denoted as $M^X/G/\infty$ in queuing notation. The arrival process at a stocking location is obtained by applying the standard MRP demand explosion technique to the product structure. The service time is the actual lead time. For a buffer j that does not have an upstream supplier, the actual lead time, denoted $\tilde{L}_j$, is equal to the nominal lead time, L_j, from given input data. For an intermediate buffer j, the situation is different. Let M_j correspond to the set of upstream suppliers of buffer j. The actual lead time of finished goods buffer j, $\tilde{L}_j$, is defined as

$$\tilde{L}_j = \begin{cases} L_j, & \text{w.p. } p_{0j} \\ L_j + \tau_i, & \text{w.p. } p_{ij} \end{cases} \quad \text{for } i \in M_j \tag{1}$$

where

$$p_{0j} := \left(1 + \sum_{k \in M_j} (1 - f_k)/f_k\right)^{-1} \quad \text{and} \quad p_{ij} := p_{0j}(1 - f_i)/f_i \tag{2}$$

The quantity f_i is the fill rate at supplier buffer i, that is, the fraction of orders filled from safety stock. From the above definition, the actual lead time at buffer j is equal to its nominal lead time if the order is filled immediately from its upstream suppliers. If supplier i has a stockout, which happens with probability p_{ij}, it is the nominal lead time, plus an addition delay τ_i. This additional delay is the time required for the supplier to produce the next unit to supply the order. The distribution of the additional delay can be derived from Markov chain analysis.

The key quantity in the analysis is number of jobs, N_j, in the $M^X/G/\infty$ queue. The safety stock inventory I_j and the backorder level Q_j relate to N_j through the following formulas:

$$\begin{aligned} I_j &= \max(R_j - N_j, 0) \\ Q_j &= \max(N_j - R_j, 0) \end{aligned} \tag{3}$$

where R_j is the base-stock level. We can write $R_j = \mu_j + k_j\sigma_j$, where k_j is the so-called safety factor, and $k_j\sigma_j$ the safety stock. This way, the distributions of I_j and Q_j can be related to the distribution of N_j which can be derived from standard queuing results (Liu, Kashap, and Templeton, 1990). The quantities m_j and s_j denote the mean and standard deviation of the actual lead time $\tilde{L}_j$.

With the arrival and service processes in place, the queue is analyzed and performance measures such as inventory, backorders, and fill rates derived. In particular, the fill rate f_j is computed as

$$f_j = \phi(k_j)\frac{\sigma_j}{\mu_j} + \left(1 - \Phi(k_j)\right) \tag{4}$$

with $\phi(\cdot)$ and $\Phi(\cdot)$ denoting the density function and the distribution function of the standard normal variate. The expected on-hand and backorder levels are given as follows:

$$\begin{aligned} E[I_j] &= \sigma_j\left(k_j + G(k_j)\right) \\ E[Q_j] &= \sigma_j G(k_j) \end{aligned} \tag{5}$$

where the function $G(\cdot)$ is defined as $G(x) := \int_x^\infty (z - x)\phi(z)dz$.

The objective of the optimization model is to minimize the total inventory capital. The constraints of the optimization model are the required customer service levels. They are represented as the probability, say 0.95 or 0.99, that customer orders are filled within a given due date. With W_m denoting the waiting time to receive an order for end product *m,* we define the required customer service level as

$$P[W_m \le \beta_m] \ge \alpha_m \tag{6}$$

where β_m is the delivery due date (or order-to-delivery cycle time), and α_m is the fraction of orders filled by the due date. This formulation allows to specify service level constraints separately for each customer demand stream. The fill rates for the end products are derived so that the required customer service levels are guaranteed. These fill rates relate to the actual lead times of upstream stocking locations, via the bills-of-material structure of the network and the actual lead times explained above. To evaluate the network, the analysis starts with the buffers that are the furthest upstream in the network, and works its way downstream until all buffers in the network have been analyzed. This way, the model captures the interdependence at different stocking locations, in particular the effect of base-stock levels and fill rates at each stocking location on the service level of the end product.

5. MODELING ASSUMPTIONS AND DATA COLLECTION

The objective of our study is to provide computational insights on managing product complexity in large-scale supply chains. For that purpose, we selected IBM's midrange computer product line to analyze the impact of the product complexity against various customer serviceability alternatives, and in different manufacturing environments. The product structure of IBM's midrange computer product line consists of more than two hundred machine type models (MTM's) and upgrades with hundreds of feature codes as illustrated in Figure 1. The manufacturing and assembly of a model involves thousands of unique part numbers, approximately one eighth of them representing the highest level of assembly prior to building a complete system. The highest level of assembly correlates closely with the number of features that a customer can order. The end products share several common components in different ratios.

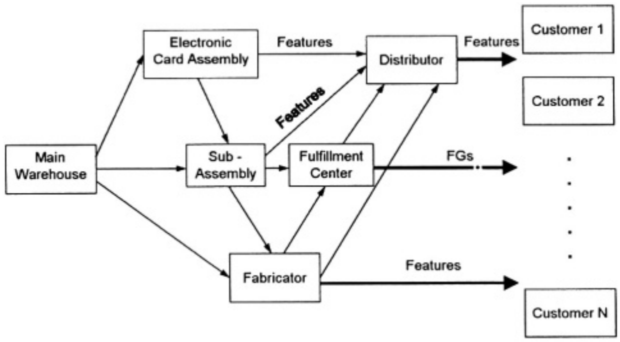

Figure 1. Supply Chain of the IBM Midrange Computer Product Line

To capture the uncertainties associated with the replenishments from suppliers and fabricators, the replenishment lead times are modeled by distribution functions derived from historical information. The forecast accuracy was determined from historical forecast and order data that we collected and analyzed over a period of one year. Analysis of the data revealed that machines, upgrades, and features had very different forecast accuracy ranges. It also showed that low volume demands have a significant lower accuracy compared to high volume demands. We therefore implemented different accuracy percentages in our model, depending on product classification (MTM or upgrade) and demand classification (low volume or high volume). Table 1 summarizes the baseline demand scenario used in our study.

Table 1. Summary of forecast accuracy scenarios; demand is non-stationary and varies by week; mean and standard deviation were derived from historical data

	High-volume products: weekly demand forecast		Low-volume products: weekly demand forecast	
	(mean)	(std.dev.)	(mean)	(std.dev.)
MTM	$d_{M,high}$	$0.20d_{M,high}$	$d_{M,low}$	$0.35d_{M,low}$
Upgrade	$d_{U,high}$	$0.30d_{U,high}$	$d_{U,low}$	$0.70d_{U,low}$
Feature – MTM	$f_{M,high}$	$0.35f_{M,high}$	$f_{M,low}$	$0.55f_{M,low}$
Feature – Upgrade	$f_{U,high}$	$0.55f_{U,high}$	$f_{U,low}$	$0.90f_{U,low}$

We used a relational modeling database to store the information associated with the various modeling scenarios, including the supply chain structure, product structure, manufacturing data, and demand forecasts. The product structures were derived from a top-down bills-of-material explosion that was processed for each MTM or upgrade. They include part numbers, parts costs, suppliers, lead times, usage quantities, and stock-to-dock delay times. All product data was extracted from corporate databases and from local site data sources. To facilitate data extraction, we developed a number of database connectivity modules that provide automated database access, extract production data, and feed them into the relational modeling database. All connectivity modules have built-in bills-of-material explosion functionality. To detect inconsistencies in data recording caused by missing or incomplete information pertaining to the bills-of-materials, we added database consistency checks that generate missing data reports, and reduce the data set to a consistent level that can be downloaded to the modeling database. The data collection process allows to supply missing data in relational tables that can be merged with the output of the explosion. To keep the complexity of the bills-of-material explosion manageable, we implemented data reduction routines through which non-critical components were automatically eliminated, based on an item's value class or annual requirements cost.

6. MANUFACTURING ENVIRONMENTS

Our computational study is designed as a scenario-based analysis. The assumptions used to derive the different scenarios can be categorized by three environments that differ in terms of the features offered for the midrange computer product family as described below:

- *Current Environment*

  The current environment represents the as-is scenario for the midrange computer product line at the end of 1997. It is used as the base case for comparison under various scenario alternatives. The current environment consists of more than 200 MTM's and upgrades and nearly 1,000 features. Almost one third of the features had a common usage of one, which implies that these features were used in only one MTM or upgrade. Table 2 lists the distribution of feature counts with respect to the ratios of common usage.

- *Historical Environment*

  The historical environment represents a worst-case scenario with a larger number of MTM's and upgrades, more features, and no parts commonality at all assembly levels. Since it turned out to be almost impossible to find consistent historical bills-of-materials, we used the current bills-of-materials and assumed that all features have a common usage of one, i.e., end products do not share common components. To get the worst-case estimation, we modeled the supply chain associated with each MTM and upgrade independently and then combined the results.

Table 2. Classification of feature counts in the current environment

Feature common usage (# used in MTM or upgrade)	As percentage of total number of features
1	32%
2-4	30%
5-9	20%
10-19	12%
20-29	4%
30-45	2%

- *Future Environment*

  The future environment is modeled to test the impact of product complexity reduction. The intent was to model an environment with fewer machines and upgrades, fewer features, increased common parts usage, increased use of common building blocks, shorter order-to-delivery lead times, and a higher percentage of on-time deliveries. We will evaluate the impact of quick response by introducing aggressive delivery targets, and analyze the implementation of a fabrication-fulfillment center model.

For the modeling environments described above, we investigate two different manufacturing models: *integrated manufacturing* and *fabrication-fulfillment.* In the integrated manufacturing model, the total assembly process from purchased parts to customer shippable products takes place in one location as shown in Figure 2.

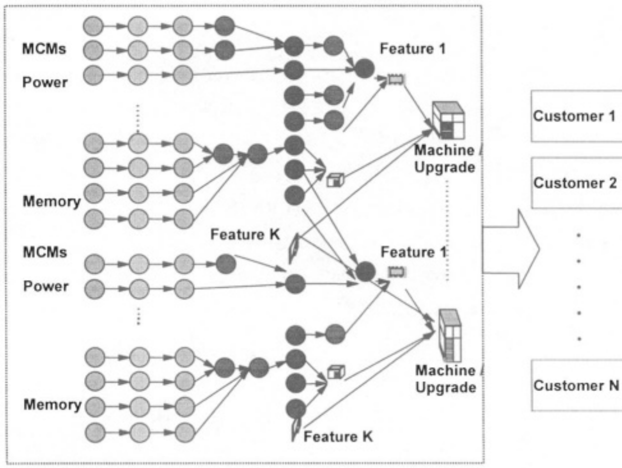

Figure 2. The Integrated Manufacturing Model

In the fabrication-fulfillment center model, the production facility is partitioned into a fabrication center and a fulfillment center as illustrated in Figure 3. The fulfillment center can be an authorized assembler that receives high-level subassemblies from the fabrication center. The subassemblies are integrated, customized and tested at the fulfillment center before the end product is delivered to the customer. In the fabrication-fulfillment center model, suppliers and fabricators replenish the fulfillment centers via pull signals. At the beginning of our study in 1997, the IBM midrange computer division operated as an integrated manufacturing center. This model is used in all experiments associated with the current and historical environment. The fabrication-fulfillment center model, by contrast, is designed for use with the future environment only.

Each modeling scenario is analyzed under a continuous replenishment policy with base-stock control. By applying the optimization capability of the inventory model described earlier, we determine the base-stock levels at each stage of the supply chain, from components, subassemblies to finished products levels as a function of delivery targets and the manufacturing environment.

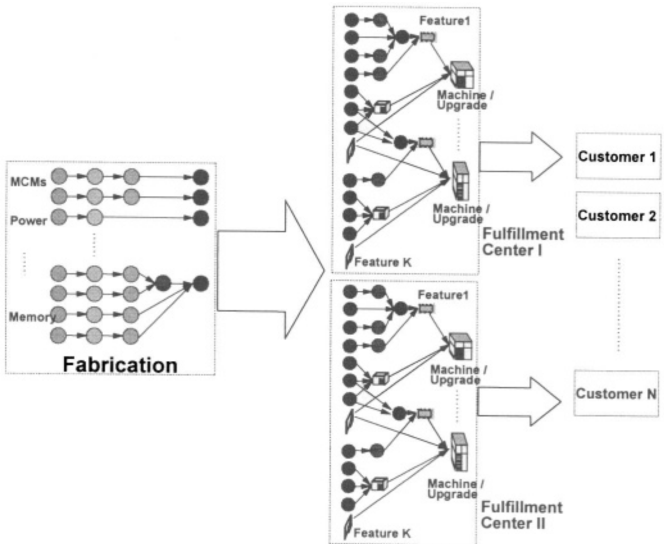

Figure 3. The Fabrication-Fulfillment Manufacturing Model

7. EFFECT OF QUICK RESPONSE

In this section, we implemented the inventory optimization scheme described in Section 4 to model the entire midrange computer supply chain. The goal is to understand the trade-off between inventories and customer delivery targets in the different manufacturing environments. We define different response models, one representing a standard response delivery target, and the other representing a quick response delivery target. Table 3 summarizes the response models. Notice that the different delivery targets translate directly into customer service level constraints that are required by the inventory optimization scheme as defined in equation (6).

Figure 3. The Fabrication-Fulfillment Manufacturing Model

Response Model	*Order-to-delivery cycle time b_i*	*Service level a_i*
Standard	11 days	73%
Quick Response	3 days	95%

As the transition from standard to quick response delivery targets was expected to start with selected systems and move gradually to cover the entire product line, we varied the penetration of the quick response program from 0% to 100% as described in Table 4. Scenario C2 defines the base case because it represents the coverage of the quick response program at the time of the study (40% of the total output). Scenario H2 is a hypothetical case to provide additional information for comparison purposes.

Table 4. Summary of scenarios studied for order-to-delivery cycle time targets; all scenarios were analyzed in the integrated manufacturing environment

Case	*Manufacturing Environment*	*Response Model*	*Quick Response Percentage*
H1	Historical	Standard	0%
H2	Historical	Quick Response	100%
C1	Current	Standard	0%
C2 (Base case)	Current	Quick Response / Standard	40%
C3	Current	Quick Response	100%

The base case, which reflects the present environment the closest, was validated against the actual inventory figures to ensure that the model represents the reality precisely. The modeling results came within 5% of the actual inventory levels planned for the midrange computer product line at the end of 1997. The historical environment represents the case of no parts commonality modeled with 0% and 100% quick response delivery targets, respectively. The differences between scenarios C1 and H1, and C3 and H2 show the impact of common parts on inventory. The inventory turnovers in the current environment improve by more than 20% over the historical environment for 0% and 100% quick response coverage. Figure 4 shows the inventory turnover results for the different scenarios.

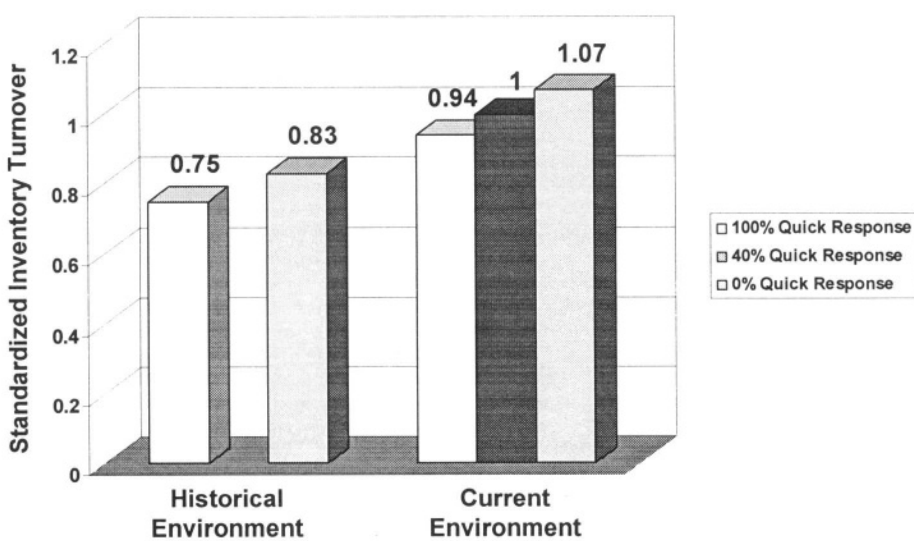

Figure 4. Inventory turnover for historical and current environment. The vertical axis is standardized with respect to the actual inventory turnover for base case in the current environment

The three cases for the current environment C1–C3 show the relative impact on inventory turnovers when the coverage of the quick response program moves from 0% to 100%. Notice that in the 100% quick response case, additional inventory is required because the short order-to-delivery cycle time makes it necessary to hold additional inventory at finished goods and the higher assembly levels.

