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“Service Innovation and Value Creation in Experience Economy”

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**Eldon Y. Li & Soe-Tsyrr Yuan
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- Welcome Message From Conference Chairs -

The Seventh International Conference on Electronic Business (ICEB-07) was held in Taipei, Taiwan, on 2 - 6 December 2007 at the Grand Hotel and was hosted by the MIS Department and Innovation & Incubation Center of National Chengchi University. The Proceedings for this Conference is presented in this volume. The ICEB Conference series aim to be the world's primary forum on broad, crosscutting issues for research and education in electronic business, attracting an international participation of researchers and practitioners. ICEB-07 continues the success of the prior ICEB events in Tampere of Finland, Hong Kong, Beijing and Singapore, and leads in this effort to chart the future course of the research and education in electronic business in terms of this year's conference theme "Service Innovation and Value Creation in Experience Economy".

Services dominate economic activity in developed economies, and yet a deep understanding of innovation remains limited. More and more corporations in the manufacturing sectors now see a growing share of revenues coming from their service units, not to mention existing strong growth of service businesses in many sectors including financial, information and business services. For becoming more systematic about service growth and productivity, service innovation is a topic of great relevance to business, academic and government leaders today. Moreover, the growing commoditisation of service offering has gradually transformed the market competition from quality of services to the creation of memorable experiences. As a consequence, the competitive position of a business now depends much on its ability to generate impressive experience through innovative delivery channel.

Since the ICEB Conference series see themselves as advocates for next waves of research and education in electronic business, this volume contains papers by leading experts in the fields; descriptions of ideas that are on the borderline between a research idea and a prototype; reports on concrete applications of the service technologies; its impact on various aspects of electronic business; plus considerations as to how society might adjust and react to the resultant changes. The major areas covered at the conference and presented in this volume include:

- Case Study in E-Business
- Cyber Law and Intellectual Property
- Decision and Information Science
- Data Mining and Business Intelligence
- E-Business Applications and Integration
- E-Business Entrepreneurship
- E-Business Models and Management
- E-Business Technology and Infrastructure
- E-Business Security, Trust and Privacy
- E-Finance and Real Estate
- E-Government and Technology Policy
- E-Learning and Innovations in Teaching
- Emerging Technologies
- Enterprise E-Services Architectures
- E-Service Auditing Techniques
- E-Service Technology and Innovation
- Group Systems and Collaborative Commerce
- Hospitality Business and the Internet

- Intelligent Agents and Web Services
- Internet Marketing and Advertising
- Internet Security and Privacy
- Knowledge Network and Management
- Personalized Ubiquitous E-Service
- Service Operations Management
- Service Science and Engineering
- Supply Chain Management and E-Logistics
- Technology and Innovation Management
- Other related topics

Although we are increasingly aware of the trend toward diversification within the context of next waves of electronic business issues, we have contributions from different research fields (e.g. Information Management, Social Science), different institutions (universities, research laboratories, companies), different application fields (e.g. e-commerce, e-business, e-industry, e-government), different work cultures (e.g. academia, industry; software engineers, researchers), different parts of the world (Asia, Australia, North America, Europe), and different user groups (e.g. everyone, special jobs, special needs). ICEB-07 emphasizes the need for identifying and experiencing the commonality between the different views, fields, and cultures involved in conference topics of interest as a common ground needs to be built and maintained in order to keep communication alive for exploring next waves of electronic business trends.

High quality papers have been selected and will be presented at the conference. Additionally, the conference features distinguished keynote speakers, which are active in the relevant communities, in addition to forums and panels. We would also like to thank all the authors as well as the Program Committee members and reviewers for their enthusiasms, their time and expertise, which helped to make ICEB-07 become a successful event.

The conference was sponsored by National Chengchi University, National Science Council of Taiwan, and Ministry of Education of Taiwan. The corporate sponsors included Institute for AdvenTech, Information Industry of Taiwan, Ministry of Education of Taiwan, Ministry of Foreign Affairs of Taiwan, National Science Council of Taiwan, PearsonEd, Trade-Van Information Service CO., United Microelectronic Corporation (UMC), Yahoo of Taiwan, The conference would like to thank all the sponsors of ICEB-07 for their generous support.

ICEB-07

Conference Chair Eldon Li

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A NEW FRAMEWORK FOR ANALYZING INTERNET BUSINESS MODEL: CASES OF CHINA

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ABSTRACT

In the recent decades, we have witnessed the growth of information technology (IT) diffusion which has led to digital convergence. This new trend of technology development brings together the telecommunications operators and entertainment media to provide new kinds of business opportunities. However, the research of emerging business models is limited. Knowledge about environmental and technological mechanisms in the adoption of new business models is especially lacking. This paper investigates two cases in the entertainment industry in China - MyShow and Super Girl - initiated in 2004. A new framework for analyzing business model has been proposed based on current research.

Keywords: Business model, China, information technology (IT), Internet.

INTRODUCTION

In the recent decades, we have witnessed the growth of technology diffusion which has led to digital convergence. This new trend of technology development brings together the telecommunications operators and entertainment media to provide new kinds of business opportunities. It changes the lifestyles of the people, and meanwhile raises challenges for the government who regulates the market. However, despite these changes, knowledge of emerging business models and its applicability in the analysis of a company's business logic is limited. Knowledge is especially lacking in environmental and technological mechanisms in the adoption of new business models.

This paper investigates two cases in the entertainment industry in China – MyShow and Super Girl – initiated in 2004. MyShow is a performer contest TV program that combines music record business with TV industry. The whole selection process was recorded and broadcasted on TV. The final winner was awarded a contract with the Universal Music Group and 1 million RMB for the production of a new record. Super Girl also attracted the “eyeballs” of the Chinese in 2004, and it was held by Hunan Satellite Television, similar to the Pop Idol TV show in the UK. Selection rounds were held all over China and people voted on the performance of the candidate singers through short messages system (SMS). The final competition attracted more than 50 million votes, Hunan Province Satellite Television (HSTV) receiving the record-high watching rate. The winner was awarded the title of Super Girl, who became an idol overnight.

This event created a Super Girl phenomenon which involved the interests of the whole society. Benefiting from it, were economic bodies involved such as, for example, HSTV, which gained a higher watching rate, and Chinese telecommunication companies, who got profits from SMS traffic. The youth were the enthusiastic participants. However, there were also concerns about its negative influence on the young generation. As an example, the ex-minister of culture being the present Chairman of Education, Science and Culture Committee of the parliament criticized it would motivate the young to seek for venality. In the analysis of both cases, a new business model, which has been derived from current business models research, is employed. We will discuss both cases' business models by investigating the components, and eventually the distinctive value of each case.

THE CONCEPTS OF BUSINESS MODEL

There exists a lot of confusion about business models because when different authors write about business models they do not mean the same thing [1]. While giving various definitions of business models, the method of categorization is based on four evolution phases [2].

In the first phase, many business definitions and classifications were proposed by academic authors. Timmers's definition about a business model is an early and much cited reference. He suggests that “a business model is an architecture for product, service and information flows including a description of the various business actors and their roles; and a description of the potential benefits for the various business actors; and a description of the sources of revenue” [2, p.4]. This concept emphasizes how a company can get profit, describes the sources of revenues and explains the potential benefits for the various business actors. Beyond the business model, Timmers [2] also provides eleven e-commerce business models and classifies them by the degree of innovation and functional integration.

Another definition is from Rappa [3], who suggests a business model is a method of doing business by which a company can sustain itself. This definition directly spells out how a company actually makes money and uses it. The business model is categorized into nine generic forms, which include brokerage, advertising, infomediary, merchant, manufacturer, affiliate, community, subscription and utility. Although the differences of two classifications are noticeable, these taxonomies share some common features [4].

In the second phase, the emphasis was gradually shifting away from the business model definitions to the components or elements of business models [5]. Linder and Cantrell [1] extend their understanding of a business model as “organizations core logic for creating value”. Also, they decompose a business model into sub-models that link together, which include the Pricing Model, the Convenience Model, the Commodity-plus Model, the Experience Model, the Channel Model, the Intermediary Model, the Trust Model, and the Innovation Model. Hamel [6] defines a business model as the business concept implemented in practice, which is a radical innovation that can lead to the value creation and change the rules of industry. Instead of giving the simple lists of business model components, this definition includes a real-life description of business model elements including customer interface, core strategy, strategic resource, and value network.

The third phase began to model the components in the form of reference models or ontology [7]. Gordijn, Akkermans and van Vliet [8] propose a business model ontology that enhances the linkage between business and information technology (IT) and applies the business model into e-business system development. This value-oriented ontology specifies value flows between business actors. Osterwalder and Pigneur [9] provide an e-business framework with four pillars: the products and services offered by the firm, the infrastructure and network of partners, the customer relationship capital, and the financial aspects. Under the ontological approach, business models are connected with computer-related technology and infrastructure to develop an e-business information system.

The fourth stage is concerned with identifying criteria for either assessing the feasibility and profitability of business models or evaluating a business model in various applications [7]. This is also a relatively more recent research domain. Hamel [6] has identified four factors that determine a business model’s value potential: efficiency, uniqueness, fit, profit booster, respectively. Afuah and Tucci [9] define three levels for measuring the performance of a business model which includes (1) Measure of profitability (e.g. compare a firm’s profitability with that of its competitors); (2) Profitability of prediction (e.g. compare a firm’s profit margin, market share with those of its competitors); (3) Business model component attributes (benchmarks for appraising each components of a business model). Around this value-centered theme, they also provide a framework for the business model with eight elements that takes in account the creation of value through several actors.

Summarily, some authors perceive the business model as an abstract business concept that describes the logic of make profits for a company [1, 2, 3, 6], while others link it with strategy, business processes as well as business information systems [9, 10]. They adopt different criteria to decompose or category the business models due to their different viewpoints, but there exists some similar understandings in nature with different description in semantics [4]. Moreover, common to all above-mentioned comments of business models is their focus on “value capture and value creation”, more or less.

A COMPREHENSIVE BUSINESS MODEL FRAMEWORK

Compared the business models mentioned most often, the most common building blocks are identified. From the synthesis, five core themes that cover all the business model components mentioned by at least two authors. They are Value, the Firm, the Firm Boundary, Environment, and Technology as concluded in Figure 1. The comprehensive business model focuses on value, while taking external environment, inter-organization environment, as well as technological driver into account. The following parts are going to argue the relationships between these five elements and the business model, respectively.

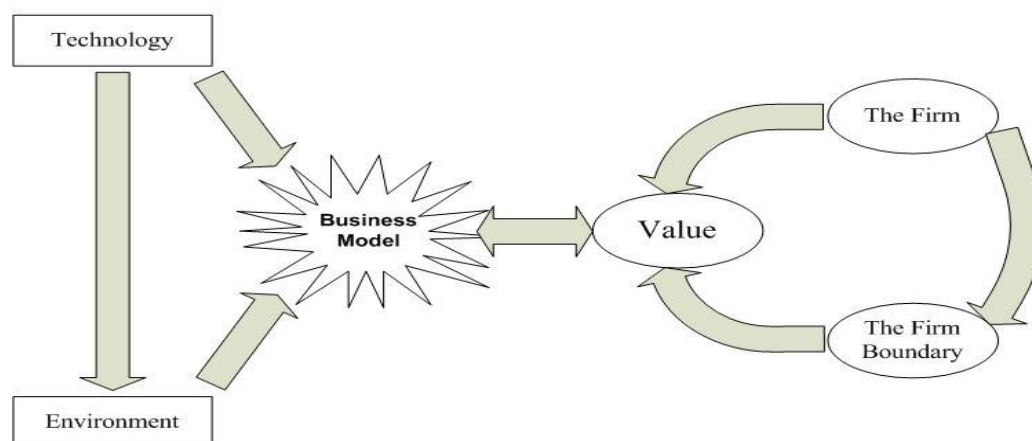


Figure 1 Comprehensive framework of business model

“Value” And Business Model

The first prominent spotlight is on the element “value” [11]. Although authors use different terms to illustrate the importance of value, the business model perspective centers on the value in virtual market. As Chesbrough [11] states, the business model creates value by defining a series of activities from raw materials through to consumers that will yield a new product or service with value being added throughout the various activities; It captures value by establishing a unique resource, asset, or position

within those activities, where the firm enjoys a competitive advantage. Similarly, Hamel [6] argues, both ‘value capture’ and ‘value creation’ occur within a value network, which can include suppliers, partners, distribution channels, and coalitions that extend the company’s own resources.

From firm’s perspective, Mahadevan [12] mentions the value stream along with business model which identifies the value proposition for the business partners and buyers in an Internet context. The value streams for an organization influence the viability of its business and revenue generation.

Afuah and Tucci [9] take consumer value into account. They state the business model is the main determining factor of a firm’s business performance, the method through which each firm builds and uses its resources to offer its clients better value than that of their competitors. Klueber [13] complements this idea, defining business models as a logical arrangement of value creation in an organization as a business network, taking its partners, competitors and clients into account. Thus, the term value network is emerging to link suppliers and customers including potential complements and competitors together [14].

In comparison between traditional supply chains to dynamic value network, the focus shifts from increasing value through internal relations to increasing value through external relations, and the amount of relations multiplies [2]. Logic of value is still the core of a business model [15].

“Firm” And Business Model

The second core element that has been discussed is the firm itself such as Revenue Stream, Revenue Source and Capability. According to Timmers [2]: A business model contains a description of the product or services the firm is providing the market. It answers the question of what the firm sells.

A business model describes the basis and the sources of income for the firm. Mahadevan [12] mentions revenue stream for the business model which is a plan for venue generation for the business. In fact, revenue stream is the realization of the value proposition on a yearly basis. Information asymmetry between buyers and suppliers generates a revenue stream often resulting in savings accruing to the buyer. Similarly, Amit and Zott [16] introduce a revenue model through combination of various value streams such as subscription fees, advertising fees and various transactional incomes. Now many organizations look towards advertising fees as their main source of revenue [12]. Hamel [6] identifies four main business model components that range from core strategy, strategic resources over value network to customer interface. These components are related to each other and are decomposed into different sub-elements. The main contribution of this methodology is a view of the overall picture of a firm. Osterwalder and Pigneur [7] found four main pillars based on business model analogy, of which products and services a firm offers is an important element to represent a firm’s capability to deliver substantial value to the customer. Revenue model and cost structure belong to the financial aspect, which determine a firm’s profit and its ability to survive in the competition. Revenue streams not only show the resource contained in a firm, value delivered to the consumer as well as a firm’s potential for creating wealth. So, redundant details about the firm can be captured through business model since a firm’s business model is always compatible with its resources [17].

“Firm Boundaries” And Business Model

The success of a firm’s business model derives from a fit not only between the firm and its customers, but also the fit between the firm and its collaborating partners. The fit is all about defining the firm’s boundaries horizontally and vertically, deciding on collaboration governance, and determining the commercial relationships between the partners of the network [18].

On firm’s horizontal level, the business model captures the value or profits generated by measuring firm’s scale and scope. Scale measures the quantity of products sold while scope measures the variety of products offered [19]. The scale and scope are consistent with the core characteristics of virtual market, namely, reach and richness as mentioned before. Reaching more customers can add a firm’s scale and richening products or services can add a firm’s scope [20], thus realizing economies of scope. Both of two enhancements might reduce the cost of a firm or increase the revenues of a firm.

In addition, the business model construct also relates to strategic network theory that might help a firm to generate more valuable products or information for its stakeholders within that network [21]. In similar, Prahalad and Ramaswamy [22] view the business model as an extension of strategic network theory by enhancing the inter-organizational ties with suppliers, manufacturers, customers. From the successful case of Priceline.com, it is believed stable inter-organizational ties will open new possibilities for a company’s wealth creation through innovative transaction methods [16].

On firm’s vertical boundaries level, the business model captures the source of value through drawing on the theories of strategy and entrepreneurship such as transaction cost economics, Schumpeter’s innovation idea.

First, the notion of business models concludes the arguments that central to the value chain by describing business processes that enabling transactions [16, 23]. For instance, Timmers [2] suggests the innovative business model architecture by combining the interaction patterns with value chain integration to create added value with a rich functionality.

Secondly, a business model explains the importance of transaction efficiency, lock-in of customers, novelty and complementarities [16]. Since the application of e-business and IT promotes the transaction efficiency, the transaction costs will be lowered [24]. The improved information enabled by Internet also reduces customers' search costs [16]. While increased rivalry and market transparency seem to lower value appropriation opportunities for firms, empirical evidence has shown that some firms have been able to differentiate themselves from their competitors through new value appropriation [25]. For example, Amazon not only offers books, but also a whole set of complementary information, some of which is based on the analysis of the customer's profile and therefore they can offer more value-added services to customers than its competitors.

“Environment” And Business Model

The fourth theme is environment. A firm's business model is continuously subject to external pressures that oblige a company to constantly adapt their business model to a changing environment. Osterwalder [26] concludes four 'macro-environments' change that directly or indirectly affect a firm's business model. They are legal or social environment, economic environment, technological environment as well as competitive environment. Also, Tikkanen [27] identifies a firm's business model as four conceptual levels, of which industry recipe aspect refers to the economic, competitive and institutional environment and their effects on the firm. In order to be successful under a competitive environment, the firm has to gather information about potential substitutes for the business' product as well as potential competitors and new entrants. In addition, the buyers of the product and any factors affecting its supply should be studied [23]. These variables are considered part of the 'micro-environment' of the business which influences the company directly [24]. That is to say, the business model is highly sensitive to the environment, which will eventually influence a firm's business performance [9].

“Technology” And Business Model

The last theme is the technology. The business model concept has become popular because of a business environment shaped by IT and globalization [19, 28]. Osterwalder [26] believes the increase in a variety in business models is closely related to the adoption of IT in business as following reasons: firstly, IT has reduced transaction costs with a new form of complex network alliance; secondly, the adoption in business offers customers with more information goods and service through a multiple channels. Thirdly, IT has been a strong enabler for a variety of innovative business models [29, 30].

The link between IT and business model is evident as in the case of online companies such as Amazon.com or eBay. According to Sabherwal and Chan [29], a study of 226 companies supports the hypothesis that alignment between business and IT strategies improves business performance. Since the general recognition of the importance of strategic IT alignment with e-business, it is the challenge for firms to invest IT effectively and productively [27].

The above five themes interact with each other and compose a comprehensive business model. It is said that a strong business model can be implemented badly, just like a weak business model can be managed successfully, which is to a large extent subjected to the influences of these five elements from different aspects. Thus, it is important for firms to ensure a smooth alignment among these continuous forces.

CASE ANALYSIS

In this section, two Chinese cases in the entertainment industry – MyShow and Super Girl – will be analyzed by drawing upon the framework that we have proposed in Figure 1.

Background

From 2000, the global music record industry suffered a downfall due to the large volume of pirate CDs and DVDs in Asia Pacific area. The unstable situation was followed by organizational downsizing, factories shut downs and company mergers. Companies were forced to look for new ways of generating profits [31]. MyShow is such a solution for a music record company. Everyone could join the show. Also, with the help of the convergence of the TV program and its popularity, they could find new artists from the society.

Meanwhile, worldwide TV production budgets are decreasing because the profit attained from advertising is going down. TV broadcasters and producers are then being forced to look for new solutions to regain their revenue stream. By combining mobile communication technology with TV broadcasting, TV producers created a new phenomenon – participation TV or SMS TV [32]. Through this new type of programs, audience can participate in the show. They contribute with votes, opinions, and, for businesses, with cash flow. Hunan Satellite TV exploited this new advance of technology and introduced Super Girl to the Chinese public.

MyShow

Launched in 2004, MyShow is a performance contest TV program. It is hosted by Shanghai Shang Teng Entertainment Ltd (SUM Entertainment) a company controlled by two shareholder groups: Universal Music Group (UMG) and Shanghai Media Group (SMG). The program is sponsored by Lycra and being broadcasted by Dragon TV, located in Shanghai, a country-wide audience. The new feature of the MyShow, that distinguishes it from previous Chinese program, is that anyone who thinks him/herself talented (singing, dancing, musical instruments) can join the program [33].

Five big cities in China were selected as the primary selection contest arenas in both 2004 and 2005. The judges were the two CEOs from Asian-Pacific UMG and China UMG. Also, many popular celebrities were invited to be judges. Every week for 3 months, the show was recorded and broadcasted in the weekend. In the first year, no participation from the audience was introduced in deciding the results. As an improvement in 2005, audience could vote for their favorite performers through their mobile phones by sending short text messages. The level of participation, however for MyShow is low, due to the show being recorded and not shown live.

In 2004, no more than 10,000 people joined the contest and in 2005 number of contestants rose to 50,000 and the watching rates saw only a 5% increase. Also to suffer from MyShow's failure to capture a wide audience, in the first year MyShow had a deficit of 3 million RMB, and zero profit for the year 2005 [34].

According to Hui [34], the CEO of the UMG Asian-Pacific, the original objective of MyShow was an experiment for training and recruiting new performers. During the show, the final contestants were already very popular and had a large fan base. The winner of the show, by turn, signed the contract with UMG and make new music record, or even TV show. Eventually, UMG would get profits. Hui also points out that MyShow's priority is music, and most importantly MyShow is a professional recruitment process, rather than an entertainment TV program. In 2006, only Shanghai is open as a contest arena, rather than the previous 5 cities. Also, this year's sponsorship is taken over by Sprite. Currently, the contest is still running its final stage.

Super Girl

Also started in 2004, Super Girl is a popular singer's contest hosted annually by state-owned HSTV. It is sponsored by a traditional dairy enterprise – The Mongolian Cow Dairy Ltd, from which it borrows part of the title: The Mongolian Cow Yogurt Super Girl Contest [35].

Different from MyShow, only female contestants can participate and there is no age limit (The State Administration of Radio Film and Television regulated that contestant must be over 18 in 2006). For the first year, over 60,000 girls went on to the Super Girl's stages in four cities' arena: Chengdu, Nanjing, Wuhan, and Changsha [36]. Another distinction was that Super Girl had introduced the killer application of SMS voting in their first year.

During the summer of 2005 in China, the most successful year for Super Girl, over 150,000 contestants joined the program's preliminary stage. About 400 million viewers watched the final contest. Because of the high popularity, the price of the TV advertisement during the show rose to 75,000 RMB per 15 seconds, and 112,500 RMB per 15 seconds in the final. A large volume of profit has been generated due to the popularity. Super Girl earned their "mother", HSTV, more than 100 million RMB (US\$12.5 million) [36].

A major value-added operation contributing to the show's unprecedented popularity is that fans are able to participate in the judging process by sending SMS via their mobile phones to vote for their favorite contestants. Different mobile network users were charged differently, for China Mobile users the price is 1 RMB/vote, for China Unicom users the price is 0.5 RMB/vote, for other operators the cost is 0.5 RMB/vote to 3 RMB/vote, etc. During the preliminary round in Chengdu (the capital city of Sichuan Province) alone, 307,071 message votes were sent respectively for the top three contestants. After sending a vote text message, each voter's mobile phone was also automatically subscribed to a binding relevant value-added service for "Super Girl", such as contestant news and program trailers, the cost of 6 RMB per service. In addition, the final ranking of the contestants depended on the SMS support rate sent in by fans, at least, according to a China state media's view rate investigation (CSM, offering TV and radio audience measurement research), more than 400 million people had watched the finale of the show, voted via SMS, and the three finalists obtained more than 8 million votes. The winner Li Yuchun got 3,528,308 votes, and Zhou Bichang won 3,270,840 votes for the second place. Zhang Liangying got 3rd place by 1,353,906 votes. So, in total were 8,153,054 votes. The interactive combination of television entertainment and mobile phones has proven to be a success key of the "Super Girl" business operation [37].

At the end of the show, the television station's SMS income from mobile message votes was approximately more than 30 millions RMB (approximated 3.743 millions US dollar). This amount may account for 30%-50% of the total profit of the TV entertainment program, and is almost equal to total advertisement income. For the SMS total profit, each participant from different industries reaped its own part in proportion with: 15% cut for China Mobile, 30% cut for China Unicom, 20% cut for China Telecom and China Netcom, the rest part is for HSTV and others [38].

According to Lu [39], the downloading of Super Girl ringtone also generated at least 1.8 million RMB /month. Hence, the "Super Girl" 2005 is a considerable successful interactive mobile entertainment business case in China. In summary, it is a typical all-win value-added business model; China's traditional entertainment industry (such as HSTV) is a big winner, at the same time China's telecommunication industry (China Mobile, China Unicom, etc.) is also a satisfied winner, even for traditional industry, The Mongolian Cow Dairy made a significant profit. The company has sold over 2 billion packs of yogurt in 2005 and their sales revenue rose by 270% [39]. Finally, the super girls will sign a contract with the Tian Yu Media Ltd, a sister company with HSTV.

Profits from the super girl road shows and CD record, related product are waiting for them to collect.

Analysis

The purpose of business model is to serve as an analytic tool in investigating the business logic of a company [40]. Through a business model one can improve the measurement and observation of a company's business logic and then establish a comparison with other company's business logic [41].

The business logic of a company constantly changes because of inside and outside pressures as mentioned above. Both internal and external elements can be seen interacting and interfering with each other. Therefore, a structured approach to business models analysis is important to understand which particular issues are changed over time [41]. Various approaches can be adopted. The approach adopted in this study centers on value and, hence, on how each element (external and internal) of the business model is contributing to or detracting from it. As a result of this approach, each element is only discussed in terms of its value creation. In this sub-section, we evaluate the logic of value creation in the cases of MyShow and Super Girl.

MyShow

MyShow's business objective is primarily premised on recruiting talented new artists. The adoption of a TV format, served as a new innovative means of attaining that objective. Nonetheless, its business model can be found lacking in several aspects, which, by turn, has detracted from MyShow's ability to create value.

The nature of the firm, joint venture, created several disadvantages. The joint venture (SUM Entertainment), established on the 27th of February of 2004, consisted of Universal Music Group (UMG), holding 49% of the share, and Shanghai Media Group (SMG), holding 51% of the share. Both organizations have reputable standings, UMG being the number one music record group in the world and SMG the second largest media group in China. Nonetheless, an alliance between two successful firms is not necessarily a recipe for success, as will be noted by the analysis of the case. Joint ventures prove difficult, in particularly when these involve two different national cultures. National culture will invariably impact the organizational culture and hence, all levels of business: strategy, communication, human resources, structure and management [42]. If a joint venture is to be successful, organizations must respond nationally and capitalize on its competitive advantage [23]. From MyShow's strategy we can note, however, that the environment was not fully understood and, hence, the potential to create value by understanding it, diminished.

Several aspects of the environment were overlooked, including China's culture and psyche. SUM entertainment business strategy is focused on three categories of product and service: organization and management of the artists' activities and music related events, development of new media and market partnership, and advertising and sales of music products such as CDs and DVDs [43]. Their strategy to adopt TV as a medium for the attainment of their primary objectives is a noteworthy response to the challenges that the companies in the music industry, including SUM, are facing. However, it is a well-rounded strategy to capture the audience. To adopt a new media stream in order to compete with growing market changes, one must understand the medium's full potential, including its social importance.

The primary objective of MyShow was professional selection, not creating value propositions for the spectator. According to Hui [34], SUM is working in function of music not of entertainment in general. As such, while value was created at a social level, through the equity of all contestants (i.e. everyone, despite background, race and social status, is given a chance of becoming a superstar), the value created for the spectator proved insufficient. This insufficiency can be noted by MyShow's lack of popularity, partly attributable to the broadcasting nature of the show, and by SUM's adoption of SMS voting in the second year as an attempt to regain the audience and thus generate more revenue.

By failing to fully understand its environment, SUM also initially concentrated on the spectator consumer and overlooked the mobile consumer. Research shows that China is a hub for the mobile market [9]. Mobiles are central in the Chinese lifestyle, much in the same manner as computers are to the American lifestyle. Yet, SUM failed to recognize and take consumption cues from the Chinese culture and thus, MyShow's success suffered from technological limitations; Only broadcasting TV and the internet were initially adopted. Several value propositions could have been created through the introduction of further technology, specifically mobile, in its business model, as was later noted by SUM.

The value created from the spectator, revenue, nonetheless was not completely lost by SUM's failure to tap into several key environmental and technological elements. MyShow essentially worked as a pre-marketing strategy of an upcoming new artist. While no money has been gained from the show itself, it is expected that SUM's revenue will increase due to the signing of a new artist, whose identity is already known to the Chinese world. Dragon TV, the broadcaster of the show, by turn gets more advertisement offers due to the popularity of the event.

To conclude, value gives an overall view of a company's bundle of products and services [9]. In this case, MyShow itself is the product. The value lies in the quality of the entertainment, which can be noted by its popularity. Figure 2 shows a comprehensive

illustration of MyShow's business model.

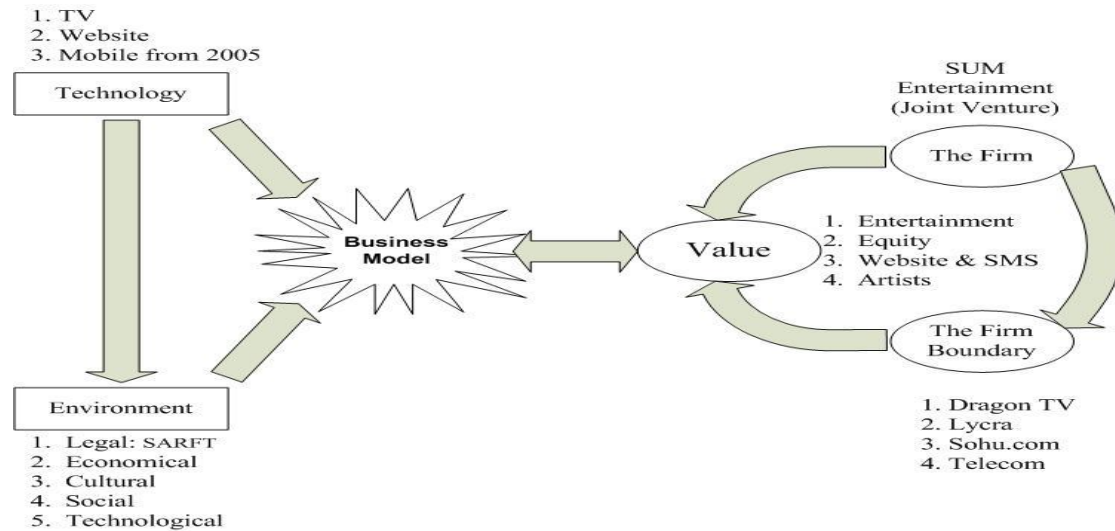


Figure 2. Business model for MyShow

Super Girl

Unlike MyShow, Super Girl is a creation of state-owned HSTV, whose strategy is to create Happy China phenomenon. HSTV had been focusing on producing entertainment programs, such as weekend TV shows which differentiate itself from other local TV broadcasters. Using this strategy, HSTV receives higher level of popularity and higher advertisement income than others [35]. Its value creation, then, like its approach, varied significantly from MyShow.

Because Super Girl's firm consisted of a state-owned enterprise, the show benefited from a clear understanding of its environment, which MyShow, operating in the same economic market, did not. More specifically, HSTV took consumption cues from its country's culture and psyche. It took the business model from "American Idol" and recycled it, knowing the influence of western culture on the Chinese young generation, the centrality of mobile phones to the Chinese lifestyle and the valorization of a "voice." Super Girl's value proposition is simple: invite the country to participate and then invite viewers to express their approval or disapproval via text messages and dig deep into the ensuing revenue stream. This proposition is not only attractive to mobile phone users (over 400 million), but also to the population in general who is seeing the show live and has been given the opportunity to vote, a valued proposition in a non-democratic society. The government, by turn, does not object due to the harmless nature of the voting. Essentially, Super Girl created context and meaning for its audience.

As a result of understanding and tapping into its environment through the adoption of appropriate strategies and technologies, Super Girl became China's big TV hit and value creation resulted for various stakeholders: company, consumer, suppliers and TV advertisers. Passive TV consumers were empowered by SMS (each consumer allowed to vote up to 15 times) and, as a result, became paying repetitive customers, increasing Super Girl's popularity and raising the premium of its advertisement slots. Advertisement sale reached up to 112,500 RMB per 15 seconds during Super Girl's final stage [36].

But to benefit from Super Girl's value creation, besides HSTV and the consumer, were also the Mongolian Cow Diary Ltd. (MCD), Super Girl's official sponsor, the telecommunication companies involved with Super Girl and Sina.com, Super Girl's official website. Following the sponsorship of Super Girl, MCD's revenue sales increased by 270% [45]. The telecommunication companies (China Mobile, China Unicom, China Telecom and China Netcom), by turn, shared the profits of SMS votes and binding services. And Sina.com's traffic increased with Super Girl fans, which could join discussions, read the latest news, see pictures, and download Super Girls' songs, the latter at a cost [42]. Figure 3 illustrates Super Girl's comprehensive Business Model, laid out according to the same business logic framework as MyShow's.

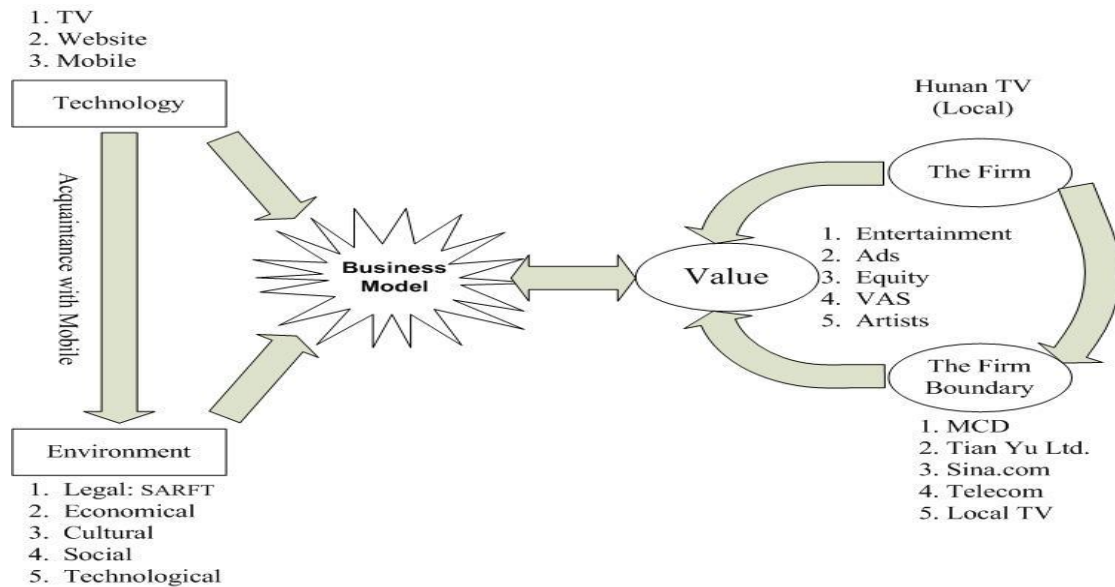


Figure3. Business model for Super Girl

CONCLUSION AND DISCUSSION

Our comprehensive approach allows companies to compare their business models with those of their competitors. Having identified MyShow’s and Super Girl’s comprehensive business model components, we can conclude their difference in Table 2 and Figure 4. Included in the table are also key figures of each show which demonstrate the value created by each business model.

		Super Girl	MyShow
CBM Components	The Firm	Local TV	Joint Venture
	The Firm Boundary	Telecom, Local TV Stations, Mongolian Cow Diary	Dragon TV, Lycra, Telecom form 2005
	Technology	Mobile	Mobile from 2005
	Environment	Acquaintance with mobile	
	Value	VAS	Limited VAS
Key Figures 2005	Contestants	150,000	60,000
	Sponsorship	RMB14,000,000	RMB 1,000,000
	SMS Votes	RMB30,000,000	unknown
	Ringtone	RMB1,800,000/month	unknown
	TV Ads	RMB112,500/15sec	unknown

Table 2 The comparison of business models for MyShow and Super Girl

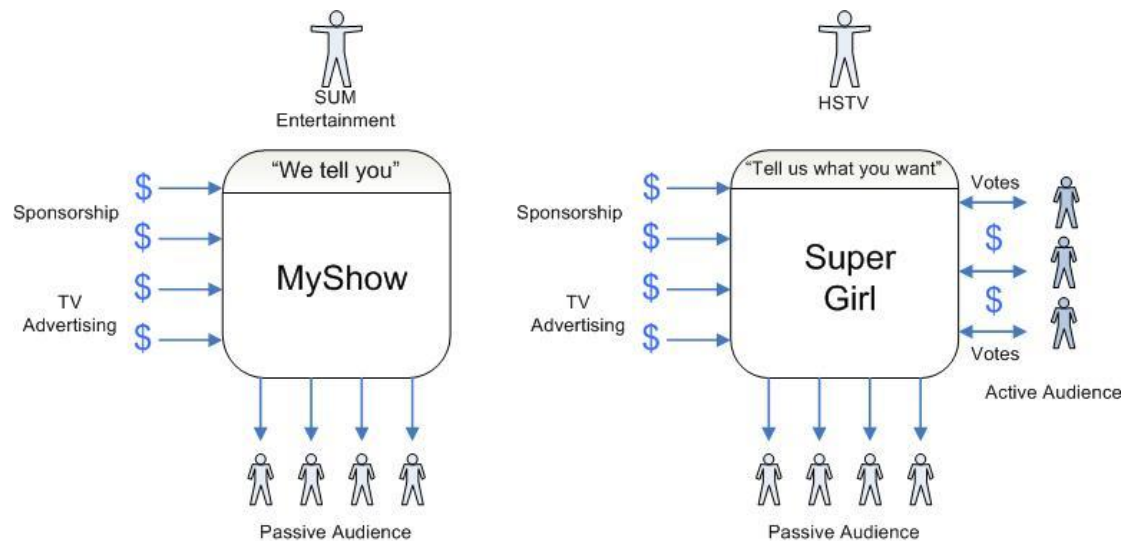


Figure 4. Comparison of the value proposition

From the figures in 2005, we can tell that Super Girl is relatively more successful than MyShow [34]. As can be noted from the cases, Environment is a critical element in a company's value creation, which is, by turn, affecting and affected by Technology. Internet and mobile technology reshape the way people communicate. Increasingly, people are spending more time online and sending text messages. The acquaintance of the modern equipment makes people feel comfortable to vote through SMS or to share opinion on a website.

Technology is a key differentiator in the two cases. In Chinese mobile market, up until July 2006, there were total 431.7 million subscribers for the mobile network, a number which will continue to grow at the approximately rate of 17.5% [44]. The SMS voting strategy has aligned the popular show with the huge telecommunications market. With the value-added service, audience can get more involved and have the collective power of deciding who is going to win. In turn, technology attracts more audience.

Technology provides value-added service as well, the SMS votes. This service provides audience with interactivity and participation. In return, telecom companies will be benefit by the charge. Besides SMS voting, ringtones, news are also available for fans once they have voted via their mobile phone. As shown in Figure 4, interactivity and participation is an important value proposition in the Super Girl case.

As can be noted by the figure, MyShow's SUM and Super Girl's HSTV both rely on sponsorship and advertising, but Super Girl has also turned the consumer into value creation. With low level of participation (mainly a passive audience), MyShow is forced to improve the quality of its content and to understand the needs of advertisers so as to build stronger relationships with them, whom SUM is dependent on for value creation. Super Girl, on the other hand, with high level of interactivity and participation, is targeting fan's loyalty and providing value added services so as to retain it. The program builds deeper relationships with active audience and allows active participation and community building in forums. As a consequence, Super Girl found a new way of value creation – the consumer.

Also to be noted in the two cases is the change issues in business model analysis, previously discussed above. The technological change causes the change of environmental issues, and finally changes the delivery of key value. As a result of the diffusion of mobile technology in Chinese society, more and more people are using mobile phones. Also, people are becoming more and more reliant on this technology. Within a few years, Chinese mobile market has come to dominate. In 2005, alone, the Chinese wireless telecommunications services market generated revenue of \$33.6 billion in; this figure represents an increase of 20.6% from the previous year and a compound annual growth rate (CAGR) of 34.2% for the five-year period spanning 2001-2005, exceeding the Asia-Pacific CAGR of 16.1% for the same period [45]. Environment elements like social and economical issues, by turn, have been changed by the mobile diffusion. Hence, the change also influences the key value at the center of the business model. This value gives Super Girl more competitive advantage.

Given the popularity of the show, more and more people from different ages are looking forward to the next season. Some older people were motivated to learn how to use mobile phone to send supporting messages to vote for their favorite contestants. Again, the environment is changing, because more and more people learned to use SMS function. Consequently, in 2005, SMS revenue has raised to approximately 30 million RMB [42].

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MOBILE TECHNOLOGY AND CULTURE CHANGE: A REDEFINING VIEW OF TIME AND SPACE

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ABSTRACT

The fast development of mobile technology in recent years has penetrated the global business world. Empirical studies, however, are substantially lagging behind this exponential technology expansion. This study thus seeks to provide a refreshing understanding of organizational changes enabled by mobile technology. More specifically, based on an interpretive approach, my study analyzes how mobile technology redefines the notions of time and space in the organization's routines and structures and how such redefining changes in turn subtly transform organizational culture. Valuable practical implications and future research directions are thus suggested.

Key words: Mobile technology, culture, time, space, interpretive, case study

INTRODUCTION

As practitioners continued to project how mobile technology would create a new competitive market and potentially transform the manner in which business is conducted [1-5], most scholarly work on mobile phenomenon over years simply addressed conceptual issues or technical concerns [6-9]. Empirical studies seemingly failed to pay adequate attention to the phenomenon until very recent years. Even with such growing attention and empirical efforts [10], most investigations tended to focus on the applications and capabilities of mobile technology [11, 12] or individual usage and adoption behavior [13, 14] including consumer intention in mobile commerce context [15, 16]. While the merit of these empirical efforts was laudable, it could not provide sufficient understanding of the relationship between mobile technology and organizations. In other words, how mobile technology transforms the organization as predicted by practitioners [17] still critically needs empirical investigation and findings. My research inquiry thus seeks to extend these recent research endeavors and in turn provide a better understanding of the process through which mobile technology transforms the organization.

My particular interest centers on how mobile technology transforms organizational culture through the perspectives of time and space. The primary research question inquires, "How does mobile technology change organizational culture?" The focus of organizational culture reflects the significant role that an organization's culture plays in today's global and diversified work environment [18-23]. In addition, similar to mobile technology, the notions of time and space are relatively new perspectives in our research community [24]. They mirror the unique attributes of mobile technology and could provide valuable insights to the organization's management.

CULTUREAL ELEMENTS

Sociologists define culture as the interaction and collective behavior recognized and practiced by actors in a group [25]. In a simple sense, culture configures social relationships and reflects "ways of life" [26]. Such ways of life represent a set of shared values that distinguish members of one group from those of another [27]. As such, the underlying assumptions of culture theory are that people concerns most about their relationships with others and others' relationships with them so they often inquire "who I am" and "how should I behave" seeking their identity and social recognition in a group [28]. Organizational culture, thus, reflects such shared values and collective behaviors in an organization's routine or everyday life.

The influence of mobile technology on the organizational culture would then need to take account of changes emerged in organization members' collective actions or shared values [29]. Such changes could be reflected in organization members' interaction and communication [30], collective work patterns [31], power and control [32, 33], interpersonal relationships [34], coordination and collaboration [35], and/or their interactions with the technology [36]. Drawing from the perspectives of time and space, I will demonstrate how the emergency of mobile technology in the organization would also explicitly and/or implicitly transform an organization via these cultural elements aforementioned.

MOBILE TECHNOLOGY IN TIME AND SPACE

By nature, mobile technology is unique for its ability to enable the technological mobility of individuals and organizations; this enabled technological mobility could provide functionality similar to that of any other technologies but at "anytime and anywhere." This "anytime and anywhere" notion is an enabled freedom, which serves to emancipate individuals from the constraints of time and space. As such, technology is no longer designed to simply help users accomplish tasks efficiently but more importantly to be attached to the users. In other words, technology will accompany individual users even as they travel. A technologically enabled mobile user would then become a moving workstation [6]. Regardless of *time* and *space*, individual mobile users could and would be working continually. The literature related to *time*-based competition and *location*-independent

flexibility, thus, can provide valuable insights to help explain how this movement benefits the organization and, in turn, transforms organization members' shared values and collective behavior, i.e. organizational culture.

Time-Based Competition

Since Stalk [37] first introduced the notion of time-based competition (TBC), TBC has significantly transformed many corporations [38]. However, with the rapid growth of the Internet and relevant technologies in the 1990s, researchers began to recognize the need for re-conceptualizing TBC's original notion—*timeliness* [39]. Timeliness is defined as “the need for speed” and considered as the driving force for IT investment [38]. Nowadays, customers are more service oriented and responsiveness sensitive [40]. They demand not just prompt service but also the service delivered at any time instantly. In other words, “speedy service” is not enough; it has to be also “*at any time*” and “*instant.*”

Location-Independent Flexibility

Similarly, conventional wisdom has recognized location as a significant factor in determining much of an organization's competitive advantage [41] or in enhancing an organization's ability to overcome many barriers [42] such as communications and interactions [43]. With the increasing effectiveness of computer and communication technology and changing life style in society, the location factor is projected to change and be centralized to individuals leading to a highly mobile workforce [44]. As illustrated by Lynskey [45], “industrial competence is now widely dispersed geographically, competencies are increasingly situated outside the firm” (p. 317) and can be found everywhere. The emancipation from the constraints of time and space enabled by mobile technology naturally changes organization members' interaction and communication [30], collective work patterns [31], power and control [32, 33], interpersonal relationships [34], coordination and collaboration [35], and/or their interactions with the technology [36], which, in turn, collectively and ultimately, transform an organization's culture in subtle processes.

RESEARCH METHODOLOGY

To help unveil how mobile technology transforms an organization's culture in subtle processes pertaining to cultural elements mentioned above, I conducted an interpretive case study to allow authentic details to surface. My inquiry involved one large public university and six private organizations in the U.S. throughout one academic year. These organizations were chosen because they have implemented wireless networks at that time and witnessed consequent organizational changes. The primary data source was based on semi-structured interviews while organizational documents and websites provided supporting materials. The interview duration varied from approximately 55 to 125 minutes. The recorded interviews were soon transcribed and resulted in 148 single-spaced pages of transcripts. My coding strategy was primarily based on “analytic coding” with two stages involved: “initial coding” and “focused coding” [46]. The initial coding was a broad search for any concrete indications that were related to conceptual definitions. As the quantity of initial codes continued to accumulate, the more frequently used codes were then articulated and developed into focused codes. The focused coding would then elaborate more on the frequently used codes and collapse or dismiss those that were less relevant.

CULTURAL ANALYSIS

The results of analytic coding revealed that culture changes not just manifested themselves specifically in the areas aforementioned but also connected to the notions of time and space. More specifically, these organizations have witnessed more responsive interactions and communications, enhanced power and control, spontaneous work patterns, impersonal relationships, simultaneous coordination and collaborations, and the shaping of technology informality; all of which contributed to an organization's cultural transformation. However, due to the limitation on paper length, only selected examples of culture changes were presented here.

Changes in Interaction and Communication

In a group of technical service providers who were constantly traveling, carrying mobile devices such as BlackBerry and cellular phones denoted that group members would expect one another to engage in and commit to a highly responsive interaction and communication. Failing to do so could result in certain difficulty of maintaining their status in work groups. The use of mobile devices thus fundamentally transformed collective communication patterns, which, in turn, contributed to the changes of organizational culture. This subtle change was best illustrated by Derek's message below.

If you are carrying one of these [BlackBerry] and you are on this account and you have it on. Ok. I send you a message; I have a high degree of certainty you got that message. If you don't answer me back I am gonna ask you why later on [time]. I think that is a fair question. And we don't accept the excuse that 'hey, I didn't get this so I couldn't help you out.' If the guy doesn't answer back... like I paged somebody an hour and half ago [time]... I know he's gotten it, so he is either in a meeting or he is ignoring me [location]. And I will know sooner or later [time]. That has definitely... you can see how that has *changed the workforce*. People are much *more intent to each other* because they know that the other person knows that you got the message. (Derek, TechServ1)

Changes in Power and Control

With lesser face-to-face interaction in a wireless enabled work environment, how a manager evaluated employees' performance and teamwork has differed from traditional face-to-face mechanism. To a manager who was task oriented and tended to

constantly monitor an employee's work progress, mobile technology could offer a medium for him/her to demand feedback from the subordinates regarding his/her work progress at anytime (*time*) and from anywhere (*space*). With the technology enabled flexibility and communication, the subordinates would have no excuse of not being able to respond promptly and constantly. The presence of mobile technology, therefore, could significantly reinforce *controlling* leadership style as illustrated by Derek's message below.

They can *supervise you more not less*. If my boss pages me on this [BlackBerry] and says 'Derek, I want to talk to you', and I am in one part of HN [their city] and he is in another part of HN [location]. He's got a cell phone; I have got a cell phone. And I get that page, what do you think the chance for me saying 'Nah, I don't want to talk to him?' —None. So what that allows is it gives him the confidence to know that if he wants to reach out and touches me, he can do it *anytime he wants to* [time]. That is about as much control as I, you know, 'cause he knows I am gonna get that page... (Derek, TechServ1)

Changes in Work Patterns and Atmospheres

Alternative ways of performing daily activities, such as working outside instead of in the offices, were also enabled by mobile technology so that employees could continue to accomplish their tasks regardless of surroundings. A highly mobile workforce even within the same facility was then emerged. As people moved around the building or the campus, they would gradually form different organizational settings, engage in conversations on which they would not normally carry, and inevitably develop an emergent mobile organizational structure within which the traditional boundaries among the divisions or departments could become less significant. Similarly, in an urgent scenario when a professor had child care needs, he/she could easily manage his/her work schedule (*time*) and conduct his/her work without physically being present at school (*space*) as indicated by Garth's message.

People who want to work at 2am can work at 2am [time]. People who have child care needs or whatever that needs to have flexible schedules [time], have much easier time doing that. We have a professor who had twins three weeks ago, *he does not need to be here, he needs to be home with his twins but he is still working* [location]. (Garth, Law1)

Changes in Interpersonal Relationships

Enabled by technological flexibility in a wireless environment, the number of mobile workers who frequently engaged in lesser face-to-face interaction increased, even when they were located in the same facility. In Energy2, for example, most people would no longer involve in face-to-face activities and most businesses were operated by wireless communication. It has been increasingly experienced that Michael's jobs including supervising his team were mostly conducted through non face-to-face situations.

These are our offices. If they weren't here [location], I would probably never see their faces because they have their own things but we can still communicate. We can still talk. I would never typically see them... Everything can be done through email. I can give him all the requirements that I have and he can reply back saying "ok it is done what you want me to do next" [time]. I see that happens more often where I don't have to talk to him on a phone anymore because I can be on the bus going back home and typing a message to him saying "Here don't forget to do this if you are still here" or something like that [location]. So everything is probably gonna be even more *impersonal* of an environment. (Michael, Energy2)

Changes in Coordination and Collaborations

Another change in the organizational culture manifested itself in how group members coordinated and collaborated with one another. As mobile technology facilitated time and location flexibility, it tremendously changed group members' perceptions and expectations as to how team work should be accomplished and in turn increasingly transformed how group coordination and collaboration were actually carried out. A typical example could be observed in the description of Richard from Compu1 where the wireless mobility allowed a presenter to send audiences his presentation immediately in a conference meeting.

I think it is just taken for granted... Now we are in a conference room, we just say... "Can you send me that presentation?" You have 30 seconds *right then and there* [time and location]. *It changes the way we work with our people, and the way we were.* (Richard, Compu1)

Changes in Technology Interaction

Finally, the last element of cultural changes centered on how the interaction between employees and technology was shaped and reshaped by mobile technology. Traditionally, the formality of organizational culture intensified as the channels of communication became more technologically dependent. As such, the formality would inevitably intensify as the communication channel relied more on technology which provided less non-verbal communication cues. However, organizational culture, largely shaped by how group members perceived their identity and how they interacted with one another, was mostly driven by informal interactions and eventually reflected in specific, locally sanctioned patterns of collective behavior. As the formality increased with the use of technology, the difficulty to develop or maintain an organization's culture would predictably increase as well. The need to discover or invent different patterns of technology usage would then be essential as suggested by Daniel.

The concept of 'water-cooler', the culture of an organization is traditionally formulated informally more than formally, right? And that 'informal' is virtual water cooler: the water cooler concept is people running into the hall so when they go to the water cooler [location]... maybe today is not the water cooler; maybe it is the juice bar, it is the coffee pot or whatever so that'll be more metaphoric. Most definitely, these are culture channels [location]. We have to channel our culture in different ways... So the

challenge is you have to keep and create that virtual water cooler, ok? You got to enable people to communicate at the lowest level of formality so they can maintain their relationships, maintain their culture and continue to use this channel as their culture... So I notice that people who are sending me a pin [text] message is much less formal [time]. And in a lot of cases, we facilitate communication and meeting the minds better than by using the exact same device that is going through the email gateway. (Daniel, UITD1)

IMPLICATIONS

The insights gained from case analysis demonstrated that subtle cultural changes in a wireless enabled environment evidently manifested themselves in responsive interaction and communication, intensified power and control mechanism, emancipated workplace and spontaneous environment, virtual and impersonal context, simultaneous coordination and collaborations, and emerging technological informality. The issues that a manager should beware would then be how to effectively deploy mobile/wireless technology to maintain positive elements in organizational culture. For example, as employees heavily rely on mobile/wireless technology, the formality of communication could result in the loss of richness that is normally better experienced in face-to-face interactions. It could also gradually shape an impersonal work environment and comprise the development of employee relations. As such, how to enhance the richness of communication and, in turn, maintain the essence of organizational culture would become critical. As indicated by interviewees, the informal use of technology could better facilitate coordination and communication, sustain the informality of organizational culture, and maintain employee relationships. Therefore, managers might need to consider creating an atmosphere that would encourage informal use of mobile technology.