8. EFFECT OF FEATURE ELIMINATION

In this section, we consider the value of reducing hardware complexity through feature elimination across the supply chain. The task of modeling feature elimination is accomplished using three different approaches to eliminate low usage features and assemblies. The first approach is to eliminate features that have low usage. From Table 2, we observe that less than 20% of features have a usage larger than nine, and almost one third of the features have a usage of one. We evaluated three cases with elimination of features with the usage of one, of one to four and one to nine. The second approach is to eliminate features based on their annual demand. Our analysis of historical data showed that 15 to 20 percent of all features in the midrange computer family represent about 85 percent of the total feature demand. We again constructed three cases and eliminated features with an annual demand of less than 200 parts, less than 650 parts and less than 2,000 parts. The third approach is a combination of the previous, eliminating features with an annual demand of less than 200 and a usage of one.

Table 5. Summary of cases with different feature elimination methods

Case	*Feature elimination method*	*Feature count as percentage of base case*	*Relative Turnover Improvement*
E1a	Usage = 1	95%	4%
E1b	Usage < 5	75%	9%
E1c	Usage < 10	50%	12%
E2a	Demand < 200	98%	6%
E2b	Demand < 650	90%	12%
E2c	Demand < 2000	80%	14%
E3	Demand < 200 & Usage = 1	95%	5%

All together, we constructed seven cases with different feature elimination schemes through elimination of low usage parts, elimination of low volume parts, or the two approaches combined. To simplify the analysis, we assumed that the elimination of a feature has no effect on customer sales; however, the dollar output of the eliminated feature is lost. All cases were analyzed using the integrated manufacturing model. The results are summarized in Table 5.

Figure 5 compares the results of feature elimination with the base case in the current environment, and the case of no parts commonality in the historical environment. The elimination of low volume features achieved better results as far as inventory turnover is concerned. Notice that the potential output loss due to eliminated features is significantly lower using the low volume elimination method as compared to the low usage elimination method, which is due to the fact that parts commonality at the feature level was not very extensive (see Table 2).

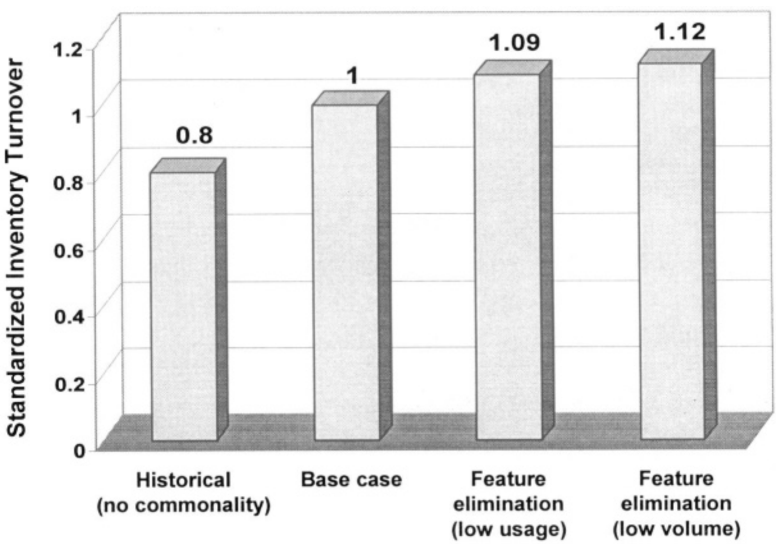

Figure 5. Inventory turnover for low usage and low volume feature elimination scenarios. The vertical axis is standardized with respect to the actual inventory turnover of the base case in the current environment. The historical environment with no commonality is included for comparison. All scenarios were analyzed in the integrated manufacturing environment

The three cases of low usage feature elimination resulted in 4-12% inventory turnover improvement with a 9% midpoint, whereas low volume feature elimination resulted in 6-14% turnover improvement with a 12% midpoint. The output loss was 25% for low usage feature elimination, and 10% for low volume feature elimination, respectively. This clearly indicates that low usage feature elimination is a less favorable strategy for actual implementation.

9. EFFECT OF FEATURE SUBSTITUTION AND POSTPONEMENT

In this section, we present some important insights into the effects of reducing hardware complexity through feature substitution. Often, similar items in a product line start out to be manufactured from distinct features, subassemblies, or components. The goal is to substitute these by common building blocks. In computer manufacturing, features can be classified into feature segments such as memory, processor and communication cards, hard files, tapes, etc. Rather than incorporating all feature segments into our analysis and defining the appropriate substitution mechanisms, which is an extremely complex task, we selected one specific feature group. The selected feature group consists of 9 purchased components at assembly level 3. These components are subsequently assembled into 14 level 2 assemblies, and then into 26 level 1 assemblies. The feature counts at the three assembly levels are illustrated in Figure 6.

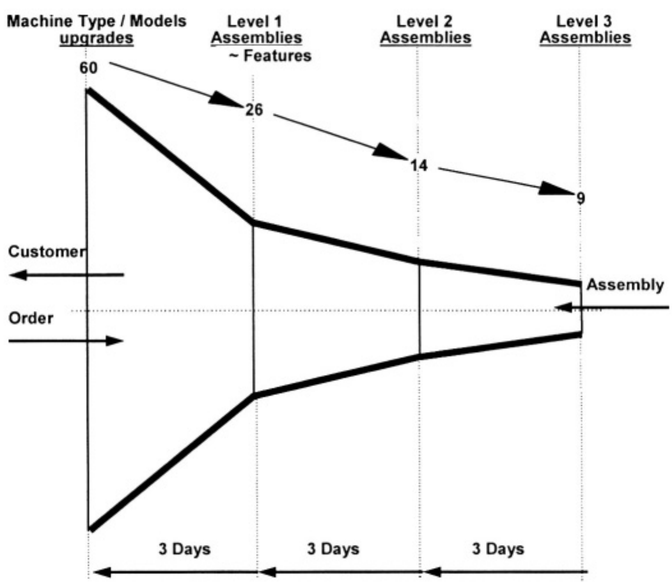

Figure 6. Feature count at assembly levels 1,2, and 3 for the selected feature group (Base case)

To avoid intricate details associated with the technological feasibility of substitutions, we consider cost as the key criterion for substitution. This implies that an item of the selected feature group can be substituted by an item of the same group if the cost is approximately the same. In order to quantify the benefit of feature substitution, we designed modeling scenarios with different degrees of substitution at the top-three assembly levels. Table 6 shows the respective feature counts.

Table 6. Summary of feature count at assembly levels 1,2, and 3 for feature substitution scenarios (selected feature group only)

		Feature Count	
Case	*(Assembly level 1)*	*(Assembly level 2)*	*(Assembly level 3)*
S0	26	14	9
S1	18	11	7
S2	16	11	6
S3	8	6	4

Notice that through the various modeling scenarios it is possible to study the impact of postponement, or delayed differentiation, at the different assembly levels. With postponement, the differentiating operations of a product are postponed until the latest possible moment prior to shipping the product to the customer. With postponement, the usage of common parts at each assembly level is increased which in turn helps to reduce inventory and improve supply flexibility. The process we established for feature substitution, which is based on replacing low volume part numbers, did not result in output loss at the customer level. Figure 7 shows the feature counts at the individual assembly levels after feature substitution.

To maintain a common point of variation for the different degrees of feature substitution, we compared the integrated manufacturing and fabrication-fulfillment center model. One would expect a larger improvement in the fabrication-fulfillment center model versus the integrated manufacturing model. For the purpose of fair comparison, we subtracted out the additional inventory due to longer transportation times in the fabrication-fulfillment center model. Figure 8 shows the relative inventory reductions as a function of the manufacturing environment and the on-time delivery targets. The results only reflect the changes due to protective stock.

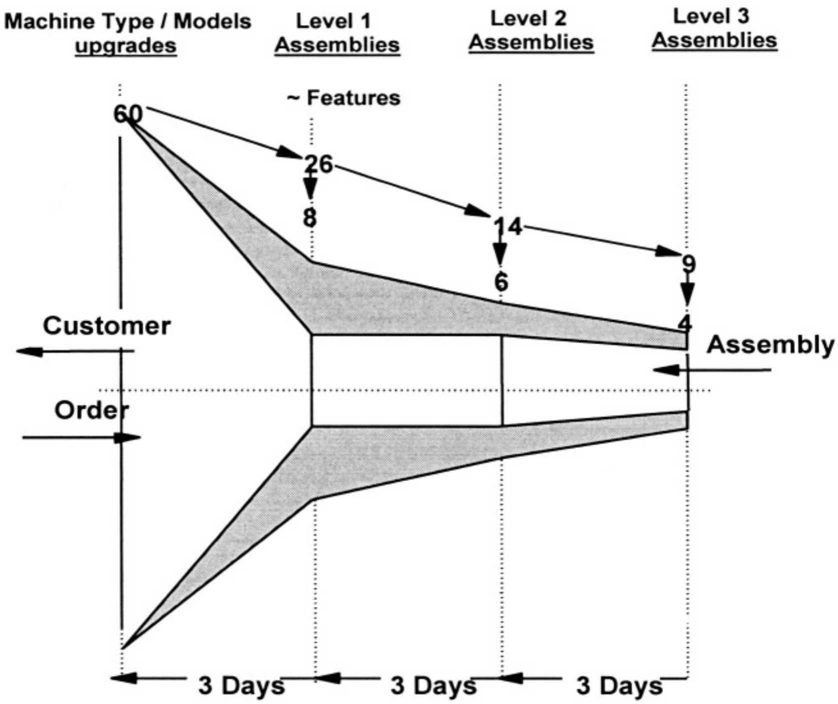

Figure 7. Feature count at assembly levels 1,2, and 3 for selected feature group after feature substitution

Assuming that the results obtained for the selected feature group are representative of the behavior of all other feature segments, Table 7 summarizes the relative turnover improvements that can be achieved by implementing postponement for the entire product family.

Table 7. Relative inventory turnover improvement achieved through postponement for entire product line

Case	*Manufacturing Environment*	*Relative turnover Improvement*
No common parts	Historical / Integrated mfg.	(19%)
Base case	Current / Integrated mfg.	0
Feature elimination (low usage elimination)	Future / Integrated mfg.	11%
Feature elimination (low volume elimination)	Future / Integrated mfg.	15%
Feature substitution w/ postponement (low volume substitution)	Future / Integrated mfg.	20%
Feature substitution w/ postponement (low volume substitution)	Future / Fab-fulfillment	34%

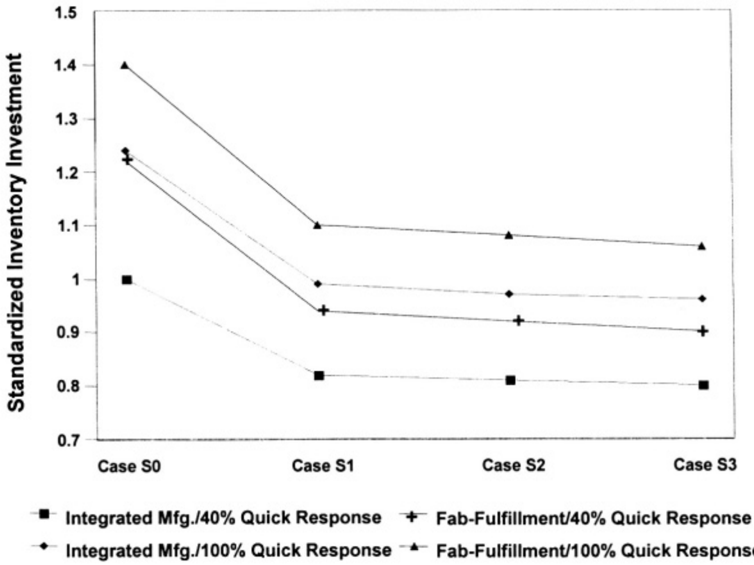

Figure 8. Standardized inventory investment for delayed product differentiation. The vertical axis is standardized with respect to the actual inventory investment for scenario S0 in the integrated manufacturing environment with 40% quick response coverage

In the simplest form of low usage and low volume feature elimination, inventory turnover improvements of up to 15% can be obtained with a small percentage of output loss. A much larger improvement can be achieved through feature substitution at all assembly levels where inventory turnover improvements of up to 34% were obtained. However, the results also show that it is absolutely critical to include level 1 assemblies in the delayed differentiation process because even at optimum inventory, significant amounts of level 1 assemblies have to be carried in order to support a quick response model with high on-time delivery requirements.

10. SUMMARY

In this paper, we addressed the problem of managing product complexity in large-scale supply networks. We presented a queueing network model that allows the analysis of the different aspects of managing product complexity, namely parts commonality, feature elimination, feature substitution, and postponement. The model determines optimal inventory levels from a constrained nonlinear programming formulation; it takes into account uncertainties in demand forecasting, lead times, and supplier reliability, as well as customer service level requirements. The model assumes global information of the supply chain utilizing a set of product data across the enterprise.

In a computational study, we quantified the impacts of product complexity reduction techniques using industrial data from a family of IBM midrange computers, consisting of more than two hundred models and upgrades and several hundreds of feature offerings. We developed different methods for feature elimination and feature substitution which were analyzed in the transition from an integrated manufacturing environment to a fabrication-fulfillment center environment, and from standard response to quick response. Our results indicated that feature substitution results in 20% inventory cost savings before the transitions and 24% inventory cost savings after the transitions.

The focus of this paper was to evaluate the trade-off between product variety and inventory investment. The implementation of feature reduction techniques will require design changes in product structure and manufacturing processes, and, as a result, fixed and variable system costs may change. Inventory investment is the key driver of variable system costs. However, in order to evaluate the overall cost-effectiveness of feature reduction techniques, non-inventory related costs (fixed and variable), such as unit processing costs, additional investment in manufacturing equipment, etc., need to be considered. These costs are typically difficult to quantify. Models that enable an analysis of all relevant system costs would be useful. Lee and Tang (1997) and Garg and Lee (1996) are among the few papers that consider these costs. Furthermore, market analyses are needed to understand the impact of feature offerings on customer demand, and to develop specific guidelines for the implementation of feature reduction techniques.

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Chapter 18

Reengineering Using "Merge-in-Transit" for Electronic Commerce

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Abstract: This paper investigates merge-in-transit as an approach to reengineering assembly, warehouse and billing processes for electronic commerce. Merge-in-transit is defined and some examples are given to illustrate its use. Processes necessary to accomplish merge-in-transit are developed, while advantages and disadvantages of merge-in-transit are studied.

Additional issues arising from merge-in-transit also are studied: Merge-in-transit software is discussed; New measures necessary for merge-in-transit are examined; The effects of merge-in-transit on others in the current supply chain are also examined.

Key words: Merge-in-Transit, Electronic Commerce, Reengineering

1. INTRODUCTION

The ability to do electronic commerce has led to the reengineering of many enterprise processes. One of the most intriguing is the reengineering of order, assembly, warehouse and billing processes using an approach called "merge-in-transit." Merge-in-transit has become institutionalized into some companies with more progressive electronic commerce strategies, such as Cisco. In 1997, Cisco manufactured portions of a communications switching system in three different locations. Orders from Bell South in Memphis, began to be delivered using merge-in-transit, from California, the midwest and the southeast (Dawe, 1997). On September 28, 1998, Cisco expanded that program when they announced the following in their "Networked Commerce News".

New Consolidated Delivery Solution is Available

The Cisco consolidated delivery solution Merge in Transit (MiT) is now available to all U.S., customers. MiT is a new Internetworking Product Center (IPC) delivery option designed to simplify the receiving and remittance processes. With MiT, all itemsfrom a purchase order ship at the same time, and a single remittance invoice is generated. This eliminates multiple shipments and invoices, making it even easierfor you to do business with Cisco. To Select the MiT solution, simply choose the "Merge Order" delivery option in "Step 6, Taxes and Shipping" ofthe IPC order checklist.

In Regions outside the U.S., MiT will be available at thefollowing times: Canada September 21, 1998; Latin America, October 1998; Europe/Middle East/Africa, November 1998; Asia/Japan/Australia, 1999.

For more information about MiT, please visit http://www.cisco.com/order/mit.html.

With this announcement MiT became an official part of Cisco's e/i-commerce strategy. Although the announcement specifies that the MiT is a new option for distribution, it is much wider reaching, including order, assembly, warehousing and billing processes. For example, with the announcement customers can receive a single invoice or bill, for items shipped from multiple vendors and/or Cisco locations. In addition, the service is not just for its U.S. customers, but instead also would include those outside the U.S.

PURPOSE OF THIS PAPER

The purpose of this paper is to investigate how the electronic commerce innovation "merge-in-transit," has led to reengineering existing enterprise processes. Examples are used to illustrate it and identify the overall set of processes and activities involved, while investigating the advantages and disadvantages.

Merge-in-transit is couched as an example of the development of a virtual organization. In order to make the virtual organization work, process changes and information infrastructures are required of each supplier/manufacturer participant. In addition to e/i - commerce case studies, further research issues are identified throughout.

THIS PAPER

In order to accomplish these purposes, this paper proceeds in the following manner. This first section has provided an introduction and tried to motivate the need for examining merge-in-transit. Section 2 couches merge-in-transit as a virtual organization structure and examines nature of such a virtual organization. Section 3 defines merge-in-transit, and examines some short case studies of its use. Section 4 summarizes the pre merge-in-transit process for assembly and warehousing. Section 5 analyzes the reengineered process arising from a merge-in-transit approach. Section 6 investigates some of the advantages and disadvantages of merge-in-transit. Section 7 summarizes some of the available software for merge-in-transit. Section 8 examines the need for some new measures to understand the emerging virtual organization. Section 9 studies the impact of merge-in-transit on other parties. Section 10 briefly summarizes the paper and some of the research issues.

2. VIRTUAL ORGANIZATION STRUCTURE IN MERGE-IN-TRANSIT

Goldman et al. (1995, pp. 7) define a virtual company as one "...where complementary resources existing in a number of cooperating companies are left in place, but are integrated to support a particular product effort for as long as it is viable to do so. ... Resources are selectively allocated to the virtual company if they are underutilized or if they can be profitably utilized there more than in the 'home' company."

As noted by Goldman et al. (1995) the idea of virtual organizations is not new. However, new information technology (IT) capabilities allow the development of virtual organizations that exploit the capabilities of those new technologies. A critical component of virtual organizations is the information infrastructure, e.g., the world wide web (WWW), since the ability to communicate facilitates development and implementation of virtually organizations.

We will call the company that is at the center of this virtual company the principal. As part of the merge-in-transit process, specific vendors have been chosen by the principal to be a part of this virtual organization. Those vendors have made an investment in processes and information systems infrastructure to facilitate communication. For example, vendors are likely to need to employ EDI (electronic data interchange), software that allows access by principals to determine the existence of capacity, etc. In addition, typically the vendors and the principal have made certain other agreements, such as to quality and the quantity that they are willing to supply to the virtual organization over some time period.

An examination of this virtual organization leads to open issues about both principals and vendor firms.

PRINCIPAL FIRMS

Is there some commonality among principals that employ the merge-in-transit virtual organization? At this point, based on some case evidence discussed latter in the paper, it appears that adopters to-date have been either highly adaptive firms searching out such change opportunities (such as Cisco) or followers riding the wave initiated by another firm. Further, what is the diffusion pattern of adaptation of the merge-in-transit innovation? Is the principal firm the innovator or is the vendor the innovator or are third parties, like UPS and FedEx, the source of the innovation? How does the use of merge-in-transit diffuse?

NUMBER OF VENDORS

One of the emerging issues of interest with respect to vendors is the number of them that are part of any specific merge-in-transit relationship. Based on case evidence, there are likely to be fewer suppliers than in other business settings, for a number of reasons, including the following.

1. Suppliers need to commit to an infrastructure, both from a systems and process perspective. This has a cost to the vendor and often to the principal firm. As a result, there is incentive to minimize the number of such suppliers.

2. Coordination is easier with fewer suppliers. There are fewer product quality and supply issues to monitor because there are fewer firms.

3. Less information needs to be disclosed to fewer participants if there are fewer vendors. Merge-in-transit can lead to vendors having substantial inside information about the principal firm. For example, they may be able to infer the principal's sales on a real time basis. The fewer with access to this information the less likely that there would be an information leak.

4. There can be greater economies of scale if there are fewer suppliers. If suppliers can generate economies of scale then they will be able to pass on price savings.

There are a number of other research issue associated with merge-in-transit vendors. How much does merge-in-transit drive down the number of suppliers? To what extent is there a need for a common infrastructure and set of processes between those firms involved in a merge-in-transit virtual organization? Are there fewer problems with information disclosures with fewer participants? To what extent are there economies of scale deriving from decreasing the number of suppliers?

3. MERGE-IN-TRANSIT

Merged-in-Transit has been defined as follows:

This service collects shipments from multiple origin points and consolidates them, in transit, into a single delivery to the customer (Dawe, 1997)

Merge-in-transit is either an issue of merging and forwarding or synchronization. In the first case, as noted by Celestino (1999), generally, a third party logistics company receives the goods from multiple origins, and assembles them at a single point near a customer, typically called a "merge point." In the second case, multiple shipments of goods may be shipped from multiple vendors, so that they all arrive at the customer at the same time. For example, as noted in the opening section, "all items ship from a purchase order at the same time ...."

With merge-in-transit, firms generally cut down the amount of particular types of inventory being stored in company warehouses, in some cases to zero. For example, Micron does not store monitors or printers in their own warehouses. Instead, the limited inventory that they do store is kept in FedEx warehouses (Cooke, 1998), and it is generally kept there for a very short time.

EXAMPLES

Micron and FedEx (Cooke, 1998). Micron employs merge-in-transit using FedEx. Micron produces the computer for the user based on their specific requirements. However, computer orders typically include peripherals, such as monitors or printers. For both same day and deferred shipments, FedEx stores computer peripherals for Micron in their Memphis air hub. Peripherals are then matched up with computers on the way to the customer. FedEx delivers computer and peripherals at the same time to the customer. As noted by John Janson, Micron's global transportation and logistics manager,

> *We send an electronic file [to FedEx] that contains our tracking numbers and they marry [the products] at the destination station. ... We send EDI transmissions to FedEx several times a day as the orders are released ... and that [information] goes into FedEx's Memphis warehouse. There a pick ticket is printed that has all the FedEx tracking information and delivery information. FedEx has a crew working around the clock - they pull monitors, put labels on them, and deliver to the FedEx hub.*

Micron lets FedEx decide on whether to transport the goods using either ground or air. As noted by Janson,

> *We don't manage how FedEx does it. If they've got time to truck, they do. We're not going to micromanage their transportation, as long as they meet our delivery commitments.*

Dell and UPS (Anonymous 1998). Dell Computer, outsources the manufacture of the monitors it sells to a location in central Texas. In order to reduce its shipping and inventory costs, Dell has the manufacturer send the monitors to various UPS locations throughout the country. Monitors are timed to arrive at the UPS facilities at the same time as the computers. Customers receive a single consolidated shipment.

Custom Table Manufacturer (Dawe, 1997). A custom table manufacturer ships tables from one of their plants and chairs (not custom made) from another plant. The two are sent to a merge point at which the shipments are placed together and sent to the customer.

REQUIRED VS. DISCRETIONARY USE OF MERGE-IN-TRANSIT

As seen in the introduction, some firms use of merge-in-transit, such as Cisco's, is discretionary, since the customer can choose whether or not to use it. However, in other situations the methodology is transparent to the customer. Ultimately, the customer probably does not care whether or not merge-in-transit is used or if the principal company assembles and ships it all together, they just care if they get their orders in a timely and cost effective manner, and that the goods arrive at the same time. At this point, it is an open issue as to the extent of time that it is a discretionary customer designated issue.

WHAT KINDS OF INDUSTRIES USE MERGE-IN-TRANSIT?

According to Celestino (1999), merged-in-transit is increasingly being used in telecommunications and electronics industries. These industries are dynamic, where products are evolving, and changing so rapidly, that inventory that is six months old may be completely obsolete. Inventory value can change substantially on a week to week basis because of technology changes. As a result, the potential for not even taking some products into inventory, associated with merge-in-transit, has some substantial benefits to companies in those industries.

The importance of merge-in-transit to high technology industries was exemplified by a recent news release. On May 24, DHL announced that they would be opening its largest U.S. service center in Silicon Valley, at Sunnyvale California (Electronic Buyer's News, May 24, 1999), in order to meet the needs of the high technology industries in the valley. They announced that the service center will provide merge-in-transit capabilities.

WHAT KINDS OF PRODUCTS EMPLOY MERGE-IN-TRANSIT?

Each of the case studies presented earlier exemplifying merge-in-transit, were component products, where different components came from different locations. In addition, within each of those components, there were some components that were commodities and some that were not. As noted by Klujit Rai, logistics supplier/manager for Sun, (Andel, 1997)

> *... I don't want to have warehouses. That means direct shipment, cross docking, and merge-in-transit. We purchase commodities, like monitors, out of San Diego and ship them directly from the point of manufacture to our customer in a reseller arrangement.*

This raises the issue as to what kinds of products do employ merge-in-transit. Based on case evidence, portfolios of components are typical merge-in-transit products. Typically one or more components are customized products, while one or more are commodities available from multiple sources.

4. PRE-MERGE-IN-TRANSIT PROCESSES

Merge-in-transit processes replaces processes for order, assembly, warehousing and billing, based on a paper structure flow of information. That traditional process flow for order, assembly, warehousing and billing proceeds in the following manner.

1. Company receives a purchase order for goods. Selected information is copied from the purchase order to an internal sales order.

2. The sales order is sent to the warehouse to determine if there are sufficient goods in inventory to meet the requirements of the order.

3. If there is not sufficient inventory then either inventory is produced or it is ordered from a vendor. If it is ordered from a vendor then the customer's order sits until that new inventory is received.

4. If there is assembly required then the principal company will assemble the product before shipping.

5. When the goods are shipped, the ordering company is invoiced, based on the sales order and what was shipped. Typically, an invoice is issued for the entire set of goods, not individual goods.

In its simplest form, the information systems requirements for this set of processes requires minimal information processing capabilities.

5. MERGE-IN-TRANSIT: THE REENGINEERED PROCESS

A process flow for merge-in-transit requires substantially different capabilities of the order processing module since it now must allow an order from multiple sources, outside the company. In addition, the order processing system must choose which of the eligible candidates best meet current needs, if any. The warehouse management system or transportation management system must be able to monitor the activity of shipments in the supply chain. Assembly then must be completed either as a synchronization process or as a merge process. Finally, an invoice or bill must be cut that includes information from multiple vendors. Accordingly, the process flow of merge-in-transit, reengineers the above process, proceeding in roughly the following sequence.

1. A purchase order is received from a customer by order processing. The purchase order may be initiated by the purchasing department or be generated by software, such as an enterprise resource planning (ERP) system.

2. An order management system determines if the order is a candidate for merge-in-transit. Not all products are candidates for various reasons, as noted above.

3. Next the order management system chooses a set of vendors (or corporate locations) that can be used to fill the order. For different components of the order there may be a single company or location filling the need. Generally, all demand requested is met, but in some cases, choice of firms is a function of capacity used to-date. In any case an order (or indication that an item is going to be taken from inventory) is sent to the supplier.

4. After choosing the vendor, and the order been placed, a transportation management system notifies carriers and the merging facility of the order.

5. Then, carriers confirm schedules with shippers and report exceptions to each other. Carriers then pick up the goods that are being shipped, again notifying if there are exceptions.

6. The merge point receives the goods, confirming their receipt with a scan of bar coded information. At the merge point, the goods are packaged into a single order for delivery. Additional services, such as some assembly, can also be accommodated at the merge point.

7. Goods would then be shipped from the merged point to the customer. Proof of delivery can then be transmitted using EDI.

8. Customer is invoiced by the principal company, or the receiving firm is "self-invoiced" using the freight information and the purchase order as the basis of the invoice.

In order to accomplish the process in a timely manner, electronic data interchange (EDI) is used to communicate exchanges of information between participants. Supply chain visibility is maintained by keeping track of the amount of inventory throughout the supply chain, including inventory in-transit.

6. MERGE-IN-TRANSIT: ADVANTAGES AND DISADVANTAGES

The purpose of this section is to assess the advantages and disadvantages of merge-in-transit systems, when compared to pre-merge-in-transit systems.

ADVANTAGES

Merge-in-transit has a number of advantages over the traditional approach, including the following.

Reduced Cycle Times from Order Receipt to Delivery. Since there are no double shipments of goods from the supplier to the principal and the principal to the customer, the cycle time can be reduced. Goods can go straight from the vendor to the customer, without the principal even seeing the product.

Reduced Inventory. Perhaps the most readily apparent advantage is the reduced inventory required to sustain the system. As JAZ ("just about zero") inventories become the goal of many firms, merge-in-transit provides an important way to push down inventory levels.

Reduced Transportation Costs. The use of merge-in-transit can lead to reduced transportation costs. At the extreme, goods are shipped directly to the customer, rather than to the principal and then the customer. Even in the case of merge points, because of their placement near the customer, the overall system generally has lower transportation costs.

Improved Customer Service. Since merge-in-transit bypasses traditional shipment of goods to the principal who then ships the goods themselves, delivery can take place more rapidly generating the ability to provide improved customer service.

Lower Obsolescence. Merge-in-transit also provides the ability to provide lower inventory obsolescence rates. As noted by Micron's President, "In this industry, the obsolescence of materials is quick. What was state of the art six months ago is not now. So the velocity with which you move materials has a significant impact on your financial well-being."

Lower Capital Requirements. Merge-in-transit requires a smaller capital investment in inventories. At the extreme, the principal does not even take possession of inventory until the goods are received by the customer.

DISADVANTAGES

There are at least three potential disadvantages of the merge-in-transit approach, when compared to more traditional approaches.

Redundant Inventory. Within a merge-in-transit system there is little system wide safety stock. As a result, any events that might benefit from having safety stock become events for which merge-in-transit is a disadvantage. For example, if a company would be subject to worker strikes, safety stock provides some protection. Without safety stock, the system would shut down immediately. Another such event occurs for products subject to price variation over time. Inventory provides a way to take advantage of low prices when those prices may go up. Further, at times throughout the year, demand exceeds capacity, unless inventory is used, e.g., at Christmas, demands can easily swamp capabilities.

Improved Information Systems. Generally, the use of merge-in-transit requires a substantial change and investment in information technology and reengineered processes. These systems and processes do not come without the corresponding investment. However, although there is an increase in costs, there is also likely to be an increase in benefits from more efficient and effective processes.

Vendor Brand Recognition. There is a potential problem that vendors, other than the principal, will begin to gain brand recognition with merge-in-transit agreements. Unless the product is appropriately integrated in appearance etc., with the other components, there is a danger that a vendor will gain control of the customer for future sales. This likely is one of the primary reasons that merge-in-transit component products gather commodities, not other differentiated or customized products from the vendors.

RESEARCH ISSUES ASSOCIATED WITH THE REENGINEERED PROCESS

There are a number of open research issues associated with processes reengineered to accommodate merge-in-transit. For example,

To what extent does merge-in-transit reduce the overall amount of inventory?

How much does merge-in-transit lower capital requirements?

How much does cycle time increase with a merge-in-transit strategy?

How much are transportation costs reduced with a merge-in-transit strategy?

Such assessments are likely to require access to internal information, because it generally is not clear to what extent the merge-in-transit philosophy is being used.

7. MERGE-IN-TRANSIT SOFTWARE

One of the most critical requirements needed to make merge-in-transit work is the software that actually facilitates the ability to integrate multiple suppliers, time their shipments and bring their shipments together. As noted in Richardson (1999) "Every shipment is a bundle of data in our information system. That information system covers all of North America. (The information system is) what gives us the ability to coordinate a couple of thousand shipments to be delivered at the same time."