In addition, IT managers might need to be aware of managerial issues emerging from an impersonal, virtual context where employees are more spontaneous with work schedule and space. If teamwork is highly emphasized in the organization, managers might need to deploy certain mechanism to promote employees' communication so that team collaboration could be maintained. Other critical issues in such impersonal, virtual environment include organizational justice and leadership. Since face-to-face interaction becomes less frequent in a wireless enabled environment, social relationships and interpersonal skills might become less significant in the workplace and, in turn, lesser a factor in outcome appraisal. The evaluation of employees' performance might then need to focus on other factors.

Since employees could be constantly mobile, how managers coordinate the team become rather critical as well. As employees' perceptions and expectations with regard to their shared values and collective behaviors in mobile, virtual environment significantly differ from traditional work environment, managers might not be able to lead their teams in traditional approaches. There is no doubt that it creates more barriers for managers because the fine line between tight (controlling) and loose (empowering) leadership style might not be easy to capture. As mobile technology and virtual workplace continue to develop, I would suggest that managers be more empowering and, in turn, coordinate and evaluate their teams based on goals and outcomes rather than the requirements of time and place that are traditionally predetermined by the organization. In so doing, managers of mobile work teams might find themselves have better time to accomplish their team projects and at the same time shape commonly recognized values and collective behaviors that help maintain long term work relationships.

CONCLUDING REMARKS

Despite practitioners' substantial discussion on the potentials of mobile technology, our research community critically needs more attention to this evolving and uncertain phenomenon. In line with recent research efforts, my interpretive case study has shed light on how subtle changes in organizations are increasingly witnessed in various cultural dimensions, particularly in relation to interaction and communication, power and control, work pattern and atmosphere, interpersonal relationships, coordination and collaboration, and the interaction with technology. Although the research purpose does not aim for generalization, the changes found in relation to organizational culture here could pave new avenues for future studies. As many interviewees revealed, the future of wireless technology would tend to embrace a more simplified device with integrated functionalities. Wireless networks and mobile technology would thus be centralized into mobile individuals and generate more powerful meanings in transmitting voice and data more swiftly. Our work environment would then tend to be virtual and ubiquitous. Mobile computing devices would be increasingly embedded in work environment and wireless networks would enable work activities boundlessly and timelessly. Any further understanding of how these technological trends lead to changes in organization culture and business practices would thus provide valuable insights to IT practitioners and researchers.

*References will be available upon request.

PERSPECTIVES FROM DIFFERENT LEVELS OF MANAGEMENT TEAMS ON BUSINESS AND INFORMATION SYSTEMS STRATEGIES ALIGNMENT-A CASE OF ALPHA NETWORKS INC.

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ABSTRACT

When formulating their business strategies, companies are influenced by both the internal and external environments. Strategic alignment has been studied extensively for more than two decades, most research has focused on the strategic alignment between business strategy and information systems [9][21][24]. Few works have studied the relationship between business strategies and IS alignment from the perspective of different levels of management.

This study uses questionnaires and interviews to analyze the perspectives of thirty-three managers from different departments. The findings show that the higher an executive's level, the greater the alignment perceived between the company's businesses and IS strategies.

Keywords: Information systems strategy, business strategy, strategic alignment, different hierarchical management teams, Alpha Networks.

INTRODUCTION

Companies are influenced by both the internal and the external environment when formulating their business strategies, and Information technology (IT) plays a crucial strategic role for companies in this process [11][16][22]. IT has become a strategic resource because it brings about or facilitates major changes in industry sectors, in competitive behavior, and in an organization's own strategy, structure, and functioning [6]. GartnerGroup's 2005 annual survey contained 10 CIO resolutions [7]. One of them was "use regulatory compliance demands to invest in related, strategic areas". In other words, CIO strategic decision-making must consider resource allocation and how IS can enhance an organization's performance. This study builds on Miles and Snow's [17] typology of Prospectors, Defenders, and Analyzers. The business strategy profiles of these three types are developed using 1) Venkatraman's [28] operationalization of business strategy; and 2) Sabherwal and Chan's [24] research based on Venkatraman [28] business strategy typology and analysis the alignment of business and IS strategies. Moreover, the paper builds the theoretical profiles of IS strategies that are the most appropriate for Prospectors, Defenders and Analyzers. Alignment is examined as a corporate IS strategy corresponding to the business strategy that the company adopts. The prospective management implications of alignment are then assessed.

LITERATURE REVIEW

Business Strategy

A business strategy is a consequence of decisions made to guide an organization in terms of the environment, structure, and processes that influence its organizational performance. Approaches that distinguish between business strategies are multivariate, textual, or typological [10]. The goal of typological approaches, especially Miles and Snow's model [17], is to create a better understanding in order to identify the real business strategy of an organization. Miles and Snow's typology consists of four types of business operation defined as prospectors, defenders, analyzers, and reactors.

Defenders have narrow product-market domains. These organizations seldom need to make major changes in their technology, structure, or methods of operation. They devote more attention to improving the efficiency of their existing operations.

Table1. Definition of business strategy attributes

Attributes	Venkatraman's Definition [28]
Defensiveness	reflects Miles and Snows'[17] defensive behavior, and emphasis on cost reduction and efficiency methods.
Riskness	captures the extent of riskiness reflected in various resource allocation decisions as well as choice of products and markets.
Aggressiveness	improves market positions at a relatively faster rate than the competitors. Product innovation and market development are highly priority in this type of company.
Proactiveness	reflects proactive behavior in relation to participation in emerging industries, constant search for market opportunities and experimentation with potential responses to changing environment trends.
Analysis	focuses on overall problem solving viewpoint. It related to the "comprehensiveness" trait, which is conceptualized and measured as an important construct of the strategic management process. This attribute does not reflect the "analyzer" behavior of Miles and

	Snow [17] typology, which simply indicates a balance between “pure prospecting” and “pure defensive” behavior.
Futurity	reflects temporal consideration reflected in key strategic decisions. It also concerns with effectiveness (long-term) versus efficiency (shorter-term).

Prospectors search for market opportunities almost constantly; hence, they are the creators of change that their competitors must respond to. Because of their highly product and market innovation, these organizations are not usually very efficient. Analyzers have the strengths of defenders and prospectors. They operate efficiently through the use of formalized structures and processes. Senior managers watch their competitors closely for new ideas, and rapidly adopt those that hold the most promise.

Reactors have little competition with their competitors. Because their organizations lack consistent strategic-structural relationships, they seldom make adjustments of any sort, until forced to do so by environmental pressure. Some researchers [10] argue that this organization type is not viable in the long run. In this paper, we do not consider this type of operation.

Miles and Snow's typology captures the strategic differences among different types of business operation in industry-independent terms [10]. Several studies [9][13][14][17][21][24][26] have identified the theoretical profiles of Miles and Snow's business strategies. Venkatraman [28] developed a strategy concept called Strategic Orientation of Business Enterprises (STROBE), which is partly based on Miles and Snow's typology. He proposed six strategic attributes, as shown in Table 1. Subsequently, Sabherwal and Chan [24] proposed a research framework and used STROBE as a strategy typology. They modified Venkatraman's attribute “riskiness” to “risk aversion” because of a more conservative view of business strategy.

IS Strategy

IS strategy focuses on systems or business applications of IT, and is primarily concerned with aligning them with business needs and using them to derive strategic benefits [6]. King [12] argues that the IS strategy should be derived from the Business Strategy. Indeed, IS strategy is directly concerned with business applications, and there have been previous suggestions that it should be aligned with business strategy [3][12][33]. Lederer and Mendelow's [15] research findings show that aligning business and IS strategies, including the developed systems being more critical to the organization and top management support for IS projects. These works suggest that alignment between business and IS strategies enhances business success.

Operational support systems are linked to IS in order to monitor and control operational level events, and are expected to facilitate operational efficiency. Several researchers [24][26] rated the importance of operational support systems as high, medium, and low for defenders, analyzers, and prospectors, respectively. Defenders using these systems are expected to encounter slower rates of change, and the systems are ideally suited for improving and maintaining efficiency. Prospectors, on the other hand, may underutilize or mis-utilize a system's resources because they frequently change their business domains, transactions and business processes.

Market information systems related to IS focus on markets and product sales. Prospectors using these systems focus on product and market trends and have bigger marketing budgets than defenders [10]. Prospectors also have more flexibility than defenders, who are unable to respond quickly to major shifts in the market. Analyzers have successful imitation, which is accomplished through extensive market surveillance. Hence, analyzers also rank high in the use of market information systems.

Inter-organizational systems emphasize stability so there are few changes in these systems [24]. Defenders and analyzers benefit more from these systems than prospectors because, unlike prospectors, they need more stable relationships with their customers and suppliers [24]. Prospectors make less use of structured inter-organizational systems because of the lack of formalization. On the other hand, inter-organizational systems can provide analyzers with product/sales information, which can facilitate complex collaboration between product and marketing functions.

Strategic decision support systems have received less attention in the literature. According to Sabherwal and Chan's [24] research, the business strategy attributes of these systems play a major role in all three configurations. Prospectors benefit from these systems because they facilitate quick strategic decision-making (proactiveness), while defenders can use them to make long-term plans (futurity). Meanwhile, analyzers can utilize these systems to obtain more information about the internal and external environment.

Strategic Alignment

Strategy alignment can be implemented in many different ways [25], one of which is business and IS strategy alignment. Several studies have highlighted the importance of this type of alignment [12][33]. Venkatraman et al. [29] proposed a strategic alignment model that includes business strategy, information technology strategy, organizational infrastructure and processes, and information technology infrastructure and processes, as shown in Figure 1.

In this model, IS processes are analogous to the business processes that support and shape the firm's ability to execute its business strategies [29, p.141]. The greater the alignment between an enterprise's business strategy and IS strategy, the more chance there is that the IS strategy will be successful. Organizations with stronger alignments between their business and IS strategies are also more likely to utilize IS to gain a competitive advantage [6][29].

Different Level Managers Involvement

Some researchers have suggested that the business strategy is not always explicit or consciously developed at the top of an organization [2][19]. In such cases, the chief executives' views of their organizations' strategies do not necessarily align with the actual strategies, which are observed by objective data [20]. These chief executives often disagree with their management teams as to what the organization's strategy should be [2].

Hambrick found that strategic awareness increases with organizational level. Managers closest to the top of the organization are the most aware of its strategy [10]. On the other hand, some scholars, such as Mintzberg [19] and Quinn [31], observed that there is a risk that an organization's middle-level managers will over-zealously and single-mindedly implement a strategy

once it is made explicit. This argument holds that strategic awareness can have a neutral or negative effect on performance. However, some studies have found that agreement about strategy among top managers is positively related to performance [33].

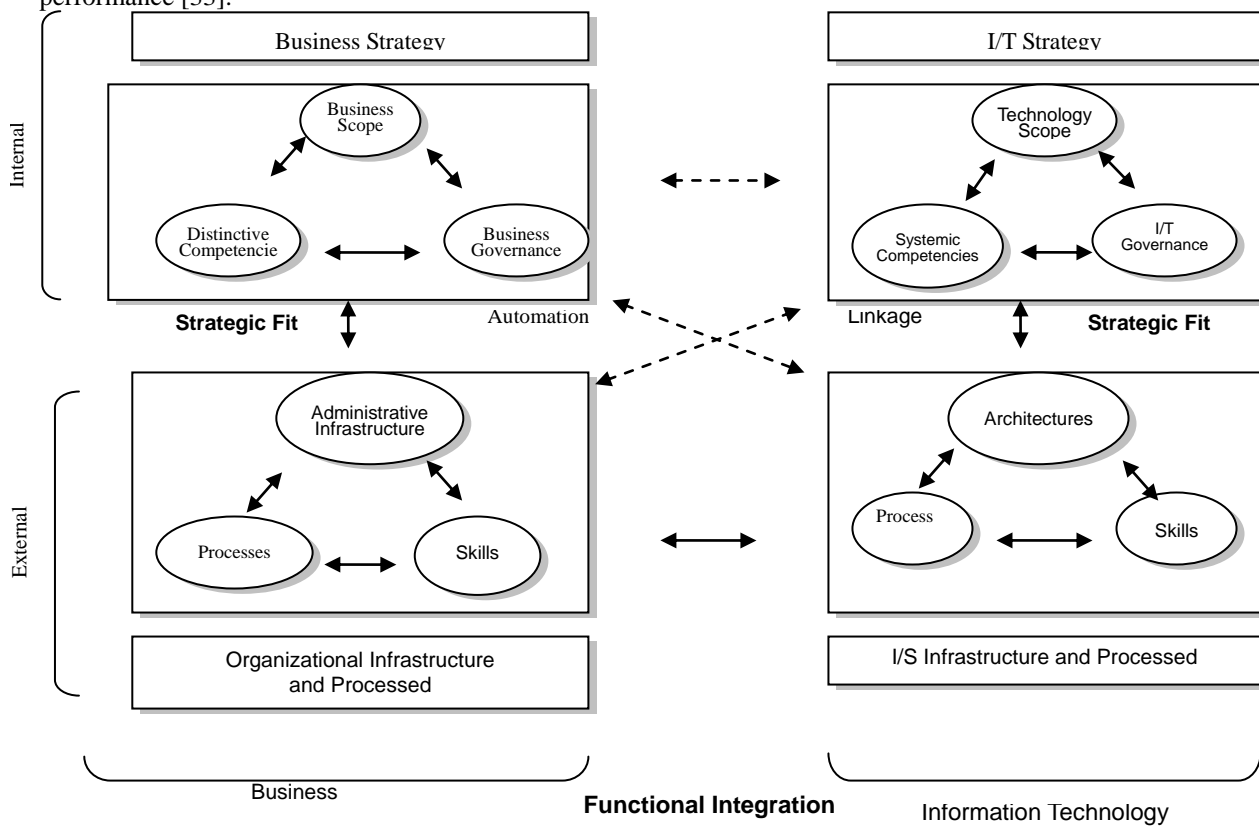


Figure1. Strategic alignment model [11]
METHODOLOGY

Research Methodology and Framework

We chose the case study method to investigate the research questions. It is one of several approaches used in social science research. Other methods include surveys, histories, the analysis of archival information, and experiments [32]. We use multiple documents and archival records to analyze the development of IS and history of IS, since such sources reduce bias and they are recommended for case study research. In fact, the various sources are highly complementary, and a good case study should therefore use as many sources as possible [30]. This study is considered exploratory since few works have investigated the relationship between business and IS strategy alignment from the perspective of different levels of management. We had a pretest for questionnaires. Reliability test is conducted. Cronbach alpha values of all constructs are all above 0.7.

The research framework of this study, shown in Figure 2, is comprised of four major components: business strategies, IS strategies, strategic alignment, and different levels of managers. We also propose four constructs. Business strategy signifies business strategy position, using Miles and Snows [17] typology and Sabherwal and Chan’s [24] questionnaire. IS strategy stands for IS strategic decisions, using Sabherwal and Chan’s [24] questionnaire. Based on this framework, we discuss the perspectives of different levels of management on business and information systems strategy alignment.

Data Collection and Analysis

This research focuses on managers in different levels of the company. A questionnaire was sent out randomly using staff members’ ID numbers. In total, 36 questionnaires were returned, of which 33 were valid. The valid retrieval rate was approximately 91.6%. Next we consider the personal attributes of the managers who returned valid samples. Using Sabherwal and Chan’s [24] analytical method, we calculate the alignment result of this company. The following Table 2 shows the 33 managers’ perceived strategic typologies.

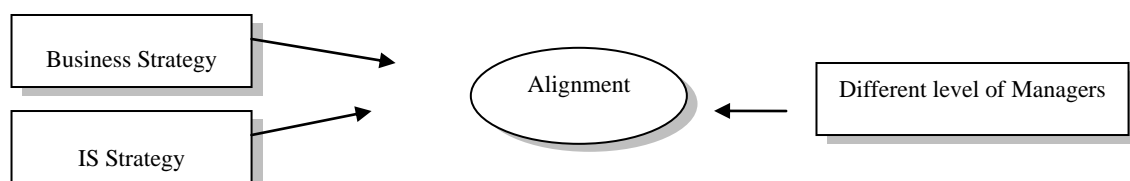


Figure2. Research Framework

We also use Pearson's correlation to analysis the relationship among some research variables. Table A (at the last page) shows the results of the correlation analysis. According to Pearson's correlation coefficient, the business strategy attributes of Defensiveness, Analysis, Risk Aversion, Proactiveness, and Futurity are highly correlated with alignment. This implies that this company prefers the Analyzer or Defender strategy. Note that Aggressiveness is not significant.

Table2. Managers perceived strategic typology

Position	Strategic Typology	Position	Strategic Typology
1. chief technology officer	D	18. section manager4	P
2. deputy general manager1	A	19. section manager5	P
3. deputy general manager2	A	20. section manager6	P
4. deputy general manager3	D	21. section manager7	P
5. deputy general manager4	A	22.section manager8	P
6. division manager1	A	23. section manager9	P
7. division manager2	P	24. section manager10	A
8. division manager3	A	25. section manager11	A
9. department manager1	P	26. section manager12	A
10. department manager2	D	27. section manager13	A
11. department manager3	A	28. section manager14	A
12. department manager4	A	29. section manager15	A
13.department manager5	P	30. section manager16	D
14.department manager6	D	31. section manager17	D
15. section manager1	D	32. section manager18	D
16. section manager2	P	33. section manager19	D
17. section manager3	P		

Note: P, A, D represent Prospectors, Analyzers, and Defenders, respectively.

If we categorize these managers by department, we obtain another picture of the strategic typologies, as shown in Table 3. A detailed analysis of IS strategy attributes shows that four attributes are correlated with alignment, especially Strategy Support Systems, which are significant at $p < 0.01$. We find that alignment is negatively correlated with Aggressiveness. The more alignment there is between business strategy and IS strategy, the lower the importance of Aggressiveness.

DISCUSSION

Business strategy is formulated by top managers and implemented by first- and second-level managers. The CTO and one deputy general manager consider that the business strategy of the company is Defender, while three deputy general managers believe it is Analyzer. Miles and Snow [9] pointed out that the attributes or characteristics of Analyzer are similar to those of Defender. We believe that this case has more conservative activities in business operations and R&D. Significantly CTO and deputy general managers agree about their perceived business strategy. However, for first- and second-level managers, the results are quite different. In other words they have many different perspectives about the company's business strategy. We find that eight section managers are Prospectors, seven are Analyzers, and four are Defenders. Inconsistent perspectives of business strategy among section managers indicate that consensus is not happened in these two levels.

Table3. Managers perceived strategic typology categories by department

Department	Chief Technology Officer	Deputy General Manager	Division Manager	Department Manager	Section Manager
Manufacturing	n/a	1A	1A	1P	1P, 1A
Marketing /Sales	n/a		1A	1A	1P, 1A
Finance	n/a	1A	n/a	1A	1A
HR	n/a		n/a	1D	1A
IT	n/a	1A	n/a	1P	1P, 2D, 3A
R&D	1D	1D	1P	1D	5P, 2D

Note: P, A, D represent Prospectors, Analyzers, and Defenders, respectively.

One reason for this situation is that first- and second-level managers do not attend business operational meetings and annual strategic planning meetings. These meetings are only for high level managers, such as the CTO and deputy general managers. Another reason is that high level managers do not clearly explain the business strategy and IS strategy to their subordinates, especially first-level managers.

Proposition 1: The higher an executive's level, the greater alignment between business and IS strategies.

On the other hand, different departments may have different perspectives about their business and IS strategies. For instance, the deputy general managers of the R&D department believe that their business strategy is Defender. Other deputy managers, such as manufacturing, finance, and IT, believe that their business strategy is Analyzer. This is because each department has its own functional strategy and it must align with the business strategy. Different departments have various culture, resource, and contributions for the company. Under these circumstances, it is difficult for deputy general managers and their subordinates to

follow the business and IS strategies completely. In addition, the perceived business strategy of the deputy general manager of the Manufacturing department is Analyzer. One division manager and one section manager have the same perception. The Manufacturing department is under constant pressure to produce products as soon as possible and it must produce highly quality products. If this department prefers Analyzer, it may need the balance between flexibility and efficiency. The company has various products, such as LAN/MAN, Broadband, VoIP, Wireless, Digital Home, and IP Camera. The Manufacturing department must schedule the production line to produce the various products on time and ship them to customers. Flexibility and efficiency are therefore important for this department.

Proposition 2: Different departments have different perspectives about the company's business and IS strategies.

In the IT department, two section managers perceive their business strategy as Defender, one section manager adopts the Prospector strategy, and three managers adopt the Analyzer strategy. The diversity of opinions may be caused by the managers' job functions. For example, R&D, manufacturing, and marketing clients need quick service and responses when they have problems with their information systems. The IT department fulfills a support function and plays an important role in serving other departments. Hence, the IT department needs more efficiency than flexibility.

In the R&D department, the perceived business and IS strategy of two deputy general managers, one department manager and two section managers is that of Defender. One division manager and five section managers think that their perceived business and IS strategy is that of Prospector. These results are quite interesting and need to be analyzed in depth. This company has a more conservative culture than other companies in the same industry. It does not develop first product to market (compares with other companies in the same industry). The CEO always observes the market trend and predicts future market needs. The CTO emphasizes efficiency and quality, but not too much creativity. One division manager and five section managers think that their business and IS strategies are Prospectors. These results show low alignment in this department, which may lead to conflict in terms of business priorities. If managers have different strategies, the company's performance will be affected.

Proposition 3: Same departments will not consequentially have consistent in perspectives about the company's business and IS strategies.

CONCLUSIONS

We have investigated the perspectives of managers at different levels of a company with regard to business and IS strategies. The results show that business and IS strategies are highly aligned at higher management levels. Different perspectives about business and IS strategies among managers are normal. When an organization grows, effective communications among different levels of managers becomes more difficult. First-level managers who do not know anything about business and IS strategies are not surprising because they hardly receive these messages from top managers. With regard to managerial implications, we suggest that senior managers should explain business and IS strategies to first- and second-level managers at department meetings. This would help those managers understand the actual strategy so they could implement in their business activities.

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TableA. Pearson's correlation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)Alignment	1										
(2)Defensiveness	.602**	1									
(3)Analysis	.663**	.713**	1								
(4)Risk Aversion	.493**	.157	.533**	1							
(5)Proactiveness	.650**	.367*	.431*	.268	1						
(6)Futurity	.628**	.207	.483**	.589**	.434*	1					
(7)Aggressiveness	-.146	.019	-.113	-.155	-.082	-.152	1				
(8)Operational Systems	.599**	.506**	.392*	.074	.319	.152	-.348*	1			
(9)Interorganizational Systems	.659**	.375*	.488**	.156	.447**	.270	-.071	.395*	1		
(10)Market Information systems	.636**	.338	.452**	.287	.460**	.479**	-.276	.513**	.633**	1	
(11)Strategic Support Systems	.664**	.329	.571**	.394*	.462**	.507**	-.373*	.525**	.672**	.824**	1

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A SLIDING-WINDOW APPROACH TO MINING MAXIMAL LARGE ITEMSETS FOR LARGE DATABASES

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ABSTRACT

In this paper, we propose a Sliding-Window approach, the SWMax algorithm, which could provide good performance for both mining maximal itemsets and incremental mining. Our SWMax algorithm is a two-passes partition-based approach. For incremental mining, if an itemset with size equal to 1 is not large in the original database, it could not be found in the updated database based on the SWF algorithm. Our SWMax algorithm will support incremental mining correctly. From our simulation, the results show that our SWMax algorithm could generate fewer number of candidates and needs less time than the SWF algorithm.

Keywords: data mining, association rules, maximal large itemsets, incremental mining, partition.

INSTRUCTIONS

Mining association rules, means a process of nontrivial extraction of implicit, previously and potentially useful information from data in database, which has recently attracted tremendous amount of attention in the database research community [5]. The most important task is to discover association rules. The computer can transform the processed data into the useful information and knowledge. Therefore, *mining association rules* has become a research area with increasing importance [8] [11].

Mining Maximal Large Itemsets

Mining maximal large itemsets is a further work of mining association rules, which aims to find the set of all subsets of large (or frequent) itemsets that has representative of all large itemsets [2] [3] [9]. For example, there are three large itemsets, L_1 , L_2 and L_3 . $L_1 = \{\{A\}, \{B\}, \{C\}, \{D\}\}$. $L_2 = \{\{AB\}, \{AC\}, \{BC\}, \{CD\}\}$. $L_3 = \{\{ABC\}\}$. The maximal large itemsets are $\{ABC\}$ and $\{CD\}$, which can cover L_1 , L_2 and L_3 . The prototypical application is in *market basket analysis*, where the items represent products and records the point-of-sales data at large grocery or departmental stores.

Previous algorithms to mining maximal large itemsets can be classified into two approaches: exhausted and shortcut. For example, the Apriori and AprioriTid [1], and Partition [12], SWF [7] algorithms belong to the exhausted approach. They find out all large itemsets and compare the resulting itemsets, L_i . Then, the maximal large itemsets are found. The Max-Miner [2], MAFIA [3], Pincer-Search [9] algorithms belong to the shortcut approach. As compared with the exhausted approach, the shortcut approach could generate smaller number of candidate itemsets in every scan of the transaction database, resulting in better performance in terms of time and storage space.

On the other hand, when updates to the transaction databases occur, one possible approach is to re-run the mining algorithm on the whole database. All the computation done at finding out the large itemsets are originally wasted and all large itemsets have to be computed again from scratch. The other approach is incremental mining, which aims for efficient maintenance of discovered association rules without re-running the mining algorithms when updates occur [11]. So, some people proposed a concept, *negative border*. The negative border is used to decide when to scan the whole database and it can be used in conjunction with any Apriori-like algorithm.

Therefore, in this paper, we focus on the design of an algorithm which could provide good performance for both mining maximal itemsets and incremental mining. Based on some observations, for example, "*if an itemset is large, all its subsets must be large; therefore, those subsets need not to be examined further*", we propose a Sliding-Window approach, the SWMax

PID	TID	Transaction
P ₁	01	ABCDE
	02	CEG
	03	ABCDEF
	04	BCEG
P ₂	05	ABC
	06	CDEG
	07	ABCDEG
	08	ABCDE
P ₃	09	ACD
	10	BFG
	11	AEG
	12	CEG

Figure 1: An example transaction database.

P ₁		
C ₁	StartPID	Count
A	1	2
B	1	3
C	1	4
D	1	2
E	1	4
G	1	2
* F	1	1

(a)

Figure 2: The result of procedure *gen_count_itemset* after scanning P₁.

P ₁		
C ₃	StartPID	Count
ABC	1	2
ABD	1	2
ABE	1	2
ACD	1	2
ACE	1	2
ADE	1	2
BCD	1	2
BCE	1	3
BDE	1	2
CDE	1	2
CEG	1	2
* ABF	1	1
* ACF	1	1
* ADF	1	1
* AEF	1	1
* BCF	1	1
* BDF	1	1
* BEF	1	1
* CDF	1	1
* CEF	1	1
* DEF	1	1
* BCG	1	1
* BEG	1	1

Figure 3: The *OneI* Table after scanning P₁.

j	k	Temp_C3 ₁ (C ₂ ¹)	Temp_I1 ₁ (C ₂ ¹)
1	4	4	3
2	5	10	6
3	6	20	10

Figure 4: The resulting checking table

Virtual Maximal Large Itemset	StartPID	Count
ABCDE	2	2

Figure 5: The result of procedure *gen_VMLI* after scanning P₁.

P ₂		
C ₁	StartPID	Count
A	1	5
B	1	6
C	1	8
D	1	5
E	1	7
G	1	4

(a)

Figure 6: The result of

P ₂		
C ₃	StartPID	Count
ABC	1	5
ABD	1	4
ABE	1	4
ACD	1	4
ACE	1	4
ADE	1	4
BCD	1	4
BCE	1	5
BDE	1	4
CDE	1	5
CEG	1	4
CDG	2	2
DEG	2	2
* ABG	2	1
* ACG	2	1
* ADG	2	1
* AEG	2	1
* BCG	2	1
* BDG	2	1
* BEG	2	1

Figure 6: The result of

procedure *gen_count_itemset* after scanning P₂.

P ₂	
Item	Count
A	6
B	6
C	8
D	8
E	8
G	3

Figure 7: The *OneI* Table after scanning P₂.

j	k	Temp_C3 ₁ (C ₂ ¹)	Temp_I1 ₁ (C ₂ ¹)
1	4	4	3
2	5	10	6
3	6	20	10

Figure 8: The resulting checking table

Virtual Largest Itemset	StartPID	Count
ABCDE	2	2

Figure 9: The result of procedure *gen_VMLI* after scanning P₂.

P ₃		
C ₁	StartPID	Count
A	1	7
B	1	7
C	1	10
D	1	6
E	1	9
G	1	7
* F	3	1

(a)

Figure 10: The result of procedure *gen_count_itemset* after scanning P₃.

P ₃		
C ₃	StartPID	Count
ABC	1	5
ABD	1	4
ABE	1	4
ACD	1	5
ACE	1	4
ADE	1	4
BCD	1	4
BCE	1	5
BDE	1	4
CDE	1	5
CEG	1	5
* CDG	2	2
* DEG	2	2
* BFG	3	1
* AEG	3	1

Figure 11: The result of procedure *check_sum* in P₃.

C ₁	StartPID	Count
A	1	6
B	1	7
C	1	10
D	1	6
E	1	9
G	1	7

Figure 12:

Maximal Large Itemsets	
ABC	1
ABD	1
ABE	1
ACD	1
ACE	1
ADE	1
BCD	1
BCE	1
BDE	1
CDE	1
CEG	1

Figure 12:

C ₂	Count	C ₄	Count
AB	0	ABCDE	0
AC	0	ABDE	0
AD	0	ABDE	0
AE	0	ACDE	0
AG	0	BCDE	0
BC	0		
BD	0		
BE	0		
BG	0		
CD	0		
CE	0		
CG	0		
CG	0		
DE	0		
DG	0		
EG	0		

Figure 13:

Virtual Maximal Large Itemset		
Itemset	StartPID	Count
ABCDE	2	2

Figure 14: The virtual maximal large itemset

Figure 15: The result of candidate

Maximal Large Itemsets	
Itemset	Count
ABCDE	4
CEG	5

Figure 16: The final result.

algorithm, for efficiently mining maximal large itemsets and incremental mining.

Our SWMax algorithm is a two-passes partition-based approach. We will find all candidate 1-itemsets (C₁), candidate 3-itemsets (C₃), large 1-itemsets (L₁), and large 3-itemsets (L₃) in the first pass. We generate the virtual maximal large itemsets after the first pass. Then, we use L₁ to generate C₂, use L₃ to generate C₄, use C₄ to generate C₅, until there is no C_K generated. In the second pass, we use the virtual maximal large itemsets to prune C_K, and decide the maximal large itemsets. For incremental mining, we consider two cases: data insertion and data deletion. If an itemset with size equal to 1 is not large in the original database, it could not be found in the updated database based on the SWF algorithm. A missing case could occur in the incremental mining process of the SWF algorithm, while our SWMax algorithm could support incremental mining correctly.

The rest of paper is organized as follows. Section 2 presents the proposed SWMax algorithm. In Section 3, we study the performance and make a comparison of the proposed algorithms, SWMax algorithm with some other previous proposed algorithms. Finally, Section 4 gives the conclusions.

THE SWMax ALGORITHM

In this section, we first describe some interesting observations, which have motivated us to design our SWMax algorithm. Next, we present the proposed SWMax algorithm. Then, based on some other observations, we present the approach of incremental mining in the SWMax algorithm.

Interesting Observations for Mining Maximal Large Itemsets

The Pincer-Search algorithm has presented an interesting observation: If an itemset is frequent, all its subsets must be frequent; therefore, those subsets need not to be examined further. The number of the 3-itemset subsets of a k-itemset should be C₃^k. In other words, if the number of 3-itemset subsets is smaller than C₃^k, then such a k-itemset will not be frequent and should be discarded from the candidate of maximal large itemsets.

Moreover, we find another interesting observation. Let's use the following example to show this observation. For each item in these 3-itemset subsets of the frequent 5-itemset {ABCDE}, we could find that the occurrence of each item is 6 (=C₂⁵⁻¹). For example, item A occurs 6 times among itemsets {ABC}, {ABD}, {ABE}, {ACD}, {ACE}, and {ADE}. That is, the number of the occurrence of item A in the 6 3-itemset subsets of the frequent 5-itemset {ABCDE} is C₂⁵⁻¹. In general, the number of the occurrence of a certain item in these C₃^k 3-itemset subsets of a frequent k-itemset is C₂^{k-1}. We will make use of these two observations in our SWMax algorithm.

Sketch of Our Algorithm

From the above observations, we develop our SWMax algorithm for mining maximal large itemsets. We use an example database shown in Figure 1 to illustrate our algorithm which is a partition-based approach. Those 12 (= N) data records are divided into 3 (= PN) partition. Therefore, the number of transactions, NT, in each partition P_i is 12/3 = 4, 1 ≤ i ≤ 3. The global support for the total 12 transactions is s = 26%. When the number of transactions containing an itemset is greater than or equal to ⌈12 * 26%⌉ = 4, this itemset is frequent.

In the first pass, we have to consider the local support number, $LocalS$, for candidates generated in partition P_i . The value of $LocalS$ is equal to (number of transactions in partitions P_1, P_2, \dots, P_i) times s . For example, we have $LocalS = \lceil 4 * 26\% \rceil = 2$ for candidate generated in partition P_1 , when we scan partition P_1 . We have $LocalS = \lceil 8 * 26\% \rceil = 3$ in partition P_1 and $LocalS = \lceil 4 * 26\% \rceil = 2$ in partition P_2 , when we scan partition P_2 .

In pass 1, we aim to find all temporary large 1-itemsets and 3-itemsets. We scan the whole database by focusing on each partition P_i in sequence, $1 \leq i \leq PN$. When we scan the item list of each transaction in partition P_i , we will generate temporary candidate 1-itemsets and 3-itemsets, and record the result in variables $Temp_C1I$ and $Temp_C3I$, respectively, by calling procedure $gen_count_itemset$. We add a temporary candidate X into $Temp_C1I/Temp_C3I$ only if X does not occur in $Temp_C1I/Temp_C3I$. When a temporary candidate X is added to $Temp_C1I/Temp_C3I$, we also record its $StartPID$ as PID , where $StartPID$ means the starting PID in which the candidate is generated. Moreover, we increase the count of such a candidate by one.

After all transactions in partition P_i is scanned, we call procedure $check_sum$. A temporary candidate X can become the formal candidate if $X.count > LocalS$, when $LocalS$ is the local support of partition, $X.PID$. If a temporary candidate could not pass the checking step, it is removed from $Temp_C1I/Temp_C3I$. The final results as shown in Figure 2 has removed all these itemsets which are marked with *.

Up to this point, if the scanned partition is not the last partition, we will generate virtual maximal large itemsets, gen_VMLI , from $Temp_C1I$ and $Temp_C3I$ as shown in Figure 4. In procedure gen_VMLI , for each 3-itemset element X in $Temp_C3I$, we will check whether each of elements Y in X is in the table $OneI$ or not. If it occurs the first time, we will add element Y to table $OneI$. Moreover, we will count the occurrence of each element Y . The result for this example is shown in Figure 3. After we get the count of each 1-item element occurring in candidate 3-itemset C_3 , we start to call procedure gen_check_table to create a checking table as shown in Figure 4, to help us determine the virtual maximal large itemset. In procedure $gen_check_table(ND)$, we generate the values of C_3^k and C_2^{k-1} , $4 \leq k \leq ND$. The purpose of these values has been explained in our observations as described before. For this example, we have $ND = 6$, since the size of table $OneI$ is 6, which implies the size of the possible virtual maximal large itemset is limited to 6. From Figure 3, the possible case is itemset $\{ABCDEG\}$. To decide whether itemset $\{ABCDEG\}$ is the virtual maximal large itemset, we could make the decision based on these observations as mentioned in Section 3.1: *If an k -itemset is large, all its subsets must be frequent.* That is, those C_3^k 3-itemsets subset of a frequent k -itemset should also be frequent. Moreover, all the k items will have C_2^{k-1} occurrences among these frequent 3-itemsets. For example, if $\{ABCDEG\}$ is a large itemset, it should have $C_3^6 = 20$ 3-itemsets subsets of this 6-itemset $\{ABCDEG\}$. Moreover, item $\{A\}$ will appear in $\{ABC\}$, $\{ABD\}$, $\{ABE\}$, $\{ABG\}$, $\{ACD\}$, $\{ACE\}$, $\{ACG\}$, $\{ADE\}$, $\{ADG\}$ and $\{AEG\}$. That is, item A will occur $C_2^5 = 10$ times. Item $\{B\}$, item $\{C\}$, item $\{D\}$, item $\{E\}$ and item $\{G\}$ will have the same case as item $\{A\}$. That is the reason why we dissolve the 3-itemset of $Temp_C3I$ to get the individual items, and stored them and related counts in table $OneI$, as shown in Figure 3.

Since $ND = 6$, in fact, there may exist 3 possibilities of the size of the virtual maximal large itemset, 4, 5, 6. Due to that the size of passed candidate C_3 , $|Temp_C3I| = 11$, the size of a virtual maximal large itemset could not be 6, since $11 < C_3^6 (= 20)$.

Based on the same reason, the size of a virtual maximal large itemset could be 5, since $10 (= C_3^5) \leq 11 < 20 (= C_3^6)$. Therefore, we decide the size of the virtual maximal large itemset should be 5 by calling function $CheckRange(W)$ with $W = 6$, due to $Temp_C3_2 (= 10) \leq |Temp_C3I| (= 11) < Temp_C3_3 (= 20)$. Moreover, we find the corresponding occurrence of each 1-item in such a virtual maximal large itemset with size = 5 should be 6 times. That is, we choose the one, $Temp_II_2 = 6$, as the threshold, $threshold1$, for the times of the occurrence of 1-item in $Temp_C3I$, since $Temp_C3_j = Temp_C3_2 = C_3^5 = C_3^k = 10$, where $k = 5$ and $j = 2$. In the following for loop, we check whether the count of the 1-item stored in table $OneI$ is greater than or equal to such a threshold, If element $Y.count$ satisfies this condition, we then concatenate Y with in the string variable Z . In our example, element G does not satisfy this condition. Therefore, finally, we have the virtual maximal large itemset $Z = \{ABCDE\}$ with $StartPID = 2$. We store this result in table $Virtual_MLI$.

Similarly, transactions in partition P_2 are scanned and procedure $gen_count_itemset$ is called to generate new 1-itemsets and candidate 3-itemsets if it is possible. Then, we call procedure $checksum$ to check whether candidate 1-itemsets/3-itemsets generated in partitions P_1 and P_2 could be the passed candidates or not. After passed candidate 1-itemsets/3-itemsets are determined, we try to generate the virtual maximal large itemset from the result scanned so far. We call procedure gen_VMLI to generate the checking table again. Similarly, we have to construct the $OneI$ table first for the result stored in $Temp_C3I$. Then, the checking table is created as shown in Figure 8. At this time, we have 13 3-itemsets generated. Therefore, the threshold is 6 and the virtual maximal large itemset is $\{ABCDE\}$ again as shown in Figure 9. Because the virtual maximal large itemset $\{ABCDE\}$ is already generated in partition P_1 , it will not be added into $Virtual_MLI$ at this time.

Similarly, we scan transactions in partition P_3 , generate candidates as shown in Figure 10 and determine passed candidate 1-itemsets/3-itemsets as shown in Figure 11. However, for partition P_3 , the last partition, we do not try to generate the virtual maximal large itemset. Because the virtual maximal large itemset generated in the last partition will scan the same number of partitions with candidate itemsets of C_k in the second scan. For example, if we have a virtual maximal large itemset, $\{ABCDE\}$, generated after scanning partition P_3 . We will record $StartPID = 1$, and proceed the second scan. After the second scan, we have the final count of both each itemset of C_k and $\{ABCDE\}$. Then, we just check the count of each itemset of C_k to find out the final result of MLI , because $\{ABCDE\}$ will also be one itemset of C_k . Therefore, the virtual maximal large itemset $\{ABCDE\}$ generated after scanning the last partition in the first pass is useless.

After finishing the first scan of the transaction database, we will generate all candidate k -itemsets. Before we generate candidate k -itemsets, we can check each itemset in $Temp_C3I$ and $TCII$. If there is any itemset with $StartPID = 1$, it means that these itemsets have been finished a complete scan of the transaction database. These itemsets are L_1 or L_3 . Therefore, they do not need to be counted anymore, and we add them into MLI which represents the maximal large itemsets, as shown in Figure 12. The procedure gen_CK uses L_1 joins L_1 to generate C_2 , L_3 joins L_3 to generate C_4 , and C_4 joins C_4 to generate C_5 . Up to this point, since C_5 joins C_5 resulting in the empty set. We generate candidate k -itemsets by the $join$ function. The basic idea of the $join$ function is similar to that in the Apriori algorithm. That is, given itemsets $\{a_1a_2...a_xa_y\}$ and $\{a_1a_2...a_xa_z\}$, the result of joining the two itemsets is $\{a_1a_2...a_xa_ya_z\}$. For example, $\{ABC\}$ and $\{ABE\}$ will generate $\{ABCE\}$.

Then, the second scan of the transaction database is proceeded. We will check each itemset of $Virtual_MLI$ for each partition. We can find an itemset of $Virtual_MLI$ to be large as early as possible, such that some candidate itemsets can be reduced. Therefore, whether itemset $\{ABCDE\}$ is the large itemset could be decided now after a complete scan of the transaction database, as shown in Figure 14. The count of the itemset $\{ABCDE\}$ is 4 ($> 12 * 26\%$), so the itemset $\{ABCDE\}$ is large. Then, we call procedure $findMLI$ to prune candidates by making use of the result $\{ABCDE\}$ stored in $findMLI$.

In procedure $findMLI$, we check the sum of each itemset in All_CKI . If an item X is large and has not occurred in MLI before, we call function $remove$ to remove all subsets Y of X from MLI . For example, MLI contains $\{\{AB\}, \{CDE\}\}$, and we want to add $\{ABC\}$ into MLI . In addition to checking whether $\{ABC\}$ has existed in MLI or not, we also will remove all the subsets of $\{ABC\}$, e.g., $\{AB\}$ from MLI . Then, we add itemset X into MLI . Moreover, we remove itemset X from $Virtual_MLI$. Finally, we call procedure $reduce$ to prune unnecessary candidates from All_CKI . A candidate X in All_CKI is unnecessary if there exists large itemset Y in MLI and $X \in Y$. Moreover, if an itemset X in All_CKI is large, we call function $remove$ to remove all subsets of itemset X from MLI . Then, we add itemset X to MLI and remove it from All_CKI . The whole process of making use of large itemsets generated from $Virtual_MLI$ to prune MLI , making use of those large itemsets in MLI to prune all candidates in All_CKI , and making use of large itemset from All_CKI to prune MLI for transaction data in partition P_i scanned so far. Therefore, we use itemset $\{ABCDE\}$ to proceed procedures $findMLI$ and then $reduce$, which removes all subsets of $\{ABCDE\}$ in All_CKI . Then, we repeat the same steps, counting and pruning, for data in partitions 2 and 3. Finally, the second scan is finished, the result is shown in Figure 15. If All_CKI is not an empty set, we will make the last comparison by calling procedure $reduce$. The final content of MLI is shown in Figure 16, which contains all maximal large itemsets.

PID	TID	Transaction
D ⁻	P ₁	01 ABCDE
		02 CEG
		03 ABCDEF
		04 BECG
P ₂	05 ABC	
	06 CDEG	
	07 ABCDEG	
	08 ABCDE	
P ₃	09 ACD	
	10 BFG	
	11 AEG	
	12 CEG	
D ⁺	P ₄	13 ACD
		14 F
		15 ABF
		16 CEGF

Figure 17: The example of the transaction database for the incremental mining process

D ⁻		
C ₁	StartPID	Count
A	2	5
B	2	4
C	2	6
D	2	4
E	2	5
G	2	5

(a)

D ⁺		
C ₃	StartPID	Count
ABC	2	3
ABD	2	2
ABE	2	2
ACD	2	3
ACE	2	2
ADE	2	2
BCD	2	2
BCE	2	2
BDE	2	2
CDE	2	3
CEG	2	3

(b)

Figure 18: The result after scanning the deleted partition

D ⁻		
C ₁	StartPID	Count
A	2	7
B	2	5
C	2	8
D	2	5
E	2	6
G	2	6
F	4	3

(a)

D ⁺		
C ₃	StartPID	Count
* ABC	2	3
* ABD	2	2
* ABE	2	2
* ACD	2	4
* ACE	2	2
* ADE	2	2
* BCD	2	2
* BCE	2	2
* BDE	2	2
* CDE	2	3
* CEG	2	4
* ACF	4	1
* ADF	4	1
* CDF	4	1
* ABF	4	1
* CEF	4	1
* CGF	4	1
* EGF	4	1

(b)

Figure 19: The result after scanning the added

D ⁻		
C ₁	StartPID	Count
A	2	7
B	2	5
C	2	8
D	2	5
E	2	6
G	2	6
F	4	3

(a)

D ⁺		
C ₃	StartPID	Count
ACD	2	4
CEG	2	4

(b)

Maximal Large Itemsets	Count
ACD	4
CEG	4
F	4
AB	4

Figure 21: The maximal large itemsets in the incremental mining process.

Interesting Observations for Incremental Mining

In this subsection, we discuss some interesting observation for incremental mining. Let's D^- be the deleted database, D^+ be the inserted database, and D' is the unchanged part of the original database.

Let's consider two cases when an updated to the database occurs: data insertion and data deletion. First, for data insertion, if an itemset with size equal to 1 is not large in the old database, it could not be found in the new database in the SWF algorithm. Second, for data deletion, if an itemset with size equal to 1 is not large in the old database, it could not be found in the new database on the SWF algorithm. Because the SWF algorithm has no way to update C_1 from D^- when a data insertion occurs or a data deletion occurs. Therefore, a missing case could occur in the SWF algorithm.

Incremental Mining Process

We use the transaction database, as shown in Figure 17, to illustrate the incremental mining process. D^- means the deleted partition database, and D^+ means the added database. The SWMax algorithm reserves the candidate 3-itemsets, C_3 , and the candidate 1-itemsets, C_1 , for the incremental mining process. For the case of data deletion, we find out these itemsets X , where $X.StartPID = 1, Y \in D^-, X \in Y$, and decrease their counts. The result is shown in Figure 18.

For the case of data insertion, we scan D^+ partition to generate new candidate itemsets and increase the corresponding counts of itemsets recorded in the reserved C_1 and C_3 by procedure $gen_count_itemset$. Then, we check C_1 and C_3 with the $LocalS$, and find out the L_1 and L_3 . Therefore, we use L_1 to generate C_2 , use L_3 to generate C_4 , use C_4 to generate C_5 , until there is no C_k generated. Then, we use C_k to scan the partitions P_2, P_3 , and P_4 . All the iterations of the second scan are same as we have mentioned in the process of mining maximal large itemsets. Finally, we compare all candidate k -itemsets, C_k , and get the maximal large itemsets, as shown in Figure 21.

Table 1: Parameters used in the experiment

Parameters	Meaning
$ T $	Average size of the transactions
$ MT $	Maximum size of the transactions
F	A set of potentially large itemsets
$ I $	Average size of maximal potentially large itemsets
$ D $	Number of transactions
$ MI $	Maximum size of the potentially large itemsets
$corr$	Number of correlation level
$ L $	Number of maximal potentially large itemsets
$ N $	Number of items

Itemset ID	Range
1	0 - 0.43
2	0.44 - 0.69
3	0.70 - 0.85
4	0.86 - 0.95
5	0.96 - 1

Table 3: Parameter values for synthetic databases

Case	$ T $	$ MT $	$ I $	$ MI $	$ D $	$corr$	Size
1	10	15	6	10	5k	0.5	256KB
2	10	15	5	5	10k	0.5	379KB
3	10	15	5	10k	10k	0.25	265KB
4	5	10	2	4	20k	0.5	594KB
5	5	10	2	4	50k	0.5	1293KB

Table1: Parameters used in the experiment..

Table2: The probabilities of itemsets after

Table3: Parameters values for synthetic databases.

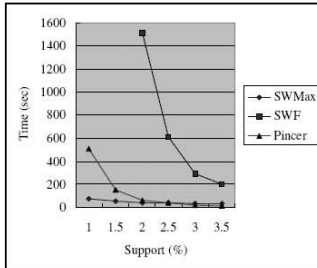


Figure 22: A comparison of the execution time (Case 1).

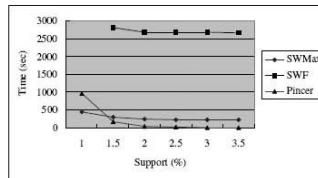


Figure 23: A comparison of the execution time (Case 2).

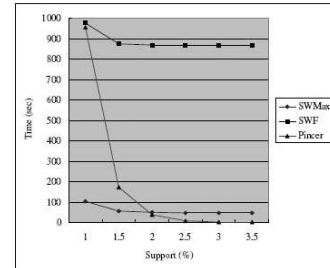


Figure 24: A comparison of the execution time (Case 3).

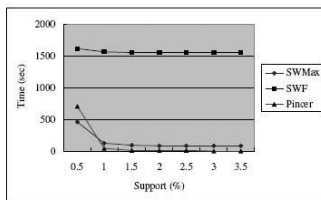


Figure 25: A comparison of the execution time (Case 5).

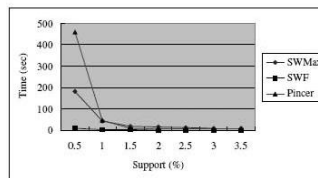


Figure 26: A comparison of the execution time for incremental mining (Case 5).

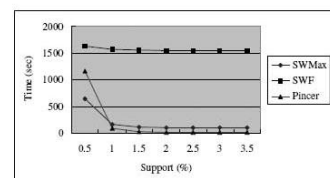


Figure 27: A comparison of the total execution time for mining maximal large itemsets and incremental minino (Case 5).

PERFORMANCE

In this section, first, we show how to generate the synthetic data which will be used in the simulation. Then, we study the performance of the Pincer-Search algorithm, the SWF algorithm and our SWMax algorithm. Finally, we make a comparison between these three algorithms.

Generation of Synthetic Data

We generated several different transaction databases from a set of large itemset to evaluate the performance of algorithms for mining maximal large itemsets. The parameters used in the generation of the synthetic data are shown in Table 1 [4].

First, the length of a transaction is determined by Poisson Distribution with a mean which is equal to $|T|$. The size of a transaction is between 1 and $|MT|$. The transaction is repeatedly assigned items from a set of potentially maximal large itemsets F . Then, the length of an itemset in F is determined according to the Poisson Distribution with a mean which is equal to $|I|$. The size of each potentially large itemset is between 1 and $|MI|$.

To model the phenomenon that large itemsets often have common items, we use an exponentially distributed random variable with a mean which is equal to the *correlation level*, to decide this fraction for each itemset. The *correlation level* was set to 0.5. The remaining items are chosen randomly. Each itemset in F has an associated weight that determines the probability that this itemset will be chosen. The weight is chosen from an exponential distribution with a mean equal to 1. The weights are normalized such that the sum of all weights equal to 1. These probabilities shown in Table 2 are then accumulated such that each value, which falls in these ranges, is used to select the itemsets.

For each transaction, we generate a random real number which is between 0 and 1 to determine the ID of potentially large itemset. To model the phenomenon that all the items in a large itemset are not always bought together, we assign each itemset in F with a *corruption level* c . When adding an itemset to a transaction, we keep dropping an item from the itemset until a uniformly distributed random number between 0 and 1 is less than c . The corruption level for an itemset is fixed, which is obtained from a normal distribution with mean = 0.5 and variance = 0.1. Each transaction is stored in a text file with the form of <transaction ID, item>.

Some different datasets were generated to be used in the simulation, Table 3 shows the parameters setting for each dataset. For all datasets, $|N|$ was set to 1,000 and $|L|$ was set to 2,000.

Experiments

Our experiments were performed on a Pentium 4 server with CPU clock rate of 1.5G MHz, 384MB of main memory, running Windows XP Service Pack 1. The transaction data is stored on a 40GB IDE 3.5" drive with a measured sequential throughput of 10MB/second. The simulation program was coded in JAVA, and compiled by JDK 1.4.2. The data was stored in a text file on a local hard disk drive.

A Comparison

For the synthetic database of Case 1, Figure 22 shows a comparison of the execution time with different values of the support between the SWF and our SWMax algorithm. The execution time of our SWMax algorithm is always less than that of the SWF algorithm. When the support decreases, the execution time of our SWMax algorithm is less than that of the Pincer-Search algorithm.

For the synthetic database of Case 2 and Case 3, these transaction databases are used to measure the influence of the *correlation level*. The results are shown in Figure 23 and Figure 24. We find an interesting observation that the correlation level has no influence on the Pincer-Search algorithm, because the Pincer-Search algorithm uses L_k to generate C_{k+1} . However, our SWMax algorithm generates candidates from transactions. Therefore, in our SWMax algorithm, the *correlation level* increases, the candidates increase. However, when $support \leq 1\%$, the number of candidates of the Pincer-Search algorithm increases a lot, our SWMax algorithm needs shorter execution time than the Pincer-Search algorithm.

For the synthetic database of Case 5, this transaction database has a small size of large k -itemsets. The candidate 2-itemsets generated from the SWF algorithm could keep the useful information efficiently. However, the counting approach in our SWMax algorithm works more efficiently than the one in the SWF algorithm. For the SWF algorithm, which uses a hash array to do counting and cannot count efficiently. Our SWMax algorithm uses the hash tree to do counting. Figure 26 shows a comparison of the execution time among the SWF, Pincer-Search and our SWMax algorithms. From the result shown in Figure 25, our SWMax algorithm always requires less execution time than the SWF algorithm. However, in Case 5, the Pincer-Search algorithm has the same times of scanning the transaction database. Table 6 shows the number of checks in Case 5. It is obviously to see that our SWMax needs more number of checks than the other two algorithms. Therefore, our SWMax algorithm needs longer execution time than the Pincer-Search algorithm when $support \geq 1\%$.