At this point the majority of the software capabilities seems to be on the shipper's side, e.g., FedEx, UPS or DHL, and the transportation industry. However, there have been some developments in software use at the principal firms.

WAREHOUSE MANAGEMENT SYSTEMS (WMS)

Much of the contemporary literature on merge-in-transit focuses on the WMS as the source of the capabilities, as in a case study of Ericsson (Cooke, 1999). Generally, Ericsson, the Swedish manufacturer and distributor of communications equipment, directly ships from its manufacturing sites to its customers. Unfortunately, they were having trouble monitoring delivery. As noted by Ake Oden, project manager for Ericsson's Global System for Mobile Communications supply group, *What we found was that we had no visibility for physical distribution. It was not possible for anyone at Ericsson to trace material after the dispatch from the supply unit.*

As a result, in 1996 Ericsson began installing software from Descartes Systems Group that would provide improved logistic capabilities. The software, Energy DeliveryNet.com, was deployed worldwide in late 1997. The software uses Sun's Solaris operating system for Unix-based workstations. The server is located in The Netherlands, and includes all of Ericsson's freight movements. In 1999, eleven transportation and logistics providers and eighty-two airlines were connected to the system.

The software has two forms of access. First, users can access it using a web browser that allows query by order number or consignment number. Second, the user can employ the systems interface.

In 1999, the system became the center of experiments to do merge-in-transit pilot in the German market. However, a third party now is controlling the merger of components. As a result, it appears that the principal is not primarily responsible for the merge-in-transit activities.

COLLABORATIVE MANAGEMENT SYSTEMS?

Unfortunately, WMS have some problems. As noted by Arthur Andersen in 1998, roughly three fourths of all warehouse management system users were planning to update or replace their systems because of a lack of connectivity to ERP and/or a lack of year 2000 compliance. In addition, if merge-in-transit does combine shipments from multiple vendors, then a "warehouse" management system is not really appropriate. Instead there should be a focus on the enterprise, its supply chain and/or collaboration across that supply chain. As a result, such systems probably should not be called WMS, but "collaborative management systems," where the focus is on facilitating collaboration through activities such as merge-in-transit.

ENTERPRISE RESOURCE PLANNING SYSTEMS

To be fully effective, a merge-in-transit approach would be integrated with a firm's Enterprise Resource Planning System (ERP) system. Inventory and shipments across the enterprise could be recorded and monitored. However, to-date, there has been limited ability directly to integrate merge-in-transit with ERP systems. For example (Reed, 1999), SAP apparently does not have merge-in-transit capabilities.

SUPPLY CHAIN FIRMS: I2 AND MANUGISTICS

One source of merge-in-transit capabilities are supply chain software, e.g., i2 and Manugistics. On June 9, 1999, i2 Technologies released "RHYTHM Internet Fulfillment Server," designed to provide the ability to link web-based customer orders to its network of suppliers and vendors. RHYTHM allows for products from multiple vendors to be merged-in-transit and then delivered.

Syntra, the logistics company, produces software designed to facilitate merge-in-transit using traditional EDI sources (Hickey 1999). However, recently they announced that they would be releasing a web-enabled version of their software. They also announced that they had recently entered into an agreement with Manugistics, the supply chain company, Syntra to integrate the two companies software. Syntra's core architecture is wrapped with programming interfaces and is XML enabled. As noted by Perry Ziff a Vice President at Syntra,

> *We 've developed code which a lot of our customers can use to talk XML and basically inserted in their application transactions over the Internet. One of the key benefits from the software is that it is very easy and inexpensive to implement - most companies will be able to do so within a day if they have XML functionality.*

8. MEASURING OF SUCCESS AND VISIBILITY

There have been at least two trends to measure the success and visibility of the merge-in-transit supply chains: building new measures and doing knowledge discovery on the new integrated database.

NEW MEASURES

Merge-in-transit has forced companies to look beyond traditional measures for process success. With merge-in-transit, firms are integrated into a virtual organization. As a result, it is important to have a number of measures regarding the ability of virtual organization members to meet the requirements placed on them. For example, changes in the amount of inventory in the system has led Hewlett Packard (HP) to add new metrics in the areas of order fulfillment and inventory (Oliver, 1999). Although they have not made those metrics publicly available, those measures focus on late or missing shipments, product quality, customer complaints and other issues.

KNOWLEDGE DISCOVERY

In addition, in some cases simply assembling the data in one place provides important capabilities for knowledge discovery. In most cases the merge-in-transit data provides one of the first looks at the way a virtual organization functions. It provides information about on-time shipments etc. As a result, the existence of a repository of data makes it possible to assess vendor performance. For example, as noted at Ericsson (Cooke, 1999), "Because we have the data in one database, it's easier to measure the contractor's performance."

9. IMPACT ON OTHERS OF MERGE-IN-TRANSIT

Merge-in-transit is not necessarily a win-win situation for all concerned. This section looks at some effects on others in the supply chain.

EUROPEAN DISTRIBUTION CENTERS

European distribution centers are warehousing centers for manufacturers from outside the particular regions, e.g., United States, and Asia. Recently, Buck Consultants International ranked European sites for their use of advanced logistic and distribution strategies. Belgium was found to be the leader, with Flanders the top region and Wallonia, fifth (Tully, 1998). The Netherlands logistic distribution centers, the leaders in the past, fell, due to complaints of congestion, generally around Amsterdam and Rotterdam. This historical excellence in distribution is substantiated by the estimate that of the roughly 1000 European Distribution Centers operated by United States and Asian companies, 56% are in the Netherlands. In Flanders, European Multinational firms operating European Distribution Centers includes, Levi's, McDonalds, Nike and Toyota. Gent, Flanders, is seen as a center for automobile distribution, with companies like Honda.

Although VAT tax concerns may dominate corporate behavior (McLeod, 1999), merge-in-transit could lead to a reduction in the need for such distribution centers. Rather than places to store inventory, merge points will be used, replacing those warehouses. Further, since merge points are generally placed near clients there may be a shift in the location of the distribution centers, unless they continue to adapt.

DOES ALL INVENTORY GO AWAY?

All the inventory does not go away. Instead there is a shift of keeping inventory from the principal firm to its suppliers. Supplier firms still keep inventory. Oftentimes, the inventory at the merge points is the supplier and not the principle firm. Instead, in some cases the principal firm would only take possession of the inventory when inventory is used in an order. In that case, rather than the order being the trigger to exchange inventory, the use is the trigger.

TYPE OF WAREHOUSE

The type of warehouse required for merge-in-transit is likely to be different than traditional warehouses. For example, as noted by McLeod (1999) merge-in-transit warehouses require lots of floor space and lots of loading bays to accommodate the large number o shipments and the short residency of the goods. As a result, traditional warehouses are not likely to meet the needs of merge-in-transit arrangements.

FATE IN THE HANDS OF FEWER PRINCIPALS

Earlier in the paper it was noted that merge-in-transit leads to the use of fewer suppliers. In the same sense that principals use fewer suppliers, in general, suppliers will do work with fewer principals. As a result, suppliers ultimately have their corporate fate in the hands of fewer principals.

WHO NEEDS TO USE MERGE-IN-TRANSIT?

Merge-in-transit has some definite benefits as noted above. Being a first mover is likely to provide some competitive advantages. However, such competitive advantages are likely to be short-lived. For example, as seen above, among the first few examples, at least two sets of companies were employing a similar strategy in the personal computer market, Dell and UPS, and Micron and FedEx. As one virtual organization introduces merge-in-transit into its industry, others in the industry are likely rapidly to follow.

10. SUMMARY

This paper has identified merge-in-transit as an important trend in electronic commerce. The paper defined merge-in-transit and provided some MiT examples. In addition, the traditional and the reengineered processes underlying merge-in-transit were reviewed. Some characteristics and trends in software designed to accommodate merge-in-transit were identified. Finally, measuring success and visibility also were investigated.

RESEARCH ISSUES

Within the context of electronic commerce, merge-in-transit poses a number of still unresolved research issues, including the following, and others, identified at various points in the paper.

- What characteristics of the principal firm lead to adopting merge-in-transit?
- To what extent does merge-in-transit lead to a decrease in the number of vendors supplying components?
- What kinds of products best employ merge-in-transit concepts?
- What are the boundaries of products that benefit from merge-in-transit processes?
- What is the actual impact of MiT on firms financial characteristics, e.g., inventory?
- What new measures are needed by firms to manage merge-in-transit systems?
- What kinds of advantages actually are achieved using merge-in-transit, e.g., cycle time, working capital reduction, etc.?
- What kinds of collaborative information systems are evolving to accommodate merge-in-transit capabilities.

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Chapter 19

Modularized Interoperability in Supply-Chains: A Co-adoption study of RosettaNet's XML-based Inter-organizational Systems

Mathew Nelson, Mary Shoonmaker, Michael Shaw, Stella Shen, William Quails, and R. Wang

Abstract: The factors that influence an organization's decision to begin using a certain type of technology have come under much study. Several theoretical models, commonly referred to as technology diffusion models, have been developed to better understand the role of these factors in the adoption, diffusion and infusion of certain types of technology. The benefits of this line of research are pervasive and the opportunities are clear. Managers gain insight as to why a technological innovation may diffuse quickly, or may stagnate. Researchers gain insight into factors causing greater assimilation depths or wider adoption breadths. Managers may find the opportunity to influence or predict these factors. Researchers may detect common influential factors across several technology types and generalize their models to a broader scope. This paper introduces an innovation diffusion model regarding a recent technological innovation known as XML-based interorganizational systems. A theoretical framework is proposed to assess the influential factors leading toward adoption and internal diffusion of the target technology. The factors under study include compatibility, relative advantage, environment and three control variables (seller versus buyer, technology conversion type, and location in supply chain). A case study utilizing RosettaNet's Partner Interface Process is presented, the results are compared to the theoretical model, and the findings stated. Overall the findings indicate substantial improvements in all financial and operational measures (ROI, transaction cost, payback, cycle time and through-put). Further, significant indirect benefits include: information ubiquity. improved employee morale, improved time allocation towards value-added activities, and significant product cost savings on the part of the buyer organization. Overall, *environmental* factors and the lack *of compatibility* with the old processes jointly resulted in the organizations' adoption of RosettaNet-based solutions. The *relative advantage* construct was determined to be the key factor that would sustain interest in the target technology likely leading towards greater internal diffusion. The paper concludes with several managerial implications and recommendations for future research.

Key words: Innovation diffusion, IT Adoption, Supply Chain Interoperability, Interorganizational systems, and XML

1. INTRODUCTION

The factors that influence an organization's decision to begin using a certain type of technology have come under much study. Several theoretical models, referred to as technology diffusion models, have been developed to better understand the role of these factors in the adoption, diffusion and infusion of technology innovations. The benefits of this line of research are pervasive and the opportunities are clear.

- Managers can gain insight as to why a technological innovation may diffuse quickly, or may stagnate (Fichman and Kemerer 1999, Cho and Kim 2002).
- Researchers can gain insight into factors causing greater assimilation depths or wider adoption breadths (Cho and Kim 2002, Fichman and Kemerer 1999, Fichman 2001, Hart and Saunders 1998).
- Managers may find the opportunity to influence or predict these factors (Davis, et al 1989, Lucas and Spitler 1999, Rai and Bajwa 1997).
- Researchers may detect common influential factors across several technology types and generalize their models to a broader scope (Fichman 1992, Cooper and Zmud 1990)

This paper introduces an innovation diffusion model regarding a recent technological innovation of XML-based interorganizational systems (IOS). A theoretical framework is proposed to assess the influential factors leading toward adoption and internal diffusion of the target technology. The factors under study include compatibility, relative advantage, environmental and three control variables (seller versus buyer, technology conversion type, and location in supply chain). A case study utilizing RosertaNet's Partner Interface Processes (known as PIP™s) is presented, the results are compared to the theoretical model, and the findings stated. Several managerial implications are summarized and recommendations for future research are presented.

The contributions from this research are significant. For instance, this is one of the first known studies to model adoption and internal diffusion of XML-based technologies in an interorganizational setting. Second, this study assesses how the content and influence of these factors change between sellers versus buyers and between participants along a supply chain. Third, an emphasis is placed on measurement variables that are quantitatively measured and objectively based. The relative advantage construct, for instance, includes the direct financial impact from the target technology's implementation (ROI, transaction costs, and payback), as well as the operational performance impact (cycle time and through-put). Fourth, the significant indirect benefits that qualitatively accrued to the participating organizations' are discussed at length. These include information ubiquity, improved employee morale, improved time allocation towards value-added activities, and significant product cost savings on the part of the buyer organization. Fifth, this paper suggests several managerial implications and recommendations.

For nomenclature purposes, the terms 'target technology', 'technology innovation' and modularized XML-based IOS are used interchangeably through out the paper. For purposes of this study, these terms are intended to connote similar meanings. Also, the term *co-adoption* is intended to imply the mutual adoption of the same technology innovation between two different organizations. This is similar to the notion *ofelectronic dyads* as defined by Choudhury, "electronic dyads are bilateral lOSs, where a buyer (seller) establishes individual logical link(s) with a selected seller (buyer).... each line[between a buyer and a seller] represents an electronic dyad." (Choudhury 1997, page 3).

2. TECHNOLOGY INNOVATION REVIEW

Many claims have been made that business-to-business (B2B) e-commerce growth over the Internet is constrained by HTML's inherent limitations - minimal content structuring capability, application coupling with back-end systems, and limited options to customize electronic business documents. Development for extensible Markup Language (XML) started in 1996 and was formerly recommended by the World Wide Web Consortium (W3C) in 1998. By allowing programmers and system developers the flexibility to define (and invent) electronic business documents, field attributes, and data tags; XML provides an avenue to overcome many of HTML's obstacles and substantially improves the ability to conduct B2B e-commerce via the Internet (Varon 2001, Sliwa and King 2000, Berinato 2001, Jones 2000, and others).

The very benefits that XML offers, however, have introduced a host of new challenges. To fully leverage the B2B e-commerce benefits that XML offers (and the Internet for that matter), industry groups and supply chain partners must agree on common sets of electronic business documents, field definitions, data attributes and communication protocols. This has spawned a host of new horizontal and vertical industry organizations with the purpose to develop XML-based standards for their respective industries. Output from such organizations have included XBRL for Extensible Business Reporting Language, HR-XML for Human Resource based XML, MathML for XML use in advanced Mathematical equations, and many others. In fact, as of August 2001, *XML.org Registry* had 105 different registered submissions for XML-based standards spanning 25 vertical and 7 horizontal industries. Similarly, *XML in Industry* had 450 different submissions for XML based standards spanning 54 vertical and 9 horizontal industries.

An example of one such XML-based standards setting organization is RosettaNet. Founded in 1998, RosettaNet is a non-profit consortium formed to develop XML-based standards for the Information Technology, Electronic Components, Semiconductor Manufacturing and Solution Provider industries. Like RosettaNet, many of these newly formed XML standard setting organizations have not limited there standards to consistent field attributes and definitions, but rather they are expanding there standards to include business dictionaries, networking protocols, and technical dictionaries organized around shared business processes within and between partner organizations. RosettaNet, for example, has developed standards for more than 75 of these shared business processes ranging from '*request engineering change*' to '*cancel a purchase order*' to '*notify of authorization to build*'. The content of each is complete with messaging service standards, business dictionaries, technical dictionaries, and business process choreography. These XML-based shared business process standards form point to point connections, via the Internet, that enable execution of the relevant business processes within and between different organizations on a global basis. They are, in effect, XML-based interorganizational information systems. On an individual basis, the scope of each of these standards is extremely small (traditionally limited to a single business function). But, collectively, taken on a business process by business process and a industry by industry basis, these standard setting organizations are developing the foundation to facilitate and enable future B2B e-commerce growth over the Internet. Alternatively, from a supply-chain perspective, a different way of depicting this technological innovation is to refer it as enabling modularized interoperability between supply chain partners.

As previously alluded, the scope and purpose of these standards setting organizations are beginning to vary greatly. Some, for instance, limit their scope to setting standards for simple XML-based business document attributes and common data definitions in their representative industries. Others, like RosettaNet, are developing modularized XML-based shared business process standards that are tantamount to an XML-based IOS. The scope of this study is focused on the latter, and not the former.

The existence of this phenomenon raises many unanswered research questions. How can XML-based standards setting organizations promote the adoption and diffusion within and between their participating organizations? What are the significant factors influencing the adoption and diffusion of XML-based IOS standards in organizations? How do these influencing factors change between seller organizations versus buying organizations? How do these influencing factors change between roles in a supply chain setting?

3. A CO-ADOPTION MODEL OF XML-BASED IOS

Figure 1 depicts an innovation adoption and diffusion model of the target technology. The factors that influence the adoption and internal diffusion of this technological innovation can be classified into four constructs-compatibility, relative advantage, environmental and control variables.

The utilization of these constructs was based on the interoperability needs between business partners in a supply chain setting. The *environmental* construct, for example, considers the influence of supply chain partner power and the expectations of technological market trends toward adoption and the level of internal diffusion of the target technology. The *compatibility* construct considers the *assumption gaps* between the *shared business process* task needs of supply chain partners versus the technology utilized to perform those tasks. The existence of large assumption gaps, or the lack thereof, could be assessed to determine its' influence on the innovation measures. Similarly, the measurement variables in the *relative advantage* construct can be computed (for both the supplier and buyer) to assess their influence on the innovation measures. These measurement variables not only include the traditional financial (transaction cost, ROI) and operational indicators (cycle time, throughput), but they also consider the indirect considerations inherent in supply chains (e.g. negotiation time, product costs, availability of substitutes). The *control variables* should prove to be extremely valuable in this model. By utilizing *control variables* as separate levels of analysis, we will be able to differentiate how these constructs change between roles in a supply chain, differentiate the influence of these constructs between buyers and suppliers and between the different types of technology utilized by partners. A complete description of construct definitions, measurement variables and references to prior innovation diffusion and IOS literature are provided below.

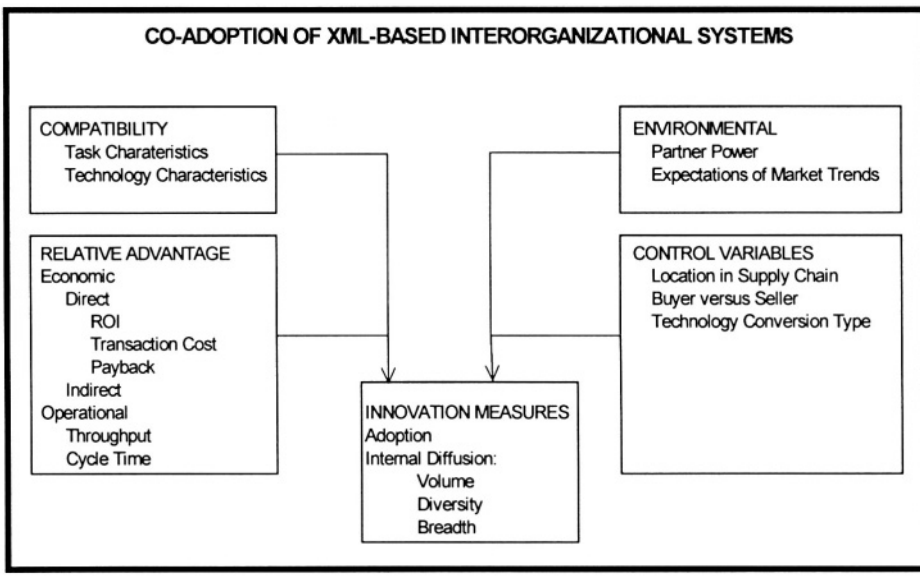

Figure 1. Co-Adoption of XML-based Interorganizational Systems

3.1 Compatibility

Technology compatibility is referred to as how the new technology is consistent with existing tasks, needs, prior experiences and processes of the adopters (Cho and Kim 2002, Cooper and Zmud 1992, Agarwal 1999). Cooper and Zmud (1992) provide a framework for assessing compatibility of a new technology by evaluating assumption gaps between the new technology characteristics versus the task characteristic needs of the organization. This framework should prove to be extremely useful for the current study for two primary reasons. First, the scope of the current study includes two distinct business processes – purchase order (PO) processing and shipments (and the corresponding debit charge-backs) from made-to-stock items. Similar technological innovations are applied to these distinct business processes that necessitate very different task characteristics. Second, the alternative technical innovations include XML-based standards (current study), web-based POs, electronic data interchange (EDI) and manual-based process solutions. In fact, if we extend the analysis to include a compatibility assessment in the old (prior to the technical innovation implementation) and new environments, results in an extremely useful matrix depicting which solution is most appropriate based on the assumption gaps identified in the various technical solutions. For instance, assumption gaps for PO processing may include volume of order requests, number of partners, an Internet-presence, and back-end system processing. Assumption gaps for ship from stock and debit may include build complexity, testing complexity, and demand variability (make-to-order versus make-to-stock).

3.2 Relative Advantage

Davis defines perceived usefulness (PU) as meaning, "the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context" (Davis 1989, page 985). In the current study, this definition is altered in two respects. First, usefulness is measured from an organizational perspective, as opposed to the individual 'user' level. This is consistent with several studies in the innovation diffusion line of research (lacovou 1995, Agarwal 1997, Cho and Kim 2002 and others). Second, by considering financial performance (direct and indirect) improvements and operational performance enhancements enabled by the technological innovation, the 'subjectivity probability' component in Davis' definition is significantly reduced. Although most IT adoption and innovation diffusion studies include financial benefits and / or operational performance enhancements to be within the scope of PU (lacovou 1995, Cho 2002, Davis 1989, and others), very few have actually used objective (unbiased) measures for PU (see Venkatesh and Davis 1996). This second notion is also consistent with research objectives of the present study. Since two of this studies' objectives are to introduce an XML-based technology diffusion model and empirically compare this model to case studies (currently omitting statistical corroboration of the model), affords a prime opportunity to quantify and report PU measures experienced by the participating organizations.

Thus, a revised definition of relative advantage for the present study (which is closer to the definition presented by Agarwal 1997) is; the extent to which a potential adopting organization views the innovation as offering financial and operational benefits over previous ways of performing the same tasks (page 562). The financial indicators to be used include ROI, transaction costs savings (before versus after), investment and payback. The operational performance indicators includes throughput (capability per unit of time) and cycle time.

3.3 Environmental factors

In general, the study of environmental factors has experienced mixed results in innovation diffusion and technology adoption literature. Except, that is, when it comes to the study of environmental factors' influence on the diffusion of IOS between organizations. Hart and Saunders studied the role of trust and power in the context of 'electronic partnerships', lacovou studied the influence of external pressures in the context of EDI adoption and integration in small businesses, and Gebauer studied the changing role of adoption strategies in an IOS environment as a result of emerging technologies (e.g. Internet-based systems) (Hart and Saunders 1998, lacovou 1995, Gebauer 2000). The influence of environmental factors clearly play a significant role in the context of IOS systems.

The two environmental factors under consideration include – *partner power* and *expectations of market trends.* The first, *partner power,* is defined as (for purposes of the present study) the percentage of sales that a given supplier is dependent on from their partner-customer. This use of the power variable is consistent with the industry under study (semi-conductor manufacturing), availability of substitute suppliers, low manufacturing capacity utilization rates and relatively low switching costs. This is consistent with Hart and Saunder's notion of supplier dependence in dyadic relationships (see page 90) and similar to lacovou's findings regarding external pressure in EDI adoption. The second, *expectations of market trends,* is an infrequently used variable in study of innovation diffusion (Fichman 1993, Cho and Kim 2002). For the present study, the definition for this variable is consistent with Cho's, "Expectation for market trend is the degree of expectation that the target technology will be pervasively adopted in the industry in the future" (Cho and Kim 2002, page 130). This is the most subjectively based variable used in the present study. The reason for including this variable is rather complex to explain, but simple in nature. RosettaNet is a non-for profit XML-based standard setting organization funded from contributions by partner organizations. Thus, partner organizations have a serious and 'vested' interest in developing and setting the most appropriate standards that need to be utilized within their industry. Indeed, a particular technical solution that has been implemented that is found not to be a high expectation of future market trends would be a significant finding.

3.4 Control Variables (Levels of Analysis)

Three control variables used in this study and include *buyers versus sellers, location in supply chain,* and *technology conversion type.* Since the present study does not develop a statistical deterministic model, the control variables are used for levels of analysis to perform on the data collected from the field study. For instance, the financial indicators of the buyer organization (ROI, transaction cost savings, and payback) can be compared and contrasted to that of the seller organization. Investigation into significant differences could prompt a richer understanding of how this innovation impacts buyer organizations versus seller organizations. Similar levels of analysis can be conducted based on the organization's role in the semi-conductor supply chain and the type of technology they converted from (e.g. manual, EDI or web-based PO).

3.5 Innovation Measures

The innovation measures (dependent variables) included in this study focus on the notion of adoption and internal diffusion. For purposes of the present study, Cooper and Zmud's product definition of adoption will be utilized, "A decision is reached to invest resources necessary to accommodate the implementation effort." (Cooper and Zmud, page 124). Fichman defines internal diffusion as, "The extent of use of an innovation across people, projects, tasks, or organizational units" (Fichman 2001, page 454). In the area of IOS (and more specifically EDI) Massetti and Zmud provide three additional dimensions to internal diffusion that will be useful in the present study - volume, diversity and breadth (Massetti and Zmud 1996). *Volume* refers to the ratio of business documents transmitted via the technology innovation channel, over the total number of business documents exchanged (regardless of the technology). *Diversity* refers to the total number of RosettaNet PIP™s implemented. *Breadth* refers to the total number of trading partners with the organization that are utilizing the technology innovation channel. The use of these definitions is consistent with other EDI studies (Hart and Saunders 2002, Massetti and Zmud 1996).

For analysis and discussion purposes, *diversity* and *breadth* will be measured at the organizational level (as opposed to an individual business process level). The reason is two-fold. First, RosettaNet's technology is fairly recent and the participating organizations in this study have a limited number of actual PIP™ implementations. Second, (as previously described) the intent of this study is empirical analysis (and not a statistical deterministic model). Thus, the use of these measures for analysis, discussion and comparison purposes is better served by studying these innovation measures at the organizational level.

4. CO-ADOPTION OF ROSETTANET STANDARDS

4.1 RosettaNet Background

RosettaNet seeks to enable interoperability in a supply chain by developing modularized technical standards surrounding shared business processes between supply chain partners. RosettaNet's modularized partner interface processes include four components: messaging service standards, business dictionaries, technical dictionaries, and business process choreography. These modularized XML-based IOS enable the electronic sharing of business information and opens the lines of communication and opportunities for everyone involved in the supplying and buying in a supply chain. Businesses that offer the tools and services to help implement RosettaNet processes gain exposure and business relationships. Companies that adopt RosettaNet standards engage in dynamic, flexible trading-partner relationships, reduce costs and raise productivity. End users enjoy speed and uniformity in purchasing practices. RosettaNet seeks to drive adoption and implementation of common processes and standards within and between member companies. RosettaNet's approach is to bring business owners from member companies together to define and agree on common processes and to develop XML-based standards to support these processes. A sample of XML-based IOS partner interface process (PIP™) standards developed by include:

Order Management	Inventory Management
• quote & order entry • transportation & distribution • returns & finance management • product configuration	• collaborative forecasting • inventory allocation • inventory reporting • inventory replenishment • sales reporting
Marketing Information Management	**Manufacturing**
• lead/opportunity management • marketing campaign management • design win management • ship from stock & debit	• design transfer • manage manufacturing work order and WIP distribute manufacturing information

The field research examines the impact of a new XML-based B2B e-commerce system implementation between a manufacturer (seller) and a distributor (buyer) in the semi-conductor manufacturing industry. The scope includes the co-adoption of the *ship from stock and debit* interorganizational system between the two companies. The technical solution utilizing RosettaNet's Partner Interface Process (PIP™) is presented and the new system's benefits are described and quantified.

4.2 The Adoption Process

The former (old environment) *ship from stock and debit* system between the seller and buyer was a hybrid of manual and automated steps including the use of fax machines, phone calls, voice messages, and internal paper work moving back and forth between departments and companies. The purpose of the *ship from stock and debit* IOS is to enable the distributor to sell excess inventory (in stock at the distributor's site) at discounted prices and debit the manufacturer for a portion of the discounted price. This process also enabled the distributor to meet competitive market price situations, or to offer volume discounts to large customers. The hybrid of manual and automated steps to complete the business process created numerous problems in the current environment including manual keying errors, unintended lost discounts, unintended expired debit-requests, and a host of logistical problems. In fact (prior to adoption) the average debit-request rejection rate by the manufacturer was 40% to 60% and the average response time per credit-request was 2 to 5 days.

4.3 The XML-based IOS Solution

The new system (see Figure 2) was developed consistent with RosettaNet's PIP™ *Marketing Information Management* standards series. Specifically, the seller and buyer both agreed to co-adopt RosettaNet's PIP#5D1- *Ship from Stock and Debit* XML-based IOS. Key standards (features) of the new system include a centralized debit authorization database with ubiquitous web-access by all partners (supplier, distributor, and manufacturer representative). Electronic receipt, notification and communication of debit authorization requests. In addition, automated centralized approval-progression status of debit authorizations is provided with automatic tolerance checks and electronic notifications of *ready-to-expire* debit authorizations.

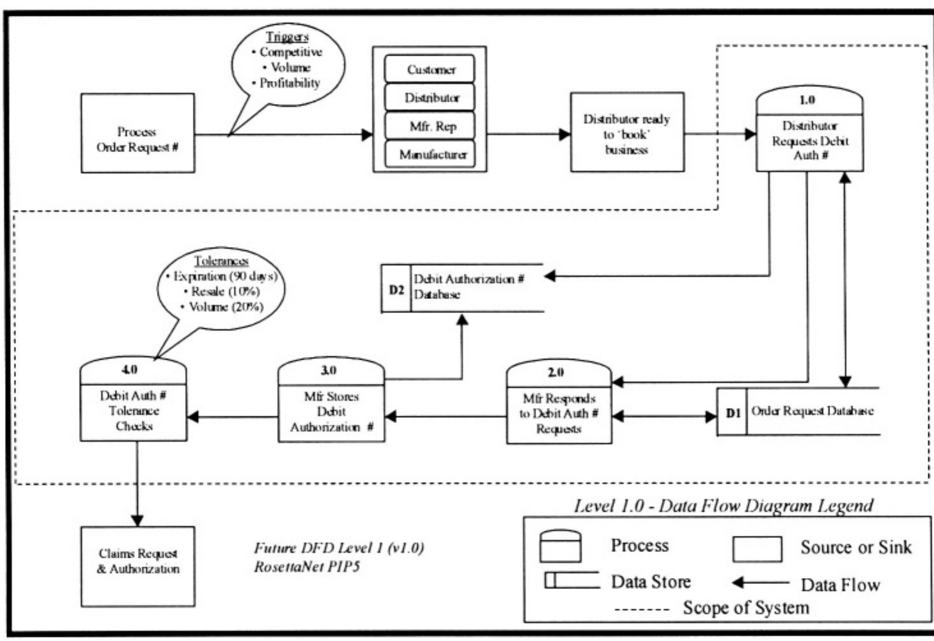

Figure 2. Level 1 Data Flow Diagram of the Ship from Stock & Debit XML-based IOS

The new system has enabled significant benefits to both the seller and the buyer. For example, reduced manual processing such as faxing, writing e-mails, re-keying information, researching debit request information and inquiring on approval status. Also, the new system enforces a 24-hour *initial* response from the seller to the buyers' initial debit authorization request. The seller has the initial option to 'accept', 'reject', or indicate 'additional research necessary'. This has resulted in significant reductions in unintended lost discounts, unintended expired debit authorization requests, and manual re-keying errors. In addition, it circumvents a host of delays inherent in manual-based processes and exacerbated in a business to business relationship (personal vacations, verbal commitments, employee turnovers, and timing).