For the synthetic database of Case 4 and Case 5, we show the comparison of mining maximal large itemsets and incremental mining of mining maximal large itemsets among these three algorithms. Figure 26 shows the different small values of support to proceed incremental mining of mining maximal large itemsets. Figure 27 shows the total execution time for mining maximal large itemsets and incremental mining of mining maximal large itemsets. We know that if the support is small enough, the number of candidates of the Pincer-Search algorithm increases rapidly. Therefore, the time of re-running the mining approach takes longer time than the incremental mining approach. In other words, if the transaction database has large size of maximal large itemsets, e.g., Case 1, our SWMax algorithm needs shorter time to do incremental mining of mining maximal large itemsets than the Pincer-Search algorithm. However, the SWF algorithm reserved all the information of C_2 in Case 5, so it needs so short time for incremental mining of mining maximal large itemsets.

Obviously, when the support is small, our SWMax algorithm needs shorter execution time than the other two algorithms in all the cases.

CONCLUSION

In this paper, we have proposed the SWMax algorithm to efficiently support both mining maximal large itemsets and incremental mining. We have presented the concept of the virtual maximal large itemset. Our SWMax algorithm is a two-passes partition-based approach, and the virtual maximal large itemsets help us to reduce the number of candidate itemsets in the second scan. The simulation results have shown that the proposed SWMax algorithm outperforms the SWF algorithm in all relational database settings. How to extend our SWMax algorithm for distributed processing is our future work.

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A SYNTHETICAL APPROACH FOR BLOG RECOMMENDATION MECHANISM: TRUST, SOCIAL RELATION, AND SEMANTIC ANALYSIS

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ABSTRACT

Weblog is a good paradigm of online social network which constitutes web-based regularly updated journals with reverse chronological sequences of dated entries, usually with blogrolls on the sidebars, allowing bloggers link to favorite site which they are frequently visited. In this study we propose an elaborate blog recommendation mechanism that combines trust model, social relation and semantic analysis and illustrate how it can be applied to a prestigious online blogging system – Wretch in Taiwan. By preliminary results of experimental study, we found some implications and empirically prove some theories in domain of social networking, and the example reveals that the proposed recommendation mechanism is quite feasible and promising.

Keywords: Blogosphere, Trust model, Social networking, IR, Back-propagation neural network.

INTRODUCTION

Online social networking systems and peer-produced services have gained much attention as a social medium of viral marketing, which exploits existing social networks by inspiring bloggers to share their own posts or personal information with the other bloggers. The weblogs indeed offers a more open channel of communication, people in the blogosphere read, commentate, cite, socialize and even reach out beyond their social networks, make new connections, and form communities [8]. A blog social network has emerged as a powerful and potentially services-valued form of computer-mediated communication (CMC). There exists a large number of information in the blogosphere, including text-based blog entries (articles) and profile, pictures or figures and multimedia resources. However, the problems of information overload still bother users, which can be tackled with by recommender system and information filtering approach (such as search engine technology).

A recommender system of weblog differs from with the others in nature. First, recommend target varies dramatically from product, movie, music, news, webpage, travel and tourism to all kinds of service, online auction seller and even virtual community. It is important for us to figure out the characteristics of recommend targets because the inappropriate use of recommendation may have a totally opposite effect by resulting unfavorable attitudes towards the recommend target.

Under blog recommendation context, it is particularly important that how we introduce some interesting, personalized and socially related weblogs of these peer-produced information to bloggers. The objective of blog recommendation mechanism in this study is bloggers or blog posts (articles). Then what kinds of blog posts do we recommend? Most popular, most similar in links or in semantic of blog network and content, or most trustworthy? These approaches and related researches will be described later, which inspire us to combine them to propose a recommendation mechanism in this study. We consider that trust model, social relation and semantic similarity play important roles in trust recommender system, social networking analysis and information retrieval/textual comparison, respectively and they are three crucial factors to help prepare the ground for the development of personalized and trustworthy recommendation mechanism.

The rest of paper is organized as follows. Section 2 presents related works. Section 3 designs a system framework of neural network based recommendation mechanism. Section 4 elaborates on methodologies of trust model, social relation and semantic analysis. Section 5 concludes the paper.

LITERATURE REVIEW

A fast-growing number of blog studies have showed that blog as social network can help researchers in understanding and analyzing certain implications and insights. It generated several issues which received lots of attention in several aspects. The concept of blog ranking is similar to the concept of blog recommend to some extent and like the process of search engine. [4] score each blog entry by weighting the hub and authority scores of the bloggers based on eigenvector calculations, which has similarities to PageRank [3] and HITS [7] in that all are based on eigenvector calculation of the adjacency matrix of the links. They contribute some dimensions to calculate the importance of webpage or blog. However, the work in [9] ranks blogs according to their similarity in social behaviors by graph-based link analysis, which demonstrates an excellent paradigm of link analysis. Note that there is an inherent problem of sparseness in the blogosphere which has already been noticed by many researchers, works in [1][9] have coped with it by extending and increasing explicit and implicit links based on various blog aspects where a denser graph will result in a better performance of ranking and recommending. Equally, in order to solve the sparsity problem, the extracted communities in [10] only cover a portion of the entire blogosphere, the ranking method extract dense subgraphs from highly-ranked blogs.

Recommend this kind of peer-produced services or objects needs not only social network-based link analysis but also the concept of trustworthiness and reliability of weblogs must take into consideration. A recommender in blog network may have similar social relationships or contents to a target user (i.e. recommendation service requester) but they may not be a reliable

predictor for inducing the recommendation. Using trust in recommender system will improve the ability of making accurate recommendation [13], which can solve a portion of weaknesses of traditional content-based, collaborative filtering (CF)-based recommendation approaches. The work in [5], trust takes on the role of a recommender system to create predictive rating recommendations for movies. And the accuracy of the trust-based predicted ratings is significantly better than the other approaches to a movie. As to sparsity problem, [14] proposes a trust-based method that is based on trust inferences, which relaxes the sparsity and the cold-start problems. Accordingly, our approach constructs a trust network by friend relationships where trust is mean to deal with these issues.

Additionally, the recommend mechanism is applied to the weblog's graph, which is a generalization of the post's graph. The blog posts are strongly representative and we can discover the preferences and writing pattern of bloggers who we want to recommend to. Traditional information retrieval (IR) technology is applied to handle the semantic of blog content. In examining the semantic similarity among weblogs, CKIP Chinese word segmentation system [11] helps us to parse and stem the crawled blog posts in this study. Index terms are highlighted through IR/NLP approaches. Many syntax-based and semantics-based approaches exist to analyze the textual relationships among blogs [15]. In [2], they proposed two methods for semantics-enhanced blogs analysis that allow the analyst to integrate domain-specific as well as general background knowledge. And the iRank in [1] acts on implicit link structure to find those blogs that initiate these epidemics, which denote similarity between nodes in content and out-links. Undoubtedly, the content of blog post is also an important source that we must take into consideration for inducing recommendation seriously.

In this paper, we focus on the issues of combined trust model, social relation analysis and semantic similarity as a means of recommending bloggers or blog posts. And the neural network is deployed to learn and capture the pattern of preferences of blog users and it is utilized to predict the final recommend score of each blog post in our recommendation network.

BLOG RECOMMENDATION MECHANISM

In this study, we propose an innovative recommendation mechanism on the blogosphere which employs the trust model, social relation and semantic analysis to construct a more comprehensive and more personalized framework for each bloggers on the entire blogspace. There are various important factors and dimensions we must take into consideration under blog recommendation context. Especially we conclude three underlying critical aspects of blogosphere- Trustworthiness and Reliability, social intimacy and popularity and semantic similarity, which contribute to TR, SIP and SS scores respectively. We present a neural network-based approach to learn and predict user's preference and affinity i.e. Final Recommend Score (FRS) of each blogger and blog post, by feeding these standardized scores into neural model. Figure 1 is the architecture of the proposed NN-based recommendation mechanism.

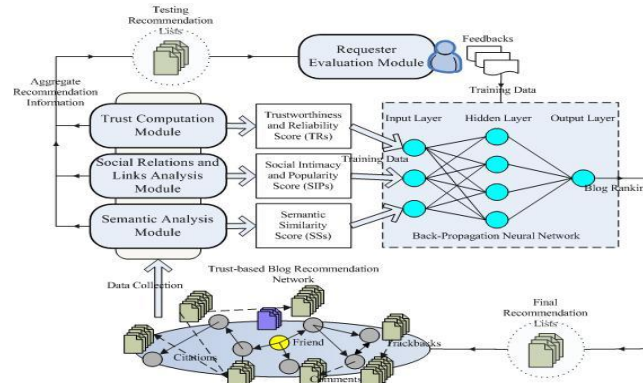


Figure 1. The architecture of the proposed NN-based recommendation mechanism

RESEARCH METHODOLOGIES

This study proposes a neural network-based blog recommendation mechanism in which we apply the concepts of trust model, social relation and semantic analysis and they contain the information of the blog network about trustworthiness and reliability, Social intimacy and popularity and Semantic similarity respectively. This information is then integrated as an initial recommend score for each objects over the recommendation network, then the initial recommend list was induced for requesters. Meanwhile, a back-propagation neural network (BPNN) is proposed to forecast the FRS according to these scores. Finally, a recommend list of blog posts or bloggers is generated for the recommendation service requester. The whole process of recommendation mechanism is divided into several steps as the figure 2 and is described as the following sub-sections.

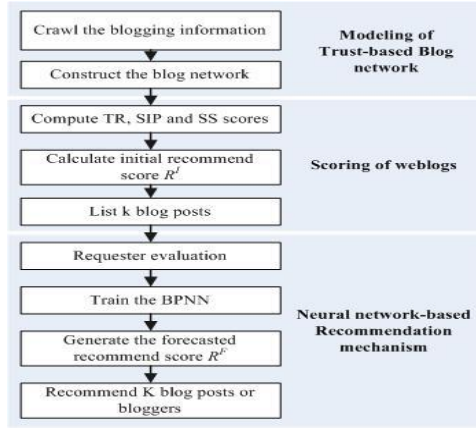


Figure 2. The whole process of recommendation mechanism and its sub-sections

Modeling of Trust-based Blog Network

Crawl the Blogging Information. First of all, we take blogsite of requester as a starting point to search available and social-reachable agents i.e. recommenders, by performing search algorithm according to blogrolls on the side bar in the blogsite of each agent. These agents are connected level-by-level by friend or friend-of relationships in the blog network. Once the agents are decided and specified or the maximum number of searching level is reach, the members of the recommender are confirmed. Then we crawl blogging information (such as blog posts, hyperlinks, comments...etc) associate with each agent on the recommendation network.

Construct the Blog Network. To implement and evaluate the proposed model, we simulate a trust-based blog network in which apply the concepts of agent and object in [4]. In this graph-based representation blog network, m agents (bloggers) and n objects (blog posts) are denoted as nodes and document-like icons, respectively. The relation edges in the network denote heterogeneous and multiplicity of links (whether explicit or implicit links), that is, it depends on the directions and entities involved here. Note that the constructed blog network forms and extends from the requester (node in yellow), then the trust information could be propagated and inferred in the agent layer. Then the scope of object layer will be determined by these objects which can be reached by these agents in the agent layer.

Scoring of Weblogs

Calculate Initial Recommend Score R^l and List K Blog Posts. We compute a recommend score (either posts or bloggers) according to their scores of trustworthy, social relation and semantic similarity after a min-max standardization approach, which is applied to each scores (showed by upper case in eq(1)). An initial recommend list is generated with a sequence of recommend score from high to low. Recommend scores $R(i, j)$ for each post j of blogger i for given the requester r is defined as following,

$$R^l(r, o_{ij}) = \alpha TR^s(r, i) + \beta SIP^s(r, o_{ij}) + \gamma SS^s(r, o_{ij}) \quad (1)$$

where uppercase l of recommend score R^l stands for initial recommend score and uppercase s of TR, SIP and SS scores mean scores after the process of standardization. Parameters α, β and γ are the self-set weights of trust score, social relation score and semantic score of objects in the blog network respectively and the values are between 0 and 1.

Then the initial recommend list was induced, which contains top k R^l score and ranges from highest R^l score to lowest one for requester for further evaluation process. Each scoring approach is presented in the following three sub-sections.

Compute TR, SIP and SS Scores:

Trust Scores (TR)

The interpersonal trust values derive directly from blogrolls is the TR scores in this study. All agents assign trust value to his/her friends listed in the blogroll on homepage of blog site. The computation of TR scores is divided into two steps: First, for a given requester (also blogger) r , we collect and aggregate trust information then form the trust-based blog network of him/her for further inference and filtering. Second, a search algorithm is applied to the constructed blog network in the former step, and set a maximum search layer as stopping criteria. The aim of this step is to find out social-reachable and available agents from the given requester who is the root of the blog network. These agents form the recommender set $RC(r)$ of requester r . The TR score of agent s is computed by trust inference mechanism which is the most widely used one in trust-based social networking computing approach [6]. $TR(r, s) = t_{rs}$ and,

$$t_{rs} = \frac{\sum_{j \in adj(r)} t_{rj} \times t_{js}}{\sum_{j \in adj(r)} t_{rj}} \quad (2)$$

where

r is the requester of blog recommendation, s stands for these social-reachable and available agents, and $s \in RC(r)$. t_{rs} is the value of trust degree from agent r to s , and $t_{rs} \in [0,1]$. $adj(r)$ means adjacent agents of agent r , i.e. friends of blogger r .

Social Relation Scores (SIP)

This section measures social intimacy and population (SIP) score of each agent in the blog network via their interrelationships and shared properties. To combine a complete view in recommendation process, SIP score is separated into SI and Popularity scores: SI addresses the social similarity strength or the degree of familiar on agent-agent aspect. However, Popularity emphasizes global reputation on object aspect. SIP score is introduced in the following formula,

$$SIP(r, o_{ij}) = SI(r, i) + Popularity(o_{ij}) \quad (3)$$

where $SIP(r, o_{ij})$ measures the scores of every object or agent in blog network given a requester agent r as a basis for comparison and computation. $SI(r, i)$ and $Popularity(o_{ij})$ represents social intimacy relation and popularity scores respectively.

Social intimacy captures the idea of social similarity by examining the degree of interaction between agents and mutual behaviors (links) toward certain blogs or websites.

$$SI(r, i) = sim(iL(r, A), iL(i, A)) + sim(oL(r, A), oL(i, A)) \quad (4)$$

where r, i stands for the requester of blog recommendation (source agent) and certain agent respectively, and $r, i \in A$. A denotes a set of agents (or websites) which are social-reachable and available agents, i.e. agents (websites) which can be reached by links (hyperlinks) or inferences mechanism. $iL(r, A)$ is a vector which simply counts the number of social links from r to each of the agents in set A , where social links in here denote out-degree link which actually includes the situations of co-citation, co-comment and mutual link between the agents. $sim(\cdot)$ is the function to compute the similarity between two agents by inner product calculation. Contrast to out-degree aspect, the latter part of formula measures the in-degree link which includes the situations of comments (citations) contributed (cited) by same author (blog post). However, $oL(r, A)$ counts the number of social links from agent set A to agent r .

Popularity measures social importance of an agent in blog network. We measure the in-degree (the number of incoming links) in this case as a rough substitute for popularity for the ease of computing. Since an object u belonging to an agent s , we compute the aggregate value of u as a weight sum of the relative number of comments and citations as following,

$$Popularity(o_{ij}) = w_{co} \times \frac{Comment(o_{ij})}{\max Comment(A)} + w_{ci} \times \frac{Citation(o_{ij})}{\max Citation(A)} \quad (5)$$

Where $Comment(o_{ij})$ ($Citation(o_{ij})$) counts the number of comments (citations) in object j of agent i . And $\max Comment(A)$ ($\max Citation(A)$) is the maximum number of comments (citations) in our dataset. Obviously, the popularity score of an agent i , $Popularity(i)$, is the sum of popularity score of objects belonging to i . The parameters w_{co} and w_{ci} are the weights of in-degree links from comment and citation behaviors respectively.

Semantic Scores (SS)

Once the blogging data is crawled, we apply CKIP (Chinese Knowledge and Information Processing) Chinese word segmentation system [11] to parse the content of blog post after the HTML tags are removed. We extract the syntactical functions which we need (normally nouns and besides we select several kinds of verbs) for the process of stop word removal. Then the remaining words are the index terms. After that, a basic cosine similarity metric of term vectors with standard TFIDF [12] weighting scheme is deployed to represent each index term of each blog article. Semantic score measures textual similarity between blog posts of requester and the posts of the other bloggers in the given blog network (once the blog network is constructed). Suppose there are n agents (bloggers) in the blog network, semantic score is an agent-to-object score which is defined as blow,

$$SS(r, o_{ij}) = sim(q, d_{ij}),$$

$$\text{Where } i \in [1, n], j > 0 \text{ and } 0 \leq SS(r, o_{ij}) \leq 1 \quad (6)$$

where q stands for index terms of blog postings which were published by requester r and we deem it as a query. Note that q could be generated by selecting any subset of objects of agent r . The variable d_{ij} is a vector of the TFIDF scores of index terms of blog post j of agent i .

Neural Network-based Recommendation Mechanism

In this study, neural network is used to capture the non-linear relationships between these factors, and requester's preferences and social status in blog social network accurately in a comprehensive view to forecast the FRS for each object or agent.

Requester Evaluation. Once the initial recommend list of k blog posts (bloggers) is delivered to requester, which accompany with a detail description of philosophy behind the recommendation processes by a web-based interface. For the requester, all he/she has to do is review these posts (bloggers) and make a unbiased evaluation by scoring each posts (bloggers) selected according to his/her own preference based on the degree of perceptibly relatedness and similarity with respect to himself/herself.

Train the BPNN. The characteristics, preference and social behaviors vary dramatically among human beings. Neural network-based recommendation mechanism is special for its leaning and forecasting abilities to imply the implicit relationships behind these factors and requester’s pattern of preference. Notably, a forecasted score for each object will be obtained and the weights of initial recommend score with respect to three scores will be learned (i.e. weighting variables α, β and γ for TR, SIP and SS scores, respectively) through the neural network. To train the back-propagation neural network, we combine three scores i.e. TR, SIP and SS, and the results from requester evaluation process as testing data for BPNN. Once the network is trained, it can be used to *Generate the Forecasted Recommend Score R^F* and then generate *Recommend List of K Blog Posts or Bloggers* to the requester.

EXPERIMENT STUDY

So far we have introduced that combine trust model, social relation and semantic analysis and they will be crucial factors to guarantee high-quality recommendations in blog network. In this section, we want to highlight how promising this recommendation framework is and how much it will satisfy the users by utilizing the blogging data from Wretch, which is a famous blog system in Taiwan, to show the entire recommendation processes. We begin by explaining how the dataset was collected. Then some statistical data will be presented such as the number of bloggers in the recommendation network, average number of friends of bloggers and of blog posts for each blogger.

Data Descriptions

We describe our proposed mechanism by using a dataset collected from the Wretch [17] which is a Taiwanese community website. It is the most famous weblog community in Taiwan with millions of users registered now where users can upload photos to album, write the blog and interact with others by these services [16].

In early July 2007, we start crawl related blogging information including blogger account, friend relations, article id, article content (object), citations, comments and publish datetime for each blogger by using the crawler we designed, once the recommendation network is constructed. Note that, the objects are crawled according to the agents which have been crawled.

The detail statistics information of this experimental recommendation network is presented in table 1 and 2. We can observe that the network size is drastically increasing, and we can predict that the network will achieve saturated situation when the network spread up to 5~6 layer. That is, the network will be close to the entire blog network of Wretch (i.e. about 2.5 millions+ users).

Table 1. Statistics of recommendation network (up to 3rd layer).

Characteristics of recommendation network	Statistics
# of agent (blogger) in the network	22,336
# of object (blog post) in the network	338,614
Average # of friend of an agent	29.722
Average # of objects of an agent	15.160
Average # of comments of an object	2.382
Average # of citations of an object	0.084

Table 2. The # of agent and friend relationship in each layer according to the root: “chiang1000”.

# / layer	root	1 st layer	2 nd layer	3 rd layer	4 th layer
The # of agent	1	23	927	21,384	299,539
The # of friend relationship	23	972	30,299	632,389	NA

So, an experimental small recommendation network about 20,000+ agents and 330,000+ objects will be construct and limited the layer to 3rd layer, due to the reasons that the network size grows up exponentially with the layer increased. And accompany with the results that computability of trust and semantic similarity will greatly decreased.

For entire network, about 57.22% of objects are isolated and without any comment and citation. From statistics, we found that 99% of the objects have comments range from 0 to 15, 80% range from 0 to 2, however 57.4% of objects do not have any comments. Moreover, 99% of the objects do not have any citations. Because of the sparse nature of blogosphere we have mentioned before, our approach seek to increase the density of the implicit links between bloggers and between blog posts. This enhances the reliability and comprehensiveness of recommendation mechanism.

Notably, the recommendation network in this study is formed according to the requester’s friend network i.e. trust network. In other words, we fetch the users, who are reachable walking the network of trust of starting requester, into our dataset. We conduct our experiments with our target requester and some of her friends listed in the blogroll who are all the bloggers of Wretch for providing recommendation information and evaluating the effectiveness of the proposed recommendation mechanism and BPNN in this study, i.e. trust value, blog posts and feedback data for training the neural network.

CONCLUSIONS

In this study we propose an elaborate recommendation mechanism that combines trust model, social relation and semantic analysis and illustrate how it can be applied to a prestigious online blogging system – Wretch in Taiwan. By preliminary results of experimental study, we found some implications and empirically prove some theories in domain of social networking, and the example reveals that the proposed recommendation mechanism is quite feasible and promising.

As to future work, we will conduct several experiments to evaluate the efficiency and accuracy of proposed recommendation mechanism and illustrate how it can be applied to online blogging system – Wretch in Taiwan. We expect that the proposed neural network-based mechanism will actually help in predicting a more accuracy and personalized recommendation list for the bloggers. Finally we will design an experimental blog system to implement the recommendation mechanism for further analysis and application.

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APPLYING DATA CLASSIFICATION TECHNIQUES FOR CHURN PREDICTION IN RETAILING

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ABSTRACT

Acquiring new customers and retaining loyal customers have been two important tasks for retailers. One critical issue to retain loyal customers is to know the customers well so that the retailers can provide the right products, do the right promotions and maintain customers from switching away to competitors, i.e. churn. In this study, we investigated the partial churners' behaviors by (1) identifying key churn predictors, (2) establishing a churn prediction procedure, and (3) applying classification techniques to detect the possible partial churners. Further, the performance of each classification technique was examined and evaluated. We adapted and modified a two-year period customer and transaction data from a retailer to verify our proposed approach. Discussion and managerial implications are provided at the end.

Key Words : Churn prediction; partial cherner, data classification, retailing

INTRODUCTION

While facing fierce global competition and fast Internet technology development, the retail environment and practices have been changed dramatically. Retailers not only need to provide the best products and services to their customers but also need to seek ways to acquiring new customers and retaining loyal customers. As many researches have indicated that retailers could benefit from large-sized customer bases and a high customer retention rates (e.g., Reichheld and Sasser, 1990[26]; Bhattacharya, 1998[2]; Ganesh, Arnold, and Reynolds, 2000[10]), it has become critical to keeping customers from defecting to competitors. Customer churn (i.e., defection) rates reported in several primary UK consumer industries have increased from 16.9% in 2003 to 19.1% in 2005, and the average customer churn rate in retailing is at 19.8% per year (Group 1, 2005). Churn is a critical problem in retailing that an AC Nielsen's report (2001) indicated that more than 70% of customers shopped on two or more supermarkets in a month period. Also, on average, retailers in US lose half of their customers every five years (Reichheld, 1996[25]). One issue to study churners is to know well their behaviors and shopping patterns. We need to know who the churners are, and the similarities and general patterns of these churners. By identifying which customers are possible defected that would allow the company to provide incentives to keep these possible churners. At practice, large-sized retailers usually have built databases to store product data, transaction data, and customer data with some semi-structured warehouses for marketing campaign uses. However, many companies don't make a great use of these data warehouses. Most of the marketing campaigns are for mass-marketing promotions but not for micro campaign use, i.e., event-driven marketing. Hence, even though companies have constantly provided lots of discount and promotion campaigns to attract new customers, the promotion benefits are limited. It is mainly because that they don't know their customers well and don't try to make best uses of the customer data.

Although churn issue has been researched in several domains, it is still under-researched for retailing and, besides, most of the studies only consider total defection but not partial defection. Thus, in this study, we try to identify partial churners' behaviors and patterns and then to retain all customers and loyal customers by gaining possible churners back from defection. There are several questions that need to be resolved and every manager wants to know: (1) Who are the most likely customers to defect and what characteristics they have? (2) Which approach has the best predictive performance and explanatory ability? (3) How to determinate churn in a non-contractual environment? Thus, we investigate the data provided by one of the largest retailers in Taiwan and try to answer these questions by using the data classification techniques and evaluate the performance of each technique applied.

LITERATURE REVIEW

Churn

Churn is defined as the customer switching behavior that has been studied in recent literature (e.g. Coussement and Van den Poel, 2006[8]; Lemmens and Croux, 2006[15]). Generally, churn analysis defines switching behavior as total defection such as customers change their mobile phone service providers or close their banking accounts. In a contractual setting, it is easier to observe when churn occurs. Companies are able to determine the exact moment when customers terminate their relationship. But it is more complex in the non-contractual industries to determine whether customers defect or not. Nevertheless, customers do not suddenly defect from the company. They typically shift some of their purchases to another store, in other words, they reveal partial defection behavior (Buckinx and Van den Poel, 2005[6]). Churn has tremendous influences on the firms. (1) The cost to attract a new customer is much higher than to retain an old one. If a customer defects, it means that the company not only loses current revenue from the customer but costs more resource to attract a new customer for replacement (Keaveney,

1995[14]; Athanassopoulos, 2000[1]; Colgate and Danaher, 2000[7]). On the other hand, retained customers produce higher margin and cost less resource than newly acquired customers (Reichheld and Sasser., 1990[26]; Mozer et al., 2000[19]). In the retail business, customers are free to shop in any store. They may choose their supplier based on a complex combination of price, goods, service, preference, convenience, and other factors. Marketing campaigns have to focus on the right target, rather than using mass marketing approaches, since the resource is limited and the competition is getting intensive time after time. Therefore, it is particularly important for companies to understand which customer that may leave (Smith et al., 2000[29]). The churn prediction model is not only able to predict which customer may leave the company but also to provide the probability. Firms can use the information from churners to improve their products or services (Page et al., 1996[23]). In the long run, the models can be integrated to design the optimal strategies of pricing, sales, advertising, direct marketing, distribution, and retention, and prevent churn in advance (Page et al., 1996[23]).

Solution Techniques for Churn Prediction

Logistic Regression

Logistic regression, also called logit model, is a well-known statistical technique for classification. It is used when the dependent variable is binary or dichotomous and the independent ones are of any type. Logistic regression is very popular for three main advantages: (1) It is easy to use and provides quick and robust results (Neslin et al, 2006[20]). (2) The basic assumption in the parameters, the linear logarithm of the ratio of group-conditional densities, is satisfied by many families of distributions. (3) It is available to give a closed form for the posterior probabilities. The probabilities of estimation and the cumulative probability are surely between zero and one.

Linear Discriminant Analysis

Linear discriminant analysis (LDA) is used in statistics to find the linear combination of features which best separate two or more classes of objects or events. The resulting combinations may be used as a linear classifier, or more commonly in dimensionality reduction before later classification. In marketing, linear discriminant analysis is usually used to determine the factors which distinguish different types of customers on the basis of surveys or other forms of collected data (Gilbert, 1968[11]; Moore, 1973[18]). The stepwise linear discriminant analysis enters the predictors sequentially to estimate the coefficients of linear discriminant function and uses Wilks's lambda to select significant independent variables.

Random Forests

Random forests combines bagging idea (Breiman, 1996[3]) and random subspace method to construct a collection of decision trees with controlled variations. This technique has many advantages: (1) generally it performs better than other available techniques (Buckinx and Van den Poel, 2005[6]); (2) properly used while existing a large proportion of the missing data; (3) robust performance regarding to noise and outliers; (4) being able to generate internal estimations of error, proximities between cases, variable interactions, and the importance of variables (Breiman, 2001[4]); and (5) fast learning rate (Buckinx et al., 2004[5]). Although random forests have been successful in its use for classification in bioinformatics, geology, medicine, and pattern recognition, the application in marketing is still rare (Buckinx and Van den Poel, 2005[6]).

Artificial Neural Network

An artificial neural network (ANN) is typically composed of an input layer, one or more hidden layers and an output layer with each consisting of several interconnected processing elements called neurons. The output of an artificial neural network relies on the cooperation of the individual neurons within the network to operate. There are several properties of an artificial neural network. (1) It processes information in parallel rather than in series; (2) is very robust in tolerating errors or failures; (3) has shown to be a very promising learning tool to model complex non-linear relationships; (4) requires no assumption that the independent and dependent variables can be any distribution; and (5) often achieves high predictive accuracy compared to other classification techniques (Buckinx and Van den Poel, 2005[6]).

Related Researches on Churn Prediction

Churn attracts lots of attention especially in telecommunication and financial sectors since competition in both sectors become more and more intensive. Mobile phone manufacturers provide new and sophisticated products to customers frequently and customers may want to switch their service providers when they want to change their mobile phones (Drew et al, 2001[9]; Lemmens and Croux, 2006[15]). Regarding to predicting performance, Mozer et al. (2000) [19] compared three predictive models including logistic regression, decision trees, and artificial neural networks. They found that an artificial neural network has the best performance. Drew et al. (2001) [9] combined survival analysis and artificial neural networks for customer classification successfully and improve the profitability of retention operations. Recently, a study found that both bagging and boosting techniques can significantly improve the classification performance of traditional classification models (Lemmens and Croux, 2006 [15]). The churn prediction issue has also been studied extensively in finance and insurance industries. For example, Smith et al. (2000) [29] utilized several techniques, including hypothesis test, statistics, clustering, decision trees, and neural network, at various stages of a holistic framework. Few studies have used data mining in retailing. Buckinx and Van den Poel (2005) [6] first proposed partial defection for churn prediction in retailing and also found that the random forest had better classification accuracy than logistic regression and neural networks. The concept of partial defection not only solves the situation that is unable to determine the exact moment when customers leave in retailing but is able to take actions before churn occurs. In addition, there are other techniques utilized in various domains, such as survival analysis (Bhattacharya, 1998[2]; Van den Poel and Larivière, 2004[30]), hazard model (Popkowski et al, 2000[24]), and support vector machine (Coussement and Van den Poel, 2006[8]).

In summary, literature doesn't confirm which technique has the best performance on churn prediction. However, most previous

researches only compared the performance of several techniques. In this study, we not only apply and compare the techniques applied for churn prediction, but also, we combine linear discriminant analysis and artificial neural network and see if it will come out a better result.

RESEARCH METHODOLOGY

Research Procedure

Based on the literature review, we choose a number of possible predicting variables and establish a churn prediction model/procedure. We then apply three classification techniques to select key churn prediction variables and then identify the possible partial churners. The first stage of the churn prediction is the data preparation. We clean, extract and transform the selected dataset from the original data files. The second stage is target selection. We identified two target groups. The first includes the entire store members and the second includes only the loyal members. The third stage is to apply the solution techniques. We apply three classification techniques, including logistic regression, random forests, and back propagation neural networks, by using MATLAB and R programs. Moreover, we combine the discriminant analysis with the back propagation neural networks for churn analysis. Finally, we evaluate and compare the performance of these techniques applied. The data used for this study is retrieved and modified from a branch store of a major retailer in Taiwan for a two-year range. The data sources include the customer profiles, the transaction data, and the promotion data. The retailer has a membership program and the active members for the particular store are around 100,000 customers.

Procedure/Model Building

In this section, we illustrate each step on how we construct the procedure/model.

Step 1: Churn identification

One of the purposes of this research is to predict the partial defection probability of individual level in the future. The variables in our classification models are all binary that the dependent variable classifies a customer who is either a stayer or a partial-defection customer (0, 1). In this study, we follow and modify the characteristics of the partial defection customer defined by Buckinx and Van den Poel (2005)[6] as below:

1. The frequency of purchases between observation period and determination period decreases more than eighty per cent.
2. The monetary of purchases between observation period and determination period decreases more than eighty per cent.

The first criterion is similar to the definition of Buckinx and Van den Poel (2005)[6] and the second criterion is able to discover whether a customer decrease his/her wallet share.

The first year data are used to observe the purchase patterns of the customers as a reference. The second year data are used to detect the partial churners. As a result, we identify 29,977 customers as the partial-defection customers. This is about 32.74% of the clients under our investigation.

Step 2: Target selection

In this study, the first target group applies the entire members and the second target group includes the loyal customers. For the second target, we followed Buckinx and Van den Poel (2005)[6] and defined the loyal customers who met the two criteria : (1) the frequency of purchase is above the average. Second, the ratio of the standard deviation of the inter-purchase time to the mean inter-purchase time is below the average. Consequently, we select 24,086 customers, who are behaviorally loyal than other customers, from total available customers. There are 4,732 partial churners of behaviorally loyal customers and the churn rate of behaviorally loyal customers is 19.65%.

Step 3: Cross-Validation

Cross-validation is a statistical practice used by iteratively partitioning the sample in two subsets of the initial data set (Hastie, Tibshirani, and Friedman, 2001[13]; Martinez and Martinez, 2001[17]). One of the subsets is used for model building and the other one is used for evaluation. This research randomly chooses a fifth of the initial sample as the testing data and the remaining observations are retained as the training data.

Step 4: Applying the solution techniques:

In this research, we use logistic regression, discriminant analysis, random forests, and back propagation neural network to construct classification models. First, we use logistic regression, random forests, and back propagation neural networks separately to predict the possible churners. Second, we apply the discriminant analysis for variable selection and then use back propagation neural network for data classification.

Explanatory Variables

Based on literature reviews and the interviews with domain experts, we identified a number of explanatory variables as the inputs to the churn detection model. Table 1 lists the predictors used in this research.

Table 1. Variables Used in this Study

Variable type	Variable name	Description
Recency	Recency	Number of days since last shop incidence
	RecencyMean	The average number of days between a customer's shop incidence
	RecencySD	Standard deviation of the inter-purchase time
Frequency	Frequency	Number of shop visits
	FrequencySD	Standard deviation of Frequency
	FreqLastMonth	Number of shop visits during last month
Monetary	Monetary	Total monetary amount of consumption
	MonetarySD	Standard deviation of monetary
	MoneLastMonth	Total monetary amount of consumption during last month
Mode of payment	Payment	Dummy indicating the mode of payment used most frequently
Promotions	PromVisit	Number of shop incidences during promotion
	rPromVisit	Ratio of PromVisit to Frequency
	PromMonetary	Total monetary amount of consumption during promotion
	PromProdMonetary	Total monetary amount of discount product consumption
Use of loyalty point	LpSpent	Total number of loyalty points spent
	LpSpentMean	The average number of loyalty points spent in every purchase
	LpEarnedMean	The average number of loyalty points earned in every purchase
Demographics	Age	Age
	Sex	Sex
	Education	Category variable of education
	FamilyNo	Number of members in the household
	ChildNo	Number of children
	DemoMissing	Dummy indicating whether or not demographic information is missing
	DistStore	Distance from the residence to the store
	Competitor	Number of retailers
Interactions	Complaint	Number of complaint
	Return	Number of returned purchase
	Online	Dummy indicating whether or not a customer is an online member
	ePaper	Dummy indicating whether or not a customer is willing to receive the e-news

Evaluation Criteria

In order to evaluate the performance of classification techniques, we use two criteria: percentage correctly classified (PCC) and area under the receiver operating characteristic curve (AUROC). Percentage of correct classification, also called error rate, is the traditional performance criterion. It is the percentage of incorrectly classified observations in the validation set. The definition of PCC is noted as the higher the PCC is, the better the classification technique is. The formula is $PCC = (A + D) / (A + B + C + D)$. The ROC measure takes into account all possible cut off levels and considers the sensitivity (the number of true positives versus the total number of switchers) and the specificity (the number of true negatives versus the total number of stayers) of the confusion matrix in a two-dimensional graph. The area under ROC (AUROC) can be used to evaluate the predictive accuracy of classification models.

DATA ANALYSIS AND RESULTS**Performances of the Models**

This study applies random forests, back propagation neural networks, and the combination of linear discriminant analysis and back propagation neural networks for churn prediction. As the benchmark, we use a logistic regression model on the same samples. Using the logistic regression model as the benchmark is also suggested by the previous studies (Buckinx and Van den Poel, 2005[6]; Lemmens and Croux 2006[15]).

Analysis of all customers

Table 2 represents the percentage correctly classified (PCC) and the area under the receiver operating characteristic curve (AUROC) of the proportion sample for entire customer base.

Table 2. Performance results of the training and testing sample for all customers

	PCC		AUROC	
	Training	Test	Training	Test
Logistic regression	0.8245	0.7633	0.8573	0.7960
Random forests	0.8791	0.8324	0.9024	0.8701
BPN	0.8480	0.7879	0.8872	0.8055
LDA+ BPN	0.8564	0.7922	0.8853	0.8276

Analysis of the loyal customers

Table 5 represents the percentage correctly classified (PCC) and the area under the receiver operating characteristic curve (AUROC) of the proportion sample for loyal clients. As a result, the back propagation neural networks have the best performance. Moreover, the combination model of linear discriminant analysis and back propagation neural networks outperforms logistic regression and random forests.

Table 3. Performance results of the training and testing sample for loyal customers

	PCC		AUROC	
	Training	Test	Training	Test
Logistic regression	0.9255	0.9041	0.9472	0.9239
Random forests	0.9660	0.9397	0.9890	0.9600
BPN	0.9819	0.9628	0.9944	0.9653
LDA+ BPN	0.9684	0.9426	0.9898	0.9600

From the analysis of results given above, we can see that the combination technique is able to maintaining good solution quality, saving memory size, and with reasonable computation time. Using linear discriminant analysis helps back propagation neural networks to decrease the dimension of the input data and to lower computation time since it selects the most important variables before training neural networks. In this research, the computation time of the combination techniques only requires about half of the time of back propagation neural networks.

Identified Key Variables for Churn Prediction

In this study, we do not only evaluate the prediction performance of different approaches but also identify several key variables in predicting churn and specific features of the churners. Results in Table 4 present the average normalized importance (Breiman, 2001[4]) of each predictor for the random forests approach and the Wilks's lambda of each predictor for the linear discriminant analysis under the entire customer base. In Table 4, we report only the first twenty key variables for random forests. Table 5 describes the identified key variables for the group of loyal customers.

Table 4. Importance of variables for all customers

No.	Random forests		Linear discriminant analysis	
	Average normalized importance	Variable name	Wilks's lambda	Variable name
1	0.9916	Frequency	0.560	Frequency
2	0.8964	FrequencySD	0.558	Monetary
3	0.8125	Monetary	0.522	FreqLastMonth
4	0.7306	Recency	0.464	FrequencySD
5	0.6513	FreqLastMonth	0.444	Recency
6	0.5800	RecencyMean	0.421	RecencyMean
7	0.5144	MonetarySD	0.418	MoneLastMonth
8	0.4533	ePaper	0.389	ePaper
9	0.4090	MoneLastMonth	0.388	Return
10	0.3660	Complaint	0.380	Complaint
11	0.3288	Return	0.379	PromProdMonetary
12	0.2919	PromProdMonetary	0.377	LpSpent
13	0.2565	DistStore	0.375	DistStore
14	0.2284	Competitor	0.371	rPromVisit
15	0.2040	rPromVisit	0.363	Competitor
16	0.1829	LpSpent	0.363	PromMonetary
17	0.1626	Online	0.362	LpEarnedMean
18	0.1429	LpEarnedMean	0.361	Online
19	0.1271	Age	0.360	Age
20	0.1119	ChildNo	0.359	DemoMissing

Table 5. Importance of variables for loyal clients

No.	Random forests		Linear discriminant analysis	
	Average normalized importance	Variable name	Wilks's lambda	Variable name

	importance			
1	0.9811	MoneLastMonth	0.602	FreqLastMonth
2	0.8591	FreqLastMonth	0.511	FrequencySD
3	0.7866	MonetarySD	0.504	Recency
4	0.7146	Monetary	0.493	MonetarySD
5	0.6458	Recency	0.486	Frequency
6	0.5771	FrequencySD	0.475	Monetary
7	0.5094	DistStore	0.468	Competitor
8	0.4437	Frequency	0.465	ePaper
9	0.3786	rPromVisit	0.463	DistStore
10	0.3149	Competitor	0.461	rPromVisit
11	0.2685	ePaper	0.460	Online
12	0.2598	Online	0.459	Return
13	0.2564	Age	0.458	Complaint
14	0.1985	Complaint	0.457	Age
15	0.1412	Return	0.457	ChildNo
16	0.0881	ChildNo	0.456	LpSpent

Tables 4 and 5 offer the similar results. It is obvious from the ranks of variable importance that behavior variables, such as recency, frequency and monetary, are much more important than others. It is not surprising since recency, frequency, and monetary (RFM) variables are well-known predictors confirming by the previous literature (Schmittlein and Peterson, 1994[28]; Reinartz and Kumar, 2000[27]; Lemon, White, and Winer, 2002[16]; Buckinx and Van den Poel, 2005[6]). A model only using transaction and demographics variable offers an AUROC of 0.7601 compared to 0.8055 in the case of back propagation neural networks on the test sample. The results are similar in other models.

Nevertheless, some variables proposed in this study are similarly important on churn prediction, such as promotion, use of the loyalty points, and customer interaction. It is opposite to the finding of Buckinx and Van den Poel (2005)[6] that use of the loyalty points is not important on churn prediction. Since the loyalty points are earned from every purchase and can be used for price discount, they could be a switching cost for customers. On the other hand, customers who purchase lots of discount products and shop a lot during the promotions tend to be price-oriented. For customer interaction, variables like ePaper, Complaint, and Return are even in the top ten important predictors of random forests and discriminant analysis. It seems reasonable because the increase of complaint and returned goods result in dissatisfaction and lead to future defection. On the contrary, a customer who is willing to receive the information from the company may want to build a long term relationship with the company.

Comparing to other predictors, demographics seem not too important. It is notable that the most important variables of demographics are DistStore and Competitor. These variables give empirical evidence that customers may defect in the future because of inconvenience.

Descriptive Statistics of the Partial Churners

In the following paragraphs, we will character the several important characteristics of the partial churners between all customers and loyal customers.

All customers

The average age of the partial churners is 36.80 years old, younger than 39.91 years old of the stayers, and roughly 58 percentages of these customers are between 25 to 39 years old. Most of them are single or have no children. As the results of the personal information, the average distance between the churners' residences and the store is around 29.80 minutes of driving and about 2.5 competitors in the area. The partial churners spend averagely NT\$ 289.28 and visit around 0.23 times in a month. Both frequency and monetary of the partial churners are less than a half of the stayers. Moreover, they purchase lots of discount products and visit during the promotion periods.

CONCLUSION

In this research, the empirical findings lead us to give several conclusions. First, the performances of the techniques we applied vary from the data. Managers and researchers have to choose their techniques carefully based on their data. However, the rule-based and the machine learning techniques could outperform than the traditional statistical techniques. Second, it is not easy for loyal customers to distinguish the partial churners from the stayers by only analyzing their transaction patterns. Third, using the decrement of RFM as the threshold may be more appropriate than using the average, since the decrement of frequency between customers are various. Fourth, variables, such as promotion, use of loyal points, customer interaction, and some customer profiles, are useful to help determine a customer who may defect or not.

A major contribution of this study is that we improve the original definition of partial defection. We suggest using the decrement of frequency and monetary rather than average as the threshold for the definition of partial defection. Moreover, predicting partial defection instead of total defection allow managers to take actions, such as proactive customer retention implements, in time before churners leave. One goal of this study is to select the important variables for churn prediction that are not only theoretically sound but also managerially applicable. For example, variables like promotion, use of loyal points as well as customer interaction are able to cluster customers based on their purchase purposes, preferences, and life styles.

Consequently, marketing managers can use these variables to segment customers into several groups and provide different marketing programs for them to increase their loyalty and purchase.

In this research, we focus on not only the group of total customers but also on the loyal customers. Since some customers may not be worth of developing long-term relationships, firms do not need to analyze and to retain every customer. A large percentage of the sales come from a small percentage of your clients (Niraj, Gupta, and Narasimhan, 2001[22]; Buckinx and Van den Poel, 2005[6]). Only the loyal customers are worth of retention and loyalty efforts. For the possible partial churners whose values are above a certain threshold, the firm can provide some special incentives they might draw interest to them to keep them stay. It helps managers to focus their limited resource on the right target rather than mass marketing.

Churn prediction is only the first stage of customer relationship management (CRM). There requires more follow-up researches to investigate the actual reasons why customers switch and leave. In other words, the people who are classified as future churners can be used to compose focus groups and conduct questionnaires or interviews to understand the reasons and attributes of churn. Accordingly, managers can use the information to design more effective retention strategy and improve their quality of services and products to increase the retention rate and increase the profitability for the firm.

There are several limitations of this research. First of all, we use only one year of available data to determine the target of this study and another one year to evaluate partial churners. To what extent this time restriction affects our results is indistinct. The more the results may change whenever more data is available. This gives the opportunity for future researchers to investigate what happens after some time to the people who are classified as partial churners. Furthermore, the variables used as inputs in this research are based on the data from a company internal data warehouse. The variables are able to be extended with customer perceptions from focus groups and interviews to increase the performance of the models. Future researchers can use questionnaires to get useful insights from customers and combine it with data mining techniques to get more robust conclusions.

This study applies several statistical and machine learning techniques. However, there remain many classification models have not been used for churn prediction in retailing, such as support vector machine, survival analysis, and hazard model. There has no conclusion which model is the best since the performance of the models vary from data and input variables.

REFERENCE

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APPLYING PARTICLE SWARM OPTIMIZATION TO SOLVE PORTFOLIO SELECTION PROBLEMS

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ABSTRACT

Particle swarm optimization (PSO), introduced by Kennedy and Eberhart in 1995, is a social population-based search algorithm and is generally similar to the evolutionary computation techniques that have been successfully applied to solve various hard optimization problems. The standard Markowitz mean-variance approach to portfolio selection involves tracing out an efficient frontier, a continuous curve illustrating the tradeoff between return and risk. In this paper we applied the particle swarm approach to find an efficient frontier associated with the classical and general (unconstrained and constrained) mean-variance portfolio selection problem. The OR library data sets were tested in our paper and computational results showed that the PSO found better solutions when compared to genetic algorithm (GA), simulated annealing(SA), and tabu search(TS).

Keywords: Particle swarm optimization, Portfolio selection, Mean-variance approach, Efficient frontier

INTRODUCTION

In the portfolio selection problem, given a set of available securities or assets, we want to find out the optimum way of investing a particular amount of money in these assets. Each one of the different ways to diversify this money between the several assets is called a portfolio. For solving this portfolio selection problem, Markowitz' mean -variance model of portfolio selection is one of the best known models which assumes that the total return of a portfolio can be described using the mean return of the assets and the variance of return (risk) between these assets [3, 11]. In its basic form, this model requires to determine the composition of a portfolio of assets which minimizes risk while achieving a predetermined level of expected return what it is called the efficient frontier. For every level of desired mean return, this efficient frontier gives us the best way of investing our money.

However, the standard mean-variance model has not got any cardinality constraint ensuring that every portfolio invests in a given number of different assets, neither uses any bounding constraint limiting the amount of money to be invested in each asset. This sort of constraints are very useful in practice. In order to overcome these inconveniences, the standard model can be generalized to include these constraints. In this paper we focus on the problem of tracing out the efficient frontier for the general mean-variance model with cardinality and bounding constraints. In previous work, some heuristic methods have been developed for the portfolio selection problem. There are some methods that use evolutionary algorithms [6], tabu search (TS) [1] simulated annealing (SA) [1, 2, 5, 10] and neural networks [5]. Here we present a different heuristic method based on PSO. The results obtained are compared to those obtained using three representative methods from [1] based on genetic algorithms (GA), TS and SA.

Following this introduction, in Section 2, we present the model formulation for the portfolio selection problem and describe the PSO as well as the way to use it for solving this problem. Section 3 design two computational experiments to evaluate the PSO model. In Section 4, we present some experimental results and, in Section 5, we finish with some conclusions and future work.

LITERATURE REVIEW

The problem of optimally selecting a portfolio among n assets was formulated by Markowitz in 1952 as a constrained quadratic minimization problem [2]. In this model, each asset is characterized by a return varying randomly with time. The risk of each asset is measured by the variance of its return. If the component w_i of the N -vector w represents the proportion of an investor's wealth allocated to asset i , then the total return of the portfolio is given by the scalar product of w by the vector of individual asset returns.

Portfolio Selection

In this section we first display the standard (unconstrained) Markowitz portfolio model and illustrate the way to calculate the efficient frontier. Second we showed the optimal Markowitz portfolio model that we want solve. Finally we show the general Markowitz constrained optimal model that we want solve.

Standard (Unconstrained) Markowitz Portfolio Model

Let:

N be the number of assets available,

u_i be the expected return of asset i ($i=1, \dots, N$),
 σ_i be the covariance between assets i and j ($i=1, \dots, N$; $j=1, \dots, N$),
 R_{exp} be the desired expected return.

Then the decision variables are:

w_i the proportion ($0 \leq w_i \leq 1$) held of asset i ($i=1, \dots, N$) and using the standard Markowitz mean –variance approach [1] we have that the unconstrained portfolio optimization problem is:

$$\text{Min} \sum_{i=1}^N \sum_{j=1}^N w_i \cdot w_j \cdot \sigma_{ij} \quad (1)$$

subject to

$$\sum_{i=1}^N w_i u_i = R_{\text{exp}} \quad (2)$$

$$\sum_{i=1}^N w_i = 1 \quad (3)$$

$$0 \leq w_i \leq 1, \quad i = 1, \dots, N$$

Eq.(1) minimizes the total variance(risk) associated with the portfolio whilst Eq.(2) ensures that the portfolio has an expected return of R_{exp} . Eq.(3) ensures that the proportions add to one.

The optimal Markowitz portfolio model that we adopt is as follow Eq.(4).

$$\text{Min} \lambda \left[\sum_{i=1}^N \sum_{j=1}^N w_i \cdot w_j \cdot \sigma_{ij} \right] - (1-\lambda) \left[\sum_{i=1}^N w_i \cdot u_i \right]$$

subject to

$$\sum_{i=1}^N w_i = 1$$

$$0 \leq w_i \leq 1, \quad i = 1, \dots, N \quad (4)$$

The General Markowitz Constrained Optimal Model

In order to extend our formulation to the cardinality constrained case let:

K be the desired number of assets in the portfolio, ε_i be the minimum proportion that must be held of asset i ($i=1, \dots, N$) if any of asset i is held, δ_i be the maximum proportion that can be held of asset i ($i=1, \dots, N$) if any of asset i is held, where we must have $0 \leq \varepsilon_i \leq \delta_i \leq 1$ ($i=1, \dots, N$). In practice ε_i represents a “min-buy” or “minimum transaction level” for asset i and δ_i limits the exposure of the portfolio to asset i . Introducing zero-one decision variables:

$$z_i \begin{cases} 1 & \text{if any of asset } i \text{ (} i=1, \dots, N \text{) is held,} \\ 0 & \text{otherwise} \end{cases}$$

The cardinality constrained portfolio optimization problem is

$$\text{Min} \lambda \left[\sum_{i=1}^N \sum_{j=1}^N w_i \cdot w_j \cdot \sigma_{ij} \right] - (1-\lambda) \left[\sum_{i=1}^N w_i \cdot u_i \right] \quad (5)$$

subject to

$$\sum_{i=1}^N w_i = 1 \quad (6)$$

$$\sum_{i=1}^N z_i = K \quad (7)$$

$$\varepsilon_i z_i \leq w_i \leq \delta_i z_i, \quad i = 1, \dots, N \quad (8)$$

$$z_i \in [0, 1], \quad i = 1, \dots, N \quad (9)$$

We use the same way like Ref[1] that applying to a weighting parameter(λ) to combine both minimizes the total variance (risk) associated with the portfolio and ensures that the portfolio has an expected return of R_{exp} . Eq.(6) ensures that the proportions add to one whilst Eq.(7) ensures that exactly K assets are held. Eq.(8) ensures that if any of asset i is held ($z_i = 1$) its proportion w_i must lie between ε_i and δ_i , whilst if none of asset i is held ($z_i = 0$) its proportion w_i is zero. Eq.(9) is the integrality constraint.

Particle Swarm Optimization

Particle swarm optimization (PSO), introduced by Kennedy and Eberhart in 1995, is generally similar the evolutionary computation techniques (Trelea, 2003). PSO is a social population-based search algorithm of social influence and learning from it's neighborhood. In PSO, a swarm resembles a population and a particle resembles an individual, is initialized with a swarm of particles, and position of each particle represents a possible solution. the particles fly through the multidimensional search space by dynamically adjusting velocities according to it's own experience and neighbors [4, 7, 8, 12].

$$x_{id}(t+1) = x_{id}(t) + V_{id}(t+1) \quad (10)$$

Where $x_{id}(t)$ denote the position of particle i in the d dimension search space at time step t ; unless otherwise stated, t denotes discrete time steps. The position of the particle is changed by adding a velocity $v_{id}(t+1)$ to the current position. The $v_{id}(t+1)$ calculating is as following:

$$V_{id}(t+1) = w \times V_{id}(t) + c_1 \times rand() \times (p_{id} - x_{id}(t)) + c_2 \times rand() \times (p_{gd} - x_{id}(t)) \quad (11)$$

Where $v_{id}(t)$ is the velocity of particle i in dimension $d=1, \dots, n$ at time step t , $x_{id}(t)$ is the position of particle i in dimension d at time step t , and c_1, c_2 are positive acceleration constants used to scale the contribution of the cognitive and social components respectively, and $rand()$ is random value in the range $[0, 1]$, sampled a uniform distribution. These random values introduce a stochastic element to the algorithm.