5. COMPARISON OF CASE STUDY VERSUS THE THEORETICAL MODEL

The following is a comparison of the Co-Adoption of XML-based IOS model to the RosettaNet ship from stock and debit IOS system. See Table 1 for a Summary of Findings.

5.1 Compatibility

From a compatibility perspective, both organizations would rank *low compatibility* with respect to the old environment and *high compatibility* with respect to the new environment. The reasons are straightforward. The inherent 'tasks needs' of this ship from stock and debit business process include; high transaction volumes, time sensitivity (due to the product's price volatility), and high collaboration between organizations. Both organizations were previously using a hybrid of manual and semi-automated processes (e-mails, fax machines, phone calls, etc.) in the old environment. Clearly, the underlying assumptions of the technological innovation are much more congruent with the task needs of this business process.

5.2 Relative Advantage

Overall, the quantified benefits of the new system are substantial (see *Table 1*). The seller experienced a 45-minute reduction in handling time. The buyer experienced a 82% reduction in size of the 're-work' queue. Overall, the seller gained a 650% increase in transaction capability per hour and the buyer gained a 67% increase in transaction capability per hour. From a financial performance perspective, the new system has reduced ongoing transaction costs by 87% for the seller and by 40% for the buyer. The ROI for the IT investment is 52% for the seller (with a payback in 1.9 years) and 55% for the buyer (with a payback in 1.8 years).

The indirect benefits have been substantial as well. Both organizations benefited from improvements in: information ubiquity, improved employee morale (due to decreased frustration with the manual process), improved time allocation on valuè-added activities, and overall convenience. Due to the nature of the system and the large re-work queue reductions, the buyer in this instance has also gained significant indirect financial benefits in product cost savings. Although the buyer was unwilling to quantify these savings for purposes of this study, the savings are significantly larger than the direct financial savings. As a result, the overall relative advantage of the technological innovation is considered *moderate* for the seller, and *high* for the buyer.

5.3 Environmental

With respect to partner power, neither organization is highly dependent on the other. When considering the dollar value of ship from stock and debit transactions (the sales value of transactions could not be ascertained due to company confidentiality), the value of transactions between the two organizations with respect to the annual sales is .1% for the seller and .01% for the buyer. Thus, using the partner power notion, the buyer has slightly more power over the seller. Although slight as this may be, combining this fact with the significant indirect financial benefits afforded to the buyer as a result of this technological innovation, provides reason why the buyer was very motivated for this system's implementation.

The *expectation of market trend* was *extremely high* with the seller and the buyer. Both organizations never questioned or expressed concerns regarding the benefits of utilizing XML-based IOS systems. In addition, the fact that several major organizations in the semi-conductor industry formed RosettaNet to establish XML-based IOS, was an important point in establishing the expectation of market trend.

5.4 Control Variables (Levels of Analysis)

Since the present study includes only one instance (and two organizations) of the target technology, utilizing control variables *for levels of analysis* has limited benefits. Indeed a recommendation for future study would be to extend this type of analysis to multiple instances of the target technology. Despite this, however, a few conclusions can be reached. For instance, the seller's role in the supply chain was that of a manufacture. The buyer's role was that of a distributor. If one considers the underlying business process (ship from stock and debit) and the inherent limitations of the *technology conversion type* (manual based processes in the old environment), one could begin to generalize that co-adoption of an XML-based interorganizational system under this set of circumstances would have a high likelihood of providing greater indirect financial benefits to a buyer / distributor, rather than a seller / manufacturer.

5.5 Innovation Measures

In terms of the case study (based on the empirical results, but without statistical corroboration), the *lack of compatibility with the old technology* and *expectations of market trends* are what lead to the decision to adopt RosettaNet – based solutions. Or, more specifically, the *lack of compatibility* between the business needs of the organizations and the old technology, is what drove the organizations to *inquire* about new *technological innovation (XML-based IOS) options.* The *environmental factor* (*expectations of market trends*) *directed* the organizations to select RosettaNet –based solutions. The *relative advantages* (direct financial and operational benefits) are sustaining the organizations continuos interest in XML-based IOS solutions and will likely lead to greater internal diffusion (volume, diversity and breadth).

Table 1 – Summary of Findings

	MANUFACTURE	DISTRIBUTOR
CONTROL VARIABLES		
Location in Supply Chain	COMPONENT MFR	DISTRIBUTOR
Buyer versus Seller	SELLER	BUYER
Technology Conversion Type	MANUAL	MANUAL
COMPATIBILITY	HIGH	HIGH
Task Charateristics	High volume, High collaboration needs, Time sensitive data	
Technology Characteristics	High compatibility with new XML-based IOS	
RELATIVE ADVANTAGE	MODERATE	HIGH
ROI	52%	55%
Transaction Cost	-87%	-40%
Payback	1.9 years	1.8 years
Indirect:		
- *Information Ubiquity*	X	X
- *Real-time request tracking*	X	X
- *Improved Salesman time allocation*	X	
- *Convenience*	X	X
- *Improved Employee Morale*	X	X
- *Product Cost Savings*		X
Throughput	650%	67%
Cycle Time	-91%	-40%
ENVIRONMENTAL		
Partner Power	LOW (0.1%)	LOW (0.01%)
Expectations of Market Trends	HIGH	HIGH

6. MANAGERIAL IMPLICATIONS

Several key managerial implications and recommendations can be provided. First, addressing the research question: How can standards setting organizations promote the adoption and diffusion within and between their participating organizations? XML-based IOS standard setting organizations, like a RosettaNet, should consider assessing the 'assumption gaps' between the tasks needs of organizations versus the capabilities of their old technology. As was the situation with both the supplier and buyer in the case study, their tasks needs demanded high volume, time sensitive, and high interorganizational collaboration business processes. Yet, their old technology was a hybrid mixture of manual processes and antiquated technology (faxes, phone calls, and e-mails). Large assumption gaps existed. Similar 'generic' assumption gaps could be identified in a simple two-by-two matrix, with business processes (e.g. P.O. processing, engineering collaboration, work-order processing) along one axis and antiquated technologies (manual, EDI, web-PO) along the other axis. This could easily identify if and where assumption gaps exist and assist in identifying where the XML-based interorganizational systems could provide solutions.

In addition, they should consider tracking and cautiously promoting the direct financial benefits and operational performance improvements of XML-based IOS implementations. Obviously not all XML-based IOS implementations should expect the significant ROI, transaction cost savings, and payback experienced by the organizations involved in the case study. However, over time and with a greater volume of implementations, averages can be developed. 'Best in Class' expectations can be formed. Similar to the proceeding recommendation, utilization of a 'generic' and simple two-by-two recording matrix with business processes along one axis and of types technologies to convert from (manual, EDI, web-PO) along the other axis.

Also, standards setting organizations should develop of a framework for consistent identification and quantification of indirect benefits enabled by XML-based IOS implementations. As was the situation in this case study, and as is often the case in IT implementations, the indirect benefits are far greater than the direct benefits. An indirect benefits framework would, at a minimum, need to include four dimensions: (1) current (old) technology, (2) business process, (3) location in supply chain, (4) buyer versus seller. Although some companies (as was the situation in this case study) may be reluctant to quantify the indirect benefits, ranges should be approximated. Once again, over time and with a greater volume of implementations, averages can be developed. 'Best in Class' expectations can be formed.

Second, addressing the research question: What are the significant factors influencing the adoption and diffusion of XML-based IOS standards in organizations? The lack of compatibility between the business needs of the organizations and the old technology, is what drove the organizations to inquire about new technological innovation options. The environmental factor (expectations of market trends) directed the organizations to select RosettaNet –based solutions. The relative advantages (direct financial and operational benefits) are sustaining the organizations continuos interest in XML-based IOS solutions and will likely lead to greater internal diffusion (volume, diversity and breadth).

Third, addressing the research question: How do these influencing factors change between seller organizations versus buying organizations? Both organizations experienced low compatibility in the old environment and high compatibility in the new environment. The seller organization earned higher direct financial and operational performance benefits from the XML-based IOS implementation. The buyer organization earned significantly greater indirect financial benefits as a result of product cost savings enabled through the XML-based IOS implementation. The seller organization has slightly greater 'partner power' influence over the buyer organization.

Fourth, addressing the research question: *How do these influencing factors change between roles in a supply chain setting?* The buyer (distributor) organization earned significantly greater indirect financial benefits as a result of product cost savings enabled through the XML-based IOS implementation. This same result could be anticipated by other buyer organizations under the following circumstances: (1) The relevant business process is similar to a 'ship from stock and debit' process and (2) Both organizations are converting from manual-based business processes to XML-based IOS technology and (3) The seller organization is a manufacturer and the buyer organization is a distributor.

7. CONCLUSIONS

The factors that lead to the adoption and internal diffusion of a recent technological innovation occurring in industry were examined. We labeled this technology innovation phenomenon as XML-based interorganizational systems. A theoretical model was introduced to measure the diffusion of this technology and the factors included compatibility, relative advantage, and environmental. A study was presented describing one instance of this technology innovation implementation based on the use of RosettaNet's modularized XML-based IOS technical standards. The findings were compared to the theoretical model and conclusions with managerial implications presented.

There are several limitations to this study in its' current form. First, it is based on one instance of this particular technology. Indeed, to make this model generalizable, several more instances need research and consolidated with the present study. Second, both participating organizations migrated from manual-based processes to the target technology. A richer and generalizable study would include organizations migrating from a variety of different technology types in the old environment (e.g. EDI, proprietary solutions, or web-based PO). Third, in the analysis of measurement variables and the assessment of constructs, this study heavily emphasized the use of quantifiable – objective variables. Future research in this area should include those factors, but also include subjectively based measurement variables. This would allow, for example, the organization's anticipated implementations of the target technology in the next year, two years, etc. This would also allow for better framing (and comparisons to prior literature) around the indirect benefits from this technology.

Despite these limitations, however, several insights were gained. An acknowledgement, and perhaps a framing, was captured surrounding a recent technological innovation (XML-based interorganizational systems). This technological innovation is a significant enabler to enhancing modularized interoperability in supply chains. In addition, it was concluded that the combination of *lack of compatibility with the old processes* and *environmental factors*, jointly resulted each of these organization's adoption of RosettaNet-based solutions. Further, the *relative advantage* construct was determined to be the key factor that would sustain interest in this technology innovation likely leading towards greater internal diffusion. As indicated in the *managerial implications* section, this lends insight into future adoption strategies by RosettaNet and other XML-based industry setting organizations. Furthermore, the implementation of this technology innovation created substantial financial and operational improvements to the participating organizations. The ROI, transaction cost savings, payback, decreased cycle time and increased through-put capability, for both the seller and buyer, were substantially improved and quantified.

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Chapter 20

A Study on the Value of B2B E-Commerce: The Case of Web-based Procurement

Chandrasekar Subramaniam and Michael J. Shaw

Abstract: Web-enabled business-to-business (B2B) e-commerce enhances inter-organizational coordination and results in transaction cost savings and competitive sourcing opportunities for the buyer organization. However, organizations are unsure if this is an improvement over existing information technology such as EDI. In particular, what is the value of B2B e-commerce to a buyer organization and how to measure this value? What factors most affect the realization of the value of B2B e-commerce? Using the case of Web-based B2B procurement system, we propose a framework to quantify and measure the value of B2B e-commerce system and identify the factors that determine this value. Our analysis indicates that, even though all stages of B2B procurement is affected by the Web, the value of Web-based procurement is most determined by the process characteristics, organization of business units and the "extended enterprise".

Key words: Inter-organizational Information Systems, Value of B2B E-commerce, Web-based Procurement, Measurement of Value, Extended Enterprise

1. INTRODUCTION

Business-to-business (B2B) e-Commerce technologies and electronic markets are emerging as the critical infrastructure of modern Web-enabled organizations. The Internet and the Web provide a cost-effective mechanism for organizations to engage in search, negotiation and coordination with their suppliers anywhere in the world (Buxmann and Gebauer, 1999; Kalakota and Robinson, 1999). At the same time, the Web is also being used to integrate and manage business processes across traditional firm boundaries to create an "extended enterprise" of the firm and its business partners (Shaw, 2001). However, even in the face of these opportunities and seemingly easier to implement Web-based technologies, many organizations have been surprised at the range of responses shown by both their business units and business partners. On the one end of this range, there are users who strongly feel the need for a Web-based system and are enthusiastic about it. On the other end, there are users who are certain that a Web-based system can offer no improvement over their existing systems and procedures. In between, there are users with different expectations regarding the usefulness and preferred features of a B2B system.

Central to the concerns expressed by potential users of B2B e-Commerce systems is the lack of any sound *framework to precisely determine the value of a B2B system* from the perspective of user as well as the enterprise. In this context, managers responsible for implementing B2B systems are faced with the challenge of convincing all potential users, internal and external to the organization, of the real value of these systems. Medium and large manufacturing firms, with their decentralized and focused facilities, face more challenges in implementing B2B e-Commerce systems because of greater variation in the nature of their business operations and, often conflicting, objectives of their internal units.

Our research objective is to develop and validate a framework to better understand the value of B2B e-commerce and the factors that affect this value. More specifically, we propose that process and organizational attributes play a significant role in determining the value of B2B e-commerce. Using Web-based B2B procurement, also called e-procurement, as a case of B2B e-commerce, we develop a framework to theoretically and empirically determine the value of B2B systems and to verify the role of process and organizational attributes. B2B procurement in most organizations involves very unstructured processes and a broad range of products and services, providing wide variations in the parameters that determine the benefits from a Web-based system. Opportunities to improve procurement activities have significant economic implications for the enterprise. Our paper is organized as follows. The next section presents a general model of an e-procurement system and introduces the major research questions. We then review related research on the impact and value of IOS. Extending this research to B2B e-commerce, we develop a framework to determine the value of e-procurement. We use an economic model to analytically evaluate the value of e-procurement and present some initial findings from a study at a large manufacturing organization. We conclude by discussing the implications of our findings for design and implementation strategies.

2. B2B E-PROCUREMENT SYSTEM

The procurement of goods and services by organizations, called business-to-business (B2B) procurement, constitutes an important business activity. Large organizations spend more than 15 to 30 percent of their revenue on procurement of non-production goods, such as office equipment, supplies, computers, and peripherals[1]. However, traditional B2B procurement practices, particularly those related to non-production goods, have been plagued by problems, such as inefficient buying, redundant and disconnected processes, non-strategic sourcing and maverick purchases. Use of Web-based procurement solutions, also called e-procurement solutions, is expected to address several of these problems (Buxmann and Gebauer, 1999; Kalakota and Robinson, 1999).

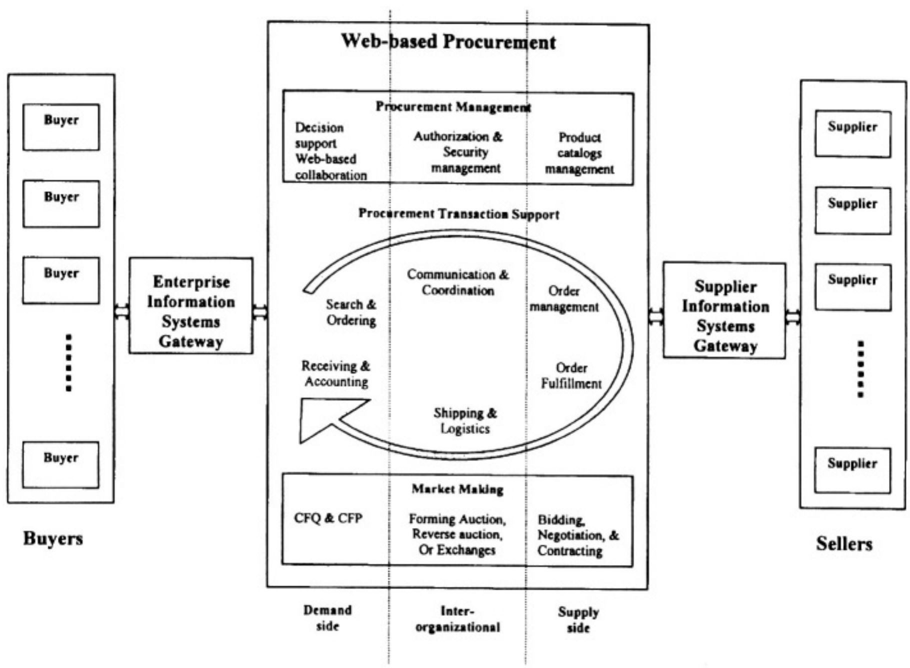

Figure 1. Functionalities of a Web-based procurement system

An e-procurement system, shown in figure 1, is a Web-based client/server application used to replace the manual procurement process. The system is usually connected to other business critical information systems in the enterprise, such as the enterprise resource planning systems (ERP) or the electronic data interchange (EDI) systems. This is done to leverage the critical enterprise data present on these systems, so that they need not be duplicated on the e-procurement system. On the supplier side, the e-procurement system can be integrated with the suppliers' order fulfillment system or may just link to product catalog on the website of the supplier.