The personal best position, p_{id} associated with particle i in dimension d is the best position the particle has visited since the first time step. The global best position, p_{gd} , at the time step t , is the best position discovered by all of particles found since the first time step.

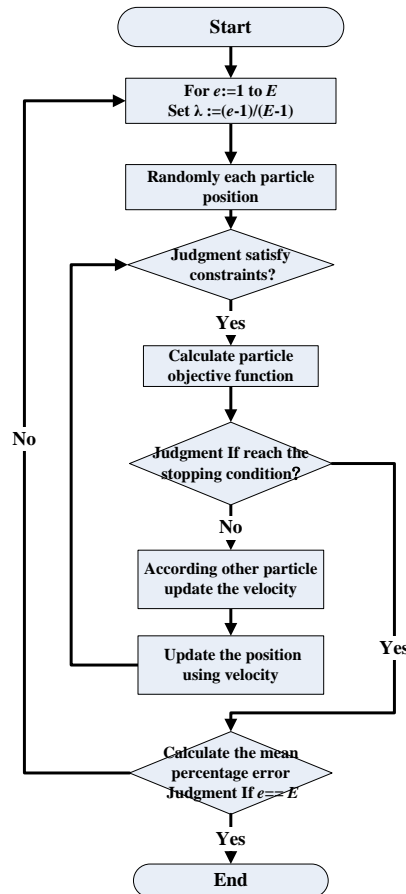


Figure 1. Procedure of PSO for po

COMPUTATIONAL EXPERIMENTS

In this section, we definite our experiments as searching the general efficient frontier that solves the problem formulated in last two optimal models. We employ the five sets of benchmark data that have been already used in [4, 7, 11] These data correspond to weekly prices from March 1992 to September 1997 and they come from the indices: Hang Seng in Hong Kong, DAX100 in Germany, FTSE100 in UK, S&P100 in USA and Nikkei225 in Japan. The number N of different assets considered for each one of the test problems is 31, 85, 89, 98 and 225, respectively. The mean returns and covariances between these assets have been

calculated for the data. The sets of mean returns and covariances are publicly available at <http://people.brunel.ac.uk/mastjjb/jeb/orlib/portinfo.html>.

All the results presented here have been computed, as in Ref. [2], using the values $K=10$, $\varepsilon_i=0.01$ and $\delta_i=1$ for the problem formulation. So we have tested 51 different values for the risk aversion parameter λ .

In this paper, we used the variance(standard deviation) and return of the best solution for each λ to compare to standard efficient frontiers to measure percentage error respectively, and took the minimum value from variances error and mean returns error as our the percentage error associated with a portfolio.

Let the pair (v_i, r_i) represent the variance and mean return of a point in a heuristic efficient frontier. Let also v_i^* be the variance corresponding to r_i according to a linear interpolation in the standard efficient frontier. We define the variance of return error e_i for any heuristic point (v_i, r_i) as the value $100(v_i - v_i^*)/v_i^*$ (note that this quantity will always be nonnegative). In the same way, using the return r_i^* corresponding to v_i according to a linear interpolation in the standard efficient frontier, we define the mean return error η_i as the quantity $100(r_i - r_i^*)/r_i^*$.

The error measure was also defined in [2]. It is calculated averaging the minimums between the mean return errors e_i and the standard deviation of return errors η_i .

IMPLEMENTATION RESULTS

We present the values correspondent to the minimum error measure in Table 1 to

To evaluate the performance of PSO, we first applies the PSO for five test data sets on unconstrained portfolio problem in Ref.[1]. Table 1 shows the comparable results on mean percentage error and to benchmark with three other heuristic algorithms (genetic algorithm (GA), simulated annealing(SA), and tabu search(TS)) developed by [1]. In this evaluation, the parameter settings of the PSO algorithm are as follows: positive acceleration constants c_1 and c_2 are set to (2, 2), and weight of velocity is set to 0.2. Table 2 presents the comparison of five test data sets for constrained portfolio problem. It is obvious that PSO does a better job in finding the standard efficient frontiers with the lowest overall mean percentage error.

Table 1 Result for unconstrained portfolio problem (Mean percentage error)

Index	Number of assets(N)	GA	SA	TS	PSO
Hang Seng	31	0.0202%	0.1129%	0.8973%	0.0198%
DAX	85	0.0136%	0.0394%	3.5645%	0.0094%
FTSE	89	0.0063%	0.2012%	3.2731%	0.0064%
S&P	98	0.0084%	0.2158%	4.4280%	0.0071%
Nikkei	225	0.0085%	1.7681%	15.9163%	0.0082%
	Average	0.0114%	0.4675%	5.6158%	0.0102%

Table 2 Result for constrained portfolio problem (Mean percentage error)

Index	Number of assets(N)	GA	SA	TS	PSO
Hang Seng	31	1.0974%	1.0957%	1.1217%	1.0554%
DAX	85	2.5424%	2.9297%	3.3049%	2.1231%
FTSE	89	1.1076%	1.4623%	1.6080%	1.0028%
S&P	98	1.9328%	3.0696%	3.3092%	1.5699%
Nikkei	225	0.7961%	0.6732%	0.8975%	0.7756%
	Average	1.4953%	1.8461%	2.0483%	1.3100%

CONCLUSION

In this paper we have applied a PSO heuristic algorithm to solve portfolio selection problem based on both standard Markowitz mean-variance model and this model added to cardinality and bounding constraints. Dealing with this kind of constraints, the portfolio selection problem turn into a mixed quadratic and integer programming problem for which no exactly and efficiently optimal algorithms exit. Performance evaluation of our PSO under the same settings of error computational way has been implemented in five benchmark datasets and compared our results to three other heuristic algorithms that included genetic algorithms, simulated annealing, and tabu search.

The results of the performance evaluation indicate that our basic PSO has outperformed the other method for the most part.

Therefore, we can conclude that the PSO is an effective and efficient heuristic algorithm to solve constrained portfolio selection problems.

Future work

In this paper we investigate the ability of the PSO heuristic to deliver high quality solutions for the mean-variance model enriched by additional constraints but from a practical point of view, however, the Markowitz model may often be considered too basic, as it ignores many of the constraints faced by real; world investors: trading limitations, size of the portfolio, etc. Including such constraints in the formulation results in a nonlinear mixed integer programming problem which is considerably more difficult to solve than the original model. In the future we plan to investigate more complex portfolio selection problems that include real constraints.

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COMPARISON OF CLASSIFICATION ALGORITHM PERFORMANCES IN KNOWLEDGE MAPPING FOR ORGANIZATION EXPERTS

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ABSTRACT

The knowledge map describes who has what knowledge (tacit), where the knowledge collected, and helps to learn the jobs and expertise in organization. In many organizations there is a lack of directions to manage knowledge and knowledge map. Data classification is one technique using in knowledge mapping. This paper proposes an approach for knowledge mapping of experts in organization by comparing the performances of four classification algorithms. The classification proposed in this paper in the domain of energy expert. We measured prediction performances by comparing algorithms with four classification algorithms: two types of decision trees (ID3, C4.5) and two rule-based (OneR and Prism). These four algorithms are measured their effectiveness with K-fold cross-validation method on their classification correctness. The results show that C4.5 algorithm is the best one in decision tree, and Prism is the best one in rule-based. Among the four algorithms, C4.5 is the best performance in classification for knowledge mapping. Future research and implication are also suggested.

Key Words: Data Mining, Classification, ID3, C4.5, OneR, Prism, Cross-Validation

INTRODUCTION

In this day, organizations have many employees with specific working experiences. Some organizations have encounter problems and difficulties in their operations; sometimes they can not find experts to solve problems just in time. This is due to these organizations do not classify experts in their expertise or create knowledge mapping. Data mining techniques can be used to find potential useful knowledge, such as patterns and rules [9]. Also data mining tasks include clustering, classifying and association rules [10]. This paper used classification algorithms. Each techniques employs a learning algorithm to identify a model that best fits the relationship between the attribute set and class label of the input data. Knowledge mapping helps organization to find experts in the task. The meaning of knowledge map or knowledge mapping has mention here. Vail [17] proposed definitions of the terms knowledge map or knowledge mapping as follows “A knowledge map is a visual display of captured information and relationships, which enables the efficient communication and learning of knowledge by observers with differing backgrounds at multiple levels of detail. The individual items of knowledge included in such a map can be text, stories, graphics, models, or number.” and also “Knowledge mapping is defined as the process of associating items of information or knowledge (preferably visually) in such a way that the mapping itself also creates additional knowledge.” In other words, knowledge map should assist an individual employee, a team or an organization unit in understanding and using the knowledge available in an organizational setting [4]. Further, it provides the relations of the people within an organization. We can find out interest areas, areas of expertise, tasking and characterize how work is being addressed within actual organization (i.e., who, what, where and when) with this knowledge map. In addition to the knowledge maps will serve as a blueprint to pinpoint knowledge sources and will facilitate finding relevant information and knowledge pockets in the organization. In this paper, we present the research that relate, as follows in related work. The paper is organized as follows. Section 2, we review the related work. In Section 3 is the theory of classification algorithms. In Section 4 is the Study Framework. The experimental results are revealed in Section 5. Finally in Section 6 is about Conclusions and Future work.

RELATED WORK

Eppler [4] seeks to establish the conceptual and empirical basis for an innovative instrument of corporate. The knowledge maps include 5 types that can be used in managing organizational knowledge. They are knowledge-sources, - assets, -structures, -applications, and -development maps. Burkhard et al. [2] proposed a framework derived from three case studies on Knowledge Maps in Organizations. In organizations speed, clarity, and effectiveness are essential for the transfer to knowledge. Eppler [5] proposed a simple knowledge map type based on these primary classification principles which are by purpose, by graphic form, by content, by application level and by creation mode. Lin and Hsueh [11] proposed creation and maintenance knowledge map functions by utilizing information retrieval and data mining techniques. They use hierarchical clustering and k-means clustering to create knowledge map. The same method is used to classify new documents into existing clusters by comparing new document vector and cluster centroid vector. The performance of the knowledge map creation method is measured by precision and recall. Soman and Bobbie [16] used machine learning schemes, OneR, J48 (C4.5) and Naïve Bayes to classify arrhythmia for ECG medical dataset. The precision in prediction of this study is based on 10-fold cross validation. Despite the high accuracy rate of J48 is revealed, whereas OneR and Naïve Bayes show stable accuracy for the same dataset. The accuracy rate of OneR is the lowest among the three algorithms. Holmes and Trigg [6] used a diagnostic tool for comparison of tree-based supervised classification model. The decision trees

produced by C4.5 with default setting. Result from the study seeks to enhance to classification accuracy of learning algorithm by using 10-fold cross-validation. The experiments show that there is a fairly strong correlation between the relative edit distance to the full tree and the cross validation error except where highly relevant nominal attributes contain many values. Andreeva et al [1] used two machine learning classifiers: J48 (C4.5) and OneR to classify BreastCancer dataset and compare them in terms of correctly classified. The results show that J48 (C4.5) is higher accuracy than OneR. Lastly, Zhou and Yao [19] proposed three algorithms for classifications: ID3, Prism, and Prism-concept by using 5 cross-validation, the three algorithms are tested for the accuracy of prediction. The prediction accuracy of Prism is higher than ID3, Prism-concept in each 5 cross-validation. It seems that ID3, C4.5, OneR and Prism are four candidate algorithms for classifying the dataset to build the decision tree for prediction tasks.

The above literatures have applied classification method to create model for knowledge mapping. In Thailand, there is scanty study in creating an expert knowledge map by using classification algorithms. The objective of this study is to identify the best fit classification algorithm of knowledge mapping by comparing four classification algorithms. They include Decision Trees: ID3, C4.5 and Rule-based: OneR and Prism algorithms.

THEORY OF CLASSIFICATION ALGORITHMS

Classification is one of supervised learning algorithm, which is suited for predicting or describing data set with binary or nominal categories. The objective of classification is to reduce the detail and diversity of data and resulting information overwork by grouping similar data. A classification model can be used to predict the class label of unknown instants. The major classification approaches consists of decision tree, decision rules, k-nearest neighbors, Bayesian approaches, neural networks, regression-based methods and vector-based method [8]. In this section we describes theory of two decision trees and two decision rules sometimes called rule-based, these four algorithms will be used in this study.

Decision Trees

Decision tree is a popular structure for supervised learning. It is a method for approximating discrete-value functions that is robust to noisy data and capable of learning disjunctive expression. A family of decision tree that includes widely used algorithms such as ID3, C4.5 and ASSISTANT [12].

Decision tree are commonly used for gaining information for the purpose of decision-making. Decision tree starts with a root node on which it is for users to take actions. From this node, users split each node recursively according to decision tree learning algorithm. The final result is a decision tree in which each branch represents a possible scenario of decision and its outcome.

In this study we chose two algorithms to build decision tree. ID3, C4.5 are popular decision tree algorithms which used in this study.

C4.5 Algorithm

C4.5 algorithm is Quinlan's extension of his own ID3 algorithm for generating decision tree [10]. This algorithm recursively visit each decision node, selecting the optimal split, until no further splits are possible. The C4.5 algorithm is not restricted to binary splits, it produces a tree of more variable shape. By default it produces a separate branch for each value of the categorical attribute.

C4.5 algorithm uses the concept of information gain or entropy reduction to select the optimal split. Main improvements included in C4.5 deal with the pruning methodology and the processing of numeric attributes.

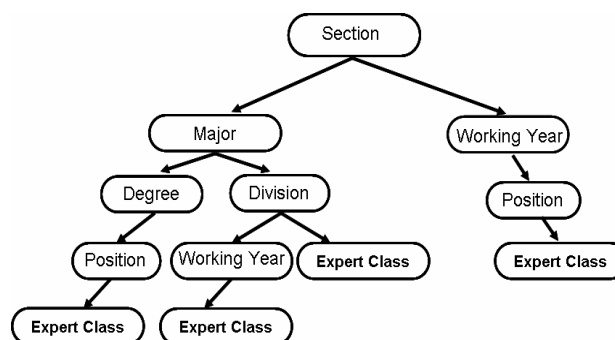


Fig. 1. Example of Decision Tree for Expert Classification

Both ID3 and C4.5 apply entropy measures their splitting functions, however C4.5 has more advantages than the former since it has tree pruning function and further it can be modified to handle data sets with missing values (Quinlan, 1993).

Rule Based

The rule-based system itself uses a simple technique: It starts with a rule-base, which contains all of the appropriate knowledge encoded into IF-THEN form. It called production rules or just rules. In the IF part to some action in the THEN part. A rule

provides some description of how to solve a problem. Rules are relatively easy to create and understand [13].

Rules as a knowledge representation technique, any rule consists of two parts: the IF part, called the antecedent (premise or condition) and the THEN part called the consequent (conclusion or action).

The basic syntax of a rule is:

IF <antecedent> THEN <consequent>

In general, a rule can have multiple antecedents joined by the keyword AND (conjunction), OR (disjunction) or a combination of both. The OneR and Prism Algorithms are interesting in make rules and easy to understand it.

OneR Algorithm

OneR is one of the simplest classification algorithms, proposed by Holte [14]. OneR produces simple rules based on one attribute only. It generates a one-level decision tree. Each attribute value will be determined. OneR algorithm creates one rule for each attribute in the training data. The rule with the smallest error rate selected.

The algorithm is as follows : For each value V of that attribute, create a rule :

For each attribute A:

1. Count how often each class appears
2. Find the most frequent class, c
3. Make a rule "if A=V then C=c"
4. Calculate the error rate of all rule
5. Author Information

Prism Algorithm

Hong and Tseng [7] apply Prism algorithm which has the idea of information gain instead of entropy as ID3. Attribute valued pairs in terms of information theory, can be thought of discrete messages. The amount of information gain about an event in a message I is defined as:

$$I(i) = \log_2 \left[\frac{\text{probability of event after the message is received}}{\text{probability of event before the message is received}} \right] \quad (1)$$

Information gain is chosen for describing a class with a larger priority. The task of the Prism algorithm is to find the selector x which contributes the most information gain about a specified classification δ_n

If the training set contains instances of more than one class, then for each class δ_n , Prism performs the following steps in turn.

1. Calculate the probability of occurrence, $p(\delta_n|x)$, of the classification δ_n for each selector x
2. Select the x for which $p(\delta_n|x)$ is a maximum then create a subset of the training set
3. Repeat steps 1 and 2 for this subset until it contains only instances of class δ_n .
4. The complex rule is conjunction of all the selectors used in creating the similar subset.
5. At training set, erase all instance covered by complex rule
6. Repeat steps 1-5 until all instances of class δ_n have been removed.

Cross-Validations

Cross validation is a method for estimating the true error of a model. When a model is built from training data, the error on the training data is a rather optimistic estimate of the error rates the model will achieve on unseen data. The aim of building a model is usually to apply the model to new, unseen data [17]. An alternative to random sub sampling is

cross-validation. In this approach, each record is used the same number of times for training and exactly one for testing. This method, we partition the data into ten equal-size subsets. First, we choose nine of the subsets for training and other for testing. This approach is called a ten-fold cross-validation. The k-fold cross-validation method generalizes this approach by partition the data into k equal-sized partitions. During each run, one of the partitions is chosen for testing, while the rest of them are used for training. This procedure is repeated k times so that each partition is used for testing. The total error is found by summing up the errors for all k runs.

Evaluation of Performances

The prediction performances of four algorithms are evaluated by using precision, recall, F-measure and Root mean-squared error (RMSE). Precision and recall appropriateness have been used extensively to evaluate the retrieval performance of information retrieval algorithms. However, a more careful reflection reveals problems with these two measures. First, the proper estimation of maximum recall for a query requires detailed knowledge of all the documents in the collection. With large collections, such knowledge is unavailable which implies that recall can not be estimated precisely. Second, recall and precision are related measures which capture different aspects of the set of retrieved documents [18].

Precision

Precision is the measurement of how much of the data returned is correct.

$$\text{Precision} = \frac{\text{Number of correct answers given by system}}{\text{Number of answers given by system}} \quad (2)$$

Recall

Recall is the measurement of how much relevant data in the system has

$$\text{Recall} = \frac{\text{Number of correct answers given by system}}{\text{Total number of possible correct answers}} \quad (3)$$

F-measure

Precision and Recall stand in opposition to one another. As precision goes up, recall usually goes down. The F-measure combines the two values.

$$\text{F-measure} = \frac{(B^2 + 1) * (\text{Precision} * \text{Recall})}{B^2 * (\text{Precision} + \text{Recall})} \quad (4)$$

When $B = 1$, precision and recall are weighted equally.

When $B > 1$, precision is favored.

When $B < 1$, recall is favored.

Root Mean-Square Error (RMSE)

The mean-squared error is one of the most commonly used measures of success for numeric prediction. This value is computed by taking the average of the squared differences between each computed value (c_i) and its corresponding correct value (a_i). The root mean-squared error is simply the square root of the mean-squared-error. The root mean-squared error gives the error value the same dimensionality as the actual and predicted values. The small values of RMSE means the better power of prediction [15].

$$\text{RMSE} = \sqrt{\frac{(a_1 - c_1)^2 + (a_2 - c_2)^2 + \dots + (a_n - c_n)^2}{n}} \quad (5)$$

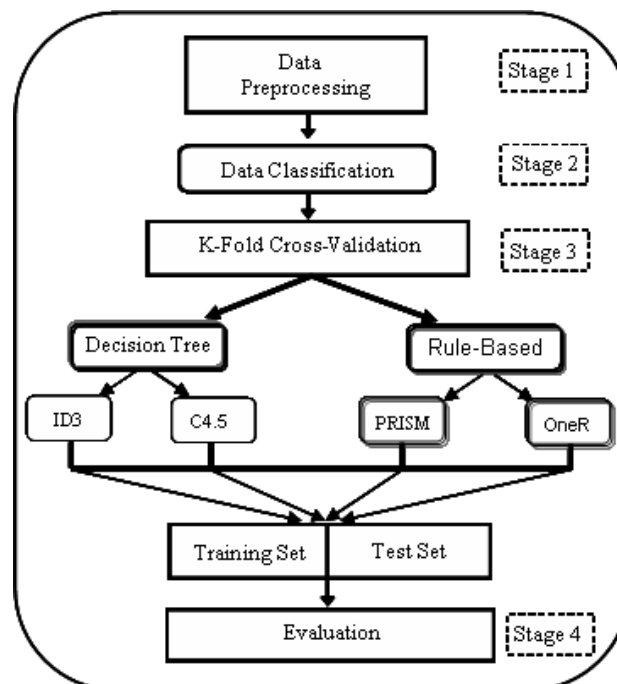
STUDY FRAMEWORK

Fig. 2. Study Framework

Stage1 : Data Preprocessing

The preprocessing process consists of two methods: data cleaning attributes and data transformation. Data cleaning, which

consists of identifying the data to be mined, then choosing appropriate input attributes and output information to represent the task. Data transformation, include organizing data in desired ways converting one type of data to another (e.g., from symbolic to nominal, numerical) defining new attributes, reducing the dimensionality of the data, removing noise, “outliers”.

Stage 2 : Classification

Classification is the **prediction** of nominal (discrete) values. Rules are generated from trained data and then applied to new data. It was decided to concentrate on an algorithm for generating four classification algorithms (i.e., Trees such as ID3 and C4.5 Rules such as OneR and Prism). All are well supported by the text and other supplements.

Stage 3 : k-fold Cross Validation

One crucial stage where comparison of models is using form of cross validation. This stage is consisted of training set and test set data. This paper conducts the comparison of trees-based supervised classification algorithm and rules-based. Cross validation is the method of choice for evaluation. The method of deriving specific attributes and procedures that seek to enhance the classification accuracy of a learning algorithm. The emerging standard in machine learning for estimating the error rate is to use stratified 10-fold cross validation. The data is divided randomly into ten parts, in each of which the class is represented in roughly the same proportion as in the entire dataset. Each of the ten parts is held out in turn while the learning scheme builds a model from the remaining nine parts [6].

Stage 4 : Evaluation

There are four measurements used in this study: Precision, Recall, F-measure, Root mean-squared error. Precision, the high accuracy of prediction, it should be high values. Recall is opposite to precision values. F-measure, the higher value implies the high accuracy. Finally, root mean-square error, it ought to be a small number.

EXPERIMENTAL

In this section, we compare four classification algorithms such as ID3, C4.5, OneR and Prism by using 10-fold cross-validation. In the results of experiment of each algorithm are shown in Fig. 3. to 6. The performance measurements are Precision, Recall, F-measure and Root mean square error.

Dataset

All data used in this experiment are collected from personnel department of one energy state enterprise which is responsible for generating and transmitting electrical power to meet the demand of Thai industries and inhabitants. The responsibility of enterprise workers can be classified by type of machine and equipment they are working with, for example, operational work, turbine, instrument and control, water system, boiler, electrical system, lignite and ash conveyor, and administration and planning. Key personnels are engineer, technician, occupational worker and administrative officer. Therefore, the classification of the experts is composed of 18 areas. Also the dataset are grouped into 17 classes. The input dataset used in the Waikato Environment for Knowledge Analysis (WEKA) program, it has format extension ‘.arff’ file. The dataset has nine nominal attributes as shown in Table 1, There are 467 instances, and as indicated above, in 17 classes.

Table 1 : Attribute of Dataset

Attribute Names	Description
Working years	number of years in defined position
Position	the position in employee job's.
Degree Earned	level of education.
Faculty Study	faculty graduated.
Major	major graduated
Department	working department
Division	working division
Section	working section
Expert	expertise

Table 1 shows the attributes used in this experiment, they include personal attributes, which consists of : working years and position. In education attributes consist of : Degree Earned, Faculty Study and Major. An institute attribute consists of : Department, Division and Section. Finally, attribute Expert Class Label.

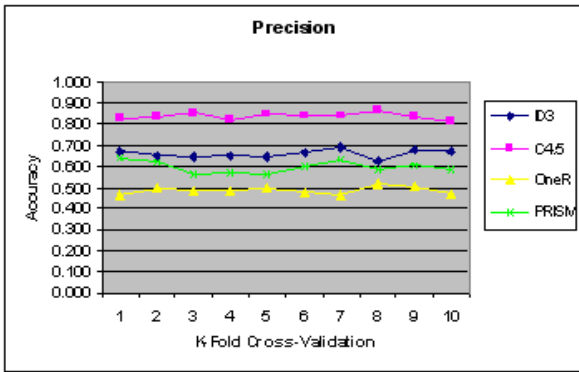


Fig. 3. Comparison accuracy of ID3, C4.5, OneR and Prism in Precision

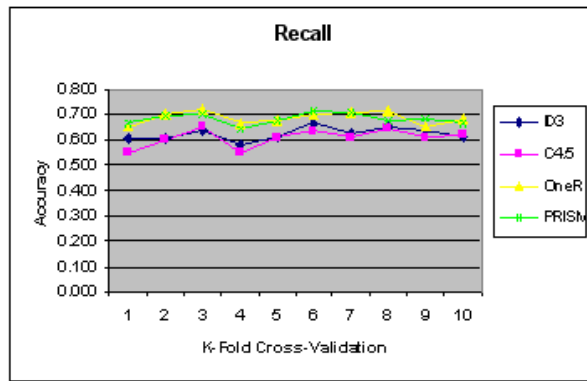


Fig. 4. Comparison accuracy of ID3, C4.5, OneR and Prism in Recall

Fig.3. and 4 show the performance comparisons of four algorithms: Decision Tree (ID3, C4.5) and Rule-Based (OneR, Prism). Fig 3 shows that both Decision tree algorithms C4.5 (0.86) and ID3 (0.69) have higher precision than Rule base: One R (0.51) and Prism (0.63). While C4.5 is the highest of all. In Fig.4., results of Recall are opposite to Precision, both OneR (0.72) and Prism (0.71) have higher recall than ID3(0.66) and C4.5 (0.64).

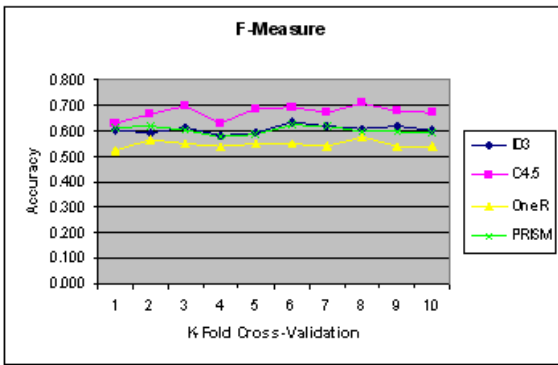


Fig. 5. Comparison accuracy of ID3, C4.5, OneR and Prism in F-measure.

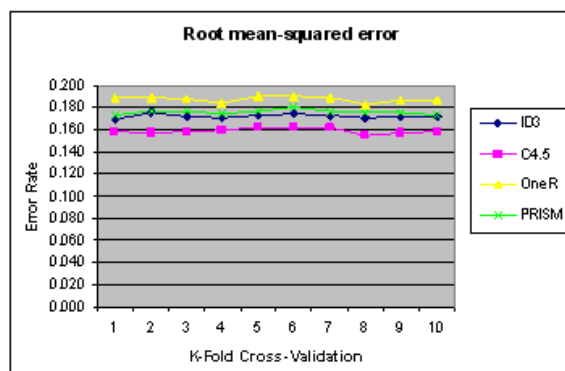


Fig. 6. Comparison error rate of ID3, C4.5, OneR and Prism in Root mean-squared error.

Fig. 5. shows the F-Measure value of four algorithms, C4.5 has the highest F-measure value (0.71) which can be implies that it is the most accurate. The value of ID3 (0.6) is close to Prism(0.6). The least is OneR(0.57). Fig. 6. The smaller RMSE value, the more power of prediction. OneR is the most error rate (0.190), While C4.5 is the best, it has the smallest error (0.154).

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CONCLUSIONS AND FUTURE WORK

This paper proposes an algorithm for knowledge map creation of experts in an organization to assist tacit knowledge visualization. In this study, we classified domain knowledge by using Decision Trees (ID3 and C4.5) and two Rule-based (OneR and Prism). In practical experiments with k-fold cross-validation it was shown that an average of four classification algorithms in terms of precision prediction. The prediction performances of four classifiers are measured by four indices used for evaluating the efficiency of classification. The indices include precision, recall, F-measure and Root mean-squared error. Results reveal that C4.5 algorithm is the best one in precision, F-measure and RMSE. In the error rate prediction, Prism has the smallest numbers, OneR has the most error rate.

This research also represents the first step toward successfully extending this approach beyond knowledge mapping for experts in energy industry. Our proposed classification algorithm potentially can be extended to classify of many other knowledge workers in organizations of related industry such as engineering or different industries such as manufacturing. Our future work is applying data mining techniques for supporting organizational knowledge management. In order to increase the prediction power of classification, alternative clustering algorithms such as K-Mean or Self-Organization Map (SOM) might be applied to segment dataset to similar group. Then each group is used to build decision tree for knowledge classification.

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INTELLIGENT AGENT FOR CALL CENTER: USING DATA MINING TECHNIQUES AND OLAP FOR AUTOMATIC ANSWERING INTERNET USAGE PROBLEMS

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ABSTRACT

This study proposes a system for an automatic question analysis and answering using data mining techniques and OLAP. By applying information extraction techniques, relevant information is taken out from of the Internet connection questions provided by users. By using data mining, user profiles and their questions on the Internet usage are used as input for the system. Two steps clustering by SOM and K-Means algorithms are used to segment user data on their characteristics which obtained from user profile. Then output from clustering and question extraction are used for OLAP (Online Analytical Processing) to analyze the cause of the Internet usage problems. After internet usage questions have been asked to the systems, the answers for solving the Internet connections for cases are replied interactively. Results from this study reveal that it is practical to develop an automatic question answering system. The proposed automatic system had been tested with sample questions from the Internet Service Provider, Call Center in Thailand. Precision of the automatic system is about 70% which is good. This study offers useful information regarding the areas of data mining for Call Center or Customer Relationship Management Center.

Keywords: data mining, SOM, K-Mean, OLAP, Internet usage, automatic question analysis

INTRODUCTION

Nowadays, it is accepted that customers are the one who play key roles in business competition. Companies spend five times more money to acquire a new customer than to keep an old one for purchasing a new product [12]. In order to compete in the competitive local and global market, customer services are significant for all companies including small, medium and large enterprises. Therefore customer relationship is assumed as one asset of the business. Thus the collection, collation, and interpretation of customer data to attract and keep customers through business process in order to create long-lasting, customer centric and mutually beneficial relationships and customer services [5, 9].

The numbers of internet usages are increasing tremendously every year. Problems of users with the Internet connections are also increasing. Thus, the Internet Service Provider also needs to help users solve these problems. It is claimed that 80% of internet connection problems are simple and can be solved by users without the assistance of a call center. These problems include telephone cord is not plugged tightly, or misspelling password for authentications. In July 2005, the number of phone calls related to internet usage problems in True Corporation which is one of the largest internet service in Thailand are about 71,628 calls. This is huge and these calls consume a lot of service times.

The objective of this study is to offer the proposed question answering systems by using SOM and K-Means algorithms to cluster user data then applying OLAP cube to analyze cause of the internet connection problems then the answers are automatically provided. This study includes four main sections. Section 2 is the related theories and studies in the past. Section 3 is research methodology and experiment. Last, section 4 is conclusion of the study.

LITERATURE REVIEW

Collaborative filtering is the popular technique, it works by considering and comparing the feature of active users and original users who would have the similarly user database. The system which uses this technique is MovieLens [7]. Weng and Liu, 2004 proposed an approach in analysing historical data of user and cause of problems. Results show that problem characteristics and solving styles might be found in customers with similar computer usages. Clustering Feature (CF) Tree and Agglomerative Hierarchical are two steps using for data clustering [13]. Chaimeun et al. [2] proposed the principles of data to cluster Thai handicraft customers by using a hybrid algorithm including SOM and K-Means algorithm. At the first stage, SOM is applied to calculate the optimal number of clusters. Output from the first stage had become input in the second stage, it used for K-Means algorithm. Further, two steps clustering of data by using SOM and K-Means have been applied extensively in various studies [10].

OLAP cube is applied with large and complex database resides in data warehouse. It has a powerful ability in organizing views and structuring data adapted to analysis. Messaoud et al. [11] proposed a hybrid technique which can decrease processing time of OLAP cube. This approach combines OLAP with one data mining algorithm: Agglomerative Hierarchical Clustering (AHC) for clustering complex data.

Data mining is defined as finding hidden information in a database. Otherwise, it has been named exploratory analysis, data driven discovery, and deductive learning. Many papers proposed two-stage methods of data mining techniques including SOM and K-Means algorithm in clustering. The majority used SOM to find the optimal number of clusters because of K-Means requires an input which is a predefined number of clusters, k. This two step clustering has been applied in this study to cluster user data into groups according to their user profiles and computer literacy.

1. K-means Algorithm

K-means algorithm [1, 6] is the simplest clustering algorithm and widely used in clustering or segmentation. K-means requires an input, named k, which is a predefined number of clusters. The steps of the K-means algorithm are given below.

Input:

$S = \{s_1, s_2, \dots, s_n\}$ // set of elements

k // Number of desired clusters

Output:

K // set of clusters

K-Means algorithm:

assign initial values for means $m_1, m_2, m_3, \dots, m_k$;

Repeat

assign each item s_i to the cluster which has the closest mean;

calculate new mean for each cluster;

Until convergence criterion is fulfilled;

2. Kohonen's Self-Organizing Map (SOM)

SOM is a neural network algorithm which is the most popular, and powerful in the unsupervised learning domains. It works effectively in unexpected and changing conditions. The basic idea is to:

1. Represent high dimension data in a low-dimensional form without losing any of the 'essence' of data.
2. Organize data on the basis of similarity by putting entities geometrically close to each other.

Summary Steps are as follows [4]:

1. **Initialization:** The weight vectors and thresholds are initialized to small random values, in an interval (0,1). Then, assign small positive values to the learning rate parameter p and r values.

2. **Activation**

Compute the neuron output at iteration p

3. **Learning**

For each input node

- Find the shortest distance to any output node.
- Adjust selected node's weight according to current stage of p .
- Adjust neighboring node's weight according to current stage of p
- Go to next unvisited input node. If there are no unvisited input nodes left then go back to the very first on and go to Step 2.

4. **Iteration.** Continue repeating Steps 2 and 3 until the synaptic weights reach their steady-state value.

3. OLAP (Online Analytical Processing)

OLAP system is a system which has a focus on the interactive analysis of data and actually provide more capabilities for visualizing data and generating summary statistics. OLAP provides multi dimensional of data representation (13).

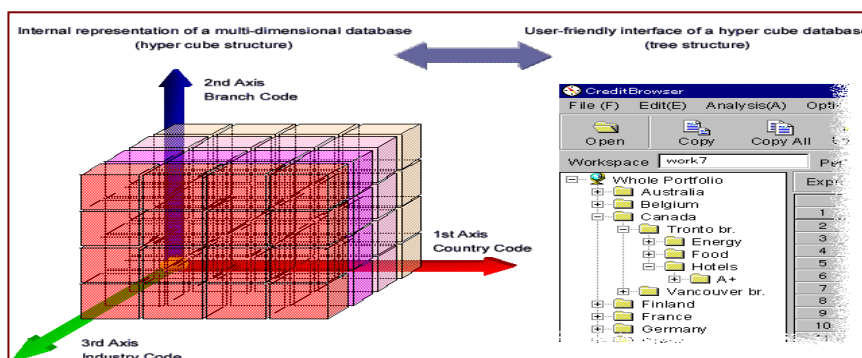


Figure 1. Multi dimensional representation for enterprise data.

4. Root Mean Square Standard Deviation (RMSSTD)

The RMSSTD [8] is the variance of the clusters; RMSSTD measures the homogeneity of the clusters to identify homogenous groups, the lower RMSSTD value means the better clustering.

$$RMSSTD = \sqrt{\frac{\sum_{j=1..d} \sum_{k=1}^{n_{ij}} (x_k - \bar{x}_j)^2}{\sum_{j=1..d} (n_{ij} - 1)}} \tag{3}$$

Where n_c is number of cluster, d is number of dimension

\bar{x}_j is expected value in the j^{th} dimension.

n_{ij} is number of element in i^{th} cluster j^{th} dimension.

5. R Squared (RS)

RS is used to measure the dissimilarity of clusters. Formally it measures the degree of homogeneity degree between groups [8]. The values of RS range for 0 to 1 where 0 means there is no difference among the clusters and 1 indicates that there are significant difference among the clusters.

$$RS = \frac{SS_t - SS_w}{SS_t}, \text{ where} \tag{4}$$

$$SS_t = \sum_{j=1}^d \sum_{k=1}^{n_j} (x_k - \bar{x}_j)^2, SS_w = \sum_{j=1..n_c} \sum_{k=1}^{n_{ij}} (x_k - \bar{x}_j)^2$$

EXPERIMENT

This study presents methods for question analysis and answering system of call center. The system can help customers in trouble shooting of errors in the Internet connections without the assistant of call center. Framework of the study is depicted in Figure 1. There are three main steps for the systems. First, user questions on the internet connections have been captured and extracted to get the keywords which represent the questions. Then keywords are stored in the same database as the solutions of internet trouble shootings. Second, user profiles from user database are preprocessed to get the selected attributes. User data focused on the internet usages are clustered. Third, user data in each cluster, extracted questions (keywords) and trouble shooting solutions are analysed by OLAP cube.

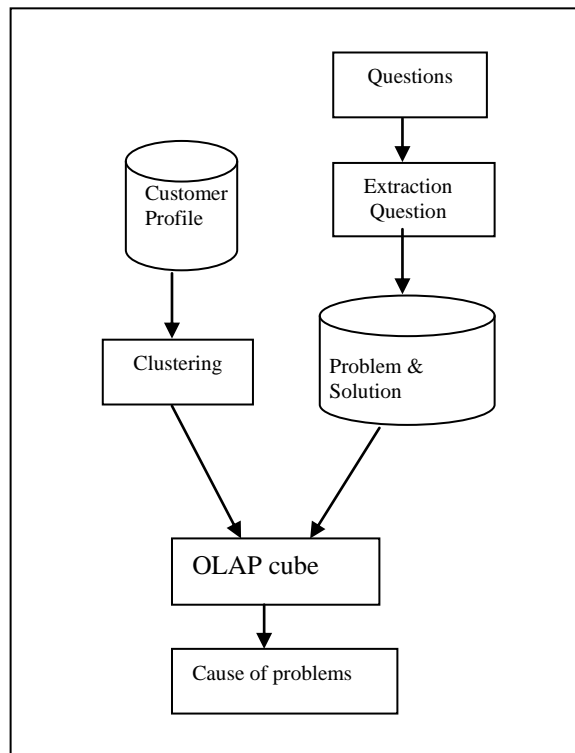


Figure 1. Framework of the study

Table1. Grouping words having the same meaning

Word synonymy	Intension
Connect, เชื่อมต่อ, ต่อเน็ต, connected	การเชื่อมต่อ / Connect
ตัด...ดับ, หลุด, เน็ตตัด, disconnected	เน็ตหลุด / Frequently disconnected
Hisp, high speed internet, ไส้ปืด, hi speed internet	Hi-speed internet
เออเรอ, Error, Errors	Message Error
...ช้า, เร็ว...k, speed...MB, slow	ความเร็ว / Speed

Thai documents are written continuously without stop words or spaces between words. First the questions need to be separated into single words by using Swath program developed by Charoenpornasawat [3]. Then Latent Semantic Analysis is applied for solving problems of words which have many meanings namely polynymous and the case of many words which have the same meaning as synonym. Then similar words are grouped in one concept (attribute). Table 1 depicts the word synonym and their intension.

1. Classification of problems

The problems in internet connections are divided in two main groups by the assistant of experts and engineers as: (1) internet can not be connected (Offline case) and (2) internet can be connected (ONLINE case) with some problems. Then each category is divided in subcategories. Each node of the decision tree contains clues or answers which help customers to solve their problems in the Internet connections. Figure 3 reveals the structure of decision tree used in this study. The scope of this study is only on ONLINE case.

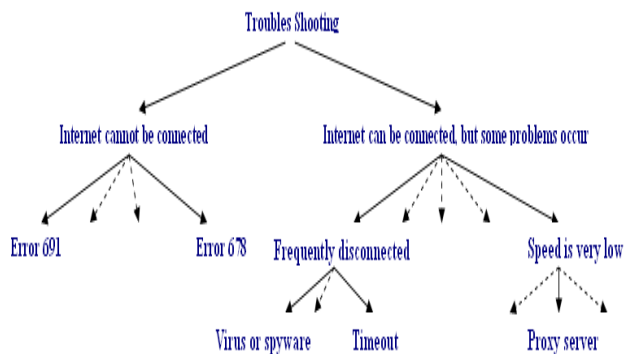


Figure 3. Hierarchical structure of trouble shooting for internet connection problems

2. Data Clustering

Sample data in this study is obtained from Call Centre at an Internet Provider Corporation in Thailand. Data was cleaned and selected for the one that related to the Internet connection problems. Then, experts in computer network answered questions from call centre. These questions-answers are stored in the knowledgebase. The 7,110 transactions are obtained from call center. Then customer profiles are used for data clustering.

Features used for customer data segmentation included: (1) customer type, (2) time, (3) operating system, (4) IT Literacy, (5) internet connection speed and (6) modem.

Clustering data by combining algorithm between SOM and K-Means from Clustering Technique

Step 1: Use Kohonen’s self-organizing maps neural network (SOM) to group data into 2-10 groups. For choosing the best number of clusters, RMSSTD (Root Mean Square Standard Deviation) and RS (R square) are used to measure similarities and differences among different clusters. The results from both measurements suggested that the optimal number of groups is 8. Then, the output from this step (k value=8) is used as input for the next Step.

Step 2: K-Means Algorithm is used for segmenting data. The number of group or k value is derived from step 1. In this step customer data are segmented based on customer transactions and their behaviors. Results are depicted in Table 2. Characteristics of each cluster are as follows:

Table 2. Clustering user data into 8 groups by using SOM and K-Mean Algorithms.

Features		Clusters							
		1	2	3	4	5	6	7	8
Period of working	0:00 –9:59 am.	5	13	0	24	283	0	3	0
	10:00 am.–17.59 pm.	70	36	0	165	888	1	10	0
	18:00 pm.-23:59 pm.	476	177	3,078	453	0	8	31	678
Operating System	Windows XP	551	226	3,068	639	1,162	0	0	677
	Windows 2000	0	0	4	1	3	0	0	0
	Windows ME	0	0	0	0	0	3	27	0
	Windows 98	0	0	0	0	0	6	17	0
	Others	0	0	6	2	6	0	0	1
Modem	Zyxel	0	0	0	202	334	0	10	678
	Billion	0	0	3,078	440	805	0	34	0
	Huawei	418	95	0	0	32	7	0	0
	Other	133	131	0	0	0	2	0	0
IT literacy	High	57	41	275	78	123	0	3	70
	Medium	444	174	2,555	529	938	7	36	543
	Low	50	11	248	35	110	2	5	65
Customer	New	6	3	216	71	319	0	3	27
	Old	545	223	2,862	571	852	9	41	651
Speed of internet	<256 Kb	127	0	377	0	308	5	9	133
	512 – 768 Kb	424	0	2,701	0	845	3	33	545
	1 – 2 Mb	0	123	0	333	17	1	2	0
	> 2 Mb	0	103	0	309	0	0	0	0
Total		551	226	3,078	642	1,171	9	44	678
percent		8.6	3.5	48.1	10.0	18.3	0.1	0.69	10.8

Cluster 3 is the largest of all, it is about 48.1%, the second biggest is **Cluster 5** (18.3%) and the smallest is Cluster 6 (0.1%). **Cluster 3**, data characteristics is old customers who use only modem brand: Billion and Window XP to access the Internet in the evening with broad band (512-768 KB). **Cluster 5**, the second largest (18%), includes the old customers who use Window XP, modem: Billion to access the Internet in the evening with broad band (512-768 KB). **Cluster 4** is about 10%, include the old customers who use Window XP, modem: Billion to access the Internet in the evening with high speed (> 1 Mb). **Cluster 8** is about 10%, include the old customers who use Window XP, only modem: Zyxel to access the Internet in the evening with broad band (512-768 KB). **Cluster 2** is about 3.5%, include the old customers who use Window XP with modem: Huawei to access the Internet in the evening with broad band (1-2 Mb). **Cluster 6**, the smallest, is about 0.1%, include the old customers who use Window 98 modem: Huawei to access the Internet in the evening with band width <256 Kb. **Cluster 7** is about 0.69%, include the old customers who use Window ME, modem: Billion to access the Internet in the evening with broad band (512-768 KB). Majority of customers are old customers.

3. Using OLAP cube

After the data were segmented to 8 clusters, then data in each cluster together with keywords from questions extractions were analyzed by OLAP Cube. Table 3 shows lists of factors and their probabilities which relate to the internet disconnections. These factors include (1) splitter not installed, (2) line deteriorated, (3) many connecting points, and (4) virus. In cluster 1 (Table 3), the frequencies of disconnect is related to using too many connection points since this factor has the highest probabilities (64.41%).

Table 3. Data analysis of internet connection problems and their causes in Cluster 1 by using OLAP

OLAP Cubes (Group 1)			
Problems	Causes	N	Probability
Frequently disconnect	Splitter not install	2	3.39 %
	Many connecting points	38	64.41%
	Virus	4	6.78 %
	Line deteriorated	15	25.42 %
Total		59	100.0%

4. Evaluation

7,110 transactions from customer questions of the internet connections are used for evaluation. The data are divided into two sets: 6,399 transactions (90%) are used for training the system and 711 transactions (10%) are used for testing the system. The precision for this experiment is 70.46% which is good result for prediction.

CONCLUSION

This study proposes a question analysis and answering system for call center. We have proposed the new approach by combining data mining techniques and OLAP. Data of internet customers are clustered by using SOM and K-Means algorithm. First, SOM is used to find the appropriate number of clusters (k). Then, K-Means algorithm is applied to segment data in k clusters. Data in each cluster together with key words extracted from questions and causes of problems provided by domain experts are analyzed by OLAP cube. Output is the probability of each item to be the cause of problems. The system has been evaluated by measuring precision power in predicting the cause of internet failure. The performance of system is about 70% which is good. The proposed system will be useful for building a prototype of help desk or customer relationship. Further, the processing time for OLAP cube is improved since data have been segmented into clusters before using OLAP processing. It further benefits in improvement the effectiveness since clustering data will decrease the data complexity.

Future research should be done on the development of intelligent systems/agent for customer relationship management; this system can be an automatic system that helps customers and company to work more efficiently and effectively.

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APPENDIXES

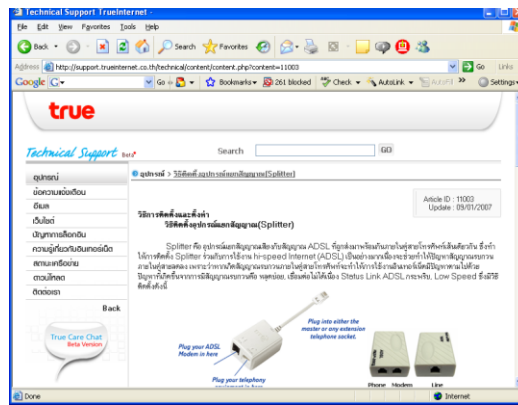


Figure 4. Internet disconnections due to splitters, system provides splitter installation procedures.

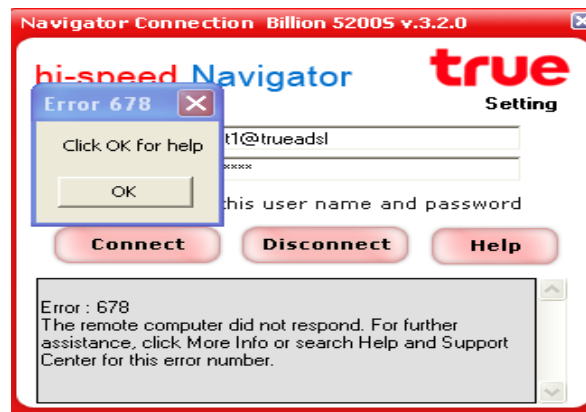


Figure 5. System providing assistance to user on trouble shootings for the internet connections with error codes.

PRIVACY PRESERVING K-MEANS CLUSTERING WITH CHAOTIC DISTORTION

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ABSTRACT

Randomized data distortion is a popular method used to mask the data for preserving the privacy. But the appropriateness of this method was questioned because of its possibility of disclosing original data. In this paper, the chaos system, with its unique characteristics of sensitivity on initial condition and unpredictability, is advocated to distort the original data with sensitive information for privacy preserving k-means clustering. The chaotic distortion procedure is proposed and three performance metrics specifically for k-means clustering are developed. We use a large scale experiment (with 4 real world data sets and corresponding reproduced 40 data sets) to evaluate its performance. Our study shows that the proposed approach is effective; it not only can protect individual privacy but also maintain original information of cluster centers.

Keywords: Privacy preserving, data mining, k-means clustering, chaotic distortion

INTRODUCTION

Data distortion methods have been popularly used in privacy preserving data mining to mask the original data from revealing. A large proportion of research uses randomized data distortion techniques for preserving the privacy [1]. Also known as data perturbation or data randomization, data distortion protects privacy for individual data records through modification of its original data, in which the original distribution of the data is reconstructed from the randomized data. Whereas, it is noted that random objects have “predictable” structures in the spectral domain and then offers a random matrix-based spectral filtering technique to recover original data from the data set distorted by adding random values [2]. Aiming at resolving this problem, the chaos system, with its unique characteristics of sensitivity on initial condition and unpredictability, is advocated to distort the original data with sensitive information for privacy preserving k-means clustering (PPKC).

K-means is a simple and widely used clustering technique to group items into k clusters, which results come in two forms: assignment of entities to clusters and the cluster centers themselves [3]. In this scenario, the cluster centers represent the total characteristics of a population, which should be kept for utilization. The fundamental objective of chaotic distortion is to modify the original dataset so that the original data points were changed to preserve individuals’ privacy and the cluster centers still keep very closely to the original ones. This paper contributes to the literature in two aspects. First, the chaotic series is advocated for data distortion and the chaotic distortion method is introduced for PPKC. Second, we propose three specific performance metrics for PPKC, which includes an individual privacy preserving measure, a population information loss measure, and a comprehensive privacy vs. information loss index. Our systematic experiments show that the proposed method achieves outstanding performance in privacy preserving yet maintains good clustering results.

RELATED WORKS

The random distortion method attempts to preserve privacy of the data by modifying values of the sensitive attributes using a randomized process. Two commonly used methods are probability distortion and point distortion [4]. Among point distortions, value distortion is the most prominent one.

Oliveira and Zaiane [5] introduced a new method called dimensionality reduction-based transformation for privacy preserving clustering over centralized and vertically partitioned data. The method relies on the intuition behind random projection to protect the underlying attribute values subjected to cluster analysis. Inan et al. [6] proposed a method for constructing the dissimilarity matrix of objects from different sites in a privacy preserving manner which can be used for clustering over horizontally partitioned data. Jagannathan et al. [7] presented a simple I/O-efficient k-clustering algorithm that was designed with the goal of enabling a privacy-preserving version of the algorithm. Merugu and Ghosh [8] presented a general framework for distributed clustering that takes into account privacy requirements. It is based on building probabilities modes of the data at each local site, whose parameters are then transmitted to a central location. Jagannathan and Wright [9] introduced the concept of arbitrarily partitioned data and provided a privacy preserving protocol for k-means clustering using cryptographic techniques in the setting of arbitrarily partitioned data. Vaidya and Clifton [3] also proposed a method for k-means clustering over vertically partitioned data. Klusch et al. [10] proposed Kernel density estimation based clustering method over distributed data. In Table 1, we summarize the major works in terms of specific data mining tasks, proposed methods, and performance measures used.

Table 1: A summary of privacy preserving clustering works

Ref.	DM task	Method	Measures
[5]	Clustering centralized & vertically partitioned data	DRBT	<ul style="list-style-type: none"> • Overall quality: F-measure • Communication cost • Accuracy • Stress error
[6]	Clustering horizontally partitioned data	Constructing dissimilarity matrix	<ul style="list-style-type: none"> • Communication cost • Computation cost
[7]	K -Clustering over horizontally partitioned data	K -clustering algorithm	<ul style="list-style-type: none"> • Privacy • Communication complexity • Computation complexity
[8]	Clustering horizontally distributed data	Building probabilities modes	<ul style="list-style-type: none"> • Quality cost: KL-divergence • Privacy cost
[9]	K -means over arbitrarily partitioned data	Cryptographic techniques	<ul style="list-style-type: none"> • Communication complexity • Computation complexity • Privacy
[3]	K -means over vertically partitioned data	Cryptographic techniques	<ul style="list-style-type: none"> • Security • Communication cost
[10]	Clustering over distributed data	KDEC	<ul style="list-style-type: none"> • Privacy • Communication cost

As shown in Table 1, most researchers emphasized clustering task over distributed data. Correspondingly, communication cost is the most concerned measure. These works seldom used the specific metric for clustering except for F-measures [5]. Specific data mining techniques are selected for specific tasking, and specific performance metrics should be used according to the characteristics of certain data mining task.

CHAOTIC DISTORTION

Since both probability and value distortions have non-negligible drawbacks for privacy preserving data mining, effort has been made to explore a different method for better protection. Undoubtedly, it is a reasonable idea to modify the individual sensitive information with aggregate distribution unchanged. The key point is how to choose suitable noise to distort the original data. The so-called noise should meet two conditions:

- 1) It should be noisy enough in order to protect the individual privacy.
- 2) It does not change the data distribution significantly in statistics.