The Web-based capabilities built into e-procurement systems help organizations create an efficient and responsive procurement process. More specifically, use of e-procurement impacts four major B2B procurement activities - search, negotiation and contracting, coordination, and monitoring and control.

Search: Users and procurement personnel spend a considerable amount of time in just identifying the right product and supplier to match their business needs. A Web-based IOS, such as e-procurement system, is used to quickly locate a required product or supplier. Using electronic catalogs and intelligent search engines, users can search across product categories and specifications to identify the right product to order in considerably less time. Also, by linking to enterprise systems, such as ERP, and automatically filling in the details necessary for the order, the Web-enabled user interface minimizes the data to be input, thus avoiding a major source of errors and mismatches.

Negotiation and contracting: Web-based negotiation and contracting has had a significant impact on the costs to the enterprise. Use of Web reduces the time and resources spent by various parties in exchanging information and processing the bids. As organizations consolidate their suppliers using a more centralized Web-base system, the number of contracts to be negotiated also reduces. Even though contracts form an important concept in transaction costs, there has been surprisingly little discussion in the IT literature of the effect of the Web on contracting.

Coordination: In addition to electronic processing at much lower costs than manual processing, We-based systems can support increased and more complex coordination. Coordination involves the sharing and exchange of relevant information among the enterprise and its business partners. Several times, during the fulfillment of an order, procurement personnel need to communicate and exchange information with the suppliers and users. Procurement systems based on paper documents and telephone involves more time of the procurement staff and higher communication costs. Using a Web-based procurement system provides real-time information flow and is less costly to coordinate with suppliers and users. This leads to faster resolution of any problems and results in lower order cycle time. The low communication costs of the Web and the lesser time spent by the procurement staff in coordination results in lower transaction costs.

Monitoring and control: Using a Web-based procurement system, organizations can achieve their twin objectives of responding effectively to the user needs as well às leveraging their combined buying power. Users can search the catalog to identify the most cost-effective supplier and place their orders. Corporate B2B managers can aggregate the demand for the whole enterprise and use this to negotiate competitive prices for the products, which they can then make available to any business unit, irrespective of the size or location of the unit. *Centralized control,* combined with the availability of an increased range of items on the electronic catalog, motivates more users to order through the e-procurement system, reducing the extent of "premium buys".

The use of Web-based systems is expected to provide better value than traditional IOS, because of the use of a public network and the much wider scope of application within the enterprise (Gebauer, et.al., 1998). However, the method used currently by most organizations to compute the value and justify their e-procurement investment relies upon the average estimated savings for a procurement transaction and the transaction volume. The individual share, in the investment, of the internal business units is also based on this simple estimation. This simple estimation ignores the differences in the procurement needs and current processes within the firm. For example, using the current value estimation procedures, large business units with higher transaction volume will share a higher proportion of the investment, as they are deemed to benefit more. But, if they have established efficient procedures in a non-Web environment, the benefits from a Web-based system will be minimal. From the point of view of the business unit, there is no justification for their investment in e-procurement. Thus, we see that there is a need to understand how e-procurement value differs within the firm and what attributes contribute to these differences. At the same time, such an understanding should be based on theoretical support and should be empirically verifiable. Thus, in our research on e-procurement, the major research questions are:

1. What is the value of B2B e-procurement to an enterprise? How to measure this value?
2. What factors affect the value of B2B e-procurement?
3. What implications do the differences in value within a firm have for the design and implementation strategies of e-procurement solutions?

3. A REVIEW OF RELATED RESEARCH

The impact of IT on firm performance has long been a subject of intense research, with issues studied ranging from measurement of the impact, to the conditions that are necessary to realize these impacts. The realized impact in the form of actual improvement in firm performance represents the value of the IT system to the organization. However, researchers have pointed out the conflicting results yielded by these studies (Davern and Kauffman, 2000; Hitt and Brynjolfson, 1996; Mukhopadhyay, et.al., 1995; Sircar, et.al., 2000). Some of these issues relate to measurement, while others relate to the complexity of isolating the effect of IT on firm performance (Mukhopadhyay, et.al., 1995). Part of the problems of relating IT investments to firm performance is the effect of confounding factors, such as other internal performance improvement measures and external economic influences. Another issue is that some IT investments may provide benefits after a certain period of time, but may actually increase operating costs in the short run (Kauffman and Kriebel, 1988). Researchers suggest a process oriented approach to overcome these confounding problems. Kauffman and Weill (1989) suggest that the locus of impact, i.e. the business process, be the primary level of value analysis for the benefits to become discernible for the investing firm. Barua, et.al. (1995) suggest a multi-stage, process oriented study to measure the first-order and higher-order impact of IT. Mukhopadhyay (1998) uses such an approach to understand how EDI benefits an organization.

Research on IOS impact and value, particularly use of EDI, has shown that it is largely positive in improving the efficiency of business processes and overall performance of organizations (Mukhopadhyay, 1998; Srinivasan, et.al., 1994). The electronic processing and communication of inter organizational data improves the timeliness and accuracy of the information, allowing the trading organizations to better plan and manage their assets, such as inventory (Barret and Konsynski, 1982). The use of IT improves the process quality, which in turn improves the level of output (Mukhopadhyay, et.al., 1997). This type of impact is mainly on the operational level and results in cost reduction, higher productivity and improved quality (Mukhopadhyay, 1998). IOS also increases the bargaining power of the buying organization, which now has a better information visibility of its business processes (Porter, 1985; Porter and Millar, 1985). At the same time, however, by having access to more information about the buyer, a supplier can better match the preferences of the buyer and extract a premium price. The close relationship built between the buyer and the supplier may also enable the supplier to gradually increase the level of business with the buyers.

These impacts, however, are neither guaranteed upon implementation of the system nor are they uniform across the organization (Barua, et.al., 1995; Davern and Kauffman, 2000; Mukhopadhyay, 1998; Weill and Olson, 1989). Realization of the value of the system is conditional upon internal and external factors, some of which are controllable by the organization (Weill and Olson, 1989). These are called conversion contingencies, i..e "a spectrum of things that are likely to influence realized value from a system" (Davern and Kauffman, 2000). For example, the contribution of IT system depends on other resources, such as people and investments in associated processes (Kauffman and Kriebel, 1988). In a study of EDI impact, Mukhopadhyay (1998) found that the level of operational benefits of EDI increased with increased integration of IOS with internal systems, but decreased with more parts variety and number of trading partners. Suppliers handling a higher proportion of their business electronically saw higher performance than other suppliers. With respect to strategic impact, the size of the supplier determined what incentives are needed to join the system. The strategic benefits were found to be higher if the buyer initiated the system or if the system had been used for a longer period of time.

Even while some of the issues and critical variables of previous research are relevant for Web-based systems, some issues and variables assume increased importance. The capability of EDI to reduce the communication and processing costs and errors are also found in Web-based systems. But, in Web-based systems, the potential to reduce search costs is great and affects each B2B transaction. Thus, in our research, for example, savings in search cost emerges as an important economic benefit. Coordination costs are reduced significantly by using the Web and our research quantifies the extent of economic impact of this reduction. The Web allows organizations to choose from different procurement models, an issue that did not arise with EDI systems.

Many studies have looked at different pieces of the B2B puzzle, such as supplier selection (Bakos and Brynjolfsson, 1993; Barua, et.al., 1997) and impact of electronic markets (Bakos, 1998; Gurbaxani and Whang, 1991). B2B e-commerce is rapidly transforming how organizations structure and coordinate their business relationships, but there are very few systematic studies in this area that tries to understand the impacts comprehensively from an organizational perspective. In the following sections, we develop our

B2B value framework and evaluate the role of business factors in determining the level of the impact.

4. VALUE OF WEB-BASED PROCUREMENT

Our framework is based on a multi-stage impact model of information technology on enterprise processes (Barua, et.al., 1995; Kauffman and Kriebel, 1988; Hitt and Brynjolfson, 1994; Mukhopadhyay, 1998). The principle is that certain features or capabilities of the Web are used to enable B2B operations, which have impact on a set of intermediate variables. These intermediate variables lead to improvement in the performance variables. Any improvement in each of the performance variables contributes to the improvement of the effectiveness of the procurement process, which is the B2B goal of the enterprise. The framework is shown in figure 2.

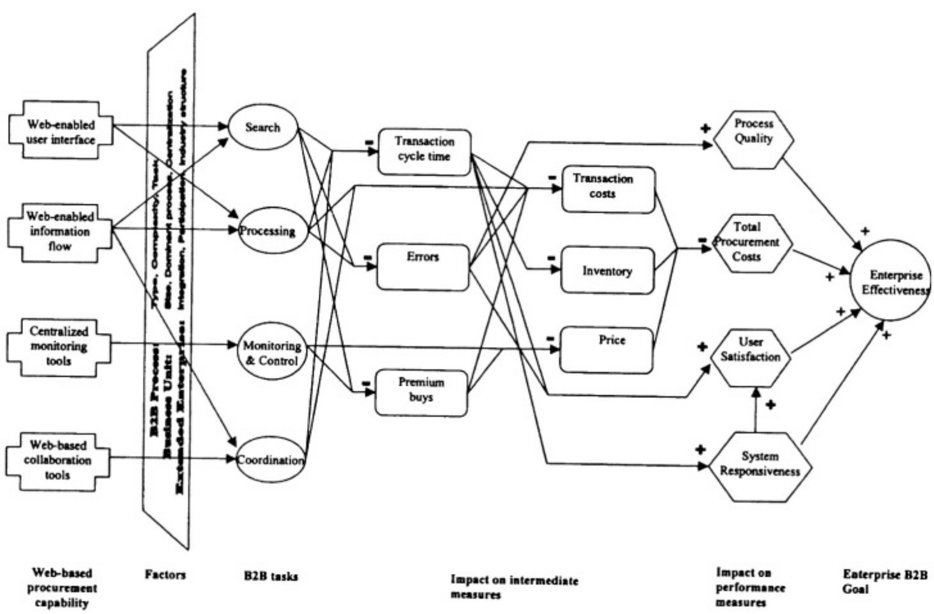

Figure 2. Framework for the value of Web-based procurement

Our level of analysis is "product category", which is a collection of procurement transactions of products with similar procurement characteristics, such as demand, search, coordination, and control. From a practical stand point, organizations groups purchases of products into similar categories, as it helps them to establish uniform procedures and business rules for a category, instead of for each product or transaction. Hence, for example, all office stationery, including paper clips, printing paper, and other stationery items, are grouped in a category called "office-supplies". We expect the impact of e-procurement to be similar on transactions within each category and different across categories. For each "procurement category", we identify the benefits and costs of e-procurement to arrive at the value for this "procurement category".

4.1 Impact on B2B tasks

A Web-based procurement system provides enhanced search capabilities, faster and accurate processing, real-time and rich-media information support, and low communication and coordination costs (Buxmann and Gebauer, 1999; Luckling-Reiley and Spulber, 2000). From the buying enterprise point of view, use of a Web-based system affects four major categories of B2B operations - search, order processing, monitoring and control, and coordination.

Search: Search costs are costs incurred by the buyer to locate an appropriate seller and purchase a product (Bakos, 1997). Search costs in procurement are incurred at two places – when the professional buyer looks for a supplier for contracting purchases and when the individual user in the organization looks for the appropriate product to order. In both cases, the Web and associated search engines considerably lower the search costs, which can be quite significant in large organizations. Web-enabled search engines help users to easily search using multiple methods to ensure that she can find the right product even with limited available information. This "user-friendliness" of the system reduces the "premium buys", where the user goes around the procurement system and incurs higher processing and product costs (Kalakota and Robinson, 1999).

Processing: Web-based procurement system involves electronic document routing and information flow, thus reducing labor costs involved with manual processing. Web-based system can automatically route the product request for the necessary approvals and order placement with suppliers. This reduces the transaction cycle time and gets the materials to the user faster. As the system requires minimum data inputs during the information processing cycle, much of the sources of errors are eliminated. Thus, we find that Web-based procurement processing lowers the cycle time, errors and the processing costs.

Monitoring and control: Using a Web-based procurement system, organizations can achieve their twin objectives of responding effectively to the user needs as well as leveraging their combined buying power. Users can search the catalog to identify the most cost-effective supplier and place their orders. Corporate B2B managers can aggregate the demand for the whole enterprise and use this to negotiate competitive prices for the products, which they can then make available to any business unit, irrespective of the size or location of the unit. Centralized control, combined with the availability of an increased range of items on the electronic catalog, motivates more users to order through the e-procurement system, reducing the extent of "premium buys". Thus, the major benefits of Web-based monitoring and control are reduction in average product price and reduction in "premium buys".

Coordination: One of the major advances of Web-based IOS over other traditional IOS, is its ability to support increased and more complex coordination. Several times, during the fulfillment of an order, procurement personnel need to communicate and exchange information with the suppliers and users. Using a Web-based procurement system provides real-time information flow and is less costly to coordinate with suppliers and users. This leads to faster resolution of any problems and results in lower order cycle time. The low communication costs of the Web and the lesser time spent by the procurement staff in coordination results in lower transaction costs.

4.2 Impact on performance measures

The impact of the use of Web for B2B on performance measures can be discussed based on the concept of first order and higher order impacts suggested in IT literature (Barua, et.al., 1995; Kauffman and Kriebel, 1988). The first order impact is on intermediate measures that are closer to the process, which in turn affects the performance measures. One of the most visible performance impacts of Web-based procurement is the lower ***total procurement cost***. The reduction in transaction cycle time, caused by the use of Web-based procurement, reduces the labor time used in the process and the labor cost component of the transaction costs. Costs incurred due to electronic processing and coordination is several magnitudes lower than those involved in manual processing and coordination. Lower incidence of errors in a Web-based procurement system reduces the need for labor for error resolution, reducing transaction costs. With less lead times for acquiring products, organizations can store less in inventory and increase inventory turns, leading to lower inventory costs. Lower average price negotiated for contracted items and the lower product development costs contribute to the reduction in the total procurement costs.

Quality of the procurement process is an indicator of how well the system meets the prdòcurement needs of the enterprise. Any error in the processing cycle decreases the chance that the product delivered to the user will fully meet her expectations. A measure of process quality is the proportion of B2B orders rejected or returned by the user. Another measure is the number of user complaints about the product. By reducing the probability of errors, a Web-based system can reduce the potential mismatch between user needs and the delivered product, thus reducing user complaints.

User satisfaction refers to the perception of the user in the system's effectiveness to meet her business demands. This is more than the receipt of a matching product. User satisfaction is affected by how well the system is perceived to meet user expectations. Higher cycle time and more errors in the process leads to lower user satisfaction. Access to required information with minimum effort, faster resolution of complaints, and ease of use of the system interface are some ways in which user satisfaction can be improved by a Web-based system.

System responsiveness is the ability of the B2B procurement system to respond to the needs of the user and the enterprise. It reflects not only the time taken to get the user what she needs, but also the ability to locate alternative sources, within a reasonable time, if necessary. For example, a user or a business unit may require a critical item to prevent the idling of expensive production machinery. Delay in locating or procuring the item may cost more, though indirectly, than even the cost of the item. In such situations, a responsive system will help search internal and external locations to find the item in the shortest time possible and the best way to get it to the business unit.

In summary, by implementing a Web-based procurement system, a firm can anticipate the following potential impact on its intermediate and performance measures.