Clearly, we need a kind of noise, which cannot be predicted as white noise of certain distributions. A chaos system looks like but not a random system, which has the important characteristics of erotic and sensitive dependence on initial conditions. If the initial condition and chaos equation are unknown, the chaotic data series cannot be predicted. These features make it suitable for data distortion. Suitable chaotic data series within a limited range is a feasible candidate for data distortion for privacy preserving data mining.

Unpredictability of Chaos System

A chaotic system is a deterministic system that shows an irregular oscillatory process. It is difficult to distinguish chaos from random behavior [12]. There are three fundamental characteristics of chaos which makes it suitable for data distortion: 1) irregular periodicity, 2) sensitivity to initial conditions, and 3) a lack of predictability. Because of these characteristics, chaos function has been used by modern cryptographic schemes [13]. Logistic differential equation or logistic map, though simple, displays the major chaotic concepts. The logistic model can be expressed as:

$$x_{k+1} = rx_k(1 - x_k), \quad k=1, 2, 3, \dots, \quad r \in [3.57, 4] \quad (1)$$

Sensitivity to initial conditions leads to the unpredictability. This is the key reason of using a chaos system for data distortion.

Chaotic Distortion Procedure

Chaotic distortion is a method that adds a chaotic time series to the original data as the perturbed data such that:

$$Y = X + f\{X, L(X_0, r)\} \quad (2)$$

Where $L(X_0, r)$ is the logistic chaos matrix with the initial conditions matrix X_0 and parameter r . The $f\{X, L(x_0, r)\}$ represents the chaotic series matrix used to perturb the original data set X , which is the function of original dataset X and the logistic chaos matrix. In order to obtain a greater distortion, the chaotic matrix must be designed to fit the distribution of original dataset X . The perturbed data set Y will be displayed, replacing the original data. The privacy of individual information is thus well protected because of the unpredictability of the chaos series.

The proposed procedure is as follows:

- 1) *Select the chaos equation to produce the chaotic time series.* Here we use a logistic map with the parameter $r = 4$ for chaotic noise generation.
- 2) *Randomly generate the initial condition matrix of the chaos system.* The randomization of initial condition matrix makes it more difficult to predict the chaotic matrix and thus the privacy information can be protected.
- 3) *Produce chaotic matrix, analyze the data characters, and modify the chaotic series if necessary.* The chaotic time series is used as noise, which cannot be too prominent to mine the aggregate distribution of the original data. A common method is to modify chaotic data series based on the value ranges of every attribute in original dataset.
- 4) *Distort the original data by adding the chaotic data to produce the perturbed data set according to equation 2.*
- 5) *Analyze the aggregate characteristics of the perturbed data set to verify that the aggregate information loss is at an acceptable level.*
- 6) *Publish the perturbed data if the aggregate distribution has not been changed significantly.*

PERFORMANCE METRICS

We propose three measures based on the characteristics of PPKC. For k-means clustering, the cluster centers indicate the population information used for decision making. Therefore the cluster centers after data distortion should be kept as close as possible to the original centers to minimize the population information loss. We use centers distance to measure information loss. On the other hand, the individual objects should be distorted to be as different as possible from the original individuals in order to protect the individuals' privacy. We use the average distance between the original and correspondent perturbed individuals to measure the privacy protection performance. Whereas, these measures may be varying greatly for different datasets because of the different data ranges. With this consideration, a comprehensive index to measure the overall performance is also proposed.

Information Loss Measure

Our evaluation focuses on the overall quality of the generated clusters after data distortion. We compare how closely each cluster center of the distorted data matches its corresponding cluster center in the original data set.

Definition 1: K cluster centers $C_i = (c_{i1}, c_{i2}, \dots, c_{in})$, where $i = 1, 2, \dots, k$, are obtained based on the original data set with k -means clustering, $C_i^d = (c_{i1}^d, c_{i2}^d, \dots, c_{in}^d)$, where $i = 1, 2, \dots, k$, are corresponding cluster centers based on the distorted data set. The information loss of distortion (ILD) of cluster center C_i can be measured by the Euclidean distance between the corresponding cluster center pairs:

$$ILD_i = \sqrt{\sum_{j=1}^n (c_{ij} - c_{ij}^d)^2} \quad (3)$$

The average information loss ILD is the mean value of ILD_i ($i = 1, 2, \dots, k$).

$$ILD = \frac{1}{k} \sum_{i=1}^k ILD_i \quad (4)$$

Clearly, smaller ILD values indicate less information loss.

Privacy Protection Measure

The privacy protection measure should indicate how closely the original value of an item can be estimated from the distorted data [11]. We define a privacy protection measure as the average Euclidean distance between each data and its corresponding distorted data.

Definition 2: Consider a dataset matrix with m records and m attributes, $X = [x_{ij}]_{m \times n}$, and the distorted data set, $Y = [y_{ij}]_{m \times n}$. The privacy protection of the distortion (PPD) can be measured by the average Euclidean distance:

$$PPD = \frac{1}{m} \sum_{i=1}^m \sqrt{\sum_{j=1}^n (x_{ij} - y_{ij})^2} \quad (5)$$

Clearly, a larger PPD value indicates a better privacy protection.

Comprehensive Index

A tradeoff between individual privacy protection and population information loss is needed. In order to protect individuals' privacy, a preferred high degree distortion of original data may cause large information loss. On the contrary, less distortion of original data may cause more risk of privacy disclosure. A comprehensive index of distortion (CID) is proposed to measure the overall performance of PPKC with the consideration of both privacy protection and population information loss.

$$CID = \frac{PPD}{ILD} \quad (6)$$

Clearly, a larger CID indicates a better overall performance of distortion. Specifically, if CID is greater than 1, the privacy protection effects overtake the degree of information loss. We may conclude that the distortion with CID being greater than 1 is a good performance, while the distortion with CID being less than 1 is an unacceptable performance.

PERFORMANCE EVALUATION

We empirically validate the chaotic distortion for privacy preserving k-means clustering using four real datasets. The experiments are conducted on a PC with AMD Athlon 64 processor, 1.81 GHZ clock speed and 512 MB RAM. The algorithm is programmed with Matlab clustering toolbox [14].

Data sets

We use four real-world datasets to evaluate the relative performance of the proposed method. Obviously, most attributes of these data sets are confidential business and financial information.

- 1) *Census data* [15]. There are 1080 individual records with 13 census related attributes, such as final weight, gross income, employer contribution for health insurance, net earnings, federal income tax liability, social security retirement payroll deduction, interest income, total person earnings, total other persons income, total person income, state income tax liability, taxable income, and total wage & salary.
- 2) *Housing data* [16]. There are 506 individuals records with 15 attributes, including housing price, age, number of rooms, property-tax rate, crime rate by town, , and so on.
- 3) *Tarragona data* [15]. There are 834 records with 13 financial accounting attributes including fixed assets, current assets, uncommitted funds, paid-up capital, short-term debt, sales, labor costs, depreciation, operating profit, financial outcome, gross profit, and net profit.
- 4) *Wages data* [17]. This data set consists of a random sample of 534 persons from the CPS with information on wages and other characteristics of the workers, including sex, number of years of education, years of work experience, occupational status, region of residence and union membership.

Experimental Settings

- 1) *Data sets duplications*: Every dataset is duplicated to produce 10 derived data sets with disordering the sequences of records. We name the original data set and the 10 corresponding disordered data sets as a data set family. For example, we refer *census* and the corresponding 10 derived data sets as census-family. In total, we have four dataset families and every family contains 11 data sets. We reproduce the data families for two purposes. First, we want to test the sensitivity of the proposed method to the record orders in a dataset. Second, the experiment scale is enlarged to make the analysis result more reliable.
- 2) *No. of clusters*: In the course of *k*-means clustering the number of clusters must be given by the user before the clustering, but it is rarely known apriori [14]. In this case it must be tested with different numbers of clusters with validity measures. Therefore we conduct the experiments on every data set with 7 cases of the number of clusters from 2 to 8.
- 3) *Evaluation metrics*: In addition to the three measures proposed in this paper, Dunn's Index (DI) [18] is used to measure the clustering validity for *k*-means method. The relationship of CID vs. DI is also analyzed to reveal the underlying rules. According to [19], the larger values of the index indicate the presence of compact and well-separated clusters.

Testing Procedure

Our performance evaluation was carried out through the following steps:

- 1) *Chaotic distortion*. The most important for chaotic distortion is to generate the suitable chaotic matrix for data distortion according to the characteristics of the original data set as shown in equation 5. The initial condition matrix X_0 of the logistic matrix is generated randomly by uniform distribution; the r is set as 4. In order to minimize the overall information loss, we subtract 0.5 from every data of logistic matrix, and produced the chaotic matrix L . The final chaotic distortion series for *ith* attribute of dataset, $f_i\{X_i, L_i\}$, is obtained based on the dataset distribution characteristics as follows:

$$f_i\{X_i, L_i\} = 0.1 \cdot L_i \cdot (\max(X_i) - \min(X_i)) \quad (7)$$

Where X_i is the i th attribute of the original dataset X , L_i is the i th column of the logistic matrix L .

- 2) *Dataset normalization.* We normalize the original and distorted data sets with min-max normalization.
- 3) *K-means clustering over original and distorted data sets.* For every data set, we run k -means clustering 10 times for a specific number of clusters to eliminate the influence of initial randomization of the algorithm. The numbers of clusters are assigned to 2 to 8 for every dataset. In total, every dataset is clustered for 70 times (7x10).
- 4) *Evaluation metrics calculation.* The metrics include privacy protection measure PPD, information loss measure ILD, Comprehensive index CID, clustering validation index DI, and CPU time.

Results and Discussion

We show the average metrics CID, DI and time in seconds for every data set family in Tables 2. Overall, the comprehensive performance of privacy protection vs. information loss is satisfying because all CID values are greater than 1. The computations are fairly efficient because all CPU time is less than one second.

Table 2: Summary of computational results

(a) Census-family								(b) Housing-family							
Index	No. of clusters							Index	No. of clusters						
	2	3	4	5	6	7	8		2	3	4	5	6	7	8
CID	24.7	17.09	6.18	8.68	3.06	2.44	1.78	CID	20.28	8.96	2.58	0.64	1.54	1.38	1.53
DI	0.05	0.037	0.04	0.039	0.04	0.04	0.04	DI	0.206	0.054	0.059	0.062	0.06	0.059	0.058
Time	0.61	0.270	0.47	0.630	0.40	0.50	0.57	Time	0.060	0.150	0.170	0.210	0.12	0.130	0.150

(c) Tarragona-family								(d) Wages-family							
Index	No. of clusters							Index	No. of clusters						
	2	3	4	5	6	7	8		2	3	4	5	6	7	8
CID	1057	5.76	4.36	2.960	2.49	2.470	2.42	CID	13.22	4.87	1.88	1.95	1.65	1.49	1.49
DI	0.128	0.043	0.022	0.014	0.011	0.009	0.008	DI	0.378	0.347	0.262	0.238	0.201	0.176	0.148
Time	0.120	0.260	0.470	0.600	0.410	0.490	0.530	time	0.050	0.080	0.110	0.140	0.090	0.090	0.090

IN-DEPTH ANALYSES AND RESULTS

Sensitivity to The Order of Records

We test the PPKC's sensitivity to the order of records to analyze whether the order of records will influence the performance of PPKC or not. In order to eliminate the influence of the number of clusters, we calculate the average CID with all cases of cluster numbers. Then ANOVA is conducted for every data set family as shown in Table 3. The large P-values indicate that they are not statistically different between data sets in a family. Therefore, we conclude that the proposed method is not sensitive to the order of records.

Table 3: ANOVA: CID sensitivity to object orders

Index	Census	Housing	Tarragona	Wages
P-value	0.23	0.65	0.49	0.30
F	1.33	0.78	0.95	1.20

CID vs. DI

Naturally, we want to know whether there are relationships between CID and DI. In order to clearly show the relationship, we scale up the values of DI as compatible with CID. Figure 1 shows the relationships between CID and DI for the 4 data set families. The common rule underlying these figures is that CID and DI has same trends. The coefficient of correlation between CID and DI are 0.69, 0.91, 0.99, and 0.82 separately for census, housing, Tarragona, and wages data set families. This reveals that the CID measure is especially suitable for k -means clustering.

(a) Census-family

(b) Housing-family

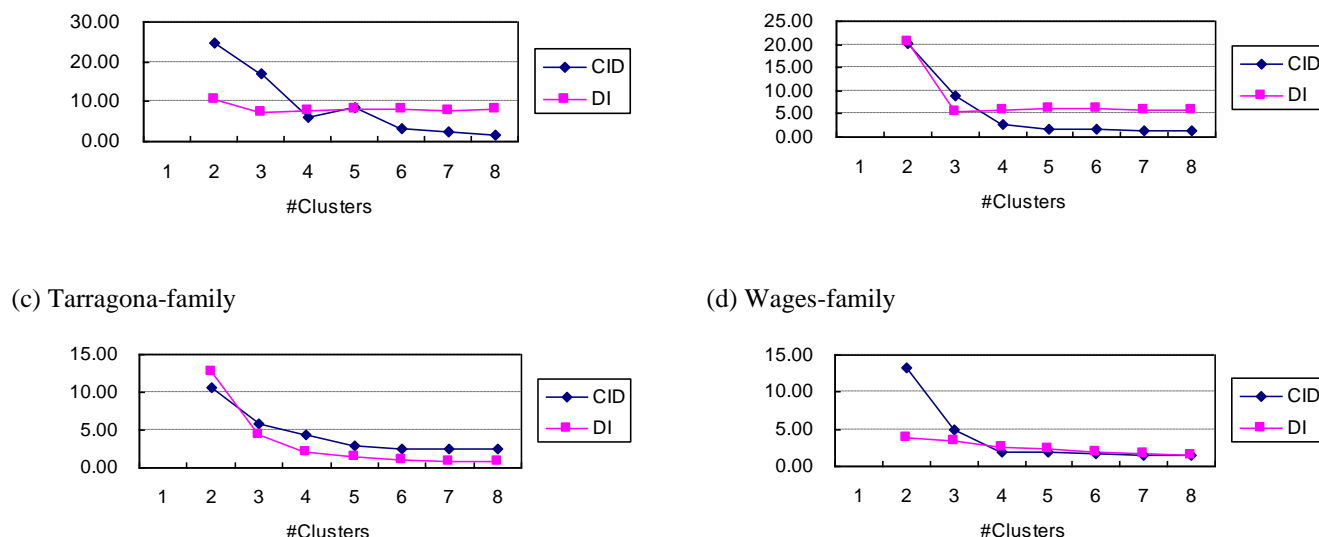


Figure 1: Comparisons of CID vs. DI

Privacy Protection vs. Information Loss

For any privacy preserving data mining task, we hope to have less population information loss but with more privacy protection. Although the values of comprehensive index CID for all data sets are greater than 1, we use statistical analysis to check if there are statistically significant between privacy protection and information loss. For every specified number of clusters, we conducted paired t-test between PPD and ILD with the results of all datasets. As shown in Table 4, the values of PPD are significantly greater than ILD for all cases of cluster numbers. This proved that the proposed method can protect privacy with relatively little information loss.

Table 4: Paired t-test: PPD vs. ILD

Index	No. of clusters						
	2	3	4	5	6	7	8
T stat	3.90	3.97	3.91	3.98	3.95	3.89	3.84
P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CONCLUSIONS

Data distortion is a popular privacy preserving method. Whereas, the original data may be constructed with a suitable approach, and thus the privacy may be disclosed. In order to satisfy the conflicting objectives of providing high quality distorted dataset and at the same time preventing from exact or partial disclosure of individual information, a chaotic distortion technique is proposed for privacy preserving k -means clustering. A simple chaos system, logistic map, is used to produce the chaotic series as a noise replacing the white noise. It is sensitive to initial conditions and unpredictable, which makes the chaos system suitable for privacy preserving.

Three performance metrics specifically for k -means clustering are proposed including privacy protection index PPD, information loss measure ILD, and a comprehensive index CID for privacy preserving k -means clustering. A large-scale experimental analysis using four real world dataset families is conducted to verify the performance of the proposed approach. Our computational experience shows that the chaotic distortion method not only can protect individual privacy but also can maintain the original cluster centers information. It is also quite computationally efficient. Future studies can be extended to evaluate the relative performance of different chaotic distortion systems, as well as its appropriateness for other privacy preserving data mining methods.

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TRANSACTIONS BEHAVIOR ANALYSIS FOR INTERNET AUCTION FRAUD

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ABSTRACT

People often enmesh the Internet auction frauds which damage the benefits of Internet market and threaten transactions security. This research applies social network analysis and data mining to extract characteristic features from two random collected transaction datasets of Yahoo auction site. One dataset is used to construct prediction model and another is treated as validation. The average accuracy ratio of proposed model is at least 90%. The findings are: (1) the abnormal accounts involve circular transaction; (2) fraud accounts can accumulate higher positive reputations in very short time from its circular transaction and rarely play key nodes in transaction network.

Keywords: Internet auction fraud, social network analysis, data mining.

INTRODUCTION

With the progress and rapid development of Internet techniques, there is no doubt that various business transaction models have formed in Internet. Through Internet, people can easily search for information, order, sell and trade the products or have auctions. Internet auction is one of the few successful business models through Internet [9]. With Internet, "auction" is no longer the activity participated by few people; anyone can sell and buy any products on auction platforms such as Yahoo! Auction and eBay. There are thousands of objects displayed on auction websites at any time. According to the report of MIC [14], American Internet auction market has become one of the important shopping paths for the Americans. By 2010, the market scale will break through \$65 billion USD. With the growth of Internet auction scale and the increase of transaction amounts, Internet auction transaction becomes the target of fraud criminals. Because of the lack of effective countermeasures, Internet auction frauds have been the first of top 10 frauds in recent years [16]. The Consumer Sentinel database of Federal Trade Commission (FTC) also showed that the pleadings of Internet auction frauds in 2005 topped among the consumption issues [1]. In economic, the loss in Internet auction frauds reached \$ 183 million USD in 2005 and it increased to \$ 198 million USD in 2006. The amount of loss was rapidly increasing among all fraud cases which had great impact to the society and became an important issue of Internet development.

There are many researchers do their efforts in counteracting Internet auction frauds in terms of cheating in auctions [11], payment of fake credit cards [4] and quality of auctioned products [3], and so on. But, rare are in discussion the auction transaction behaviors. This research will follow Wang et al [23] treated social network analytical indicators to detect Internet auction anomaly network. Then, we will apply data mining to generate classification rules to discriminate suspicious and fraud accounts from the anomaly network.

In the following sections, section II is the theoretical background, including Internet auction fraud, social network and data mining. Section III is the analytical methods proposed by this research which introduces transaction network construction, discrimination of normal or abnormal transaction networks and the planning of this research. Section IV includes the experimental results, the rules of Internet auction account detection and the characteristics of different types of accounts. Section V is the conclusion and relative future research direction with respect to the control of Internet auction frauds.

THEORETICAL BACKGROUND

Internet Auction Frauds

Internet auction refers to the auction transaction carried out over the Internet [13]. Different from the traditional auctions, Internet auction means that the buyers and sellers had the transactions without facing each other. Besides, Internet auctions allowed anonymous transactions. Thus, the sellers could easily apply for several account. With the mature development of Internet and the continuous increase of Internet users, Internet auctions had transactions with the advantages and characteristics of Internet and gradually boomed everywhere around the world. However, the essence of Internet changed the way of information exchange between the buyers and sellers. The buyers accept unidirectional messages provided by the sellers which resulted in significant information asymmetry in Internet auction transactions [12]. Due to the information asymmetry between the buyers and sellers and the lack of validation on the authenticity of the goods, the buyers are more likely to encounter the frauds [21]. The fraudsters will tend to have many accounts to forge their reputations and do their best to develop varied frauds to enlarge their benefits [22].

Therefore, Chua & Wareham [5] suggested that Internet auction supplier, institutions and governments should know well about different types and characteristics of Internet auction frauds and fraudsters. They suggested these institutions should construct an effective policy to prevent Internet auction frauds to reinforce the related regulations of current Internet auctions. Ba et al. [2] suggested establishing the credibility validation mechanism of the third party and validating individual identities by public key cryptography and digital signatures to increase the authenticity of the accounts as individuals. Other studies indicated

the development of combined evaluation mechanism by different Internet auction suppliers to increase the reliability of auction transactions [10] [18] [19] [25]. These studies mostly discriminated the dishonest or bad participants according to the reputation of participants' past behavior. The Reputations will help the future transaction participants to find the reliable others to avoid the potential Internet auction frauds [7]. However, the methods will increase the management cost of Internet auction. The cost will add the entering barriers to buyers and sellers. It makes Internet auctions activities become more complexity.

Social Network

The application of social network has been adopted by social science for decades. Mitchell [15] defined social network as the individuals' connection in a group. Applying social network can build the connection of relationships and characteristics of these individuals [6]. Social network consisted of actors, relations and ties [8] [20] [24]. Social network analysis is a good method and technique to understand the relationships among individuals, groups or organizations. It provides several structured indicators for analysis [20], such as centrality and subgroup which are related to this research.

1. *Centrality*: In centrality, the measurement is *degree* which applied to observe the transaction frequency of the accounts. When the *degree* of one account is higher, it means there are more accounts having transaction to the account.
2. *Subgroup*: It aims to investigate the subgroup network of certain accounts in the abnormal social network. The measurement of subgroup includes *k-core*, *k-plex*, *n-cliques* and *betweenness*.

Data Mining

Data mining (sometimes called data or knowledge discovery) is the process of analyzing data from different perspectives and summarizing it into useful information. It combines the techniques of database, machine learning, artificial intelligence, expert system, pattern recognition, statistics, and data visualization. This research will apply decision tree and neural network to construct the prediction model to discriminate the suspicious and fraud accounts in the auction network.

THE PROPOSED APPROACH

Construction of Auction Transaction Network

The data source of current research was random collected from auction transaction database of Yahoo auction in Taiwan. The research obtained the initial account from the blacklist announced by Yahoo auction and confirmed the account were "invalid". It then constructed the auction transaction network based on initial account according to the following steps and finally acquired 1488 transactions. Blacklist referred to the list of abnormal transaction accounts announced on auction websites. The list was checked by Internet auctions platform supplier, and validated by the police. Transaction relationship of Internet auctions can lead to a complete transaction network and the steps are as below:

1. Selecting the initial accounts (O)
2. Searching for the accounts ($T_i, i = 1$ to m) having direct transactions with the initial accounts (O); $O \rightarrow T_i$ denotes O sold products to T_i .
3. Searching for the accounts ($T_j, j = 1$ to n) having direct transactions with accounts T_i besides accounts (O); $T_i \rightarrow T_j$ constructing the transaction network based on accounts (O)

Discrimination of Normal /Abnormal Auction Transaction Networks

Resnick [19] pointed out that buyer and seller in normal Internet auction transaction would not remember each other to have repetitive transaction. Thus, when there was "one-to-many" or "many-to-one" transaction in transaction network, it was regarded as normal transaction. When there was transaction circulation of certain accounts in transaction network, it might be abnormal transaction [23].

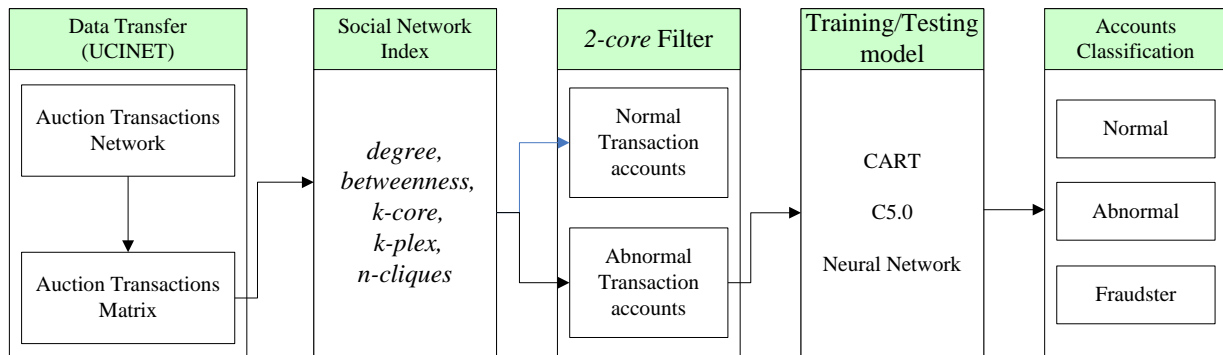
Research Setting

As mentioned in section II, there are varied indicators of social network analysis for identifying the relationship of accounts. These indicators were applied for the analysis of Internet auction transaction network, as shown in Table 1.

Table 1. The application of social network analytical indicators to the analysis of Internet auction transaction network

Indicator	Classification of features	Descriptions
<i>degree</i>	<i>degree</i> <i>in-degree</i> <i>out-degree</i>	It shows the transaction relationship of the accounts. When we observe the accounts by A, <i>in-degree</i> means A buys the products from others; <i>out-degree</i> means A sells the products to others. Thus, we construct the transaction network.
<i>betweenness</i>	<i>nbetweenness</i> (<i>normalizing betweenness</i>)	The moderating capacity of the accounts in abnormal transaction network
<i>k-core</i>	<i>1-core, 2-core, 3-core,</i> <i>4-core, 5-core, 6-core</i>	When <i>k</i> is more than 2, it means there is circular transaction among the nodes
<i>k-plex</i>	<i>k-plex_k=2_size=5</i> <i>k-plex_k=2_size=6</i> <i>k-plex_k=2_size=7</i>	In abnormal transaction network, we find the accounts in the same group. It shows that there is regular transaction relationship among the accounts in this group. When <i>size</i> is 5, it means there are 5 nodes in the subgroup.
<i>n-cliques</i>	<i>n-clique_n=1_size=3</i> <i>n-clique_n=1_size=4</i> <i>n-clique_n=1_size=5</i>	It forms the accounts in the same group and the accounts in the said group have transactions with those out of the group.

Through Table 1, different indicators will generate different subgroup which formed by certain accounts. We can get different types of certain subgroup. When the accounts are in the certain subgroup, these accounts will be marked as 1; if not, it will be marked as 0. The analytical process diagram of transaction network is shown in Figure 1.

**Fig. 1. Analytical process of diagram of Internet auction transaction network**

In Figure 1, we first transformed the Internet auction transaction network into transaction matrix and calculated the features of the accounts by different indicators. The step aimed to transform the transaction into indicators. We filtered transaction abnormal accounts by *2-core* and further discriminated suspicious or fraud accounts by data mining. We trained and tested the models by three different methods, including C5.0, CART and Neural Network (NN) to construct and examine different models. In order to validate the accuracy ratio of the models, this research randomly collected 428 transaction accounts (11 of them were validated as fraud accounts) from Yahoo! Auction website to validate the accuracy ratio of the models by training. Table 2 was the numbers of training, test and validation data.

Table 2. Table of training, testing and validation data

	Total accounts	Fraud accounts
Training and testing data	1488	21
Validation data	428	11

THE EXPERIMENT

This research constructed Internet auction transaction network by in-degree and out-degree relationship among the accounts. Then, it generated abnormal transaction network by *2-core* and established the model by CART, C5.0 and Neural Network. Table 3 is the accuracy ratio of 1488 accounts by 5-fold cross-validation training and test.

Table 3. Accuracy ratio of training and test of different models (N=1488; 5-fold cross-validation)

Model	Training of accuracy ratio			Testing of accuracy ratio		
	Average	Worse	Best	Average	Worse	Best
CART	98.03%	97.3%	100 %	92.10%	90.13%	94.15%
C5.0	84.98 %	78.57 %	89.19 %	79.84%	74.36%	84.75%
NN	78.08 %	75.61 %	83.78 %	60.52%	54.68%	67.98%

Since NN is the lowest accuracy ratio for model training and test, we only describe the results of CART and C5.0. First of all, the accuracy ratio of training and test models by CART was the highest. When training the models, the average accuracy ratio could

reach 98.03%; when testing the models, we could have average accuracy ratio up to 92.10%. In C5.0, the average accuracy ratio could reach 84.98 %, and when we tested the modes, the average accuracy ratio could reach 79.84%. The rule description is shown in Table 4 and Table 5.

Table 4. Descriptions of judgment rules constructed by CART

Rule	Rules	Descriptions
1	<i>If $n_{betweenness} < 0.0135$ and $6\text{-core} < 0.5$ Then $fraud = 1$</i>	When $n_{betweenness}$ of the accounts is less and 0.0135 and the accounts is in the transaction group upon 6-core, the accounts are considered as fraud ones.
2	<i>If $n_{betweenness} \geq 0.1605$ and $k\text{-plex}_{k=2_n=5} \geq 0.5$ Then $fraud = 1$</i>	When $n_{betweenness}$ of the accounts is more than or equal to 0.1605, the accounts are in the transaction group upon 5 nodes($k\text{-plex}_{k=2_n=5}$) and each account has transaction relationship with at least three other accounts, the accounts are considered fraud ones.

Table 5. Descriptions of judgment rules constructed by C5.0

Rule	Rules	Descriptions
1	<i>If $k\text{-plex}_{k=2_n=5} > 0$ and $n_{betweenness} \leq 0.063$ Then $fraud = 1$</i>	When the accounts are in transaction group upon 5 nodes ($k\text{-plex}_{k=2_n=5}$), each account had transaction relationship with at least three other accounts and $n_{betweenness}$ of these accounts are less than or equal to 0.063, they are considered fraud ones
2	<i>If $k\text{-plex}_{k=2_n=5} > 0$ and $n_{betweenness} > 0.15899999$ Then $fraud = 1$</i>	When the accounts are in transaction group upon 5 nodes ($k\text{-plex}_{k=2_n=5}$), each account had the transaction relationship with at least three other accounts and $n_{betweenness}$ of these accounts are more than 0.159, they are considered as fraud ones.

In order to validate the judgment rule effect of the above model, the research validated the other 428 transaction accounts collected. After comparing with the blacklist and website information, we found that there were 38 abnormal transaction accounts and 11 fraud accounts in abnormal transaction accounts. The diagram is shown in Figure 4. The validation results are shown in Table 6 and Table 7

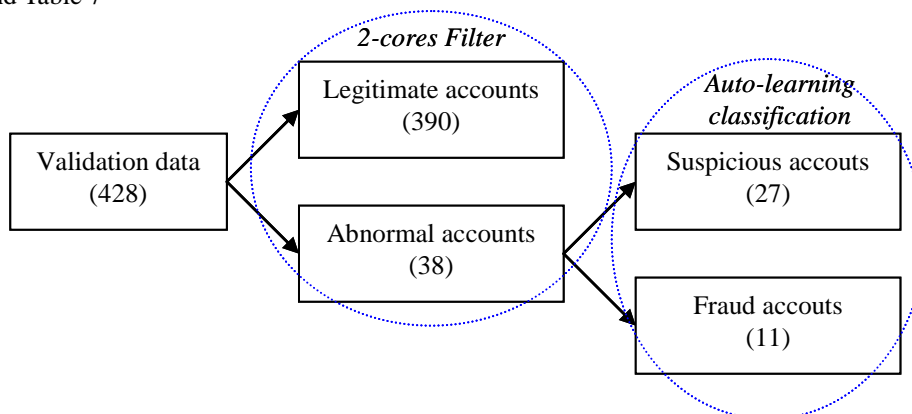


Fig. 4. Classification of validation data (428 pieces of transaction accounts)

Table 6. Prediction result of different training models without the filtering of 2-core (N=428)

Model	CART		C5.0		NN	
	Prediction as Fraud accounts		Prediction as Fraud accounts		Prediction as Fraud accounts	
Fraud accounts	No	Yes	No	Yes	No	Yes
No	414 (99.28%)	3 (0.72%)	407 (97.09%)	10 (2.40%)	401 (96.16%)	16 (3.84%)
Yes	7 (63.64%)	4 (36.63%)	8 (72.73%)	3 (27.27%)	8 (72.73%)	3 (27.27%)

Table 7. Prediction result of different training models with the filtering of 2-core (N=38)

Model	CART		C5.0		NN	
	Prediction as Fraud accounts		Prediction as Fraud accounts		Prediction as Fraud accounts	
Fraud accounts	No	Yes	No	No	Yes	No
No	26 (96.30%)	1 (3.70%)	26 (96.30%)	1 (3.70%)	20 (74.07%)	7 (25.93%)
Yes	2 (18.18%)	9 (81.82%)	2 (18.18%)	9 (81.82%)	8 (72.73%)	3 (27.27%)

After comparing Table 6 with Table 7, we found that when we directly predicted 428 transaction accounts, the accuracy ratio (36.63%) of fraud accounts was much less than that (81.82%) with judgment after filtering the transaction accounts. The accuracy ratio of the model by NN was much less than those of the models upon CART and C5.0. The comparison of accuracy ratios before and after filtering the transaction accounts are shown in Table 8.

Table 8. Comparison of accuracy ratios before and after filtering the transaction accounts by 2-core

Model	CART		C5.0		NN	
	Before 2-core	After 2-core	Before 2-core	After 2-core	Before 2-core	After 2-core
Accuracy ratio of non-fraud accounts predicts as non-fraud ones	99.28%	96.3%	97.6%	96.3%	96.16%	74.07%
Accuracy ratio of fraud accounts predicts as fraud ones	36.36%	81.81%	27.27%	81.81%	27.27%	27.27%

CONCLUSION AND FUTURE WORK

Although the auction websites provide reputation and blacklist information which might help the buyers and sellers to discriminate the frauds before the transactions, there are still varied frauds. So far, there are no strict laws and complete Internet auction security mechanism in Taiwan or other countries to effectively control Internet auction frauds. This research proposes a simple method to construct the judgment rule on fraud accounts by social network analytical indicators and data mining techniques to reduce the probability of Internet auction frauds. This research can detect the suspicious transaction accounts and fraud accounts in Internet auctions by proposed model. Based on the research results, we realize that social network analysis can transform the Internet auction account transactions into indicators. We can first classify all transaction accounts into normal and abnormal ones by 2-core. With data mining, we can further divide the abnormal transaction accounts into suspicious and fraud accounts. There are different meanings of these three transaction accounts (normal, suspicious and fraud) in terms of social network indicators and auctions:

1. *k-core* can find the abnormal transaction accounts in the whole transaction network. When there are at least 2 2-core in the accounts, it means there are circular and abnormal transactions among the accounts.
2. When *k* value of *k-core* is higher, it means the transaction relationship among the accounts in the group is closer and they tend to be fraud accounts;
3. *k-plex* means there are related groups among the accounts, *nbetweenness* means the possibility of the moderating capacity of the accounts in transaction network. When *k* value is 2 and the accounts consist of 5 nodes (*k-plex_k=2_n=5*), we can find fraud accounts by observing *nbetweenness* of the accounts.

With regard to data mining techniques adopted by this research (CART, C5.0 and Neural Network) except for Neural Network, accuracy ratios of CART and C5.0 are both at least 90%. After comparing the transaction data before and after the filtering by 2-core, we find that the prediction will be better after filtering transaction data by 2-core and the accuracy ratio can increase from 36.63% to 81.82%.

Internet auction has become one of the important activities to Internet users in Taiwan. However, the business also increases the frauds. The future studies can be held in the following:

1. The types of Internet frauds will be changed frequently. We can analyze different fraud patterns for future crimes.
2. Through the analysis on actual Internet auction frauds, we can find whether the fraudsters have its organization to commit crime or whether they share experience to other to improve their crime behaviors.
3. This research only analyzes the transaction data collected from current Internet auction transaction websites. If we can cooperate with auction suppliers and obtain the detailed records of validated fraud accounts, we can advance the analysis of

Internet auctions and develop pre-warning detection system to target the potential fraud accounts.

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CUSTOMER RELATIONSHIP MANAGEMENT: EXAMINING THE CENTRAL PROPOSITION IN THE ONLINE CONTEXT

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ABSTRACT

This paper presents a summary of a doctoral dissertation investigating the application of customer relationship management (CRM) theory to the online context. The major finding of this study was to confirm that the central proposition of CRM theory is supported in the online context—that is, while the operational context influences the extent to which effective service enhances the relationships between a firm and its customers, and their resulting perceptions of customer loyalty; there is general support for a mediating relationship in which effective service will enhance the quality of the relationship between a firm and its customer, and increase loyalty perceptions from the customer. The study has also revealed that the service delivery channel has a significant and differential affect on the central proposition and the interactions of the key relationship marketing constructs. Perceptions of financial risk were not observed to significantly affect either service quality or relationship quality perceptions.

Keywords: Customer relationship management (CRM), online context, service operations, electronic marketing, electronic business.

INTRODUCTION

Customer relationship management (CRM) has received widespread attention among both academics and practitioners over the past decade. Its popularity has been largely predicated on the belief that a systematic approach to the management of customer relationships will result in greater loyalty and higher financial returns [14]. In terms of electronic marketing (e-marketing), CRM has been espoused as a means of enhancing customer loyalty and curtailing the large proportion of business failures in the online industry [11].

The nurturing of loyal customers has been identified as the single most important issue for business success [15] [10]. However, this has been confounded in e-marketing by a focus on aggressive customer acquisition rather than on building enduring relationships with loyal customers [5]. According to Gefen [7], many firms have been successful in attracting attention and completing an occasional transaction online, but they have had difficulties in inducing people to return. The same authors noted that this situation is complicated by the fact that most firms spend more on acquiring a typical customer than they are likely to make in profit from the ‘buying life’ of that customer.

One of the difficulties of theory development in this area is uncertainty regarding the applicability of established theories in different contexts. Scullin *et al.* [16] suggested that the real value of online marketing will be ascertainable only when there is a clearer understanding of how established economic and managerial theories apply in this new environment; in particular, how such theories apply to the challenge of creating customer loyalty in the online environment. Similarly, Durkin and Howcroft [6] have suggested that, despite the recent popularity of CRM, there is still much to be understood about the development of strong relationships in the electronic marketplace (e-marketplace).

Against this background, the present research endeavours to clarify the role of relationship marketing in the management of customer relationships and the development of customer loyalty in the online context. In particular, the research attempts to identify the key drivers of service quality and relationship quality in the online context, and the effect of relationships on attitudes and behaviours.

RESEARCH PROBLEM AND HYPOTHESES

Burns and Bush [3] assert that an effective research study in management should provide the information that managers require to resolve a particular problem. In accordance with this view, the present study endeavours to assist online businesses in developing loyal relationships with customers. The research will add to academic knowledge in the area of relationship marketing by investigating the espoused link between effective relationships and customer retention in the domain of online retailing—a domain in which this link has received little research attention.

The research aims to identify the drivers that lead to the delivery of superior service and the development of effective relationships with customers. The research problem can be presented in the following general terms:

How do firms create effective and enduring relationships with their customers in the online context?

In addressing this research problem, three research issues and sixteen hypotheses have been identified from a review of the literature. The research issues and their associated hypotheses are listed below.

Research issue 1 (R1):

How are the principal constructs of relationship marketing conceptualised, and how do they interact in the development of superior relationships in the online context?

The hypotheses to be tested with respect to this research issue are as follows:

Hypothesis 1 (H1): Overall retail service quality in the online context is comprised of the dimensions of: (i) physical aspects; (ii) reliability; (iii) personal interaction; (iv) problem-solving; and (v) policy.

Hypothesis 2 (H2): Retail service quality is positively associated with customer loyalty in the online context.

Hypothesis 3 (H3): Overall relationship quality in the retail context is comprised of the dimensions of: (i) trust; (ii) effort/value; (iii) understanding; (iv) communication; and (v) cooperation.

Hypothesis 4 (H4): Relationship quality is positively associated with customer loyalty in the online context.

Hypothesis 5 (H5): Customer loyalty in the online context is comprised of both an attitudinal component and a behavioural component, and the level of attitudinal loyalty is positively associated with the level of behavioural loyalty.

Hypothesis 6 (H6): Relationship quality mediates the influence of service quality on customer loyalty in the online context (rather than service quality and customer loyalty each having an independent effect on customer loyalty).

Research issue 2 (R2):

How do perceptions of security affect the constructs of service quality and relationship quality?

The hypotheses to be tested with respect to this research issue are as follows:

Hypothesis 7 (H7): Perceptions of retail service quality in the online context vary with different levels of financial risk.

Hypothesis 8 (H8): Perceptions of relationship quality in the online context vary with different levels of financial risk.

Research issue 3 (R3):

How does the service-delivery channel affect the conceptualisation and interaction of these constructs?

The hypotheses to be tested with respect to this research issue are as follows:

H9: Overall retail service quality in the offline and online contexts is comprised of the dimensions of: (i) physical aspects; (ii) reliability; (iii) personal interaction; (iv) problem-solving; and (v) policy.

H10: Retail service quality is positively associated with customer loyalty in both the offline and online contexts.

H11: Overall relationship quality in the banking context is comprised of the dimensions of: (i) trust; (ii) effort; (iii) value; (iv) understanding; (v) communication; (vi) customer power; (vii) social bonds/liking; and (viii) cooperation.

H12: Relationship quality is positively associated with customer loyalty in both the offline and online contexts.

H13: Customer loyalty is comprised of both an attitudinal component and a behavioural component, and the level of attitudinal loyalty is positively associated with the level of behavioural loyalty in both the offline and online contexts.

H14: Relationship quality mediates the influence of service quality on customer loyalty in the offline and online contexts (rather than service quality and relationship quality each having an independent effect on customer loyalty).

H15: The service-delivery channel affects the impact of service quality on relationship quality.

H16: The service-delivery channel affects the impact of relationship quality on loyalty.

JUSTIFICATION FOR RESEARCH

The sale of goods and services online is a major contributor to the Australian economy. Indeed, the total value of online commerce in Australia increased from \$A5.1 billion in 2000 to \$A33 billion in 2005 [1]. However, this figure represents only a fraction of the total global sales conducted online, and worldwide e-commerce is expected to reach over \$US5.5 trillion by the end of 2006 [19].

Despite the economic significance of the online sector, there is a relative paucity of research that has examined the dynamics of online exchange and/or the requirements for building effective relationships online. The literature that does exist on commercial exchange in an online environment has tended to concentrate on the process of effective service delivery (that is, website design, pricing, assortment, and security), rather than the factors that lead to the creation of strong and enduring relationships [12] [18]. With regard to CRM, Sibley Jr. [17] has asserted that research has tended to focus on developing the theory of CRM, rather than testing the strength of the central proposition—that superior service leads to improved relationship quality which, in turn, results in greater customer retention and loyalty.

The present research thus contributes to the existing literature by: (i) providing valuable insights into online exchanges; and (ii) examining the effects of service quality and relationship quality on customer loyalty. In doing so, this research: (i) provides practical guidance to practitioners who desire an improved understanding of the relational needs of their customers; and (ii) assists academics who desire a better understanding of the links between relationship quality and customer retention in a consumer retail context.

METHODOLOGY

The present research adopts a three-stage methodology that includes: (i) a single cross-sectional survey of online shoppers; (ii) an involvement experiment testing the influence of perceived financial risk; and (iii) a survey of retail banking customers using a single cross-sectional methodology.

The first of these, the *single cross-sectional survey of online shoppers*, is quantitative in nature. It includes a range of nominal, ordinal, and scaled response questions, and is designed to gather the opinions of online shoppers regarding service quality, relationship quality, and loyalty (see Appendix). The survey is administered to a convenience sample of 249 students at the University of Newcastle, resulting in a useable sample of 145 respondents. It utilised a survey instrument consisting of modified scales for retail service quality [4], relationship quality [13], attitudinal loyalty [20], and behavioural loyalty [9]. The data thus obtained are subjected to a range of statistical processes including descriptive analysis, correlations, factor analysis, linear regression and structural equation modeling. The aim of this analysis is to validate the measurement instruments and resolve the hypotheses.

The second element in the methodology, the *involvement experiment testing the influence of perceived financial risk*, utilises the same instrument as that used in the first element in the methodology to conduct a 2x2 (between subjects) factorial test of the perceptions of 108 final-year marketing students regarding retail service quality across two different products and two different online retailers. The data thus obtained are subjected to a range of statistical processes including descriptive analysis, factor analysis, and analysis of variance.

The final element in the methodology, the *survey of retail banking customers*, utilises a modified version of the instrument used in the first element in the methodology to explore whether a sample of 451 respondents differ in their perceptions of the key constructs across the online and offline banking contexts. The data thus obtained are subjected to a range of statistical processes including descriptive analysis, correlations, factor analysis, linear regression, analysis of variance, and structural equation modeling.

SCOPE OF THE STUDY

The scope of this study is online retailers and banking institutions and their Australian customers. In particular, the study examines the applicability of relationship-marketing theory in the domain of business-to-consumer (B2C) marketing. This

examination concentrates primarily on the interaction between service quality and relationship quality, and the consequence of this interaction on the development of customer loyalty.

- The conceptualisations of relationship marketing and the other constructs used in this study are based on two underlying philosophical assumptions:
- Although relationship marketing is essentially an inter-personal concept, a relational exchange can also occur at the macro-level between firm and customer.
- Relationship marketing can be effectively applied to consumer situations and the online retail and banking contexts.

It is acknowledged that the research methods used in this study, like all research methods, have some limitations. In particular, the use of convenience samples and the use of a single cross-sectional method for the survey of online shoppers and online banking customers means that the applicability of the results obtained from these particular studies might be limited to the individuals sampled. Although it is tempting to generalise such results to the broader population of Internet shoppers and banking customers, this should be undertaken with caution in view of the limitations of the study with respect to statistical accuracy and representativeness of the sample. Similar limitations are associated with the experiment undertaken for the second stage of the methodology.

CONCLUSIONS ABOUT RESEARCH PROBLEM

The first research issue related to gaining a better understanding of how the principal constructs of service quality, relationship quality, and customer loyalty interact. Hypotheses 1 to 6 proposed that contextual differences did not significantly affect the ways in which service quality, relationship quality, and customer loyalty were perceived. While the dimensionality of the main constructs was consistent across online contexts, there were observed differences in which dimensions were most important between the retail and banking situations (please email the principle author for more detailed findings related to each of the hypotheses). The results also showed mixed support for the extent to which relationship quality mediated the effect of service quality on customer loyalty in the online context, with a fully mediated model supported in the online retail context and a partial mediating model supported in the online banking context. These findings demonstrate and confirm that relationship marketing theory has relevance in the online context.

The second research issue related to the effect of perceived financial risk, and was resolved by testing hypotheses 7 and 8. The findings revealed that perceived financial risk had only a moderate effect on some of the service-quality dimensions, and no effect at all on relationship quality. This suggests that the commonly cited concerns about financial security in the online context had minimal effect on the way in which service was evaluated in the present study; nor did financial risk have any significant effect on whether customers would continue to have a relationship, or develop loyalty, with a particular firm.

The third and final research issue was concerned with the effect of the service-delivery channel. Hypothesis 9 to 16 proposed that while the online service-delivery channel only minimally affected perceptions of service quality, relationship quality and loyalty; it had a significant affect on the interactions of these constructs. The findings once again supported the dimensionality of the key constructs across both channels, with observed differences in the key drivers, and a partial mediating model observed as having the best fit with the data in both the online and offline service delivery channel. This suggests that firms that operate in multiple channels need to give careful consideration to the nuances of the channel in developing their service-delivery and relationship-building strategies. In particular, the relationship between the key constructs was found to be more pronounced in the online service delivery channel.

The major finding of this study was to confirm that the central proposition of customer-relationship management theory is supported in the online context—that is, while the operational context influences the extent to which effective service enhances the relationships between a firm and its customers, and their resulting perceptions of customer loyalty; there is general support for a formative relationship in which effective service will enhance the quality of the relationship between a firm and its customer, and increase loyalty perceptions from the customer. The study has also revealed that the service delivery channel has a significant affect on the central proposition of customer-relationship management theory, and the interactions of the key relationship marketing constructs. Perceptions of financial risk were not observed to significantly affect either service quality or relationship quality perceptions. These key findings have been presented graphically in Figure 1.

Implications for Theory

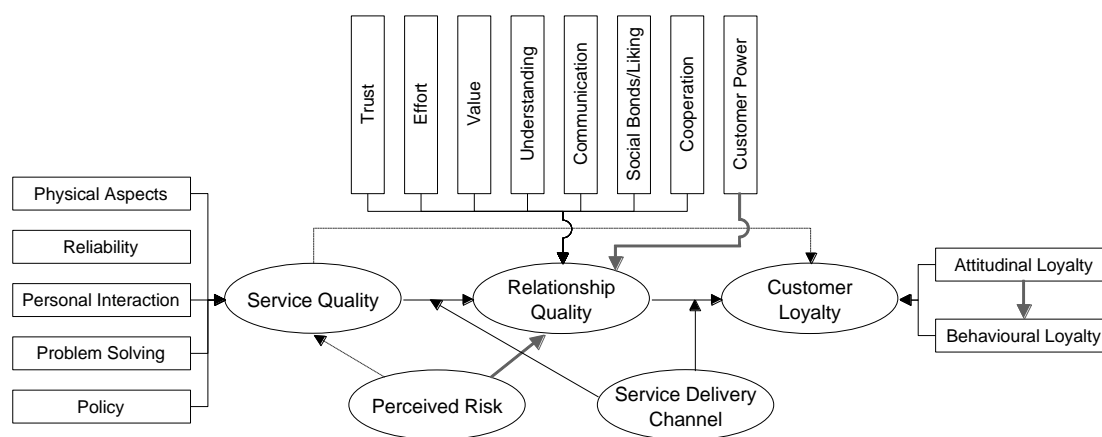
The present research contributes to theory in a number of important areas. First, it has validated the applicability of four previously developed scales. According to Jankowicz [8], this is worthy in itself. In his view, researchers often develop instruments without regard to whether alternative measurement scales have been previously validated. In this regard, the present research has therefore made a valuable contribution by validating the applicability (across a variety of operational contexts) of existing scales for retail service quality, relationship quality, attitudinal loyalty, and behavioural loyalty.

Second, the present research has clarified the interactions among the three important relationship-marketing constructs—service quality, relationship quality, and loyalty in a variety of contexts (online retail, online banking, and offline banking). The study

has confirmed that service quality affects relationship quality, and that this, in turn, affects customer loyalty. However, although this mediating relationship was shown to exist in all contexts, the constructs in each context were shown to be characterised by a distinctive set of drivers. Further, there was also evidence of a partial mediating relationship present within the banking context; confirming the importance of the direct relationship between service quality and loyalty, in addition to the mediating relationship.

Third, in assessing the relationships among these various constructs, the research considered the effects of: (i) perceived financial risk; and (ii) the online channel. The finding that the effect of financial risk was non-significant adds to the ongoing debate in the literature regarding the importance of security in the online context. In particular, the present study suggests that concerns about financial risk have little effect on perceptions of the service received; nor do such concerns affect a consumer's assessment of the relationship with the service provider. With regard to the significance of the service-delivery channel on the interaction between the principle constructs, the present study has demonstrated that the online channel affected perceptions of service quality and relationship quality, and influenced their impact on relationship quality and loyalty respectively. The present study thus adds to the growing interest in the question of how services and relationships should be managed as service delivery becomes increasingly fragmented through the emergence of multiple channels [2].

Figure 1: Key findings from this research presented graphically



Legend: black line represents supported relationship; broken black line represents partially supported relationship; grey bold line represents unsupported relationship.

Fourth, the present research has contributed to the theoretical understanding of customer loyalty by confirming the importance of a dyadic conceptualisation of loyalty (including both attitudes and behaviours). However, the findings of the study provided no support for a causal relationship between attitudes and behaviours. This finding is significant as it challenges an oft-cited and seldom tested assumption of consumer behaviour—that positive attitudes toward a product or firm will influence a customer's willingness to participate in future exchanges.

Finally, the research has added to methodological theory with respect to the application of online research methods. The online surveys and online experiment used in the present study have been shown to be valid and efficacious. This strengthens the case for wider adoption of such methodologies.

Implications for Practice

The findings of this study have several implications for marketing practice. In particular, the study has practical implications for the effective use of customer-relationship management tools. Users of these tools have tended to focus on the purchasing characteristics of customers, while ignoring the key drivers or effective service, strong relationships and loyalty. The findings of the present research provide guidance to marketing managers with regard to the identification and enhancement of these drivers.

For example, the research has emphasised the importance of developing 'trust' and making an 'effort' in attempting to foster effective relationships, and has confirmed the importance of having good 'policy' and 'problem-solving' strategies in attempting to create perceptions of service quality. Likewise, the research has confirmed the importance of such factors in the development of customer loyalty. This understanding of how the principle constructs are conceptualised, and how these constructs interact in the online context, can guide firms to enhance their CRM strategies (see Figure 2).

Although the present study analysed broad retail and banking marketplaces, marketers who are responsible for a particular portfolio of brands and/or selected service-delivery channels will be able to apply the refined measures used here as tools to investigate the customer perceptions within their own market segments and across various channels of interest to them.

Alternatively, the measures employed in this research could inform the development of a checklist that could be used to benchmark a firm's current performance against their past performance, or similarly, enable firms to benchmark against the performance of their key competitors. This could be especially valuable for marketers who are already acquainted with customer-relationship management, with the results of such activities able to guide decisions about service delivery and market segmentation (ie. segments can be developed on the basis of attitudes and context in addition to behaviours).

The study also confirmed the significance of the online service delivery channel in the development of enduring relationships. As indicated in Figure 2, marketers would benefit from measuring the differential impact of their service delivery across multiple channels. Likewise, the complimentary nature of the online channel should motivate marketers to develop strategies that make better use of the channel's ability to positively moderate the overall relationship and loyalty perceptions of their customers.

Limitations

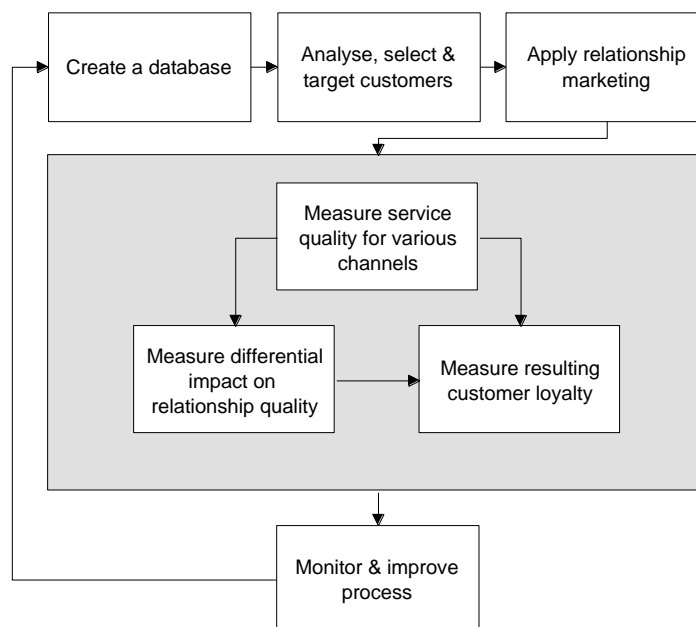
As with all research projects, the present study has limitations that need to be considered when interpreting the results. First, the inevitable restraints of time and resources that accompany a study such as this meant that the research examined only *customers'* perceptions of relationship-marketing activities. It is acknowledged that this fails to address the question of the perceptions of the firms themselves, their strategic priorities, and their resource limitations. Similarly, these inevitable restraints prevented an examination of relationship marketing in the important business-to-business (B2B) context.

Second, the research used a behavioural intention scale as part of the loyalty measurement. Although the Juster scale [9] is a reliable predictor of future behaviours, the correlation of these behaviours with actual behaviours would have provided a more comprehensive analysis. However, this would have required a longitudinal research design, which was not possible in the context of the time and resources available to the present study.

Third, the choice of research design also limits the generalisability of the findings. For example, the use of student samples is often criticised for not being representative; however, in the case of this research the student samples used here were not significantly dissimilar to the broader Internet user population [1]. Likewise, the adaptation of previously validated scales carried some risk of misspecification; however, this was minimised by careful scale selection and refinement. In any case, the use of previously validated scales in a new context does have benefits in terms of the development of methodological theory (as noted above).

Despite these limitations, it is submitted that the research strategy employed for this study can be considered appropriate and efficacious.

Figure 2: Enhanced model for CRM



Further Research

Future research could build on this research by extending its scope to include a consideration of additional variables. Internal factors such as psychographics and demographics could be examined, as could external factors such as defensive marketing tactics of competitors, website quality, and the activities of supply-chain members. All of these could be explored in terms of their effects on the structural relationships among service quality, relationship quality, and customer loyalty. In addition, the

personal characteristics of the consumers (ie. gender, age, education, experience etc) could be investigated for possible moderation effects; likewise, the effect of loyalty on profitability could be included in future analysis.

Further research is also required into the present study's findings with respect to: (i) attitudinal loyalty; and (ii) perceived financial risk. With regard to the first, the apparent lack of influence of attitudinal loyalty on behavioural loyalty requires further attention, as does the effect of attitudes on actual behaviours (rather than behavioural intentions). With respect to financial risk, future research could explore other ways to investigate perceived financial risk; alternatively the current method could be applied within a real purchase situation, rather than a hypothetical scenario.

Future research could also examine the transferability of these methodologies to different contexts and viewpoints. In particular, the business-to-business (B2B) context could be included in future research. Furthermore, it would be interesting to explore other service-delivery channels, and the effect of these channels on overall relationship with, and loyalty to, a firm.

Finally, future research in this subject area could be conducted using alternative methodologies or samples. For example, changes over time could be assessed by a longitudinal study. In addition, or alternatively, the present study could be replicated using a different sample and a greater number of operational contexts.

CONCLUSION

This paper has provided a discussion of the conclusions and implications of this research. The discussion has included a summary of the research findings against each of the hypotheses, an elaboration of the conclusions related to each of the three research issues, a consideration of the implications for practitioners and academics, and a brief discussion of the limitations of the present study and the opportunities for future research.

It is apparent that this research has made a significant contribution in a number of areas. In particular, the research has achieved its principal objective of testing the central proposition of customer-relationship management in the online context. This examination led to the proposal that relationship quality is a mediating variable between service quality and loyalty—and subsequent testing confirmed this mediating role.

The research has also resolved the three identified research issues by presenting sixteen distinct conclusions as follows:

- Conclusion 1: The dimensionality of the retail service quality (RSQ) construct was supported in different online contexts.
- Conclusion 2: Service quality was antecedent to customer loyalty in different online contexts.
- Conclusion 3: The dimensionality of the relationship quality (RQ) construct was supported in the retail context.
- Conclusion 4: Relationship quality (RQ) was antecedent to customer loyalty in different online contexts.
- Conclusion 5: Attitudinal loyalty was not found to drive behavioural loyalty in different online contexts.
- Conclusion 6: Relationship quality (RQ) mediated the influence of service quality (RSQ) on customer loyalty in both online contexts.
- Conclusion 7: Perceptions of retail service quality (RSQ) were only partially affected by different levels of financial risk in the online context.
- Conclusion 8: Perceptions of relationship quality (RQ) did not vary with different levels of financial risk in the online context.
- Conclusion 9: The dimensionality of the retail service quality (RSQ) construct was supported in both the offline and online contexts (with modification).
- Conclusion 10: Service quality (RSQ) was antecedent to customer loyalty in both the offline and online contexts.
- Conclusion 11: The dimensionality of the relationship quality (RQ) construct was supported in the banking context.
- Conclusion 12: Relationship quality (RQ) was antecedent to customer loyalty in both the offline and online contexts.
- Conclusion 13: Attitudinal loyalty was not found to drive behavioural loyalty in either the offline or online contexts.
- Conclusion 14: Relationship quality (RQ) mediated the influence of service quality on customer loyalty in both the offline and online contexts.
- Conclusion 15: The service-delivery channel affected the impact of service quality on relationship quality.
- Conclusion 16: The service-delivery channel affected the impact of relationship quality on loyalty.

In summary, it was found that the selected scales were applicable with modification, that the dimensionality of the principal constructs was supported, and that the hypothesised structural relationships were found to be applicable in most circumstances. Although the service-delivery channel was found to have a moderating effect on the central proposition, there was no support for a proposed moderating effect of perceived financial risk.

Despite the acknowledged limitations of the present study, it is apparent from a consideration of the implications of this research and the opportunities for future investigation, that this study has made a significant contribution to a better understanding of relationship-marketing theory and a better appreciation of how to realise practical benefit from customer-relationship

management.

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iPRICE: A COLLABORATIVE PRICING MODEL FOR E-SERVICE BUNDLE DELIVERY

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ABSTRACT

Information goods pricing is an essential and emerging topic in the era of information economy. Myriad researchers have devoted considerable attention to developing and testing methods of information goods pricing. Nevertheless, in addition; there are still certain shortcomings as the challenges to be overcome. This study encompasses several unexplored concepts that have attracted research attention in other disciplines lately, such as collaborative prototyping, prospect theory, ERG theory, and maintenance from design, economic, psychological, and software engineering respectively. This study proposes a novel conceptual framework for information goods pricing and investigates the impact of three advantages: (1) provides collaborative process that could generate several prototypes via trial and error in pricing process, (2) deliberates the belief of consumer and producer by maximizing utility and profit, and (3) offers an appropriate service bundle by interacting with consumer and discovering the actual needs.

Keywords: Information goods pricing, Collaborative Prototyping, Markov chain, ERG theory.

INTRODUCTION

Due to the unique cost structure and product characteristics¹ of information goods, the possibility to follow traditional pricing strategies becomes unfeasible and the differential pricing strategy is recognized to be crucial. Varian (1995) identified two key pricing issues (price discrimination and bundling) [[14]].

The nature of price discrimination, in general, aims for optimizing the prices instead of lowering the prices, possibly from different perspectives. For instance, from the perspective of producers (i.e., maximized profits), a producer charges different users at different prices according to their different willingness-to-pay (WTP).

Myriad researchers have devoted considerable attention to developing and testing methods of information goods pricing. Nevertheless, in addition; there are still certain shortcomings as the challenges to be overcome: (1) lacks consumer involvement for pricing process, (2) only takes producer's perspective into consideration (either cost-based or profit-based oriented), and (3) places the price without interacting with consumers that based on maximum satisfaction. Thus, dynamic pricing has become an essential issue recently and is widely accepted to overcome this dilemma.

Accordingly, this study proposes a novel method for information goods pricing and investigates the intended contributions: (1) provides collaborative process that could generate several prototypes via trial and error in pricing process, (2) deliberates the belief of consumer and producer by maximizing utility and profit, and (3) offers an appropriate service bundle by interacting with consumer and discovering the actual needs.

iPRICE: A SYNTHESIZED APPROACH

System Framework

The shortcomings of extant pricing methods are addressed in the aforementioned section. Commonly, the focus is merely on specific category up to present. Seldom of researches offer a synthesized approach for information goods pricing. In addition, a critical challenge occurs in omitting the interactive pricing process under risk to elicit the needs accurately. This synthesized approach which called iPrice system comprises the GUI module, collaborative prototyping module, optimal-price estimation module, and version revisionary module as the chief components of the system (as shown in Fig. 2). Each module will be further illustrated in the following sections.

¹ Economics of IT. <http://oz.stern.nyu.edu/io/pricing.html>

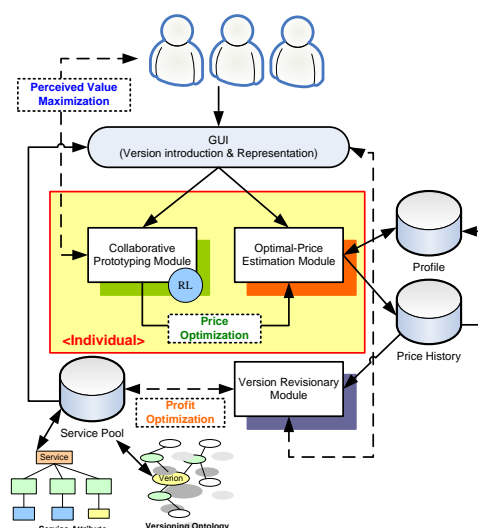


Fig. 1. System Framework

COLLABORATIVE PROTOTYPING MODULE

The collaborative prototyping module (CP Module) is the foundation among other modules; meanwhile, the aim is to co-design the bundle with the user that evolved from a selected version. There are two possible inputs for collaborative prototyping module. A selected version from GUI module is one of the inputs for this module while user's feedback is another input that will enhance the quality of collaborative process. On the other hand, an ultimate bundle and the utility are two outputs of the module. The bundle satisfies user's needs and enfolds combinational services.

Prototyping

Prototyping, which is the process of developing prototypes, is an integral part of iterative user-centered design; meanwhile, it enables designers to try out the ideas with users and to gather feedback. The main purpose of prototyping is to involve the users in testing design ideas and get their feedback in the early stage of development; thus, reduce the time and cost [[8]]. Collaborative prototyping is a novel approach that based on the notion of prototyping. Collaborative environments for product development have become the new design paradigm for engineering organizations.

Collaboration permits greater information sharing, concurrent engineering, virtual prototyping and testing, and total quality management. Additionally, the anticipated benefits of a prototype in reducing risk must be weighted against the time and money required to build and evaluate the prototype [[12]]. In summary, collaborative prototyping identifies user requirements and furnishes feedback on the working design against the requirements. Moreover, it provides certain of advantages: (1) reduce development time, costs and risks, (2) require user involvement to receive user feedback, (3) facilitate system implementation based on user's anticipation and satisfaction, and (4) expose developers to enhance the product in the future.

ERG Theory

ERG theory is a model of human motivation appeared in 1969 by Clayton Alderfer which extended and simplified Maslow's Hierarchy in a shorter set [2]. Meanwhile, it approaches the question of "what motivates a person to act?" and assumes that all human activities are motivated by needs. ERG theory consolidated Maslow's five need categories into three; meanwhile, the letters ERG stands for three levels of needs: Existence, Relatedness, and Growth. Further, the details for each category are described as follows:

Existence Needs: include all the various forms of material and physiological desires (e.g., food, water, air, clothing, safety, physical love and affection).

Relatedness Needs: involve relationships with significant other people (e.g., to be recognized and feel secure as part of a group or a family).

Growth Needs: impel a person to make creative or productive effects on himself and the environment (e.g., to progress towards one's ideal self).

Moreover, three relationships among different categories are identified in ERG theory, which are satisfaction-progression (moves up to higher-level needs based on satisfied ones), frustration-regression (moves back from current unsatisfied needs to lower-level needs), and satisfaction-strengthening (strengthen current level of satisfied needs iteratively). As for the implications for management, the ERG theory assists the managers to recognize that an employee has multiple needs to satisfy simultaneously. Furthermore, if growth opportunities are

not furnished to employees, they may regress to relatedness needs.

Method

The core concept of CP module is the mixture of collaborative prototyping and ERG theory to furnish customized bundles via interaction. The needs could be separated into three categories which are introduced in ERG theory. We assume that the user's needs shift among three categories time by time. Namely, three different needs are identified as existence, relatedness, and growth needs. Moreover, Markov chain is employed to predict the behavioral patterns of needs (with the assumption of a user's need shifting along variant time).

Markov chain is a discrete-time stochastic process with the Markov property (only the current state is necessary for predicting a subsequent state or states and states prior to the current state are not needed if the current state is known). Markov chain enfolds certain advantages: (1) finite states, (2) time interval, (3) probability-based, and (4) dynamic. We assume our system is described at successive times the states (each of which has known a finite number of possible outcomes). At these times the system may have changed from the state it was in the moment before to another or stayed in the same state. The changes of state are called transitions. The system is with the initial state (N_0) and the transition matrix (P). The possible states of need hierarchy at any time period can be determined according to the initial state and transition probabilities.

The state in a given period depends on the iteration of the state of preceding period (N_{t-1}) and the transition probabilities: $N_t = N_{(t-1)}P$. The initial probabilities of P are derived from the user's profile and will be rectified in accord with the user's behavior. The composition of the need hierarchy can be expressed in a row vector (e.g., $N_t = (E, R, G)$ where N represents a need hierarchy and t represents time).

Suppose we have a sequence with t frames and the states are represented by $\{N_1, N_2, N_3, \dots, N_t\}$, where N represents the state at time t . The furnished bundles are denoted as $\{B_1, B_2, B_3, \dots, B_t\}$. Each furnished bundle is conditionally dependent on only the previous state (i.e., $P(N_{t+1}=B_{t+1} | N_1=B_1, N_2=B_2, N_3=B_3, \dots, N_t=B_t) = P(N_{t+1}=B_{t+1} | N_t=B_t)$). Accordingly, the formulation for Markov chain to forecast the next state is $N_t = N_{(t-1)}P$.

OPTIMAL-PRICE ESTIMATION MODULE

The optimal-price estimation module (OPE Module) is the most significant component to estimate the optimal price for charge. The inputs of OPE module are the information of each bundle and the profile of the user. Meanwhile, the output is the optimal price that mixes and takes various inputs into account. The notion of OPE module enfolds the design of prospect theory and mental account which will be detailed in the following sub-sections.

Prospect Theory

Prospect theory (PT) was developed by Kahneman and Tversky (1979) which is concerned with behavior of decision makers under risk. The definition of prospect theory is "decision making under risk can be viewed as a choice between prospects or gambles." Unlike expected utility theory (EUT) which concerns itself with how decisions under uncertainty should be made (a prescriptive approach), prospect theory concerns itself with how decisions are actually made (a descriptive approach) [6].

Prospect theory has been successfully used to explain a range of puzzles in economics, especially for behavioral finance. Nevertheless, there are several phenomena which violate these tenets of expected utility theory such as certainty effect, reflection effect, and isolation effect. For example, if there is a problem for a person to make the decision that:

(A) 2400 with certainty

(B) 2500 with probability 0.33, 2400 with probability 0.66, and 0 with probability 0.

The result reveals that 82% of people chose (A) from the experiment. However, the rational decision maker is supposed to choose (B) with maximum utility (i.e., $2500 \times 0.33 + 2400 \times 0.66 = 2433$) from viewpoint of expected utility theory. This demonstrates the certainty effect which stands for people tend to weight and choose outcomes with certainty. Further, the reflection effect is the second critique for expected utility theory. The reflection effect implies that risk aversion in the positive domain is accompanied by risk seeking in the negative domain from the empirical data. Ultimately, the isolation effect means people often disregard components that the alternatives share and focus on the components that distinguish them.

On the other hand, the decision maker is assumed to evaluate the prospects and choose the highest value among them according to the definition of V in terms of two scales: π and v . The first scale, π , associates each probability p with a decision weight $\pi(p)$, which reflects the impact of p on the over-all value of the prospect. The second scale, v , assigns to each outcome x a number $v(x)$, which reflects the subjective value of the outcome. The outcomes are defined relative to a reference point which serves the zero point of the value scale. Thus, v measures the value of deviations from the reference point as gains and losses. In prospect theory, the mapping of real probabilities onto subjective decision weights is described by a special function called the " π " function. Further the mapping of real value onto subjective value is described by a special curve called the " S " curve, which is defined in terms of losses and gains from a status quo.

Mental Account

The mental accounting is the extension of prospect theory which divides the utility from into acquisition utility and transaction utility. Acquisition utility is a measure of the value of good obtained relative to its price, similar to the economic concept of consumer surplus. Transaction utility measures the perceived value of the deal [12]. For the analysis that follows, three price concepts are used. Let p be defined as the actual price charged for some good z . Afterwards, \bar{p} is defined as the value equivalent of z for some individual. Finally, let p^* be called the reference point for z . Thus, the acquisition utility is the net utility that accrues from the trade of p to obtain z which is designated as $v(\bar{p}, -p)$. On the other hand, the measure of transaction utility depends on the price the individual pays compared to some reference price (p^*). Formally, it is defined as the reference outcome which means the value of paying p when the expected or reference price is p^* and is designated as $v(-p; -p^*)$. Hence, the total utility from a purchase is the sum of acquisition utility and transaction utility. The value of buying good z at price p with reference price p^* is defined as $w(z, p, p^*)$ where $w(z, p, p^*) = v(\bar{p}, -p) + v(-p; -p^*)$. Additionally, the most important factor in determining p is fairness, which depends in large part on cost to the seller. In short, the concept of mental accounting applies prospect theory to move toward consumer behavior. The mental account includes other features of prospect theory such as concavity of gains and loss aversion. Meanwhile, the total utility will be estimated more accurately from acquisition utility and transaction utility which furnishes the notion of reference price. Thus, prospect theory can be linked with a great many other psychological and cognitive theories.

Method

The major components are identified in OPE module as optimal price estimation, which are design fee, number of bundles, and testing efforts. The design fee stands for the costs for customized prototypes (i.e., bundles) and is estimated by maximum utility among them. The number of bundles is related to testing efforts which considers the collaborative process is worthy and needs to be charged for the user.

The cost of a bundle stands for the costs for a sequence of services enfolded in a bundle. Accordingly, a formula emerges according to four identified components which is $P \geq D(U) + T(N) + C$, **where D is the design fee function, U is the maximum utility, N is the number of bundles, T is the function of testing efforts for collaborative process, and C is the function denotes the service costs for a bundle.**

Further, it is essential for the OPE module to explore the maximum utility among bundles. The operational process for probing maximum utility is separated into two folds and formulated as $U = v(p) + \pi(p)$, which are prospect theory (the utility is equal to the value function by weight function) and mental account (the value function is the sum of acquisition utility and transaction utility). As in the foundation of prospect theory, the value function and weight function are dissimilar according to varied users. Supposedly, the value function and weight function initiate from normal distribution and adjusts by the profile and behaviors of each individual respectively. The value function is divided into acquisition utility (the value of good received that compared to the outlay) and transaction utility (the perceived merits of the deal).

Acquisition utility is the net utility (i.e., $v(\bar{p}, p)$) that accrues from the trade of p (i.e., the cost of a bundle and we assume it's equal to the price needed to pay at least) to obtain z (where is valued at \bar{p}) which will be coded as the integrated outcome $v(\bar{p} - p)$. Additionally, the transaction utility depends on the costs that compared to reference price p^* . Formally, it is defined as the reference outcome $v(-p; -p^*)$; in other words, stands for the utility when the costs and reference price are p and p^* respectively.

Furthermore, three functions in the formula are identified as design fee function (D), testing effort function (T), and cost function (C). Firstly, the design fee function is a convex and incremental function (map utility value to design fee). Secondly, the testing effort function is a concave and incremental function (map the number of bundles to testing effort). Ultimately, the cost function is a concave and incremental function (map number of services in the bundle to cost).

VERSION REVISIONARY MODULE

The version revisionary module (VR Module) is based on the theory of software maintenance. The concept of VR module is derived from software maintenance and the aim is to revise the version which may be unselected for a long time or yield lower profits among others. The inputs of VR module are price history and the versions from GUI module. The price history records the price for each bundle which is related to the original version; thus, the system can estimate the profits for each version. Additionally, the output of VR module is the revised version that may replace the original one with lower profits.

Software Maintenance

Software maintenance has become a significant issue nowadays that previous researches have focused upon the prevention and elimination of errors in newly developed software. The goal of software maintenance is to produce

software closely toward error-free. Conceptually, variations in error rates are expected to be a function of either the software system or factors in the maintenance environment.

A maintenance process takes the previous version of the system as the main input; however, is affected by other factors such as the skills of maintainers. The existing system can be examined with a measurement of reliability that can identify the system's static characteristics causing higher error rates. Meanwhile, most of these characteristics can be described as software size and complexity.

In short, the maintenance model is proposed and used to identify managerially controllable factors which affect software reliability. The results reveal that high error rates may result from: (1) underwent frequent modification, (2) programmers with fewer experiences, and (3) high reliability requirements. Thus, the managers can make quantified judgments to reduce error rates via implementing a number of procedures, including enforcing release control, assigning more experienced maintenance programmers, and establishing and enforcing complexity metric standards.

Method

The error rate (λ) is modeled as a stochastic variable whose mean varies from application system to application system, specifically as a multiplicative function of several explanatory variables pertaining to those systems. In particular, the error rate is modeled as a random draw from a lognormal distribution with mean λ , the formula represents as $\lambda = f(\text{static, dynamic, environmental})$, where $f(\cdot)$ is a multiplicative function. The lognormal distribution and the exponential distribution are widely used in the software reliability literature, both being consistent with the intuition that error rates should be distributed with an early peak and a single long tail.

The parameter value of error rate varies from application to application, based on the values of the structural variables which determine it. The following fixed effects regression model was estimated: $\ln \text{ERRORS} = \beta_0 + \beta_1 * S + \beta_2 * C + \beta_3 * OF + \beta_4 * V + \beta_5 * Sa + \beta_6 * P + \epsilon$, where $\beta_0 \sim \beta_6$ is the weight coefficient for each indicator and ϵ is the residual parameter. The independent variable (ERRORS) is defined as the unselected decision among all versions (i.e., unselect or select). The system gathers the information for each version periodically and initiates the estimation of weight coefficients at a specific time. The dependent variable ERROR provides the clue to predict the discrimination among versions via the significance of weight coefficients. If the error rate is greater than an error threshold, the system terminates the computation. Meanwhile, the system rectifies the version(s) based on versioning ontology and service attribute taxonomy. Subsequently, the new version(s) will be assigned to replace the old one until all versions are verified.

Table 1. The Indicators of Error Rate

$\lambda = f(\text{static, dynamic, environmental}) = \ln \text{ERRORS} = \beta_0 + \beta_1 * S + \beta_2 * C + \beta_3 * OF + \beta_4 * V + \beta_5 * Sa + \beta_6 * P + \epsilon$	
Static Indicators	
<i>Size (S)</i>	The number of bundles.
<i>Complexity (C)</i>	The number of different services in the version.
Dynamic Indicators	
<i>Operational Frequency (OF)</i>	The number of bundles paid last month.
<i>Volatility (VF)</i>	The version is subject to the number of frequent changes up to present.
Environmental Indicators	
<i>Satisfaction (Sa)</i>	The subjective score that is assigned by the user.
<i>Profit (P)</i>	The average profit for each version.

CONCLUDING REMARKS

The contributions of the new pricing method for the system are unfolded which: (1) furnishes prototypes for the user during the collaborative process, (2) predicts the need for next time period proactively and accurately, (3) generates certain of prototypes for trial, (4) estimates the optimal price based on maximum utility, and (5) revises the versions with lower profits automatically. Moreover, there are several implications for service providers which: (1) generate prototypes in order to grasp user's feedback simultaneously, (2) grab the user's needs immediately so as to response quickly, (3) estimate the optimal price based on user's maximum utility, and (4) rectify the versions with mobility except the automation by the system. In short, the new pricing method for information goods fills the gap among previous literatures which only takes consumer or provider into account. Different from existing works, the new pricing method is novel in integrating distinctively important concepts yielding more benefits to consumers and profits to more providers. Thus, the method also guides and provides a roadmap for information goods pricing for future research.

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INTER-ORGANIZATIONAL PROCESS INTEGRATION PROBLEMS

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ABSTRACT

In this paper, we discuss eight high-level problems that show up when partnering companies decide to set up cross-organizational processes. It is important in practice to be aware of the existence of these problems and to deal with each of these problems. The problems concern the facts that it is difficult to agree on pre and postconditions of tasks, that parties need to agree on how to trigger task executions, that investments have to be distributed among the parties, that service levels should be agreed upon, that partners should preserve the value of the functions that are executed in the process, that process ownership must be considered at an inter-organizational level and that partners may change over time

Keywords: Inter-organizational process integration problems, preconditions and postconditions, process ownership, service levels.

INTRODUCTION

For many years companies have been optimizing their internal functioning. With the advent of the Internet, however, information sharing among companies has become much more feasible so that the optimization effort is nowadays mostly no longer confined to that of individual enterprises: optimization can happen at the level of Extended Enterprises (i.e., collections of partnering companies [5]). Clearly, Extended Enterprises that are successful in their Extended Enterprise wide optimization effort will undercut other value chains that fail to do so and only optimize the individual components of the value chain rather than the value chain in its entirety. In this paper, I present an extract of the literature review of my PhD-dissertation [3], so as to discuss a number of inter-organizational process integration problems.

To create competitive end-to-end processes, companies within an Extended Enterprise need to deal with the following challenge: Partners should appropriately align the tasks that need to be executed in an end-to-end process and control the execution of those tasks. The term 'control' has many meanings [10,13]. With execution control in the previous sentence, we mean that some party (1) can initiate the task and that he (2) can monitor the task execution and steer the flow of the process. When looking for a way to stand up to the challenge, Extended Enterprises will be confronted with a number of problems. In this paper we present eight problems. To a large extent the problems we discuss here can be seen as modifications of the inter-organizational data integration problems we have discussed in [4]. Roughly stated, the problems we consider (i.e., the problems of which we think they may be important for companies in their decision w.r.t. the process solution) are the following:

- If we look at the building blocks of the process, the tasks, we notice that these blocks have to be arranged: the tasks should be executed in some order. The different partners may, however, have different requirements with respect to the order.
- While trying to find an appropriate arrangement of the building blocks, the companies may note that they have a different understanding of what the blocks at hand actually are. That is, the outcome they expect from some task execution may be different. Moreover, the outcome they expect from the entire process execution may be different too.
- Once it is known what tasks need to be executed and in what order they will be executed, it has to be decided how the task executions can be triggered.
- To realize the processes investments are needed. Partners have to agree on who will bear the costs and who will do the effort.
- The partners have to agree on what are the required service levels for the process, and for the individual tasks being part of it. At runtime, the service levels that are needed from one task depend on the service levels that are actually provided by other tasks.
- On itself, an individual task is often worthless. It is in combination with a number of other tasks that the function provided by one task becomes useful. The value of executing a single task depends on the value of the functionality of the entire Extended Enterprise process. In an Extended Enterprise partners should preserve the value of the functional proposition of the process in order to preserve trust.
- A party has to be designated who is responsible for making decisions with respect to the process: What are competitors doing, and should a new design be considered? Are new service levels required? Should some party get a rap on the knuckles? etc. This party should be enabled to do his job: he should get access to information about the current process, and get control over the execution of the process.
- The partners may change over time so that the parties that are designated to provide some service differ, and/or the parties that may want the execution of some service differ.

In what follows, we subsequently discuss each of these problems in more detail. Each time we (1) define the problem, (2) show how it is related to the challenge defined above, (3) discuss the relevance of the problem, especially in the context of the

Extended Enterprise, and (4) illustrate the problem.

To illustrate the problems, we will generally start out from the same exemplary process. The example is a fictitious process that could show up in the Personal Computer (PC) industry. Say there is a customer who wants a computer. A Reseller, for example the IT department of his company, can deliver computers. This Reseller then requires the computer Manufacturer to build a computer. This Manufacturer books the orders and produces the desired computer, but he relies upon a Shipper to pick up the computer to ship it to the Reseller, and upon a Factoring company to make sure the payment is settled.

Figure 1 shows a simplified BPMN (Business Process Modeling Notation) model of how the process between the different partners could look like. In BPMN, the solid arrows show sequence flows, the dashed arrows show message flows.

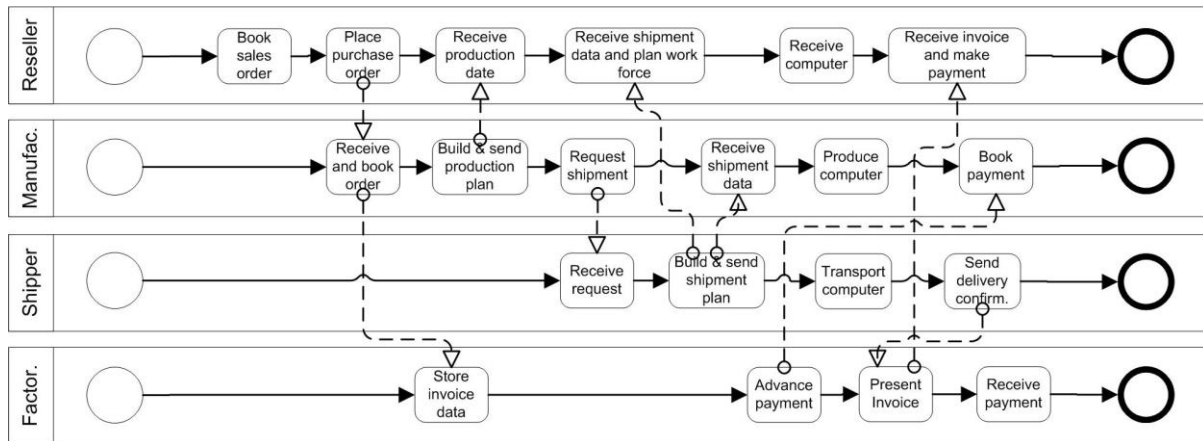


Figure 1: Example of a process

OVERVIEW OF INTER-ORGANIZATIONAL PROCESS INTEGRATION PROBLEMS

Problem 1: Companies Foresee The Execution Of Tasks In Different Situations

The different partners may have different expectations with respect to the situations in which a task will be executed; this in terms of previously finished and unfinished tasks, available capacity, timing, etc.

Problem Description

If different parties foresee different conditions for task execution the process may never be executed entirely. Partners may fundamentally disagree on the preconditions for each task, or may just not be aware of the fact that they disagree.

In [13, p35] a precondition is defined as “A logical expression which may be evaluated by a workflow engine to decide whether a process instance or activity within a process instance may be started.” Companies are only willing, able and planning to execute some task if the world they perceive is in an appropriate state. The other way around, other companies may expect them to execute some task if the world is in some specific state. If there is a difference between what one company expects the other to do on the one hand, and what the other company can, is willing and is planning to do on the other hand, the process cannot be executed successfully.

This problem has both, a task and a process component. A task can only be executed if the necessary preconditions are fulfilled. The preconditions can be fulfilled at different moments in the entire process, but (in general) the task will only be executed once during the process; it has to be agreed when that will be.

Relationship to the challenge

If there is no agreement about the order of execution, the execution of the tasks is clearly not decently controlled. In this case one cannot talk about the end-to-end process that is to be implemented, as different parties perceive the end-to-end process differently.

Relevance

An agreement on the preconditions is important because the system may otherwise enter some state of deadlock. This is especially true in Market B2Bi (as defined in [5]). In Market B2Bi companies can only deploy the ‘lowest common denominator’ process, possibly leading to a process that is not rendering the envisioned outcome [14]. In an Extended Enterprise (as defined in [5]) companies will be less reluctant to execute the tasks they are requested to execute even though their own preconditions are violated. This, however, does not imply that preconditions should not be negotiated. In the Extended Enterprise companies are likely to be willing to negotiate and to adapt preconditions upon tasks, while this is not true in Market B2Bi.

Illustration

The following examples show cases where there is actually no (agreed-upon) process that the companies try to execute.

The Reseller may not be willing to pay for the computer until the shipment has arrived, whereas the seller may not be willing to hand over the computer if no payment was made.

The Reseller may be willing to pay for the computer before he received the computer, but not be planning to pay before receipt.

The seller may be postponing the delivery of the computer until he received the payment. The lack of explicit agreement about

which of the possible process sequences (both are acceptable) is to be used actually suspends the process.

Say that the shipping costs are calculated ad hoc for each package, depending on traffic conditions, fuel prices of the day, etc. In this case the reseller may be willing to pay before delivery, but he cannot pay until he knows how much he has to pay, something that is only determined once the computer is delivered.

Problem 2: Different Parties Have A Different view On The Post-Conditions Of Tasks And Processes

The concept of delegation typically supposes that only a task executor knows how some task is executed; others are generally only supposed to know what the task does. Still, others may have a wrong perception of what the task does. A task is executed to achieve some results, some of which are not relevant or not visible for all parties. By extension, a process is executed to achieve some results, some of which are not relevant or visible for all parties.

Problem Description

Partners may have a different perception of what a task and of what an entire process actually do. Some results of the execution may be relevant for a party, while others may not be relevant. Partners have to agree on (relevant) results of some execution.

Partners have to agree on the so-called post-conditions of a task and of a process. In [13, p36] a post-condition is defined as ‘A logical expression which may be evaluated by a workflow engine to decide whether a process instance or activity within a process instance is completed.’ Stated differently, the post-conditions show what the task/process is supposed to realise.

Relationship To The Challenge

The requirement to align tasks within a process implies that someone who determines what one task should do has to know (to some extent) what the other tasks do. A process realizes post-conditions by executing a number of tasks. One can only correctly align the tasks if it is clear how the tasks are supposed to fit together for the realization of the intended outcome of some end-to-end process.

Relevance

There are several reasons why it is important to understand what a task does:

- As we stated earlier, tasks executed by different companies are typically linked through so-called ‘outcome interdependencies’, but in a collaborative setting they are linked through ‘behaviour-interdependencies’: their execution (i.e., behaviour) gets intertwined. To mix the tasks decently it is imperative to know what the tasks actually do, and what the entire process is expected to do.
- Secondly, if some task cannot be executed successfully by one party, another party may be brought in who can execute it. In that case, however, one has to map the task as it was to be executed by the original party to the task as the new party is planning to execute it. If both tasks are not realizing the same post-conditions they can probably not be exchanged.
- It may be the case that some ‘new’ task actually realizes what was to be done by several ‘old’ tasks (or the other way around: one old task is replaced by several new tasks) resulting not only in changes in who executes some task but also in the control flow.
- Some of the task execution results may be visible, while others may not. In case undesired effects ensue from the task execution it is important to know that the task execution actually entails more than just realizing what is agreed upon.

The fact that tasks are perceived differently creates obstacles to change tasks and/or processes. It is difficult to creatively use some task in some process design if the task is not really understood. Fortunately, for the execution of the process parties only need to understand their own part in the process.

Illustration

In the computer-sales process the Manufacturer’s request for a shipment results in an update of the Shipper’s planning and a transmission of the shipment date to the Manufacturer and the Reseller. This information may be important for the Reseller as an input for tasks such as planning the work force for installing computers at the customer’s site. In case a new Shipper would be needed, the shipment request might not result in a transmission of the shipment date to the Reseller. The Manufacturer would then get the additional task to forward the shipment date to the Reseller.

Hidden, undesired effects may ensue from some task execution. For example, the Shipper may forward data to competitors about which Reseller buys which computers from the Manufacturer. Competitors could then strive to do direct marketing.

Problem 3: It Has To Be Revealed How Task Executions Are To Be Triggered

Once it is known what tasks need to be executed in what sequence it has to be stipulated how one can make sure that some task will be executed.

Problem Description

Task requestors may not be aware of how they can make sure the task execution is initiated, or they may not be enabled by the executor to initiate the execution.

A task can be executed if (1) the system is in an appropriate state to execute the task, and (2) the inputs necessary for task execution are available.

- If a task execution completes (successfully or unsuccessfully) within some company this changes the state of the Extended Enterprise into a state where some tasks can, have to, or cannot be executed by some of the partners. Consequently it may be important that those partners are informed about this state change. Through message transmissions partners can communicate state changes so that they perceive the (relevant parts of the) state of the Extended Enterprise the same. A partner which notices or is notified of a state change may then start the execution of some activities.

- Inputs that are necessary for some task may already be available or not when the system enters a state where execution is desired. Inputs are – in the context of the processes we consider – data.

In an Extended Enterprise, initiating a task will thus typically require the transmission of information (see e.g. [17] about BPMN). This fact creates a direct link with [4]: it is acknowledged that there is some need to share information and several problems can arise when trying to share that information. Understanding and enabling business processes is critical to providing relevant, timely and accurate information to individuals [18].

The inputs that are necessary for a task and the state change that triggers the task are not necessarily communicated in a single message. Often it will be possible to transmit the inputs well before the state changes, so that the inputs are already available when the task executor gets another message that signals the state change. In other cases making an input available is supposed to signal a state change itself. As an example, let us consider the product engineering process. If the engineers have updated the engineering BOM (Bill of Materials) they may publish this BOM to a shared storage space. If the task of creating a manufacturing BOM should actually be triggered by the fact that a new engineering BOM was created, the manufacturing company should be subscribed with the shared storage space to be informed whenever a new engineering BOM has arrived, or the engineering company would have to send directly a message to the manufacturer that a new BOM was uploaded. That is, a message should be sent to signal the state change, while the inputs are available in the shared storage space.

The problem is thus that a party that is involved in initiating a task that is to be executed by another party has to know what inputs he has to make available and/or what state changes he has to mention to the task executor. The other way around, a party that is sending messages may not be aware of the fact that these messages actually are involved in the initiation of a task execution.

Relationship To The Challenge

The execution of tasks can only be controlled if it is known what state information and what inputs are needed to start the task execution.

Relevance

If a transmission from some party triggers the execution of a task by another party, but the transmitting party is not aware of this, he may not execute the transmission suitably. That is, his transmission may not be in line with the process requirements.

If the task executor does not enable the other party to initiate the execution, or this other party is not aware of how he could do so, this other party cannot control the execution of the task.

The importance of triggering task executions by informing a partner about some event that happened is clear if one considers the growing importance of SCEM (Supply Chain Event Management). Nowadays companies want to be informed fast about changes in the state of the Extended Enterprise in order to be able to quickly seize opportunities and to swiftly react to threats. Two basic aspects of SCEM are just monitoring and notification [1]. If one partner monitors the tasks he executes and immediately notifies his partners about relevant events, the partner can react to those events. It has, of course, to be stipulated what are ‘relevant events’. What is relevant to one company is not necessarily relevant to another company. That is, not every company can give a valuable response to each event. In an Extended Enterprise partners can monitor events that are of particular interest to each other (and not to others).

Of course, informing a partner about an event that has occurred can only trigger the execution of a task by that partner if that partner is already in an appropriate state for the rest. Maybe the partner still has some preconditions to fulfil himself before the task can be executed, and the partner will then be self-triggering the task execution.

Illustration

A new Shipper may not be aware of the fact that he triggers the ‘present invoice’ activity of the Factoring company when he sends a delivery confirmation to the Factoring company. Therefore, the way the Shipper deals with this message transmission may be inappropriate. He might for example only send confirmations once a month instead of several times a day.

In our example the shipment may be initiated on the basis of the manufacturing planning (i.e., the internal clock of the Shipper triggers the shipment task). It could be, however, that a new Shipper only uses that information to make a provisional shipment planning and that he waits to send out trucks until he gets the notification that the system is in the state ‘computer manufactured successfully and waiting for transportation’ (i.e., the Manufacturer triggers the execution). In this case the Manufacturer would have to inform the Shipper explicitly about this task completion event in order to initiate the shipment task. This requires the Manufacturer to enable his systems (be it computers or humans) to monitor the production and to transmit information on the completion event, and it requires the Shipper to enable his ‘systems’ to receive and process such information and to let such receipt trigger the shipment-activity (e.g., by sending a message to the GPS-system in the truck of the driver who is closest to the Manufacturer).

Problem 4: Different Parties May Have To Make Investments

To realize processes investments are needed at two levels: both tasks and process control need to be implemented.

Problem Description

Partners have to agree on the tasks they should be able to perform and on the service levels they may expect from each other (see later). These requirements all come at some price and it has to be determined who will pick up the check for these investments, and how the benefits will be distributed.

Also, to control the entire end-to-end process investments have to be made so that the necessary task executions can be triggered and followed up.

Relationship To The Challenge

Some tasks may not yet ‘exist’, or may not yet exist in an appropriate quality or form. Investments are thus needed to align the different tasks in the process so as to realize the foreseen end-to-end process with the desired service levels. Some partners may

have to make investments to make it possible for another ‘controlling’ party to trigger a task execution, or to make it possible for themselves to control another’s task execution.

Relevance

If the process only requires standard tasks to be executed the parties do not have to make process-specific investments. This implies that a party performing a task can easily be replaced by another party that performs the same standard task and that few investments are lost (or need to be made) if some executor is replaced by another one.

In the Extended Enterprise partner-specific investments may be made. If a party makes an investment in tailoring some task this investment may become obsolete or even inconvenient if the company has to or wants to leave the Extended Enterprise. Extended Enterprise specific investments create a lock-in.

Subramani [15] states that the benefits from B2Bi efforts (studied in a buyer-supplier context) often only go to one (strong) party, but that in case of relationship-specific investments that create a means of differentiating from other networks all parties are likely to retain some of the benefits.

Illustration

A small Shipper may not offer functionality to customers to trace their packages. The partners in the Extended Enterprise may request him to build such a tracing functionality by investing in RFID technology in its different warehouses. The Manufacturer may also have to invest in the RFID technology so as to put tags on the different products. All parties, the end-customer, the Reseller, the Seller, the Shipper himself, and the Factoring company may be interested to know where the computer is at some moment and to act upon this information.

The event ‘computer is delivered’ enables the Factoring company’s task to collect the money. In fact, this event has to trigger the execution of the task. If the Manufacturer is the process owner it may be up to him to trigger that task execution. He would then have to follow up the task of the Shipper (passively by waiting for a notification or actively by polling) and ask the Factoring company to collect the money. Alternatively it is possible that the Shipper himself has to take care of triggering the task execution of the Factoring company. That is, the Shipper directly has to inform the Factoring company that the delivery has happened. In that case, the Manufacturer does not have to make investments to trigger the Factoring company’s task execution. Yet another solution is that the Manufacturer sends the Factoring company a message with the planned delivery data when he receives an order and that it is agreed that the Factoring company can collect the money on the date stipulated in that message unless he gets an ‘inhibiting message’ from the Manufacturer or the Shipper. The execution of the Factoring company’s task is then not tied to the execution of the Shipper’s task but to the planning of that task, which results in other investments to be made.

Problem 5: The Parties Are Dependent Upon The Service Levels Provided By The Different Systems

The value of executing a specific task depends on the value that is realised by the entire process. In general, business processes can only be valuable if they are executed with appropriate service levels. The partners thus have to agree on what are the required service levels for the process, and for the individual tasks being part of it.

Problem Description

The service levels that should be and that can be provided by some task are increasingly dependent upon the service levels provided by other tasks. Problems with service levels of one task may, therefore, escalate.

Furthermore, the task triggering can only happen if the triggering and the executing systems are both operational.

Relationship To The Challenge

It is acknowledged that a process can only be brought to a favourable conclusion if all the tasks in the process are executed appropriately (and thus if all tasks can be initiated in time).

Relevance

As tasks become more interwoven there are more relationships between tasks. The value of a task that is executed before another task is dependent upon the service levels provided by the succeeding task. Even the most excellent task executions may become useless if other tasks are not executed decently (e.g., in time), so that compensating tasks may be needed.

Also, the other way around, a task that is executed after another task is dependent upon the service levels provided by the preceding task. End-to-end process service levels can only be achieved if individual components provide sufficient service levels. If a preceding task is executed fast a succeeding task has additional time to execute; if the preceding task is executed too slowly a succeeding task has to be executed faster, or may not even need to be executed at all. Clearly, in the real-time enterprise real-time coarse-grained services can only be delivered if the fine-grained services can be delivered in real-time.

In Market B2Bi (as defined in [5]) dependencies will be relatively low because one party can easily be replaced by another one. In Extended Enterprise integration (as defined in [14]) companies consciously become more dependent upon each other: only this specific party is to execute some part of the process, and if he fails to do so in time there is no possibility to take recourse to another service provider (e.g., in another instance of the process execution).

Illustration

If the systems of the Shipper go down, no shipment can be requested. Also, if those systems are down, the signal from the RFID tag that tells the company the computer is delivered may not get through, and the Factoring company may not be informed about the fact that the delivery has happened.

A small problem may escalate. As an example, let us consider the situation where the Shipper is only allowed to deliver after payment. If an employee of the Factoring company postpones entering some settlement in the system (i.e., the Factoring company fails to do its job with appropriate service levels), the Shipper cannot fulfill its task either. The fact that the customer doesn’t get his goods (or has to wait a prolonged time for the goods) even though he has prepaid the delivery – something he does not like to do anyway (!) – may cause him to switch suppliers.

Problem 6: Partners Must Preserve The Value Of The Functional Proposition Of The Process In Order To Preserve Trust

A process has some value because of its functional proposition (i.e., the functions it promises to execute). Companies are dependent upon each other for maintaining that functional proposition valuable.

Problem Description

According to Smith and Fingar [14, p4] “processes are the main intellectual property and competitive differentiator manifest in all business activity.” The value of a functional proposition is directly related to the uniqueness of the proposition. Therefore, partners should not bring the process design into the open.

Furthermore, a process may be valuable for it has some unique tasks in it. Partners trust the providers of these unique tasks not to offer this task execution to others (i.e., not to include this task execution in the functional proposition of a competing Extended Enterprise), as this would lower the value of their process’s functional proposition.

Partners that make process specific investments count on it that their task will be executed during the execution of some process. If their task is eventually, however, omitted from the functional proposition or the process is dropped all together this harms their believe that future investments will pay off.

The other way around, partners trust each other to be really able to execute the tasks they promise to execute. If an initiating party has sent the necessary initiating messages, it should be able to trust the other party that the task is truly executed. The party is trusted to realise the promised outcome, and therefore to try to retain specialized people that manually execute a part of the process for example. Furthermore, the party is trusted not to execute any other, hidden tasks that lower the value of the process (e.g., call the customer of the partner to ask for information which is not strictly necessary for the task at hand).

Relationship to the challenge

Partners should only do the effort to align the tasks of some process if they can trust their partners.

Relevance

This is very much a problem that is confined to the realm of Extended Enterprise integration. In Market B2Bi companies offer their services apart from a specific process in which they should be included. There is no need to preserve some process’s functional value as there is no specific process for which the service was developed.

In Extended Enterprise integration the services that are offered are expected to be part of a specified Extended Enterprise process. Harming the functional proposition of this process jeopardizes the value of the task the party implemented. This can be expected to harm trust, to reduce the willingness to make new investments, to reduce creative impulses, etc.

Illustration

If a Manufacturer produced a screen and a computer that were ordered, but the Shipper does not pack the screen decently and it gets damaged during transport, the Resellers’ orders are not fulfilled (although the Manufacturer did his job). Similarly, if the Factoring company uses wrong tax rates in its calculations, problems arise. That is, the value of the promise to deliver some functionality is damaged because one of the parties is actually not capable of executing the task it said it would execute.

Problem 7: Process Ownership May Not Be Well Arranged

If the process is to be managed end-to-end a process owner has to be designated.

Problem Description

There may be several parties or (more probably) no party designated as end-to-end process owner.

The process owner has an end-to-end accountability for the process [7]. He is responsible for reengineering the process [8]. He decides what partners to involve in the business redesign and how far the process integration should go [2]. He must ensure that the process is understood by the people who execute it, and that they possess the required tools for execution and that they follow the specified design [9]. If there is no clarity about who is the process owner no party can be pointed out to take these tasks on him.

Relationship To The Challenge

Who has the responsibility to determine what is an appropriate execution of the process, and to make sure the process is executed appropriately? Who decides who can execute a subprocess (or task) and who can initiate that execution, who has to monitor the process, etcetera? Who decides how different tasks are brought together to form an end-to-end process?

Relevance

In an Extended Enterprise processes are supposed to be more actively managed, redesigned and optimized than in Market B2Bi. This naturally requires clear process ownership. If there is no clear owner, it is not clear who is accountable for the process or where to go with suggestions with respect to process improvements. Also, parties may not be well-informed about their role in the process and they may feel like there is no party that is appointed to rap them on the knuckles if they perform badly.

In [12, p1] it is stated that several research areas (such as Supply Chain Management) assume that the responsibility for process management and process design rests in the hands of one powerful party, but that in many inter-organizational settings there is often no (explicit or implicit) agreement of process ownership. Still, unambiguousness in process ownership seems to be one of the critical success factors of combining IT support and business process redesign [6].

It is not only considered to be important to know who is the process owner, but also to know who the others think the process owner is. The customers may perceive the party that is closest to them as the party that is responsible for the process, while this party actually does not own the process.

Illustration

If the goods arrive too late at the Reseller’s store, how will this be dealt with? Should the Reseller suggest to replace the Shipper or is this the task of the Manufacturer? Or should the Shipper not be replaced, but the process be redesigned? Who is allowed to

make changes to the process? Can the Factoring company require the Reseller to pay before delivery, or can this only be decided through the agency of the Manufacturer?

While the Manufacturer (the big company in the value web) is likely to be the process owner of the process in Figure 1, the end-customers may assume the Reseller is responsible for the process: he is responsible for choosing his partners. The process owner can then ask the assistance of the Reseller in redesigning the process. If the Manufacturer wants to know what requirements the end-customers have with respect to the process, he will probably have to talk with the Resellers about this. For a similar real-life example of a problem with process ownership (at AT&T), see [11].

Problem 8: The Involved Parties May Change Over Time

Problem Description

The partners may change over time so that the parties that are designated to provide some service differ, and/or the parties that may request the execution of some service differ.

Former task initiators should then no longer be able to initiate tasks, nor should they get feedback about task executions. Former task executors should no longer be requested to execute the task, nor should their output be considered. New task executors and/or initiators should be brought into the process (resulting in a re-appearance of the problems mentioned in the other sections of this paper).

Relationship To The Challenge

The parties that control the process may 'disappear' and new parties may enter the network that need to control the process. New parties can be added that execute tasks which need to be controlled too. Their tasks have to be brought in line with the rest of the process (or the rest of the process has to be aligned with their tasks).

Relevance

Flexibility is nowadays often mentioned as an important requirement upon companies. One way to achieve flexibility is to make it easy to remove and add parties in the process so that companies can swiftly deal with problems and take advantage of opportunities that show up. This is something that is not likely to happen often in Extended Enterprises. Still, this does not mean that partners never will be dropped or added.

Illustration

The party that ships the products may change. The Manufacturer's system then has to be informed about who is allowed to do the shipping now. It also needs to know how the new Shipper works: is he continuously re-planning the transportation schedule or only making a planning once a day. On the one hand, he can use this knowledge to determine whether it makes sense to ask for new shipments (and to expect a reply with 'expected delivery time') from the moment the computer production is finished, or whether it only makes sense to do so once a day. On the other hand, the new Shipper may be required to change the way he executes the task (e.g., to set up a continuous re-planning system by having the re-planning task triggered by the Manufacturer's message) so as to align his task with the remainder of the process.

The Reseller may need to agree that this new Shipper will do the shipping. After all, the customer may perceive the Reseller as the 'responsible party' for the entire process, and the Reseller then has to make sure that the Shipper can provide the desired service levels at reasonable prices.

For the part of the new Shipper: he has to find out whether he is expected to transport the goods as fast as possible when the computer is produced, or as fast as possible when an entire pallet of computers is ready, or when this could happen at the lowest cost, or only when he got a message that the payment of the customer was successful, etc.

CONCLUSIONS

In this paper, we have presented eight problems that show up when companies pursue inter-organizational process integration. (1) If we look at the building blocks of the process, the tasks, we notice that these blocks have to be arranged: the tasks should be executed in some order. The different partners may, however, have different requirements with respect to the order. (2) While trying to find an appropriate arrangement of the building blocks, the companies may note that they have a different understanding of what the blocks at hand actually are. That is, the outcome they expect from some task execution may be different. Moreover, the outcome they expect from the entire process execution may be different too. (3) Once it is known what tasks need to be executed and in what order they will be executed, it has to be decided how the task executions can be triggered. (4) To realize the processes investments are needed. Partners have to agree on who will bear the costs and who will do the effort. (5) The partners have to agree on what are the required service levels for the process, and for the individual tasks being part of it. At runtime, the service levels that are needed from one task depend on the service levels that are actually provided by other tasks. (6) On itself, an individual task is often worthless. It is in combination with a number of other tasks that the function provided by one task becomes useful. The value of executing a single task depends on the value of the functionality of the entire Extended Enterprise process. In an Extended Enterprise partners should preserve the value of the functional proposition of the process in order to preserve trust. (7) Inter-organizational process ownership has to be arranged. (8) The partners may change over time so that the parties that are designated to provide some service differ, and/or the parties that may want the execution of some service differ. Importantly, these eight problems show up in a different way in different process configurations. Knowledge about the way process configurations suffer from these problems can be used as a basis for assessing which inter-organizational integration solution is best in some specific situation. Indeed, many different inter-organizational integration solutions exist. In [3], we have presented the Business-to-Business integration solution space, which comprises several (de)centralization dimensions. When considering process integration, it is for example important to assess whether there is one central party that is controlling the process execution or whether the inter-organizational process execution control is more or less decentralized.