<u>Impact on intermediate measures</u>
Lower transaction costs
Lower inventory holding costs
Lower price

Impact on performance measures
Higher process quality
Lower total procurement costs
Increased user satisfaction
Increased responsiveness of the system

The potential value of a Web-based procurement system to an organization is the extent to which it can derive benefits from the systems, net of its investments and other implementation costs. One way to estimate the value of a system is to quantify the improvements in the performance measures in some economic terms. However, measuring and quantifying the impact on the intermediate measures will provide more precise estimate of the value of the system (Kauffman and Kriebel, 1988; Mukhopadhyay, 1998), but require more detailed data at process level.

5. FACTORS THAT AFFECT THE VALUE OF WEB-BASED PROCUREMENT

Research on IT impact shows that implementing a system does not automatically guarantee realization of the potential value (Barua, et.al., 1995; Davern and Kauffman, 2000; Mukhopadhyay, 1998; Weill and Olson, 1989). The realized value depends on several conversion contingencies (Davern and Kauffman, 2000). These conditions could be firm level controllable conditions, such as training of users, or can be external influences, such as actions of competitors and technology (Weill and Olson, 1989). The factors that affect the benefits and costs of e-procurement, and hence its value, occur at three levels of increasing scope – procurement process, organization of business units and the "extended enterprise". For each product category, it is possible to identify the values of these factors and analyze the effect of these factors on the value of e-procurement for this category.

The *first level of factors is the process,* where the use of e-procurement is immediately felt. Research on information technology and transaction costs has identified asset specificity and product description complexity, in addition to transaction frequency, as important characteristics that affect the impact (Malone, et.al., 1987; Williamson, 1996). With respect to e-procurement, we look at asset specificity more broadly as the specificity and structuredness of the procurement process that affect the value. Also, we look at complexity of not just product description but of the entire procurement process. With the transaction frequency, these two characteristics form the process level factors in our study.

The *next level considered is the business unit,* which is the principal unit of e-procurement investment and implementation strategies. The value of e-procurement to a business unit can be determined by aggregating the value of all its procurement categories. However, beyond the process, e-procurement creates a fundamental shift from decentralized purchasing to centralized purchasing. As the major driver of the price benefits is the increase in centralization, and the extent of decentralization in the current procurement system is different in each business unit, the value realized for a category of procurement will depend on the change in centralization achieved.

The *third level considered in out study is the extended-enterprise.* The scope of B2B operations goes beyond the buying enterprise and extends to the "extended enterprise", to include all suppliers and other business partners. However, differences in the market conditions of the underlying procurement process create differences in the ability of the organization to reduce the transaction costs and to negotiate better prices. Of these market conditions, the most critical for e-procurement is the fragmentation in the supply chain of the underlying product.

5.1 B2B process characteristics

B2B processes differ along several dimensions, such as specificity, structuredness, variation in demand, frequency of orders, value of product, extent of human intervention required and complexity of the tasks involved. In this research, we propose to group these dimensions into two factors – type and complexity. We note that in addition to the differentiation of the processes based on these factors, the distribution of transaction volume in each category plays an important role in determining the level of impact.

Process type: The procurement transaction of each product category is associated with certain procedures, business rules, people involved and systems used. On the one end, there are products with customized needs, high demand volume and potential uncertainties associated with supply, which can lead to high transaction costs for the buyer enterprise, if each transaction has to undergo the supplier search, approvals, processing and ordering. If the demand for such product is regular and the product specifications do not change with time, organizations can reduce the transaction costs by negotiating a long-term contract with a supplier and designing an automated procurement process for reordering the items. We call this type of procurement as "***structured***" procurement. Examples of such procurement include *tooling items, welding wires, and custom replacement parts.*

On the other end, there are some products that are not suitable for any level of automated procedures. Often organizations allow the end-users to take advantage of best deals available at the time of ordering and there is very little benefit of tying such procurement to product-specific purchasing steps with a particular supplier. These procurements tend to have very broad procurement rules giving plenty of freedom to the users to choose suppliers. We call this type of procurement as "***unstructured***". Examples of this category of procurement include office equipment and furniture.

The structured ordering procedures result in very little time spent by the user and procurement staff in the current process for search, input and processing activities at the level of each transaction. The streamlined and repetitive nature of the orders reduces the scope for errors in input and processing. The use of Web is mainly to replace the paper based manual communication with electronic communication. On the other hand, it is difficult to set up meaningful automatic replenishment procedures for unstructured procurement needs and every user request must be processed individually and the order placed with suppliers. More time is spent in search, input and processing for each transaction, mostly in the form of labor. The greater variety of these requests and the higher human intervention increases the incidence of errors, and staff time is spent more in error resolution. When we Web-enable such unstructured procurement, we save more on the resources used for search, input, processing and error resolution. Thus, we expect the use of Web for unstructured processes to result in higher value than its use for more structured processes.

Proposition 1: Use of Web-based procurement for unstructured processes results in greater value than its use for structured processes

Complexity of process: The complexity of a transaction refers to the need for additional efforts to process the transaction successfully. For example, a critical component may have to undergo special inspection prior to any use, requiring investments in testing equipments or inspection personnel. As the complexity of a required item or ordering process increases, it involves more transaction costs due to more search time, increased coordination requirements, need for more data processing, and the higher probability of errors. But, even if the complexity is high, if the transaction volume is insignificant, the organization cannot expect significant value from the use of Web. Hence, the realized value depends not just on the complexity of the procurement process, but also on the transaction volume of this procurement category.

Proposition 2: The value of Web-based procurement increases with the complexity and transaction volume of the process.

5.2 Organization of business units

The effect of the process level factors gives us a sense of its impact on the value from the transactional perspective. However, the procurement systems, which handle these transactions, serve different business units and user constituencies, and each unit perceives and realizes different values even from the same Web-based procurement system. The major factors that determine the different values are the volume of transactions, the distribution of the volume of different types of processes, and the existing degree of procurement centralization in each business unit.

Size of business unit: The use of Web results in positive operational benefits (in terms of cost savings) on each transaction, irrespective of its type, even though the level of benefits may vary. The benefits accumulate more as the volume of transactions of the business unit increases. Hence, between two business units with similar distributions of the different types of transactions, a larger business unit can be expected to derive higher transaction cost benefits than a smaller business unit. In addition, the benefits due to price reduction through centralization are higher for a business unit with larger volume of B2B purchases.

Proposition 3: Among business units with similar distributions of different types of B2B processes, larger business units realize higher values from the implementation of Web-based procurement.

Dominant type of B2B process: While we earlier proposed the effect of the types of processes in isolation, a business unit deals with a mix of structured and unstructured processes. Some units, such as manufacturing facilities, can be expected to have a dominance (higher proportion) of structured procurement processes, while other units, such as sales or administrative facilities, can be expected to have a dominance of unstructured processes. The potential value of Web-based procurement cannot be realized unless the dominant type of process is Web-enabled.

Proposition 4: Business units can derive higher value from Web-based procurement only by Web-enabling the dominant type of procurement process.

Degree of centralization: Web-based procurement systems enable organizations to centralize their purchase processes while at the same time given enough flexibility to the local units to serve their local sourcing needs. Centralized procurement benefits a business unit in three ways. First, the administrative costs (part of the transaction costs) are spread over a larger volume of purchases, thus reducing the operational costs for each business unit. Second, the visibility of enterprise-wide procurement demand and preferences helps buyers to negotiate lower prices for goods and services. Third, centralized control and monitoring, combined with the user-frieridly Web interface motivates more users to order through the e-procurement system and reduces the volume of "off-contract" purchases. Since most of these purchases cost more and are charged to the business unit, reduction in "off-contract" purchases benefits the business unit.

Proposition 5: The value of Web-based procurement system will be higher for a business unit that achieves a greater *increase* in centralization due to the use of Web.

5.3 Extended enterprise

While the characteristics of business units help us establish the value of implementing Web-based procurement system in a particular business unit, the participation of external partners, such as suppliers, is necessary to realize the value of the Web across the supply chain. A supplier, who is able to manage its production operations efficiently based on timely and accurate information received from the buyer, as well as its down-stream suppliers, benefits the entire supply chain. The factors that are important to realize the value of the Web relate to the organization of the supply chain and technology adoption, participation of the individual players, and the structure of the industry.

Integration of e-procurement with enterprise systems: E-procurement systems interact with other information systems in the enterprise and the supply chain to enable the procurement process. For example, inventory, personnel data and supplier data are accessed from the ERP system of the buyer. Design systems provide data for product development process. Supplier's manufacturing information system is accessed for fulfillment information and order tracking. The full potential of an e-procurement system can be realized only when all the information exchange and sharing is done electronically, with minimum need for turnover of paper documents. For example, even if the buyer side of procurement process is fully automated and the purchase order is sent electronically to the supplier, if the supplier prints the purchase order and re-keys the data into his own system, the chances for errors and delays are increased, reducing the benefits of e-procurement.

Proposition 6a: Web-based procurement systems that have greater integration with existing enterprise systems yield higher value than procurement systems with lower integration.

Among the- various information system applications present in organizations, some are closely related while others are disparate. For example, the functions of production planning and materials management may be closely connected, while production planning and human resource management may not have such close connection. As we integrate the existing information system applications into e-procurement, connecting to closely related systems helps leverage the synergy among those systems. An e-procurement system connected to production planning benefits more if it also connected to materials management, but benefits may be less if connected to human resource management.

Proposition 6b: Web-based procurement systems that are integrated with closely related systems result in higher value.

Participation of business partners: From the enterprise point of view, business units and suppliers are the two most important participants in e-procurement system. Business unit procurement managers are reluctant to reduce their control over procurement decisions and hence need strong incentives to motivate their users to purchase through the Web-based procurement systems. Suppliers are resistant to Web-based procurement as they anticipate fierce competition online and they need strong incentives to Web-enable their catalog and ordering process. The potential value of the system cannot be realized unless both users and suppliers participate in the system. There is also a behavioral aspect involved here. Higher participation by business units or supplier convinces the benefits of Web-based procurement and motivates them to participate. However, increased participation by business units or suppliers alone is not sufficient to realize significant benefits of e-procurement. In fact, we expect that the benefits are modest at low participation of business units, irrespective of the level of participation of the suppliers. Similarly, the benefits are expected to be modest at low participation of suppliers, irrespective of the level of participation of business units.

Proposition 7a: The value realized from Web-based procurement system is low when a small number of business units participate in the system, irrespective of the number of suppliers participating.

Proposition 7b: The value realized from a Web-based procurement system is low when a small number of suppliers participate in the system, irrespective of the number of business units participating.

We expect a synergy effect depending on who participates in e-procurement, similar to that proposed in e-procurement integration. In the "extended enterprise" supply chain, partners who have a close business relationships may add more value if they participate together in the system, rather than the participation by two unrelated partners. Suppose an MRO supplier and its suppliers participate in e-procurement, inefficiencies are reduced to a greater extent as information flow is optimized at a greater extent in the purchase process. But, if an MRO supplier and an office products supplier participate in e-procurement, each purchase process needs to be optimized, which cannot be done without participation of the lower tiers of suppliers.

Proposition 7c: In Web-based procurement, participation by business partners, who themselves have closer business relationships in the same product supply chain, results in higher value than participation by suppliers not related in the supply chain.

Industry fragmentation: The characteristics of the industry play an important role in realizing the benefits of Web-based procurement. Industry fragmentation of the demand or supply is an important factor that can be managed by using the Web. In an industry fragmented on the demand, supply or both sides, we expect high levels of search costs and inefficiencies in the traditional procurement. Intermediaries play an important role in reducing the transaction costs, but even they are limited by technology. Such industries are greatly benefited by the Web, which allows the integration of demand and supply on a global scale. We expect that enterprises that procure from a fragmented product supply chain derive higher benefits from Web-based procurement.

Proposition 8: The value of Web-based procurement is greater if the existing product supply chain is more fragmented on the demand, supply or both sides.

6. IMPLICATIONS OF THE ANALYSIS FOR THE DEVELOPMENT OF ADOPTION STRATEGIES

Buyer organizations implementing a buy-side Web-based procurement system cannot do it in one-step. There are two major strategies to choose from.

1. All the purchases can be Web-enabled, but the system is implemented one business unit at a time.

2. A specific type of purchase is Web-enabled across the enterprise, and after successful implementation, the next type of purchase is Web-enabled.

In addition, the buyer organization should also consider the participation of suppliers in order to realize the benefits from the Web.

If the organization chooses to implement by business units, then it will compare the characteristics of business units to decide where to implement first. The units with the highest decentralization of existing purchases should be chosen because of the potential for greatest change in centralization (proposition 5) and resulting higher benefits. However, if the choice is between business units with similar distributions of purchase types, the larger the unit, the greater the benefits from Web-based procurement (proposition 3). After a business unit has been chosen for implementation, the type of purchase to implement first is decided by its proportion of structured and unstructured procurement, and its inventory levels. If the business unit has a higher proportion of structured procurement that deals with highly fragmented product supply-chains, Web-enabling structured procurement yields greatest benefits (proposition 8). Otherwise, Web-enabling unstructured procurement yields greatest benefits.

If the implementation strategy involves enterprise-wide adoption of the system, the process type and complexity play a critical role in selecting which purchases to Web-enable first. Unstructured and complex purchases involve a high level of search and coordination. They also require stricter control in view of potential non-compliance hazards. This type of purchases requires higher levels of human interaction. Thus, the firm should Web-enable the search process of unstructured and complex purchases in order to derive maximum benefits (proposition 1 and 2). However, if the proportion of unstructured and complex purchases is very low compared to other types of purchases, the greatest benefit comes from Web-enabling moderately complex purchases.

Once an implementation strategy is chosen, there are two critical factors that influence the realization of maximum benefits – integration of Web-based procurement with current systems and the participation of suppliers. The procurement system should be designed to automatically retrieve and use data that is already available in the system, instead of duplicating the input. Also, it should provide the necessary data required by other applications. The greater the level of the integration with the organization and supplier systems, the greater will be the benefits (proposition 6a). In a manufacturing organization, purchasing is closely linked with engineering design and materials management, because of the higher need for customized components. The focus in implementation should be to integrate the Web-based procurement system with the design and materials management applications, rather than with accounting or human resource applications (proposition 6b). Thus, buyer organizations should not only integrate with other applications, but integrate with applications whose functions are closely related to the procurement process.

The other critical factor is participation. In order to encourage more use of the Web-based system, more suppliers have to be included in the procurement systems by adding their products to the electronic catalog (proposition 7, 7b). However, if the suppliers who are connected to the buyer-side system are themselves connected to their suppliers, there is further reduction in the cycle time and errors and improved coordination is possible. This leads to higher benefits than if two suppliers not related in the supply chain are added to the catalog (proposition 7c). Hence, buyer organizations should not only look to add more of their suppliers to the system, they should also motivate the suppliers' suppliers to join the Web-based system.

7. CONCLUSION

Global scope and enhanced supply chain coordination capability beyond immediate business partners illustrate the big leap that Web-based IOS makes over traditional IOS. Using the Web, organizations and its several levels of suppliers can integrate their supply chain across the "extended enterprise" in order to remove the inefficiencies and to be able to respond effectively to demand changes. While previous generations of IOS were linear links between organizations, Web-based IOS are truly "networked" business systems. The economic contribution of each participant in this network, benefits realized by each participant, optimal incentives for increased participation and the type of "network externalities" created are very interesting issues for research and practice. Also, the strategic impact of this network and its critical drivers are areas of research that will have tremendous value for organizations in the new economy.

Even as organizations are moving to Web-enable their B2B processes in the hope of improving their B2B supply chain and reaping economic benefits, there is a need to fully understand how this value is created and realized. Once we know how the value is created, it is critical to identify the factors that explain the differences in the realization of Web potential across the entire B2B supply chain. This will help B2B managers to plan their B2B adoption strategies to ensure that the migration to e-procurement results in maximum benefits to the "extended enterprise". We have provided a start to this effort by developing a framework for understanding the value of Web-based procurement and the factors that affect the value. We were able to establish the effects of process related factors, such as type and complexity, in determining the value of Web-based procurement to an enterprise, and the implications for implementation strategies. Future work on this research will use a comprehensive measurement of economic value and more empirical data to validate our framework both theoretically and empirically.

Note

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Keyword Index