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U-ATM: AN AUTONOMOUS TRUST MODEL FOR EXPLORING UBIQUITOUS COLLECTIVE WISDOM

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ABSTRACT

Ubiquitous e-service is one of the most recent links in the chain of evolution that has characterized the different eras of the internetworking environment. In order to leap the trust barrier for the user to embracing these ubiquitous e-services, we propose an Autonomous Trust Model for exploring collective wisdom in the ubiquitous environment (hereafter termed "U-ATM") as an instance of ASEM. ASEM (Ambient e-Service Embracing Model) addresses the core elements (of relevance to the integrated concern of trust, reputation and privacy) required for assuring such desired features as convenience, safety, fairness and collaboration for mobile users when they engage with ambient e-services. The U-ATM highlights the distributed peer-to-peer interactions under an ad-hoc network composition. It especially accommodates the dynamic short-lived identity characteristics and lightweight computational capacity of mobile devices. The U-ATM we have developed is based on the ZigBee architecture as a collaborative application in the upper layer of the ubiquitous environment. U-ATM design concepts are elaborated and evaluated. A simulation is conducted. Simulation outcomes for trust decision quality enhancement show significant improvement over traditional designs. U-ATM makes it possible for users to collaborate with the nearby user groups for establishing a reliable and trustworthy interaction environment. It also facilitates and empowers the potential benefits of various ubiquitous e-service applications.

Keywords: Ubiquitous e-service, Trust, Proximal Collective Wisdom, Ad-Hoc Ubiquitous Environment.

CHALLENGES FOR UBIQUITOUS E-SERVICE

The ongoing, rapid developments in information systems technologies and networking have generated significant opportunities for streamlining decision-making processes and maximizing productivity through distributed collaborations. Emerging collaborative environments need to provide efficient support for seamless integration of heterogeneous technologies such as mobile devices and infrastructures, web services, grid computing systems, various operating environments, and diverse products. Unfortunately, such a rapid technological evolution cannot be problem free. Concerns are raised regarding the 'lack of trust' in ubiquitous e-service environment and significant security and privacy challenges for distributed collaborative applications. In such a loosely-coupled open computing system, trust management has become essential, together with traditional cryptography techniques, for building a healthy collaboration among participating peers (or agents). Hence, ensuring trust in an ubiquitous environment is one of the most important tasks of the new networking paradigm. Recent work suggests that reputation based trust systems as an effective way for nodes to identify and avoid malicious nodes in order to minimize the threat and protect the system from possible misuses and abuses by malicious nodes in a decentralized overlay networks. Such systems typically assign each node a trust value based on the transactions it has performed with others and the feedbacks it has received.

However, the ubiquitous environment is different from a traditional static environment. It presents significant challenges for users in determining which users are trustworthy. The notion of ambient e-services is proposed to identify a new scope of ubiquitous e-service, which addresses dynamic collective efforts between mobile users (enabled by Mobile-P2P technology), dynamic interactions with ambient environments (envisioned by Location-Based Services), moment of value, and low cost service provision. Since the ubiquitous identities are not designed for long-term lived and historical information is also seldom available in the ad-hoc e-service environment, previous solutions may not be applied to the ubiquitous environment. Environmental constraints and computational limitations make it more difficult to execute the process for determining which users are worthy of trust. There is no centralized or trusted 3rd party/agency to manage that task, and guarantee the trustworthiness of each identity. These new challenges complicate trust determination.

Since the ubiquitous e-service is highly correlated to user's current position, if the invasion of privacy is considered risky by users, users may resist the potential benefits of e-service. Since identities are short-lived, historical records may not available. Therefore, in an ad-hoc e-service environment that changes identity rapidly, there little information available for others to determine whether users should be trusted. Without a trustworthy mechanism that can support user privacy protection and maintain transaction security, e-services may not attract enough participants to encourage e-services providers to enhance their service quality. By the same token, once the user perceives they are well protected from possible fraud or malicious transactions, the benefits of various e-service applications will increase significantly.

To solve the problem of creating trust in the ubiquitous environment, we propose an collaborative trust e-service for exploring the collective wisdom in the ubiquitous environment, called "U-ATM". The U-ATM e-service is an ambient e-service application that may obtain value-added information through the interactions of surrounding environments and/or users. The U-ATM e-service allows users to choose and cooperate with trustworthy partners for executing transactions in the risky ubiquitous environment. The U-ATM design integrates the concept of privacy protection, reputation management, and trust estimation in the ad-hoc ubiquitous environment. It is proposed to provide a feasible solution for quality decisions in the dynamic and

distributed environment in which identities are short-lived and the computational abilities of mobile devices are limited. The U-ATM e-Service highlights the collective effort focused on collecting the user group's power as the reference for ubiquitous trust decisions.

THE COLLABORATIVE STRENGTH OF U-ATM E-SERVICE

Unlike the client/server commercial environment in which centralized databases or 3rd parties manage all trust related information, the only available information sources are from users themselves and the people around them. The major benefit of ambient e-Service was based on the collective effort, by combining everybody's strength to build up a trustworthy environment that respects security, privacy and encourages the convenience of exerting mobile peers' e-service in the vicinity. Since there is no authorized information sources in the ad-hoc ubiquitous e-service environment that guarantee which identity is trustworthy, the decision must rely on the users themselves. The U-ATM e-service highlights the collaborative power to eliminate potential risks and provide appropriate estimation for trust decisions. Various kinds of available information may increase the heterogeneity and raise the system loading especially for mobile devices with a limited computational capacity. Increasing information heterogeneity implies complex computation, but it also creates significant collaborative power. According to Govier, social trust is not blind, but derives from personal or interpersonal experience, and those experiences are gathered from the informal groups that constitute our daily life. Users may retrieve various experiences as the decision resource, but how are those experiences obtained from the ubiquitous e-service environment?

Exploring Proximal Intelligence: Experience Co-Creation

Experience co-creation occurs when users perceive powerful events from interaction experiences with other users. Reputation estimation is performed by aggregating these perceived experiences. For most commercial scenarios, reputation data is defined as transaction-based experiences. That is, when a transaction process is executed, reputation data will be established and recorded. Whether the transaction process is completed or abandoned, a reputation record from the transaction will still be generated (abandoned transactions usually have a negative effect on reputation). If reputation data is accessible, others may also take reputation data into their decision considerations. Experience co-creation in the U-ATM e-service highlights the co-creation process and the shared experience of collective effort, which provides meaningful information for collaborative interactions.

In an unknown environment, users may not be familiar with the other people around them. They may not understand who is reliable or trustworthy. There is seldom information available for trust decision in an ad-hoc ubiquitous environment. The U-ATM e-service extends the information sources from traditional commerce scenarios that consider the transaction-based experience only. Instead, interaction-based experiences are also considered as another heterogeneous data source.

Researchers have defined trust as an expectation. The expectations and determinations for trust are all related to the concepts of competence, benevolence and responsibility. Those are the major factors for satisfying the "Cognitive-based trust" and the "Affective-based trust" in interpersonal trust. When applying emotional measurement factors to judge provided services, interaction-based experiences are desirable information sources for trust estimation -- the judgment of whether the service provider has the ability to give the needed service. Does the buyer can comprehend whether the service provider really cares for their needs in providing the service? More importantly, do the provided services actually fulfill the buyer's urgent needs for all requirements? The interaction-based trust is unfolded into those three the concepts as an alternative information sources. In addition to personal experience, available information sources also include the interpersonal experiences from one's social network. Heterogeneous interaction-based trust estimations are collected from the proximal user groups which represent experience co-creation process for contributing the collaborative trust decisions.

Collaborative Trust Estimation

In order to deal with the changes originating from the ad-hoc ubiquitous e-service environment, the solution must explore other possible data sources in addition to the transaction-based information, and seek out alternative evidences for trust estimation. However, experience data obtained from the surrounding environment or evidence chains over the social network may entail risks. If the obtained information cannot provide enough reliable evidence for better trust estimation results, then the tradeoff between data usability and efficiency should be taken into consideration. Since all of the available trust experience and other heterogeneous information sources should be taken into account for trust estimation, the limitations of mobile devices make the selection for comparative valuable information sources an important issue. Users have to decide the level of risk they are willing to endure from weighted heterogeneous data sources.

In U-ATM e-Service, a creditability investigation module is designed for experience sharing collaboration. Detailed descriptions of U-ATM components are illustrated in the Section 3.2. After the creditability investigation process is completed, users may have possession of three types of information sources for trust estimation. Including:

- Personal interaction-based experience from self-owned interaction pseudonyms. (Personal Local Trust, PLT)
- Interpersonal interaction-based experience from creditability investigation. (Nearby Peer's Local Trust, NLT)
- Transaction-based global reputation for specific target peer. (Global Reputation, GR)

The interaction-based experience estimation involves two dimensions. The first requires determination of the trustworthiness from the interactions by demander (customer) to justify whether the provided service satisfies their expectation. The second is responding to the creditability investigation by consolidation of the available personal experience as a trust evaluation value and send back to the investigation demander.

The determination of how a peer can recognize whether the various received service package information will satisfy user expectation will involve the cognitive-decision for each communication message. In order to facilitate mutual understanding for each peer, an ontology is essential for effective communication. In our study, the ontology-based search has great potential to

facilitate the interaction parties matching their desired resources and comparing the received service package information in order to determine the candidate service provider. The fitness will be matched by comparing the demanded task and supplied services. Utilizing an ontology-based search for task matching can understand how the service provider understands the customer's needs and determines which service packages are the best candidates with highest fitness.

Users may have various needs and reliability concerns for different information sources, these heterogeneous sources may be applied with different importance for the user's final decision. The balance between heterogeneous information sources can be adjusted in the U-ATM Profile Management module. The following three weighted parameters are used for the sake of aggregating heterogeneous information sources as the final score for trust candidate decision. W_{PLT} represents the weight of personal interaction-based experience from self-owned interaction pseudonyms. W_{NLT} represents the weight of interpersonal interaction-based experience from creditability investigation. W_{GR} represents the weight of transaction-based global reputation. The final score computation for trust candidate selection is shown as formula (1).

$$Trust_{FinalScore} = \frac{W_{PLT} \cdot PLT + W_{NLT} \cdot NLT + W_{GR} \cdot GR}{W_{PLT} + W_{NLT} + W_{GR}} \quad (1)$$

The final score for trust candidate selection represents the aggregate results from obtained heterogeneous data sources. A higher score means the information source is more trustworthy. A risk parameter β is also set up by the user in the User Profile as the trustworthiness threshold. Once the $Trust_{FinalScore}$ is lower than β , the corresponding interaction pseudonym is removed from the transaction candidate list. The best candidate will be the first priority for further service exchanges.

U-ATM E-SERVICE DESIGN

We have identified the major challenges in an ubiquitous environment and the urgent needs for collaborative U-ATM e-service. We use an U-ATM platform that considers privacy design, reputation management, and trust management as the central concepts for establishing an autonomous trust model for exploring the collective effort in the ubiquitous environment. Different from traditional architecture, the U-ATM e-service highlights distributed peer-to-peer interaction under ad-hoc network composition, and accommodates the dynamic short-lived identity characteristics and the limited computational capacities of mobile device. Also, the U-ATM e-service provides seamless unlinkability to ensure user protection and adopts heterogeneous data sources to enhance quality for trust collaboration. Classical method designs may be used for partial solutions to the problem, but require heavy computations that are difficult to carry out in a mobile device. But most previous designs cannot be applied to our problem as their architecture is not suited to an ad-hoc ubiquitous environment and their design concepts do not address the challenges of the ubiquitous environment.

U-ATM Privacy and Security Design

The U-ATM privacy design concept is based on multiple layered pseudonyms to ensure identity security and unlinkability. The U-ATM privacy design excludes a unique personal pseudonym for interactions to protect users from possible tracking and profiling. It uses multiple interaction pseudonyms to enhance the complexity of identity tracing. By abstract the design of role/relationship pseudonyms for service version selection and delivery. (i.e. Versioning the services by specific types for performance consideration.) For transaction security, U-ATM design uses a transaction pseudonym to ensure safety for a onetime payment.

Before any interactions can be executed, peers require an identity for the service environment. We use the Interaction Pseudonym as an agent identity for the user. It should be noted that a user may possess several different agents for various e-services. An agent's identity is produced according to the service. A user can activate an agent identity or discard a specific identity based on their needs. Even if the user has many agent identities, all identities still share the same global reputation data. When an identity is created, it inherits the concurrent reputation from user's global reputation data. The reputation data for each identity does not exist separately. No matter how many identities belong to the user, he can keep only one global reputation. The diagram (Figure 1A) represents the general design concepts and the relationships of three kinds of pseudonyms. Only the Interaction Pseudonyms appear in the interaction environment. Interaction pseudonyms are generating through the same Active Pseudonym but without any linkage relationship. Interaction pseudonyms are cost-free (i.e. cheap pseudonyms); user can generate/discard them freely. However, user cannot change their active pseudonym without cost. Detailed security design and evaluations can be found in [2].

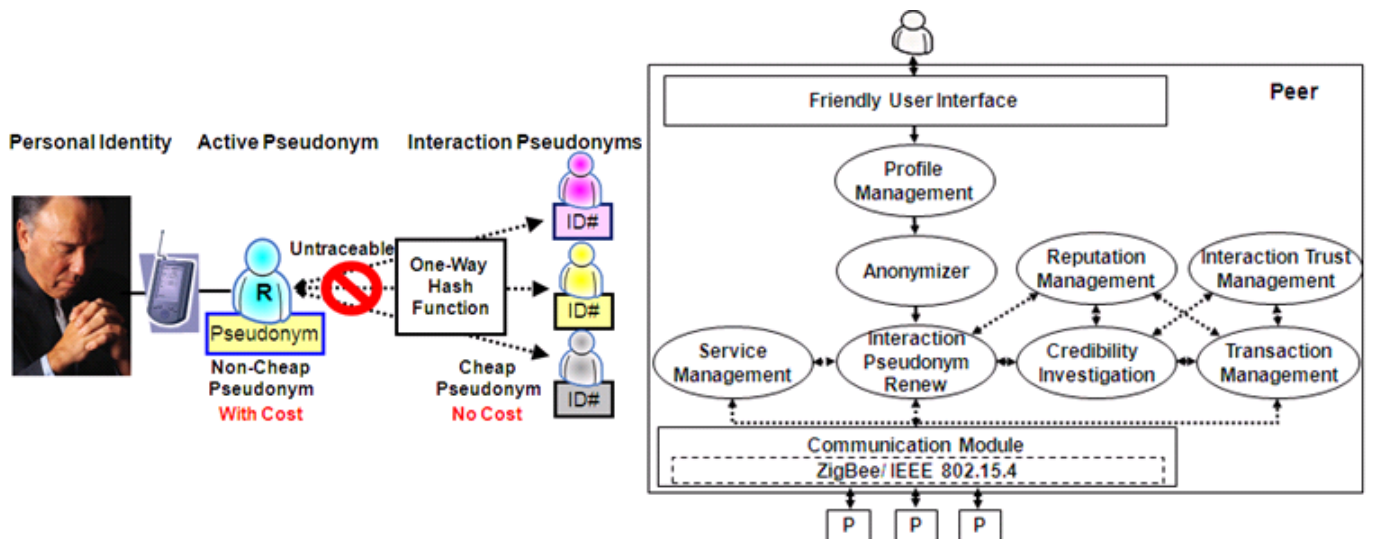


FIGURE 1. (A) General idea and relationships between the pseudonyms (B) Macro view of the Collaborative U-ATM platform

U-ATM Platform Design

The U-ATM e-service platform as well as its function modules are depicted in Figure 1B. Including:

Profile Management

In the U-ATM e-service platform, mobile users can manage their profile settings through a friendly user interface. The profiles include their preferences and the roles they would like to play, and various attributes such as user's willingness to participate, the will to disclose their interaction experiences, the risk level they can tolerate, and the reliability threshold for determining whether to interact with nearby peers. Once an identity has been generated, those settings will be assigned to the interaction pseudonym automatically.

Anonymizer

In the U-ATM e-service platform, all interactions within the ubiquitous e-service environment are using the "Interaction Pseudonyms" instead of user's real identity or personal pseudonyms. The main function for the Anonymizer is to generate diverse occasional interaction pseudonyms based on their given identity for various kinds of e-services. Those interaction pseudonyms are valid for a short period, and are localized to the corresponding e-service acquired. Because the randomized interaction pseudonyms are not linked to real personal identities and are valid for a limited range, others will be unable to trace their real owner via the interaction pseudonyms. Those interaction pseudonyms are generated by the Anonymizer and will inherit the attribute parameters automatically through the Profile management module. They are able to execute the versioning process and cope with the service management module to reduce irrelevant transmission and improve the efficiency of interaction.

Interaction Pseudonym Renew

As mentioned in previous sections, U-ATM e-service has overcome the problem of the dynamic composition of surrounding peers that may change rapidly. The Interaction Pseudonym Renew module is used to update the list of current nearby users, which exhibits all available nearby peer interaction pseudonyms. Users can interact with peers around themselves through the Communication module. The Interaction Pseudonym Renew module is connected with the Reputation Management module, which may immediately update the global reputation of peers so that all devices in range may access it. Each exchange and transmission within the Service Management module, as well as information inquiry when performing credibility investigation, is targeted to those identities obtained by Interaction Pseudonym Renew module.

Service Management

Service management in the U-ATM e-service platform includes two major interactive function modules: the "Acquire sub-module" that acquires service and forwards peer requests to nearby peers within the e-service environment; and the "Acknowledge sub-module" that responds to or acknowledges the service request received from surrounding peers. Both of the sub-modules are equipped with a matching function that facilitates the assessment for service information exchange. The Acquire sub-module gathers all the responses provided by nearby peers who receive a user's request. Those responses include service package information offered by nearby service providers. For further interaction or transaction decisions, the reputation data of those service providers are also attached to the service package information, shown as a received service list. The Acknowledge sub-module complements the Acquire sub-module. After receiving the requests forwarded by nearby users, service providers can take into account their own behavior style settings and determine appropriate responses. Service providers may decide to provide services identical to those of the request, or offer a substitute. After consulting the requester's public attributes, a suitable service package is created. The service package information attached with provider's reputation is delivered to the requesting peer through the Communication module. If the received services match the requesting peer's needs, the peer can decide follow-up interactions based on their perishability, or degree of urgency. In urgent situations, users may execute immediate transactions directly to those candidates, which will link to the Transaction module. Otherwise, they can obtain the trustworthy analysis result via the Credibility Investigation module for advanced decision-making.

Credibility Investigation

By comparison with current mobile e-services, there may be little available data for credibility and trust estimation of unfamiliar users due to the natural limitations of ad-hoc ubiquitous e-services. In the U-ATM e-service platform, the traditional transaction-based experience is considered for decision-making, along with the interaction-based experiences. For credibility investigation, there are two information sources available. The first source is similar to the current e-service's global reputation but without the linkage to the user's personal identity or detailed transaction histories. The second source is exploration of the collective effort of the social network and its most recent interaction experiences. Empowered by the characteristics of U-ATM e-service, investigated data are concurrently updated and highly related to their location at the moment. After consideration of the various heterogeneous data sources against the user risk tolerance setting in the Profile Management module, the Credibility Investigation module filters out credible candidates for further transaction management.

Transaction Management

After the user has determined the target peer for transaction, a transaction pseudonym is created automatically in the U-ATM e-service platform. This transaction pseudonym is put to use for the payment process, which is also unlinkable to the user's real identity. That is, the transaction pseudonym is only valid for the specific service transaction for that period of time. Next, the reputation management module is launched to update the global reputation's of both seller and buyer.

Reputation Management

Once the users have accomplished the transaction, a reputation evaluation token is exchanged. According to the feedback result recorded in the reputation evaluation token, the summarized global reputation data is updated automatically. The reputation evaluation tokens are blind-signed and enable unlinkability for keeping the reputation data from revealing the referee's true identity. This Reputation Management module not only acts as the information source for credibility investigation, but is also linked to the Interaction Pseudonym renew module for global reputation updates.

Interaction Trust Management

In contrast to the reputation management module that records the transaction histories, the interaction trust management module places emphasis on a user's direct interaction experience. It highlights the perceived value from the interaction's target peer and treats the interaction-based experience as another vital information source. In cooperation with the Credibility Investigation module, it provides heterogeneous information based on user experiences stored in the social network for trust estimation of unfamiliar users.

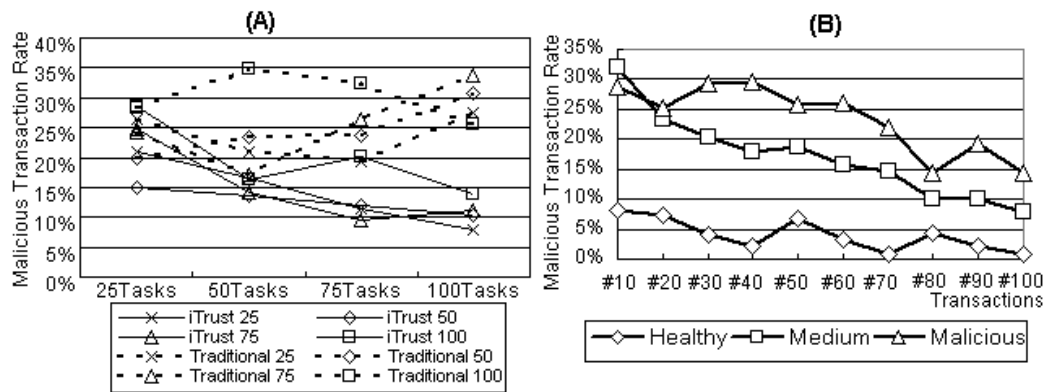
Communication Module

The ZigBee based communication module makes use of the security services that are already present in the 802.15.4 security specification. ZigBee infrastructure security includes network access control, integrity of packet routing, and prevention of unauthorized use of packet transport. ZigBee application data security includes message integrity, authentication, freshness, and privacy.

EFFECT OF COLLECTIVE WISDOM

In this simulation scenario, the goal is to verify whether the collective wisdom gathered from ubiquitous environment could improve the decision quality for estimating the trustworthiness of unfamiliar user. Two different reputation mechanisms are available for trust estimation: the traditional reputation mechanism allows users to estimate from the global reputation data and his/her owned personal transaction experience; the U-ATM e-service equipped with credibility investigation module that can explore the collective wisdom of the ubiquitous environment as well as the global reputation data, and the user's personal experience.

In the ubiquitous environment, user's perishability and their anxiety level may strongly affect their interaction behaviors. User behaviors can be distinguished from the two dimensions and sorted into 4 stereotypes. Perishability represents the level of urgency the user brings to completion of the task, the desire to obtain the service as soon as possible. With higher perishability, users prefer to consume their resources (eq. time and processing capability, etc.) in service discovery rather than comparing which user is more reliable. Instead, once the service provision is acceptable and the provider's reliability fulfills their basic trustworthiness threshold, a transaction begins. The anxiety level represents the user's mental perception of security protection and how they view the probability of privacy intrusions and security breaches. Users with lower anxiety levels may consider various received service information as an alternative choice even though the provided services may not be related to their request. By contrast, users with a high anxiety level are serious about whether the provider cares about their needs. Since accepting messages consumes a user's limited resources, spam messages or irrelevant service messages will be considered inimical actions.



**FIGURE 2. (A) Cheat Transaction Rate in U-ATM e-service and Traditional designs
(B) Cheat Transaction Rate in Healthy/Malicious environment**

The simulation experiment result is shown as the following diagrams: Figure 2A represents the transaction cheat rate in the U-ATM e-service and Traditional designs. Up to 100 transactions were executed by users with different group size. In testing the performance of collaborative trust, we have considered practical factors such as the population of malicious hosts and good hosts; the available peer numbers to simulate realistic conditions for real applications. For the overall performance, we can see that U-ATM improves the trust estimation of unfamiliar users and reduces the rate of transactions involving cheating to 15.83% in a risky environment that contains 50% cheaters, while Traditional designs can reduce the average cheat transaction rate to 25.92%. In the ubiquitous e-service environment it is lack of information available for users to estimate which user is trustworthy. This problem is more serious when a new market is opened since the global reputation of each identity is zero and may not satisfy the user's trustworthiness threshold. This will lead to a desolate e-service environment since users may be afraid to transact with unfamiliar users. As the number of transactions increases, more interaction experience is stored in the environment. At the beginning stage the average cheat rate of U-ATM is 22.28% while the Traditional is 24.68%. After 100 transactions, the average cheat rate of U-ATM falls to 10.79% while the Traditional remains high at 29.45%. We can see that the cheat transaction rate of U-ATM decreases significantly when the number of transactions increases. But the cheat rate of the traditional design still remains at the initial levels.

To evaluate the performance of U-ATM collective wisdom, different kinds of environments have been established which contains varied proportion of users. The healthy environment contains 80% honest users and 20% cheaters. On the contrary, the malicious environment contains 80% cheaters and 20% honest users. Figure 2B represents the power of collective wisdom in various environments. The experience co-creation approach could retrieve heterogeneous information sources to help users identify malicious node and prevent cheating. In the malicious environment, even in the initial stage, U-ATM reduces the rate of transactions involving cheating to 28.67% in an extremely risky environment that contains 80% cheaters. After 100 interactions, the malicious transaction rate could be decreased to a level below 15% for all kinds of environments. The simulation results clearly show that U-ATM e-service makes it possible for users to collaborate with the nearby user groups for establishing a reliable and trustworthy interaction environment. The U-ATM e-service realizes the collective wisdom and provides a feasible solution for quality decisions in the dynamic and distributed environment.

SIGNIFICANCE & CONTRIBUTION CONCLUSIONS

Trust has been considered as a top criterion for the acceptance of e-service adoption. This paper proposes a ubiquitous U-ATM platform that exerts the identity design to deliver the visions of collaborative trust e-service with an integrated consideration of trust, reputation and privacy requirements. Different from traditional architecture, the U-ATM highlights the distributed peer-to-peer interaction under ad-hoc network composition, especially to accommodate the dynamic short-lived identity characteristics and the lightweight computational capacities of mobile devices. We deploy our U-ATM based on the ZigBee architecture as an upper layered collaborative application in the ubiquitous environment. The U-ATM design concepts are elaborated and evaluated. U-ATM simulation outcomes for trust decision quality enhancement are significantly improved by comparison with traditional designs. The simulation experiments illustrate the benefits of exploring the collective wisdom and gathering the power of collaboration. Moreover, the U-ATM makes it possible to collaborate with nearby user groups for establishing reliable and trustworthy interaction environments. It also facilitates and empowers the potential benefits for various ubiquitous e-service applications. Possible future research includes field experiment for applying U-ATM in different business scenarios. Ubiquitous i-Network that enables users exploring the collective wisdom for rich collaboration rather than just information diffusion in proximity e-service environments is also worthy of further in-depth research.

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A PRELIMINARY INVESTIGATION INTO E-COMMERCE ADOPTION BY THE GROCERY INDUSTRY IN CHINA

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ABSTRACT

Electronic Commerce as a way of conducting business transactions electronically has shown great operational and strategic benefits. Developed countries have actively embraced the concept of e-Commerce and have made it an integral part of business activities. Despite its ability to bridge economic and digital gap between developing and developed countries, developing countries are still slow in e-Commerce adoption. Currently, there is still a lack of e-Commerce adoption research in developing countries to fully assess the relevance of e-Commerce in these unique environments. This study aims to shed light into the e-Commerce adoption process in China, by assessing the e-Commerce use by the grocery industry. The uniqueness of China in various aspects including cultural, economic and political, poses different challenges and requires different strategies to encourage widespread adoption of e-Commerce.

Keywords: electronic commerce, technology adoption, developing countries, grocery industry, China.

INTRODUCTION

Electronic Commerce (e-Commerce) is concerned with conducting business transactions including exchanging business information electronically using information and communication technologies [14]. E-commerce is not only limited to buying and selling over the Internet, but it is also concerned with transferring or exchanging products/services and/or information via computer networks, including the Internet, Extranet and Intranet [23]. It includes activities such as servicing customer online, collaborating with business partners and exchanging business documents within an organization over the Internet or other private networks. Because of its broad coverage, e-commerce is often referred to as e-business[10].

Electronic Commerce offers many potential benefits particularly in productivity gains and transaction cost reductions. The rapid dissemination of information, the substitution of digital for paper record keeping, and the networking capability of the Internet has improved flexibility and responsiveness, encouraged new and more efficient intermediaries, increased the use of outsourcing, expanded market access, reduced time to market by linking orders to production, and improved internal coordination [24].

Because of the potential of e-Commerce, it has been rapidly adopted in many countries, particularly developed countries, in this globalization era [2]. In US, for example, the e-Commerce sales consisting of both Business-to-Business (B2B) and Business-to-Consumer (B2C) were 1.679 trillion dollars in 2003 [26]. Overall, worldwide B2B e-Commerce was estimated to be around 7.29 trillion dollars in 2004. Future forecasts also look very promising as Forrester Research predicts that US B2C sales will grow to \$329 billion in 2010 [12].

However, all this proliferation is unilateral, mainly concentrated in developed countries. According to United Nations Conference on Trade and Development (UNCTAD), 95% of e-Commerce takes place in developed countries, with Africa and Latin America combined accounting for less than 1% of the total [28]. In 2004, only 3% of Africans had access to the Internet, in sharp contrast to 67% of North Americans. In 2003, United States and Canada combined had more computers than all of Asia. All these statistics demystify the divide which exists between these bipolar world of developed and developing nations.

E-Commerce has been considered as a way to bridge this economic and digital gap existing between the developed and developing countries. United Nations, World Trade Organization and other development agencies have championed the e-Commerce adoption to the extent that e-Commerce applications are being promoted as tools that will enable firms in developing countries to reduce their costs substantially and to access global markets. Moreover, e-Commerce use enables development in many aspects for organizations, industry and the nation, because it has the potential to improve competitiveness, productivity, and efficiency, leading to the improvement in the economy [27].

However, some observers are skeptical over the positive optimism surrounding the expectations from e-Commerce for developing countries [20]. Although referred to as a catalyst to bridge the economic disparities and digital gap between developed and developing countries, e-Commerce, in reality, has widened the gap as it has further marginalized the developing countries because they cannot implement and capitalize on e-Commerce technologies due to the different conditions between developed and developing countries [2].

At this stage, more research on the adoption of e-Commerce by developing countries is still required in order to better understand the relevance of e-Commerce for developing countries and to identify appropriate adoption strategies [4]. Such research is also important for developed countries to enable them to trade with developing countries more efficiently. Therefore, this study is designed to address the gap in the technology adoption literature by assessing the relevance of e-Commerce for People's Republic of China, or simply China, as an example of a developing country. This study aims to shed light into the e-Commerce adoption in China, by examining e-Commerce's use within the Chinese grocery industry, the driving forces and barriers to e-

Commerce adoption. A multiple case study involving various organizations within the Chinese grocery industry is used as the research method.

The study indicates that China, as the largest communist state and the most populous nation in the world, has proved itself to be an exceptional investment market and formidable competitor to the international investors with its exponential economic growth and development since the first economic reform in the early 1970s [29]. Its unique blend of open-market policy and state intervention in the nation's economic activities has perplexed many experienced foreign investors and caused some proven business practices ineffective. E-Commerce as one of the business phenomenon introduced with the opening of Chinese market is expected to have a diffusion pattern which is unique to China's business environment.

Serving a population of 1.3 billion's insatiable grocery demand and positioned at the forefront of international competition in the face of the most recent total liberalization of retail market, the Chinese grocery industry, especially the supermarket sector has many to reap from e-Commerce technologies. The Confucianism cultural heritage and collective nature of the society forged Chinese consumers' unique value system and behavior, which consequently given rise to an equally complex and distinctive grocery industry [1]. With its intensive labor requirement, high turnover, low margin and heavy competition, e-Commerce technologies stand to deliver the grocery industry significant benefits in terms of improved efficiency, effectiveness and profitability.

In the next section a literature review on the Chinese grocery industry is provided outlining its historical development, characteristics and major players, followed by an overview of the current e-Commerce technologies used in the industry. Then a discussion of the research method and preliminary findings are presented to provide an overview of e-Commerce adoption situation within the Chinese grocery industry. Finally, a number of implications of the findings are discussed to conclude the paper.

Chinese Grocery Industry

The Chinese grocery industry has evolved through time, developing numerous retail formats from wet markets, retail-cooperatives to the current dominating supermarkets in order to address the respective political, social and economic environments.

Table 1: The Evolution of Chinese Grocery Industry

Year	Format	Description
Before 1949	Wet markets, street markets, small shops	These were private retail sectors. Distribution system was virtually nonexistent. Grocery needs were fulfilled locally.
1953-1958	Retail co-operatives, State-owned enterprises (SOE)	China Communist Party (CCP) dictated a state controlled economy. Private retailers were either formed into retail co-operatives or bought out to establish SOEs to sell basic food at low prices.
1959-1980	State-owned enterprises (SOE)	CCP expanded the control on China's economic activities and extended SOE retail sector to urban areas
1981-1990	Wet markets, provisional shops, staple food stores, supermarkets (marginal-player)	Economic liberalization began. Wet markets and small shops which sell grocery items in the urban areas started to flourish again. In March 1981, the first supermarket in China was established in Guangzhou catering for foreign tourists.
1990s	Supermarkets, wet markets street markets, staple food stores	Supermarket format experienced an exponential growth in the large cities and special economic zones due to their consumers' high purchasing power.
Late 1990s – now	Supermarkets, wet markets, street markets	Supermarket started to move into other cities in the eastern region and extended into large cities in the central region.

Before the Chinese Communist Party (CCP) came to power (1949), China's retail sector was dominated by small shops and wet markets, which offered opportunities for retail-cooperatives and state-owned enterprises to dominate the market when the CCP became the ruling party. The distribution of groceries remained under the strict state control until the early 1980s' economic liberalization which allowed private ownership of retailing and wholesaling operations. The supermarket format was first introduced during this period, but its growth was hampered by a lack of appropriate suppliers and its high price [13]. However, the supermarket experienced an exponential growth during the 1990s to the 2000s. The arrival of western culture and growing consumer purchasing power has propelled supermarkets' popularity among the Chinese consumers. By 2004, the supermarket has grown into a US\$55 billion industry, consisting of estimated 53,000 units and occupying a share of 30% of urban food market [11] [13]. Table 1 summarizes the evolution of Chinese grocery industry.

Chinese Consumer Behavior

While the grocery industry is being shaped by cultural, political and economical forces through time, the Chinese consumers has also developed a set of unique behaviors which have fundamental impacts on the characteristics of China's supermarkets. Being raised in a collective society and inherited Confucius philosophy through history, current generation of Chinese consumers are extremely price conscious and tend to be very informed and disloyal shoppers. They are willing to search extensively for a better deal and consider it to be a leisure-activity [1]. Meanwhile, the vast geographical coverage and sophisticated local cultures also caused Chinese consumers to have significantly different sets of taste and value system across cities [21].

Table 2: Consumer behavior and its impact on China's supermarkets

Consumer Characteristics	Consumer Behavior	Supermarket Challenges	Supermarket Strategy
Price con-scious	Extensive product search	Under constant pressure to offer low price	Frequent sales and price wars among supermarkets
Disloyal	Shop from a number of supermarkets, based on price and product offerings.	Hard to maintain a stable customer base, under constant pressure to attract and retain customers.	Offer huge range of products from white goods to cosmetics.
View grocery shopping as leisure activity	Frequent, small shopping trips	Sales generating strategy fail to have spill-over effect on normally priced products	Extensive sales range, heavy advertising and frequent promotional activities
Local pre-ferences	Distinct product preferences in different regions.	Different inventory requirements in different regions, which makes it difficult to manage inventory centrally.	Inventory is managed on a store basis. Direct-store delivery and local sourcing are common practices.

In order to address the consumer behavior, China's supermarkets are under constant pressure to offer low prices as well as a wide range of products which support Chinese consumers' product search and comparison behavior. Sale generation strategies such as loss-leaders strategy, which is a common strategy adopted by the retailers, usually are unable to generate expected results due to Chinese consumers' preference for small frequent grocery shopping [8] [9]. In addition, the widely varying local taste made it impossible to centralize inventory management among chain stores and, as a result, local sourcing and direct-store delivery distribution strategy are common among China's supermarket chains. These Chinese consumer characteristics and behavior pose unique challenges to the supermarkets which require different strategies compared to supermarkets in developed countries, which are summarized in Table 2.

These unique market characteristics have caused unexpected problems among the first wave of foreign investors. After rushing into the Chinese market, foreign chains frequently fail to replicate their successes in the home countries [8] [9] [15].

Furthermore, Chinese consumers' obsession over price has made the competition within the supermarket sector especially furious. New entrants can easily attract a large number of customers from established chains by offering lower prices and it is a constant struggle to retain market share among the existing players. Continuous price and promotion wars are happening among the major chains, thinning their profits. The intrusion of foreign supermarket chains armed with modern management concepts and technologies further increased the intensity of the competition. To stay competitive, China has seen frequent consolidations of Chinese chains to form retail giants such as the Bailian group. Consequently, as Moustera (2001) estimates, an average of 350,000 small shops has to go out of business [19].

Major players and their operations

Over the past decades' development and competition, China's grocery industry has seen a significant shift of power in favor of the retailers [14]. The demolition of state controlled grocery distribution system has catalyzed the development in the retail sector with powerful players such as Lianhua, Suguo and Carrefour dominating the market, wielding enormous buying power.

Meanwhile, the former state-owned distribution system was left behind, exhibiting no significant growth over the past years. Coupled with the Chinese economy's transformation from sellers' market to buyers' market, retailers gained dominant position in the marketing channel [2, 14]. There are currently no major players in the distribution sector that can rival the power of retailer giants such as Carrefour or Bailian and the distribution sector of China's grocery industry remains extremely fragmented. These distributors remain small in size and usually specialize in a specific area and product category [2]. As a result, products that go through the conventional distribution channels typically have to be handled by various parties before reaching their destination.

The under development of the distribution sectors has imposed significant difficulty in inventory management for the supermarkets. Smaller supermarkets usually procure supplies directly from the wholesale market with limited direct-supply relationships for certain products [11]. Large chains, on the other hand, may use pick-and-pack (Suguo), direct-store delivery (Carrefour) or third-party logistic (Wal-Mart) system depending on their focus and size. Limited e-Commerce technologies such as B2B portals are used among these major chains to enable information exchange between the supply chain partners while the smaller chains still deploy manual procurement procedures.

Current Use of Information Technology

China is a late adopter of information technologies (IT) as most of the IT infrastructure was not deployed by the majority of Chinese firms until the late 1990s. Firms in the grocery industry have been introducing stand-alone computers to their stores and offices in the 1990s but the build-up of hardware and software for Enterprise Resource Planning (ERP) and other decision supporting functions only began two to three years ago [23]. Since the liberalization of Chinese economy, recently developed information technologies such as the Internet were quickly adopted by the grocery industry. Enterprise applications and other applications such as Electronic Data Interchange (EDI) were, however, left behind, leaving a large gap in firm's IT infrastructure, which result in low capability of many firms in facilitating electronic transactions [30].

The most commonly used technologies are Point-of-Sales (POS) system and bar-coding, which can be found in almost any supermarket. However, given the limited EDI and data analysis capabilities, the POS system is mainly used for checkout purposes only. The data collected through the system are rarely utilized for sale analysis or inventory management purposes [22]. With plenty of low cost labor working in the supermarket stores, it is apparent that computerized systems are not typically required for labor saving purposes. Sinclair et al. (1998) argue that many supermarkets in China installed computerized applications systems with an assumption that these applications' full potential benefits will eventually be realized.

Major supermarket players have taken the first step towards adopting e-Commerce technologies. In order to effectively coordinate a large number of suppliers, Business-to-Business (B2B) portals were established as a means to communicate with the suppliers electronically without worrying about the system compatibility as well as hardware and software investment at the suppliers' end. By logging into the retailers' B2B portals through the Internet, suppliers are able to obtain information about their products and hence make replenishment decisions accordingly. This approach has allowed the supermarkets to bypass the inadequate information technology infrastructure and realize some degree of VMI without significant investments.

Warehouse Management System (WMS) is another application that has been adopted by major chains to improve their operational efficiency. It is usually a standalone system that tracks and coordinates the inventory movement within the distribution centre by assisting warehouse staff to accurately store incoming inventory and prepare outgoing orders. All incoming stock is first entered into the WMS manually upon arrival to update the inventory record and generate a storage slip. It is then placed onto the inventory transportation terminal which automatically stores the inventory into the appropriate place in the warehouse. Upon receiving store orders, WMS generates an outgoing inventory slip to list stocks required and their locations in the warehouse to assist the manual pick-and-pack process. Although this system seems to be primitive based on the western standard, it is one major step forward for the Chinese supermarket chains to achieve automatic inventory control.

RESEARCH METHOD

To better understand the e-Commerce adoption by the Chinese grocery industry, this study involves a multiple case study of various organizations within the industry including manufacturers, distributors and retailers. Semi-structured interviews are used as the data collection technique to investigate the e-Commerce readiness, use and impact in the participating organizations. By interviewing all sectors of the grocery industry instead of the conventional retailer-focused approach adopted by most of e-Commerce surveys and studies conducted in China, the development of unbiased picture of grocery industry e-Commerce adoption is ensured.

At the time of writing, interviews have been conducted with three organizations of different size and type, each with different e-Commerce experiences and adoption level. Future interviews will be conducted during the next twelve months to complement the current study findings. Completed interviews were conducted with the senior managers of the organization with an estimated duration of thirty minutes to one hour depending on the organization's experience with e-Commerce technologies. The semi-structured nature of the interview allowed the interviewer to actively adapt the interview questions according to the interviewee's specific situation and responses while maintaining firm grip on the topics covered.

At the end of each interview, the information obtained was checked against the prepared questions to ensure that all questions had been answered. Interview data were tape-recorded and later transcribed as a written-up field note. Qualitative data analysis technique was used in data analysis to identify and categorize themes/concepts of interest through close examination of data in the written-up field notes. Cross case analyses were also conducted to compare the findings from different interviews. Through the cross case comparison, various emerging concepts were then refined.

The Participants

Table 3 summarizes the profile of the participating organizations in this study. Company A is a major manufacturer of instant noodles in China, with supermarkets as its major retail outlets. Employing around three hundred and fifty full-time employees, it is a typical well-established traditional grocery manufacturer in China. Despite its mix ownership, Company A is a major manufacturer of instant noodles in China, with supermarkets as its major retail outlets. Employing around three hundred and fifty full-time employees, it is a typical well-established traditional grocery manufacturer in China. Despite its mixed ownership, Company A's operation largely remains unchanged with limited addition of stand-alone computers and the Internet used by the management level. With virtually no dedicated IT investment, businesses are carried out through the conventional medium: face-to-face interaction and telephone conversations. The interviewee (Regional Manager) demonstrated little understanding of e-Commerce and was not enthusiastic about the prospects of future adoption within the organization, since the traditional way had been working well.

Table 3: Organization Profile of three interviewed companies

Company	Type	Full-time employees	Ownership
A	Manufacturer	350	Local with foreign ownership
B	Broker	25	Local
C	Retailer	80	Local with foreign ownership

Company B is a small broker of grocery items with twenty-five full-time employees. As most of other similar sized grocery distributors in China, it is independent and locally-owned. Given its recent establishment, its operation is unsurprisingly supported by IT, which gives all employees direct access to computers, Internet and E-mail. Since most of company B's employees have a tertiary degree, the interviewee (Chief Executive Officer) showed a comprehensive understanding of e-Commerce and indicated willingness in its future investment because of the organization's positive experience with IT.

Company C is a medium sized grocery retailer with foreign ownership. As other grocery retailers in China, it is equipped with the standard information technologies such as Scanner/Bar-coding, Internet and Website to attract customers and facilitate its day-to-day operation. The majority of the staff at the management level holds a tertiary degree. The interviewee (Marketing Manager) also demonstrated adequate e-Commerce knowledge and expressed commitment in maintaining the current level of IT investment, but with limited willingness to further increase e-Commerce adoption in the near future.

Study Findings

Interview with the participants reveal some important observations related to e-Commerce adoption in China, particularly within the grocery industry, which are discussed below:

Strong Telecommunication and Transport Infra-Structure in The East Coast region.

Since all interviewed organizations are located in the economically advanced east coast region of China, all interviewees gave high ratings regarding the telecommunication and transport infrastructure in the region. Neither of Company B or C suffered infrastructure related difficulties during or after its e-Commerce adoption and is very confident that these infrastructures are mature enough to fully support e-Commerce activities in the region. However, Company C expressed her doubt regarding the condition of these basic infrastructures in the less developed regions of China. It confirms the findings of other similar studies (see for example [5] [13] [23] [24] [25]) that there is significant infrastructure development disparity in China between the economically developed regions and the rural areas.

Weak Legal Framework and Privacy Protection Impedes E-Commerce Adoption

All the interviewees were asked about the state legal framework for online transactions and they expressed their discontentment. All of them believed there is a significant lack of sound laws and regulations that can effectively monitor e-Commerce activities, and, hence, China is considered not to be ready for e-Commerce in this respect. With the "lack of e-Commerce legal framework" identified as major barriers to e-Commerce adoption in previous studies [18] [21] [23] [25] [30], this finding further confirmed the presence of the barrier related to legal framework within the Chinese grocery industry specifically.

Organization's Position in The Supply Chain Affects E-Commerce Adoption

The interviews suggest that the closer the organization is to the consumer, the more information technologies are used as part of daily business procedures. With all interviewees confirming their IT and basic e-Commerce adoption situation as the industry standard practice, we can conclude that this phenomenon is relatively wide-spread within the grocery industry. Company A, the manufacturer, located further away from the consumer than other companies, repeatedly questioned the necessity of e-Commerce technologies in the manufacturing sector and expressed contentment regarding their traditional way of operation under the current situation as revealed below:

"...at the moment, our business is operating with the traditional approach and performing well, we are not really looking into any e-Commerce initiatives" (Company A).

Other participating companies, on the other hand, demonstrated a much more advanced e-Commerce understanding and IT usage. Being able to meet consumer demand is considered by the majority of the participants to be one of the major reasons for adopting IT and introducing e-Commerce. Meanwhile, Companies C, D and E (retailers), use information technology to a much greater extent than Companies B and F (distributors). This finding is consistent with the other e-Commerce survey carried out in China that identified "consumer demand" as the number one driver for e-Commerce adoption [23].

E-Commerce Usage Concentrates on Low-Level Administration Activities

Despite the active use of e-Commerce technologies in daily businesses by Companies B and C, none of them demonstrated sophisticated e-Commerce capability beyond the basic internal-external email communication and administration tasks. Internet and email are the most commonly used e-Commerce technologies in the organization enabling them to place and receive orders through email. Other applications such as Website, EFT and Barcode/Scanner are purely used for its most basic operational purposes and serve no strategic or analytical functions. None of the interviewed companies possess compatible or inter-connected systems with its trading partners. Table 4 depicts the current usage of e-Commerce technologies by the participating companies.

Table 4: e-Commerce Usage by the Participating Organizations

Company	e-Commerce technologies	Sales (%)	Business operation (%)
A	Internet, Email	0	0
B	Internet, Email, EFT, Intranet	5%	6%
C	Internet, Email, EFT, Barcode/Scanner	6-7%	10%

Low Level of Trust Among The Trading partners

After a decade of e-Commerce development and diffusion in China, it appears that organizations finally started to develop a sense of trust as a part of their business relationships. All respondents of our interviews confirmed the existence of a trustful relationship with their trading partners which enables the possibility of conducting business transactions without face-to-face interaction. However, the level of trust is still considered low. When asked about the sharing of information with their partners, both e-Commerce capable organizations B and C indicated reluctance in sharing anything vital. It appears that although businesses have made improvements in the issue of trust for the past decade, they are still largely cautious in cooperating with their partners, as revealed by the interview excerpt:

“We trust our trading partners as much as they can be trusted” (Company C).

This observation confirms the widely quoted “lack-of-trust” syndrome which is believed to be prevalent in Chinese business environment [2] [3] [6] [7] [16] [17] [18].

E-Commerce Delivers Cost Reduction, but Also Involves Negative Effects on Employees Behavior

Cost reduction is revealed to be the most prominent benefit delivered by e-Commerce technologies, as both Companies B and C quickly pointed out the labor and administration cost have been reduced by simply computerize and digitize some of the very basic operations. Even Company A believes in the cost saving potential of e-Commerce technologies when enquired about the perceived e-Commerce benefits. The other benefits are less obvious because the participants seem to have a limited understanding of the potential benefits of e-Commerce, particularly related to tactical and strategic benefits. Companies B and C expressed the likelihood of improved customer, supplier relationship and company image as a result of using e-Commerce, but there is no solid evidence that such benefits have been reaped.

On the other hand, employees’ misuse of the Internet for personal use during working hours is the major concern among the interviewed companies. All Companies A, B and C has experienced such problem and believe it threatens the operational efficiency of the company and is a major drawback of having e-Commerce technologies directly accessible to the employees.

DISCUSSION AND CONCLUSIONS

This preliminary study provides an overview of the e-Commerce adoption within the Chinese grocery industry. Some efforts have been put into e-Commerce adoption, but due to the barriers of poor national legal framework and e-Commerce infrastructure support, the overall e-Commerce adoption in the grocery industry remains at its first stage of development comprising fragmented networks and standalone applications. Despite retailers’ enormous power to impose standards and operations upon their suppliers, the amount of investments required for e-Commerce adoption is simply too large for the majority of distributors and manufacturers. The lack of trust between the two parties also significantly dampens the motivation for such advancements. As a result, the retailers simply choose to impose numerous expenses upon the suppliers to increase their profit margin instead.

In order to encourage e-Commerce adoption and diffusion within the industry and fully realize its benefits, different strategies will be required because of the uniqueness of the industry. Given Chinese government’s extraordinary influence on every single aspect of the country and the notoriously inconsistent policy implementation, businesses have to pay special attention to liaise with the local government to avoid unexpected ramifications stemmed from e-Commerce activities. Increase in government lobbying for sound e-Commerce and supporting legislations can reduce the uncertainty in e-Commerce adoption to some degree. At the moment, the lack of rule and law significantly hampers the effectiveness of the existing regulations.

The study findings also suggest that awareness and understanding of the potential of e-Commerce need to be improved within the industry to further encourage adoption. This may require the involvement of the industry body that can improve the visibility of e-Commerce practices among the industry players and to demonstrate the benefits obtained. Through progressively increasing the

awareness and understanding of e-Commerce business practices and procedures, more and more organizations will be willing to consider e-Commerce as means of organizational improvement.

In addition, since inefficiencies in managing the flow of products are prevalent within the Chinese grocery industry, streamlining the supply chain management within the industry will be beneficial for the industry. Advanced supply chain management initiative such as Efficient Consumer Response (ECR) which is originated in the United States and has been applied in other regions including European countries and Australia, can also offer many potential benefits to China. However, before achieving advanced supply chain management, improvement and the wider adoption of some basic e-Commerce technologies are still required. Thus, developing countries such as China will most probably follow the trajectory of e-Commerce adoption progression as experienced in Western / developed countries, but currently developing countries are still at the early stage of e-Commerce adoption.

The results of this study has both confirmed and complemented various existing studies on the e-Commerce adoption in China. The interviewed organizations demonstrated different degrees of e-Commerce understanding and adoption, with the retailers at the high end of the e-Commerce adoption spectrum and the manufacture at the other end. Major drivers and barriers frequently identified by previous studies are also confirmed through these interviews. During the next twelve months, more extensive interviews will be carried out to complement the finding of this current study.

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BUILDING A SEMANTIC TENDERING SYSTEM

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ABSTRACT

In the new B2B e-commerce arena, applications such as auctions and data exchange are growing rapidly. However, Web content is currently designed for human consumption rather than computer manipulation. This limits the possibility of Web automation. Fortunately, the new development of the Semantic Web that allows Web pages to provide information not only in terms of their content, but also in terms of the properties of that content, can be used for automation. Electronic tendering systems are among the successfully commercial systems that can tremendously benefit from the availability of Semantic Web. This study proposes an e-tendering system that uses the Semantic Web to investigate the automatic negotiation process. The system is built in a P2P environment to simulate a two-player negotiation. It is found that the ontology of semantic information can be used to locate qualified suppliers and precede negotiation. The bargaining power of each party is then determined by the relative magnitude of the negotiators' respective costs of haggling and the utility that varies with the degree of risk preference. Our experiments showed that applying automatic negotiation strategies to e-tendering system in semantic web can reflect the risk preference of the participants.

Keywords: Semantic Web, negotiation, P2P, e-tendering

INTRODUCTION

In the past decade, the boom in Internet technology enabled a platform for the accumulation and sharing of vast ranges of information among people, organizations, and enterprises. However, most of the information is written in HyperText Markup Language (HTML), which mainly follows a rigid format for displaying the content. This information is normally written for human comprehension. As information volume has been vastly growing, the time that is needed to locate and digest the information also increases tremendously.

In contrast to syntax-based HTML, the Semantic Web [1] organizes Web content into information (*facts*) and the meaning of that information. According to the American Heritage Dictionary of the English Language (Third Edition, 1996, Houghton Mifflin Company), semantics is the study or science of meaning in language forms, or a study of relationships between signs and symbols and what they represent. The Semantic Web, as does the World Wide Web, encourages the independent and diversified growth of Web sites while maintaining a high degree of information sharing among them. In the Semantic Web, a Web page provides information not only in terms of its content, but also in terms of the properties, called *attributes*, of that content. In this way, the use of information, such as when searching, is not limited to exploring its content, but can be extended to its properties. For example, conventional searches require a user to type in keywords, for which the search engine searches over the Internet (or through downloaded files). In the process, the volume of search results can be tremendous and some of the material is not very well related to the keywords. However, when the search is applied to a Web page that has been written in a Semantic Web language, such as eXtensible Markup Language (XML) or the Resource Description Framework (RDF), the search can be extended to the properties of the Webpage and the results are likely to be more concise and relevant. This has enhanced the possibility of having a highly automated and integrated Web service [2].

Recently, the electronic marketplace has allowed the emergence of many different types of dynamic pricing schemes. The electronic auctions of eBay and Dell and the reverse auctions of GE and GM are all successful cases. These systems are built to provide for bargaining between one buyer and one seller, forward auctions for multi-buyers and one seller, reverse auctions for one buyer and multi-sellers, and dynamic exchanges for multi-buyers and multi-sellers. The need for an automated, efficient, and trustworthy system has grown correspondingly.

In this study we developed an e-tendering system on a P2P Semantic Web and simulated the negotiation process of the e-tendering service, i.e., a reverse auction. Note that the peer to peer (P2P) architecture offers a decentralized and distributed network to avoid co-ordination bottlenecks [3]. A pure P2P sharing network is basically an information directory in which explicit knowledge is maintained on local computers [4]. In the e-tendering system, the P2P environment is engaged to simulate a two-party negotiation. The e-tendering system allows the negotiation to be done in a one-to-one manner and the seller who gives the best offer is selected to win the tender. A utility function (representing the anticipated payoff for each party corresponding to its selected strategies) is employed to determine the settlement. The bargaining power considering the relative magnitude of the

negotiators' respective costs of haggling and risk preference is applied to find the settlement. The utility function of negotiators and their bargaining power are modeled in the semantics of Web pages. A case study is presented for the purchasing problems that arise when there is one buyer, 10 sellers, and multi-bargaining issues.

SEMANTIC WEB SERVICES

The semantic Web is similar to a deductive database and a knowledge-based system, where new knowledge is deduced by applying rules to existing facts. The difference between these systems is that both the knowledge-based system and the deductive database apply rigid structures to the knowledge representation and deduction rules to ensure that new knowledge can be obtained by inference; in contrast, the Semantic Web allows Web sites to represent knowledge and rules in their own ways. In the Semantic Web, both facts and rules (called *ontologies*) bring meaningful content to Web pages [1]. The Web site information is then shared using software agents. A brokering service can be used to help software agent to discover relevant services [5]. If the ontologies of the service are not familiar to the service requester, then translation between different agents is needed [6].

Most current studies of the Semantic Web focus mainly on the knowledge representation and services carried out by the software agents of individual Web sites, such as ontology design, the visual environment for browsing, RDF model and syntax specification, and Web services with ontologies (<http://www.w3.org/>). Since the W3 Consortium advocated the concept in 1999, several applications have been successfully implemented. For example, card index information, privacy information (P3P), the associations of style sheets with documents, and intellectual property rights labeling can be found at (<http://www.w3.org/DesignIssues/Semantic.html>, accessed on September 2005). An algorithm to extract ontologies from the structured data of electronic data interchange for tendering domain is provided in [7]. An electronic government procurement system with the functions of posting and receiving bids via the Internet, vender registration, certificate authorization, contract development tools, bid/request for proposal (RFP) development, online bidding, and online payment to render government procurement efficient, transparent, nondiscriminatory, and accountable is given in [8]. Semantic process templates that use ontologies to capture much richer descriptions of activity requirements and a more effective way of providing Web services is described in [9]. Finally, conceptual architectures of both Semantic Web services and Web services to enable Semantic Web Service design and composition at the knowledge level in a language-independent manner is provided in [10].

MODEL

This study applies P2P architecture, simulated as a decentralized two-party bargaining process, in a semantic Web to the negotiation process for an e-tendering system. We assume that the two parties have a common interest in cooperating, but also have conflicting interests over exactly how to cooperate [11]. There are many definitions of negotiation. Oliver [12] considered negotiation as simply a searching process in a multidimensional problem, when each solution is considered as a dimension. Krovi et al. [13] defined negotiation as a way to resolve issues between two or more parties with opposite positions. Nunes et al. [14] assumed that negotiation is a decision-making process for reaching a consensus between collaborative parties rather than opponents. This study considers negotiation as a multiple-criteria decision-making (MCDM) problem, i.e., a multi-*attribute* decision making problem, where many criteria are taken into account as attributes for decision-making [15].

In the past decade, many investigations have resulted in negotiation systems. In general, they can be categorized into automated negotiation systems (ANSs) and negotiation support systems (NSSs), where ANSs emphasize on building of automatic negotiation processes and NSSs provide more information and strategies to the negotiators. ANSs mainly employ intelligent agents or mobile agents to travel between computers to simplify the negotiation process with machine learning techniques, such as genetic algorithms [12], rule-driven reasoning [16], game theory [15], fuzzy logic [17], and ebXML [18]. Unlike ANSs, NSSs mainly suggest solutions or provide process support. The adoptions use social-judgment theory models, genetic algorithms [19], hyper-game decision models, bargaining models, and multi-objective linear programming [20]. Similarly, Kromker et. al. developed software to support the distributed processes in a heterogeneous system environment for preparing tendering bids which require interdisciplinary co-operation [21]. However, current research investigations on the building of negotiation systems focus on either system development or machine intelligence, rather than on the negotiation process itself. Thus, our focus on the negotiation process is the major distinction with other related work in the literature.

Semantics in P2P negotiation

The semantics of P2P negotiation are expected to appear in three areas where incomplete information can be found. Here, incomplete information means that one party has some knowledge in common with its opponent, but also has private knowledge that is unknown to the other party. The criteria for a negotiation are described as follows:

(1) Partner selection: the semantic information can be used to select partners or services dynamically [9]. The partners are selected from a community, whereby the initiating entity (buyer *b*) locates a partner (seller *s*) based on preset criteria. The ontology can be referred to for selecting suppliers. Generally speaking, two types of relationships are presented in the ontology: "is-a-kind-of" and "is-a-part-of". These relationships assist in the selection process to locate more suppliers who can provide products that are close to the item that the buyer is looking for. For example, a company that sells desktop PCs, tablet-PCs,

handheld PCs, notebooks, and others may be the candidate seller when a buyer is looking for tenders for a PC with a particular specification.

A negotiation is performed in a one-to-one manner between a buyer and a seller, but many negotiations can be activated concurrently. A negotiation issue, such as the price that is offered by one negotiator, is denoted in the ranges of $[I_i, R_i]$, where $i \in \{b, s\}$, I is the initial offer and R is the reserve price. A buyer locates a seller for further bargaining when $\sum_j I_{sj} \geq \sum_j R_{bj}$ where $j = \{0, 1, \dots, n\}$ when multiple issues are adopted such as the delivery time, quantity of items required, inventory levels, and payment methods. Both parties then determine the best alternative to a negotiated agreement (BATNA) referring to the reservation points. The first offer from a seller to a buyer is $o_{s \rightarrow b}^t$ where $t = 1$ after receiving request for quotation (RFQ) from buyer b and $t \in T$ and $T = \{0, 1, \dots, m\}$. The buyer will accept the offer if she knows that the next offer may not be better than the current offer, i.e., $U_b(o_{s \rightarrow b}^t) \geq U_b(o_{s \rightarrow b}^{t+1})$, where U is the utility function of b obtained from the offer of seller s at time t compared with time $t+1$. Similarly, the seller will accept a counter offer if he/she knows that the next offer may not be better than the current offer, namely, $U_s(o_{b \rightarrow s}^t) \geq U_s(o_{b \rightarrow s}^{t+1})$.

(2) The bargaining power of each party is determined by the relative magnitude of the negotiators' respective costs of haggling and the utility that varies with the degree of risk preference. The costs of haggling take into consideration time discounting, deadlines, time constraints (waiting-time costs), or inventory levels, while the risk preference considers the attitude of the negotiator, such as risk-neutralization, risk-aversion, or risk-proneness. A negotiator is considered to be a patient player when the time-discounting rate is small.

In the e-tendering system, each entity that participates in the negotiation should have a negotiation engine. The engines of both parties determine the results based on the bargaining powers of them. Models, such as that of Rubinstein [22], which assume a constant discount rate of future utilities, are modified for this purpose.

(3) Different strategies can also be adopted in negotiation [23]. For example, new issues can be created to transform a single-issue fixed-line negotiation into integrative negotiations. Moreover, an offer can be made for a complete package at one time or for the items issue-by-issue. At this stage, the bargaining issues may also be unbundled. That is, the weights of bargaining issues can be changed. Multiple offers can also be made simultaneously, meaning that at least two proposals of equal values can be made together.

Utility Function

The utility function represents the anticipated payoff to each party corresponding to their selected strategies (<http://en.wikipedia.org>). How can the utility function of a negotiator (whether an individual or an organization) be obtained from the semantics of web pages is beyond the scope of this study. In this study, the multi-attribute utility theory (MAUT) is adopted to help a decision-maker to quantify and derive solutions with multi-criteria. The total utility can be obtained by summing up

weighted issue utilities, i.e., $U = \frac{\sum W_i \times U_i}{\sum W_i}$, where U is the total utility value ranged between 0 and 1, i is the negotiation issue, U_i

is the utility value of an issue ranged between 0 and 1, and W_i is the weights of issues ranged between 1 and 9. Applying the Neumann-Morgenstern utility function for modeling [24],

$$U_i(o_{i \rightarrow i'}^t) = U_i(o)U_i(t) \quad (1)$$

where $U_i(o)$ is the utility function of a negotiator i derived from the offer of the other negotiator i' , $U_i(t)$ is the discount rate $f(\alpha)^t$ of issue i , and α is the discount factor. As we assume a constant discount rate, the discount rate will be determined at the beginning of the negotiation. The negotiator is a patient player when $\alpha > 1$. In this study, the discount factor is a factor of the cost of haggling and is determined by the semantic data. The utility function is measured in a linear function:

$$U_j^i(o_{j, i \rightarrow i}^t) = \frac{O_j - R_j}{I_j - R_j} \quad (2)$$

for seller to issue j , and

$$U_j^i(o_{j, i \rightarrow i}^t) = \frac{R_j - O_j}{R_j - I_j} \quad (3)$$

for the buyer to issue j .

The interaction of the utility functions of both parties may form a bargaining zone. A positive bargaining zone implies that there is room for both parties to reach an agreement. In general, agreements are categorized into three levels. At the first level the

agreement is located in a positive bargaining zone and is better than the reservation points of both parties. At the second level the agreement is better than the expectations of both parties. The second level is possible because this is not a fixed-sum multi-issue negotiation, and it is possible to reach an agreement that can simultaneously improve the outcomes of both parties. The third level is called the *Pareto-optimal frontier*. At this level it is impossible to improve the agreement without sacrificing the benefits of any party.

Counter-Offer

The counter offer consists of tactics that vary the acceptance value of an issue depending on the remaining negotiation time [24].

$$o_{i \rightarrow j}^t(j) = \begin{cases} I_j^i + \mu_j^i(t)(R_j^i - I_j^i) & \text{if } i = b \\ I_j^i + (1 - \mu_j^i(t))(R_j^i - I_j^i) & \text{if } i = s \end{cases} \quad (4)$$

Function $\mu_j^i(t)$ is called the *negotiation decision function* to issue j for negotiator i and is defined as

$$\mu_j^i(t) = k_j^i - (1 - k_j^i) \left(\frac{t}{T^i}\right)^{1/\varphi} \quad (5)$$

The negotiation decision function should be between 0 and 1 (i.e., $0 \leq \mu_j^i(t) \leq 1$) to ensure that a settlement can be reached. At time 0, $\mu_j^i(0) = k_j^i$ is a constant value to determine the initial counter proposal. When $t = T$, the maximum time is $\mu_j^i(T) = 1$ and the counter offer will be the reservation value since the deadline has been reached.

Risk preference can be reflected through the negotiation decision function, in which a *risk-aversion* attitude adopts conceder behavior, a *risk-proneness* attitude takes Boulware behavior, and a risk-neutralization shows no preference. The Boulware tactic [25] has $\varphi < 1$ while conceder tactics [26] has $\varphi > 1$. In Boulware behavior, the negotiator maintains an offer close to the initial offer until the time nears the deadline. In contrast, the conceder behavior gives way to the reservation value quickly.

Equation 5 considers haggling cost as the constraint. In fact, many other resources should also be taken into consideration, such as the current inventory level and consumption rate. Therefore, equation 5 is further revised into

$$\mu_j^i(t) = k_j^i - (1 - k_j^i)(X)^{1/\varphi}, \quad (6)$$

where X is the combination of all resources. It should be noted here that the number of resources to be considered is decided by the negotiation engine in the P2P Semantic Web.

SYSTEM DEVELOPMENT

A system was developed to simulate the auto negotiation in an e-tendering system with P2P architecture using JXTA, developed by Sun Microsystems. Note that JXTA™ technology is a set of P2P open protocols that can connect various devices to a network ranging from cell phones and wireless PDAs to PC servers. JXTA peers create a virtual network where a node can interact with other peers or resources directly, even when they are behind a firewall or have different network transports.

In a P2P environment, each node on the network is known as a peer. They can communicate with each other through sending messages. In a traditional e-tendering system, there is usually a central server to receive and route queries and response messages (such as an RFQ, an acknowledgment, or a counter offer). However, in a B2B (business-to-business) environment, it is reasonable to assume that the peers are behind firewalls and NATs (Network Address Translations). Therefore, some peers are needed to take care of jobs like routing and translating. These peers, known as relays, include rendezvous peers, router peers and gateway peers. For some large-scale Intranet systems, dedicated peers may be specialized to perform each kind of job.

The class diagram of the e-tendering system is shown in Figure 1. Basically, the system includes nine classes: the buyer, the seller, the product, P2PQueryMsg, P2PResponseMsg, P2PNeg, P2PHandler, CustomerInfo, and ResolverService. Brief descriptions of these are given in Table 1.

Table 1 Description of E-Tendering Class Diagram.

Class	Method	Description
Buyer	double cal_offer (int cur_time, Product prod, double k, double ini_price, double res_price)	Generates offers and counter-offers. It first finds the stock of the materials, and then checks the inventory level and turnover rate of the product that it uses. It computes the deadline of the negotiation based on these figures and finally calculates the offering price.
Seller	double cal_offer (int cur_time, Product prod, double k, double ini_price, double res_price)	Generates offers and counter-offers. It computes the deadline of the negotiation based on the data that it has found from semantic web, and then calculates the offering price.

Product	int getStock()	Gets the inventory level of the product.
Product	int getTurnover()	Finds the turnover rate of the product.
P2PQueryMsg	P2PQueryMsg (String peer_id, String material_id, int t, String seller_id, double inventory)	Constructor of a query message, with the attributes and values specified.
P2PQueryMsg	P2PQueryMsg (InputStream stream)	Constructor of a query message with an XML document.
P2PQueryMsg	boolean comUtility(offer_price)	Compares the utility that the buyer would gain from its proposed price with that of the current price offered by the seller.
P2PResponseMsg	P2PResponseMsg (String peer_id, String material_id, int t, String seller_id, double inventory)	Constructor of a response message, with the attributes and values specified.
P2PResponseMsg	P2PResponseMsg (InputStream stream)	Constructor of a response message, with an XML document.
P2PResponseMsg	boolean comUtility (double proposed_price)	Compares the utility that the seller would gain from its offered price with that of the current price proposed by the buyer .
P2PNeg	void manageHandler()	Registers or de-registers the command.
P2PNeg	int parseArguments()	Parses the arguments following the command.
P2PNeg	int startApp()	Starts the application by sending out an initial query.
P2PHandler	int processQuery(P2PQueryMsg qmsg)	Seller peer processes. The price proposed by the buyer is accepted if it is considered reasonable; otherwise, the seller makes a counter-offer.
P2PHandler	void processResponse (P2PResponseMsg rmsg)	Buyer peer processes. The price proposed by the buyer is accepted if it is considered reasonable; otherwise, the buyer makes a counter-offer.

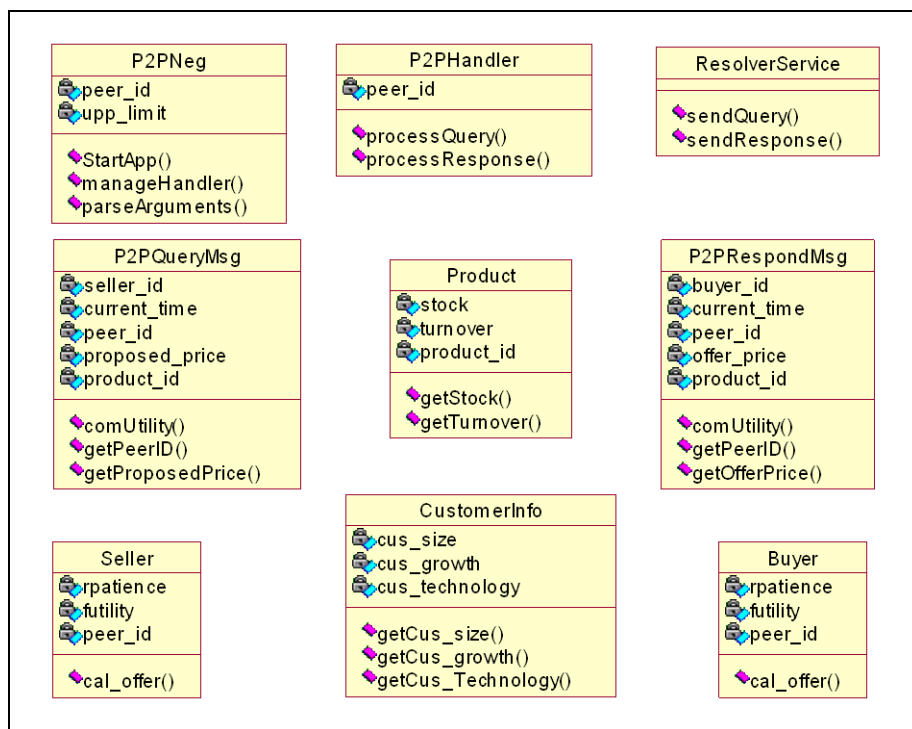


Figure 1. Class Diagram of a P2P E-Tendering System

With the help of JXTA technology, the workflow becomes simple. For example, in Figure 2, Peer 1 searches suppliers for a product in the following steps:

- (1) Peer 1 initiates a search request for suppliers.
- (2) As the partners are outside the company, Peer 1 will not search peers within the same intranet.
- (3) As only relay peers can be searched by outside parties as defined by JXTA, a node searches its relay peer first. In this example, Peer 1 hopes to communicate with peers beyond the firewall, so it sends the query to a relay peer, i.e. Peer 3.
- (4) Peer 3 has cached information about the other relay peers that it should associate with. In this example, it finds relay Peer 4 and Peer 10.
- (5) Peers 4 and 10 search peers belonged to their local network and obtain responses from Peer 6 and Peer 11, respectively.
- (6) A relay peer can forward the query to other relay peers from its cached information in case these relay peers have not yet participated. Here Peer 4 forwards the query to Peer 5 and gets a new reply from Peer 8.
- (7) All of the replies are sent back to Peer 3 and eventually sent back to the initiator, Peer 1.

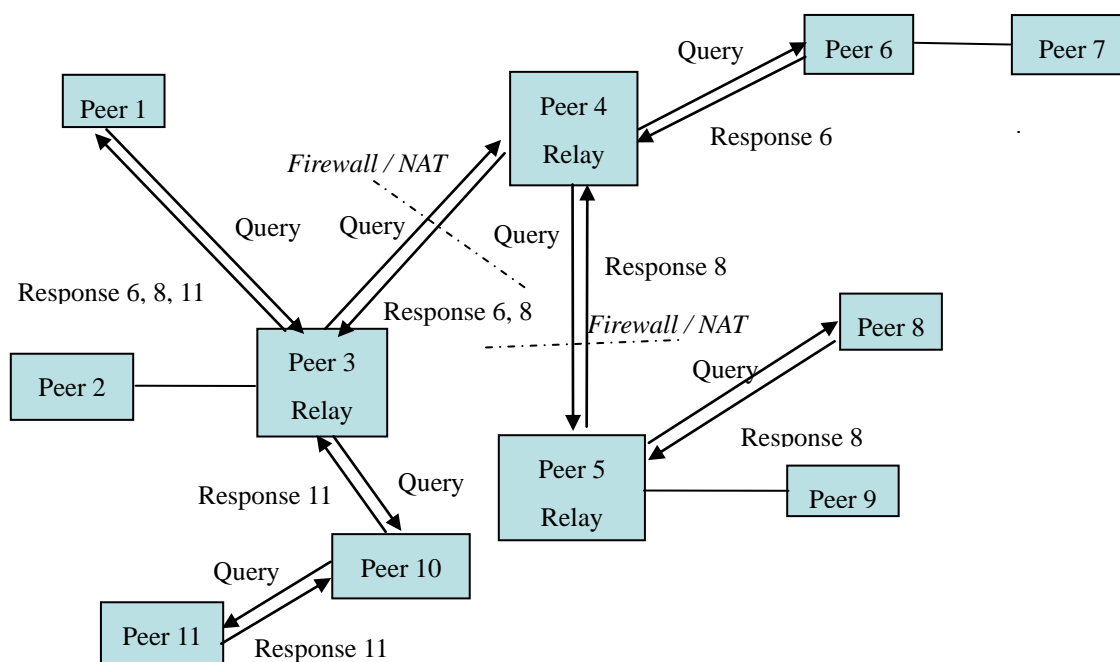


Figure 2. An Example of Locating Peers in P2P

After locating the peers, the negotiation process starts. In the P2P Semantic Web, negotiation strategies are built in each node while the ontologies are maintained in the relay peer. In general, the ontologies are not modified frequently. Updates to the relay peer should be conducted only when all the relay peers have reached consensus. The negotiation process starts when a buyer sends a RQF to a supplier (the sequence diagram is shown in Figure 3). Then, the P2PHandler class built in JXTA is used to process the query message sent to the node. The node applies methods provided by different object classes to extract the information necessary to calculate the offer and sends it back to the buyer, as shown in Figure 4. A counter-offer is made by referring to strategies built in the buyer, as shown in Figure 5. The process is repeated until a settlement that satisfies both parties is reached. Finally, the seller selects the best final offer from all suppliers and makes a deal with the selected supplier.

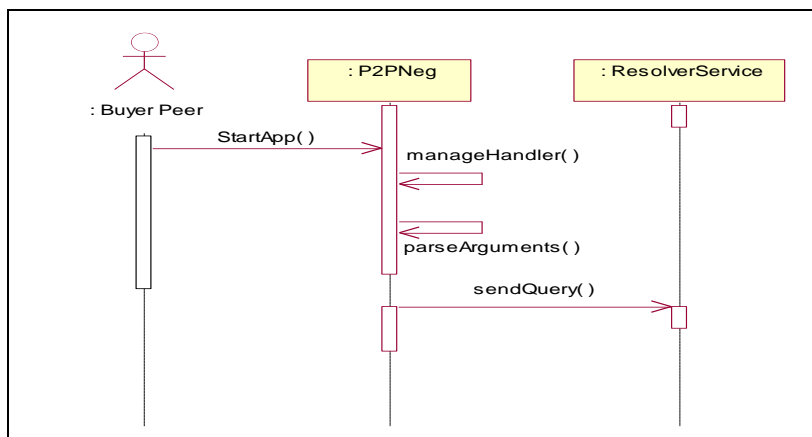


Figure 3. The Sequence Diagram describing the Scenario when a Buyer Sends a RFQ to a Seller

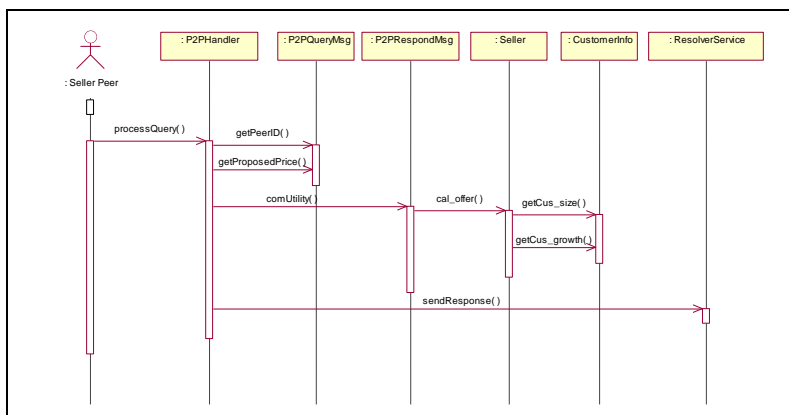


Figure 4. The Sequence Diagram to Generate an Offer from a Seller to a Buyer

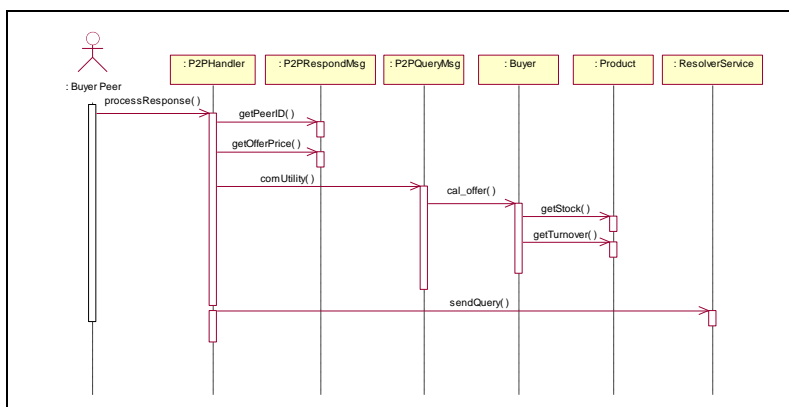


Figure 5. The Sequence Diagram to Generate a Counter-Offer

This approach has the following advantages:

1. No centralized server is needed to group all the queries and responses, because a peer is a client as well as a server under the P2P concept, and it is able to handle all the necessary actions concerning a query.
2. The peers share the burden of jobs. Although it seems that the relay peers are handing extra work, in fact the workload is not heavy, as they have only to send forward queries from their local network and leave the jobs related to outside parties to their own peers. What they have to do is only to forward a message to their known relay peers and ask these relay peers to perform the job. This approach requires only the idle resources of current machines rather than installation of new workstations to perform centralized jobs.
3. Although one relay peer, say Peer 3, stores only a limited amount of cached peers, as the relay peers are able to forward the request further, the multiple effect could be very messy. However, this does not multiply the workload of Peer 3 as the jobs are shared among all the peers.

CONCLUSION

In the new era of B2B e-commerce adoption, services such as auctions, data exchange, and negotiations have gained greater attention. However, Web content is currently designed for human consumption rather than computer manipulation. The consequence is that a user has to make a tremendous amount of effort to find needed information from millions of search results based on selected keywords. Fortunately, a new approach, the Semantic Web, structures the meaningful content of Web pages into semantic data. This provides the possibility of Web automation. This pioneering study explored the possibility of Web automation in an e-tendering system characterized by the different risk preferences of the negotiators. The architecture is built in a P2P environment to simulate a two-player game although each player can aggregate the needs of many buyers or sellers. In the P2P environment, the negotiation is conducted in a one-to-one manner and the best offer is selected as the tender. It is found that the ontology of semantic information can be engaged to locate suppliers who qualify for the negotiation to commence. The bargaining power of each party is then determined by the relative magnitude of the negotiators' respective costs of haggling and the utility varying with the degree of their risk preferences. In the future, the study could be expanded into one-to-many (auctions), many-to-one (reverse auctions), and many-to-many (exchange) negotiations.

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CORPORATE E-BANKING: A STUDY BASED ON DELONE AND MCLEAN'S IS SUCCESS MODEL

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ABSTRACT

Although there are ample of studies dealing with retail internet banking, very few studies have investigated corporate internet banking. The objective of the current research is to study the determinants of the intention to continue use online banking of the existing corporate customers. This study collected data from 154 customers of an international bank to test a model developed from the DeLone and McLean's IS success model. The results show that system quality contributes most to the perception of overall quality of the corporate e-banking service as well as the impact on the future use intention. Other factors that are found to be important are human service quality, information quality, and accuracy and security of the system.

Keywords: DeLone and Mclean model, corporate electronic banking, service quality

INTRODUCTION

There is scant of study that has investigated corporate internet banking. Few exceptions include Rotchanakitumnuai and Speece [15], which investigated how benefit and barrier factors affected the adoption of internet banking by Thai's corporate customers. In their study, transaction benefit, information quality, and distrust were found to discriminate adopters and non-adopters. Cheng et al. [2], based on the Technology Acceptance Model, found that perceived usefulness, perceived web security, and attitude affected the intention to use positively. However, perceived ease of use did not affect the intention directly.

Researchers' interest in service quality delivered by websites has prompted the development of a number of instruments such as E-S-QUAL [13] and .comQ [18] to measure website service quality. Careful analysis of these instruments reveals that they do not only measure the online characteristics of the website, they also measure some offline service components, like fulfillment and customer service. However, most of these instruments are targeting the e-tailing websites. A number of studies did attempt to understand the electronic service quality of personal internet banking [e.g., 9,17]. However, study investigating the quality attributes for corporate internet banking is scanty.

Thus, the current study attempted to identify the quality attributes of corporate internet banking services and how these attributes affect the future use intention of the existing corporate customers based on the DeLone and McLean's [6] model of IS success.

DeLone and McLean [4], after reviewing over 180 articles on system success, introduced a comprehensive success taxonomy based on six major dimensions of IS success – System Quality, Information Quality, Use, User Satisfaction, Individual Impact, and Organizational Impact. They also proposed an IS success model linking these six dimensions. Ten years later, they refined their model by adding service quality and usage intentions to the model, while at the same time they collapsed the individual impact and organizational impact dimensions into one net benefit construct [6]. The updated D&M model is shown in Figure 1.

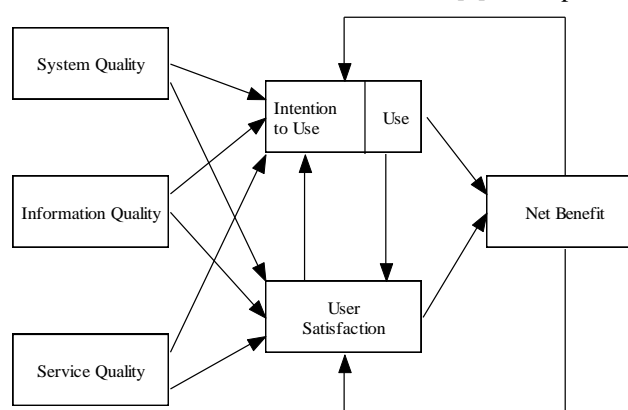


Figure 1 Updated D&M IS Success Model [Adopted from [6]]

In this model, three quality attributes are identified as measures of success. In the current study, we are interested in how the system quality, information quality, and service quality affect the intention of the current corporate to continue to use internet banking.

In order to understand which aspects are important in determining the overall quality perceptions of the corporate electronic banking service, we have modified the D&M model to include the Overall Quality of the service to replace the User Satisfaction as a mediator of the quality dimensions and the future use intention. Our research model is shown in Fig. 2

System Quality is concerned with whether or not the internet banking system is reliable, responsive, easy to use and whether the design of the interface is consistent. A large part of this definition of system quality, such as the consistency of interfaces and ease of navigation, is concerned with whether users can use the system with minimum effort and difficulties. This is very similar to the concept of perceived ease of use in the TAM. Other aspects of system quality include customerization, security and reliability of the system [5]. Information Quality assesses the system's output in such area as relevance, timeliness, and accuracy [6,16]. Service quality captures the support delivered by the bank to the corporate customers [6]. [Add SQ definition here].

Our nomological network is shown in Figure 2. Based on the DeLone and McLean's Model and the results of previous studies [6,10,11,19], we postulated that all the relationships are positive.

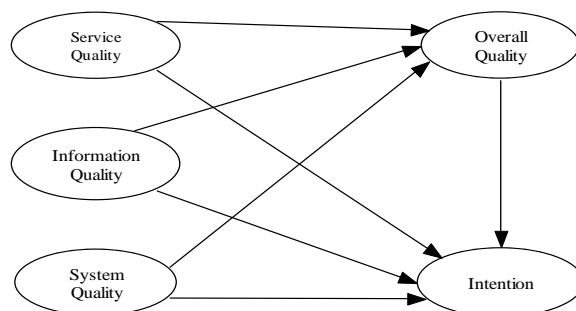


Figure 2 Research Model

METHOD

Questionnaire Design and Measures

The initial items for our constructs were adapted from a number of existing instruments. The initial item pool was reviewed by the senior management of the Internet banking operation and changes were made based on their expert opinions.

Information Quality: The measurement scale for information quality was adopted from Doll and Torkzadeh [7]. This scale consisted of 6 items, asking the respondents about the quality of the information provided by the resultant system, including its content, accuracy, relevancy, format, and timeliness.

System Quality: The measurement scale for system quality was adopted and developed from Doll and Torkzadeh [7] and DeLone and Mclean [6]. Ten items were used to measure the ease of use, system reliability, personalization, and security aspects of the system quality.

Service Quality: The items measuring service quality were developed based on the definitions given by Jun and Cai [9]. We adapted the appropriate items from SERVQUAL [12] and IS-adapted SERVQUAL [14] whenever possible, as well as developed the items for the continuous improvement dimension. Twenty one items were developed to measure the 9 dimensions of the service quality.

Overall Quality: Two items were used to measure the overall quality of the Internet Banking service.

Intention: The expected future usage of the existing corporate customers was measured with two items developed for this study. The questionnaire also contains items that collect information about the companies and the ways they were using corporate Internet banking services.

Data Collection Procedure

A total of 966 questionnaires were sent to the existing Internet banking users of the 281 commercial customers of the XYZ bank. Depending on the number of Internet Banking users they have, two to eight questionnaires were sent to each customer. Together with the questionnaire, a cover letter of the head of Electronic Banking Service Department of XYZ Bank was sent. To raise the response rate, Follow-up phone calls were made to the main contacts of each commercial customer to ask for their cooperation and a bank gift was prepared to thank for their assistance. The respondent questionnaires were sent back either by fax or mail.

Out of the 966 questionnaires, 181 copies of paper questionnaire were returned; twenty seven of them were invalid due to missing data, resulting in an effective response rate of 15.9% and a sample size of 154.

ANALYSIS AND RESULTS

Exploratory factor analysis was performed on the data in order to purify the items and to establish the dimensionality of each scale. Items that did not load heavily on the primary factors and items that had significant cross-loading(s) were removed. In discussing the use of EFA to validate measurement instruments, Burnett and Dart [1] suggested that items with factor loading less than 0.4, and items which have loadings greater than 0.4 on two or more factors, should be removed. Then the remaining items were subjected to another EFA until no further item has to be removed.

Oblique rotation using promax was used in all the factor analyses in this study. Promax attempts to maximize simple structures while allowing the factors to become correlated. It is more reasonable to assume that the set of factors of the current study are related to one another.

The forty one items that measure service quality, information quality, and system quality were subjected to principal component factor analysis. Eigenvalues and a Scree plot were used to determine the number of factors to be extracted. A five-factor structure was suggested using the criteria of an eigenvalue greater than one. A promax rotation was also performed. The result of the rotation showed that four items either has substantial cross-loading or does not load heavily onto any factor. These items were thus removed and another factor analysis was performed. A five-factor structure was again suggested. The extracted factors accounted for 71.79 percent of the total variance. The service quality items were grouped into two factors. The three items measuring the "continuous improvement" aspect were loaded in one factor, with the remaining items loaded onto another. We therefore, name these two factors as "Continuous Improvement" and "Human Service Quality" respectively. The items measuring the system quality were also grouped into two factors. One factor contains 4 items that measure the accuracy of the transaction and security of the system. The other factor contains 11 items that measure the ease of use, reliability, speed, personalization, and accessibility of the system. We thus name the first factor "Accuracy and Security" and use the original name "System Quality" to refer to the 11-item factor. The grouping of the items was shown in Table 1.

To test the hypothesis, Partial Least Square (PLS) was used to analysis the data. PLS is a component-based structural equation model technique that allow the test of the measurement and path models simultaneously and it is more suited for predictive application and theory building [8].

Before looking at the path model, the psychometric properties of the measures were first evaluated. Convergent validity was assessed based on the criteria that the indicator's estimated pattern coefficient must be significant on its posited underlying construct factor, composite reliability must be higher than 0.7, and the average variance extracted (AVE) higher than 0.5. Discriminant validity was assessed by the criteria that the square root of AVE should exceed that construct's correlation with other constructs [3].

Table 2 shows the composite reliability, square root of the AVE and the correlations among latent constructs. As shown in the second column of Table 2, the composite reliability of all the constructs is higher than 0.7 and the AVEs are higher than 0.5, which imply that the scales are reliable. As shown in Table 1, all the item loadings are quite high and are significant at .01 levels. Together with the fact that the square root of AVEs are higher than the construct's correlation with other constructs (as shown in Table 2), it indicates adequate discriminant validity.

Table 1 Items Loadings from PLS Analysis

Factor	Loading
Human Service Quality	
Performing services right at the first time	.81*
Providing services at the promised time	.83
Responding quickly to customers' requests	.89
Are always willing to help customers	.85
Have the knowledge on banking products and the Internet banking system to answer customers' questions	.86
Have the adequate interpersonal skills to communicate	.88
Treat Customers politely all the times	.84
Deal with complaints in a friendly manner	.79
Give clear answer to each requests	.89
Inform customer of important information	.67
Understand customers' needs	.85
Pay individual attention to customers	.83
Treat the customer as a VIP client	.79
The hotline support can be reached any time in office hour when Customer need help	.74
Continuous Improvement	
XYZ Bank is continuously improving its Internet Banking	.87
XYZ Bank is continuously improving its customer services	.88
XYZ Bank is continuously providing more banking products via its Internet Banking	.83
Information Quality	
The Internet Banking System provides the precise information I need	.90
The Internet Banking System provides enough information for my needs	.91
The Internet Banking System presents information in a logical way that can be read easily	.84
Information downloaded from the Internet Banking System can be easily integrated with my business operation	.82
The Internet Banking System always provides up-to-date information	.84
System Quality	
It is easy to learn how to use the Internet Banking System	.80
It is easy to login the Internet Banking System	.76
It is easy to use the Internet Banking System	.84
It is easy to navigate in the Internet Banking System	.83
It is easy to perform business tasks in the Internet Banking System	.81
The Internet Banking System provides clear result message upon action	.84
I am satisfied with the Internet Banking System's speed performance	.78
The Internet Banking System has clear website design	.81
The Internet Banking System has provided very good customization	.78
The Internet Banking System can be accessed any time	.82
The Internet Banking System has stable performance	.83
Accuracy and Security	
The Internet Banking System always execute transaction accurately	.86
The Internet Banking System always presents information accurately	.84
The Internet Banking System use reliable security measures	.81
Online transactions via the Internet Banking System are secure	.88
Overall Quality	
Based on all of your experience, electronic Banking of XYZ Bank provides a high level of services quality	.95
Based on all of your experience, electronic banking of XYZ Bank provides excellent service	.95
Future Use	
I intend to use the Internet Banking System more to perform banking service	.90
I intend to use more banking services of XYZ Bank and less banking services of other banks	.88

* all factor loadings are significant at $p < .01$

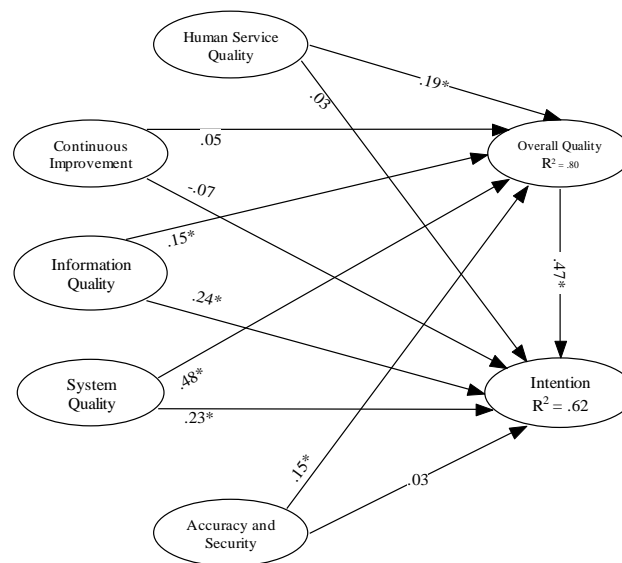
Table 2 Reliability, AVE, and Correlations among Latent Construct

	Latent Construct	Composite Reliability	1	2	3	4	5	6	7
1	Human Service Quality	.97	.82						
2	Continuous Improvement	.89	.60	.86					
3	Information Quality	.94	.57	.62	.86				
4	System Quality	.95	.64	.64	.78	.81			
5	Accuracy and Security	.91	.67	.57	.62	.69	.85		
6	Overall Quality	.95	.71	.73	.75	.80	.72	.95	
7	Future Use Intention	.90	.53	.56	.69	.73	.56	.76	.89

Note: The diagonal elements are the square roots of AVE.

Off-diagonal elements are correlations between latent constructs.

The research model was tested using the structural path model. Figure 3 presents the standardized structural path coefficients along the arrows of the proposed research model. To avoid cluttering the figure, the indicators of the constructs are not shown.



*Significant at .05 level

Figure 3 Results of the Analysis for the Research Model

As shown in the figure, human service quality ($\beta = .19$), information quality ($\beta = .15$), system quality ($\beta = .48$), and accuracy and security ($\beta = .15$) were significantly positively related to the overall quality evaluation of the internet banking systems. System quality contributes the most to the users' overall quality perception. In all, 80% of the variance in overall quality was accounted for. However, continuous improvement did not have a significant impact on the overall quality. Moreover, information quality ($\beta = .24$), system quality ($\beta = .23$), and overall quality of the internet banking service ($\beta = .47$) were significantly positively related to the future use intention. The variance accounted for is 62%. However, human service quality, continuous improvement, accuracy and security do not have significant direct effect on the future use intention.

DISCUSSION AND CONCLUSIONS

Based on the DeLone and McLean's IS success model, we have developed a scale that measure the human service quality of corporate internet banking and also test a model that investigates the impact of various quality dimensions on the overall quality perception and future use intention. The result show that system quality contributes the most to the quality perception of corporate, internet banking service, followed by human service quality, information quality, and accuracy and security all of which have very similar weight. This ordering of the quality attributes indicated that when judging the overall quality of the corporate internet banking service, customers focus much more on how well the website is running in term of ease of use, good design, reliability, and accessibility. Human service quality is not as important as the system quality because customers may not need to contact the bank personnel if they do not encounter any problem when using the e-banking system. However, when they do need to contact the bank personnel, how the employees are providing service to them is still an important factor that the customers consider when evaluating the quality of the internet banking service.

The factor accuracy and security, after separating from the general system quality factor, only have a weak relationship with the overall quality perception. Most of the discussion suggests that security is a major concern of the customers; it is not in this case. One possible reason is that we surveyed the existing users of the Internet banking of the XYZ Bank. The respondents might have fully evaluated these issue before they adopted the Internet banking provided by XYZ Bank and they also has gained experience

when using the system. They should perceive security being already at acceptable levels; otherwise, they wouldn't use it. After they began to use it, these factor was not significant any more as long as no great changes occurred. Another reason may be due to the nature of banking in general and corporate banking in particular. There are very stringent regulations that bank need to follow, thus the bank customers may believe that the security of the internet banking system should not have much problem. The corporate customers also have closer relationship with the bank so that they are less concern about the security issue.

Information quality contributes only slightly to the perception of the overall quality, but it has a moderate direct impact on the future use intention. Combining its indirect effect on the intention through overall quality, its effect on future use is only second to system quality.

Amongst the antecedents of the future use intention, overall quality has the biggest impact, followed by information quality and system quality which have very similar direct effect. The result also shows that human service quality and accuracy and security do not have direct effect on intent, their effects are totally mediated by the overall quality perception. On the contrary, system quality and information quality do affect the intention directly. Therefore, when combining the direct and indirect effects, the system quality should have the largest impact on future use intention, followed by information quality. Human service quality come in third and accuracy and security is the last amongst the factors that have effect. Continuous improvement does not have relationship with both overall quality and intention. Thus, the bank should put more resource into the development of the technical and informational aspect of the online banking system. If the online system is good, the need for customer service may be minimal. However, if the design of the system is bad, the customers may give up using it before it needs the customer service.

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CRITICAL SUCCESS FACTORS FOR ERP IMPLEMENTATION: A CONTENT ANALYSIS OF EMPIRICAL FINDINGS

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ABSTRACT

Enterprise resource planning (ERP) systems are software packages that allow companies to have greater real time visibility and control over their operations. Through a review of the ERP literature, seven critical success factors (CSFs) were identified based on the study of Nah and Delgado (2006). Content analysis was then employed on 16 published articles that reported CSFs for ERP. Correspondingly, this paper aimed to combine various results in order to determine the CSFs that contribute to success in the implementation of ERP systems. We found that the ERP CSFs referred to top management support and championship in a majority of articles, while communication was less mentioned.

Keywords: Enterprise resource planning, ERP, Critical success factors, CSF

INTRODUCTION

The rapid development of information technology nowadays forces industries to face not only regional or national competition but also global competition. Under this competitive environment, companies rely on various information technologies to enhance their competitiveness and operation performance. Specifically, an Enterprise Resource Planning (ERP) system is a very important information technology infrastructure specified in blueprints for becoming e-enterprises. ERP systems improve the efficiency of management decisions and are functionally flexible in adjusting with the changes in business needs [39]. Furthermore, an ERP system has the ability to integrate organizational resources and to support organizational strategies. Therefore, it is becoming more and more important in modern businesses [33] [37].

Since the mid-1990s, companies around the world have begun to value and to implement ERP systems [20]. Although organizations invest huge amounts of money in the ERP system, there are many cases of implementation failures. This is because ERP system implementations are critical, costly, and time consuming [27] [9]. Furthermore, ERP implementation failures can bring about calamities for companies [31]. Therefore, its implementation is a highly important management issue in the ERP literature.

Given the large financial commitment that an ERP project requires and the potential benefits it can offer if successfully implemented, it is important to understand what is needed to ensure a successful ERP implementation. Previous studies focused mostly on ERP system selection and successful ERP implementation issues [33] [3]. Furthermore, many researchers also explored the critical success factors of ERP or IT project implementation [14] [15] [6]. Even though many critical success factors for ERP implementation have been reported in academic journals with many cases studies, however, few studies summarized and analyzed their results systematically. Thus, we are unable to get the whole picture of CSFs for ERP implementation. In this research, we used content analysis to infer from the published articles the factors that lead to successful ERP implementations. Correspondingly, the primary purpose of this research is to combine various results to determine the critical factors that contribute to the success in the implementation of ERP systems.

OVERVIEW OF THE CSFs FOR ERP IMPLEMENTATION

ERP implementations always cost firms a lot, but the failure rates are still high. Therefore, there are many implementation system studies that are devoted to justifying the success of ERP implementations. Among them, numerous authors have identified a variety of factors that can be considered as critical for the success of an ERP implementation. For instance, Ehie and Madsen (2005) identified eight factors that impact ERP implementation. Through empirical studies, six out of the eight factors were identified to explain 86% of the variances that impact ERP implementation. These factors are project management principles, feasibility and evaluation of the ERP project in the firm, top management support, business process reengineering, consulting services, and cost/budget issues. In another study, Somers and Nelson (2001) asked US executives to rank ERP CSFs and generated the following "Top 10" in terms of the mean score (from 1 = low to 5 = critical): Top management support (4.29), Project team competence (4.20), Interdepartmental cooperation (4.19), Clear goals and objectives (4.15), Project management (4.13), Interdepartmental communication (4.09), Management of expectations (4.06), Project champion (4.03), Vendor support (4.03), and Careful package selection (3.89).

These previous studies addressed the key implementation issues of the CSFs. However, these factors were divergent, and some

were even overlapping. In order to gather these works systematically and understand clearly the CFSs for ERP implementation, we therefore adopted the categorization of ERP CFSs as proposed by Nah and Delgado (2006). They organized these CFSs into seven main categories, namely, (1) Business Plan and Vision, (2) Change Management, (3) Communication, (4) ERP Team Composition, Skills, and Compensation, (5) Project Management, (6) Top Management Support and Championship, and (7) Systems Analysis, Selection, and Technical Implementation. Each of these seven factors can be further described by their sub-factors. These seven categories and their sub-factors are listed in Table 1.

Table 1
Categorization of ERP Critical Success Factors

<p>1. Business plan and vision Business plan/vision Project mission/goals Justification for investment in ERP</p>	<p>2. Change management Recognizing the need for change Enterprise-wide culture and structure management Commitment to change-perseverance and determination Business Process Reengineering Analysis of user feedback User education and training User support organization and involvement IT workforce re-skilling</p>
<p>3. Communication Targeted and effective communication Communication among stakeholders Expectations communicated at all levels Project progress communication</p>	<p>4. ERP team composition, skills, and compensation Best people on the team Balanced or cross-functional team Full-time team members Partnerships, trust, risk-sharing, and incentives Empowered decision makers Performance tied to compensation Business and technical knowledge of team members and consultants</p>
<p>5. Project management Assign responsibility Clearly establish project scope Control project scope Evaluate any proposed change Control and assess scope expansion requests Define project milestones Set realistic milestones and end dates Enforce project timeliness Coordinate project activities across all affected parties Track milestones and targets</p>	<p>6. Top management support and championship Approval and support from top management Top management publicly and explicitly identified project as top priority Allocate resources Existence of project champion High-level executive sponsor as champion Project sponsor commitment</p>
<p>7. Systems analysis, selection, and technical implementation Legacy system Minimum customization Configuration of overall ERP architecture Vigorous and sophisticated testing Integration Use of vendor's development tools and implementation methodologies ERP package selection Selection of ERP architecture Selection of data to be converted Data conversion Appropriate modeling methods/techniques Troubleshooting</p>	

Sources: [22]

RESEARCH METHODOLOGY

Data Selection

Considering the nature of the research on CSFs for ERP implementation, it would be difficult to group the literature under any specific disciplines because the CSFs for ERP implementation articles are scattered across various journals. In order to narrow the range, the data generation process seeks to analyze academic journals for information related to the factors stated within published articles. The selection of journals was made using the Social Science Citation Index (SSCI), which lists special issues on ERP. Since the mid-1990s, ERP has begun to be valued and implemented by companies around the world; thus, the period from which we scanned the key information science (IS) journals was from the mid-1990s to 2006. The papers were chosen through a library database by searching for titles that contained either the keywords "success/succeed," "critical

issues/factors,” or “ERP.”

There were 45 articles found in the initial search of the literature. The full text of each article was reviewed to eliminate those articles that were not actually related to ERP CSFs. The search yielded 16 articles on ERP CSFs from 12 journals. Each of the 16 articles was carefully reviewed and classified based on the work of Nah and Delgado (2006) into seven categories and their sub-factors as shown in Table 1. Although this search may not provide a universal solution, it serves as a comprehensive platform for understanding CSFs for ERP implementation research.

Content Analysis

Content analysis is a highly flexible research method that can be applied to many problems in information studies with varying research goals and objectives [35]. Content analysis is “a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use” [18]. The primary purpose of this research is to determine the successful factors that impact ERP implementation. In this research, content analysis had been used to infer from published articles the factors that lead to the success of an ERP project.

RESULTS AND ANALYSIS OF THE CLASSIFICATIONS

Each of the 16 articles was scrutinized to identify the ERP CSFs that may be classified into seven categories as proposed by Nah and Delgado (2006). These articles were analyzed by year of publication, journal, and the classifications of ERP CSFs. The results of the content analysis are presented below.

Distribution by Year of Publication

The distribution of articles published by year, from 1999 to 2006, is shown in Table 2. Of the 16 articles, the greatest number of research output in ERP CSFs was generated in 2005.

Table 2
Distribution of Articles by Year

Publication Year	Number of Articles
1999	1
2000	1
2001	0
2002	3
2003	3
2004	2
2005	4
2006	2

Distribution of Articles by Journal

In our results list, there were a total of 12 different journals that published ERP CSFs articles. Table 4 lists the journals that published one or more articles on ERP CSFs. Most of these journals were IS/IT journals. Table 3 shows that *Information & Management*, *Int. J. Production Economics*, *European Journal of Operational Research*, and *Computers in Industry* had more than one article on ERP CSFs in their IS and IT journals. *Information & Management* caters to managers, professionals, database administrators, and the senior executives of organizations who design, implement, and manage information systems applications. Meanwhile, *Int. J. Production Economics* focuses on topics treating the interface between engineering and management. Then the *European Journal of Operational Research* publishes high-quality and original papers that contribute to the methodology of operational research (OR) and to the practice of decision making. Finally, *Computers in Industry* publishes original and high-quality application-oriented research papers, and the general topics include research on the integration of business process support such as in enterprise modeling and ERP.

Distribution of Articles by CSF Attributes

Based on the work of Nah and Delgado (2006), we organized the ERP CSFs into seven main categories. This research adopted content analysis to understand the order of emphasis that the literature placed on CSFs for ERP implementation. Table 4 shows the distribution of the articles over the seven main categories. Thirteen of the sixteen papers indicated that top management support and championship were the most critical successful factors for ERP implementation. Of the 16 papers, communication got the least support with only nine. The priority of the aforementioned seven CSFs for ERP implementation was ranked as follows: top management support and championship (13 articles), change management (12 articles), project management (12 articles), systems analysis, selection and technical implementation (11 articles), business plan and vision (10 articles), ERP team composition, skills and compensation (10 articles), and communication (9 articles).

Table 3
Journals with One or More Articles on ERP CSFs

Journal	Number of articles
Information & Management	2
Int. J. Production Economics	2
European Journal of Operational Research	2
Journal of Computer Information systems	1
International Journal of information Management	1
Computers in Industry	2
International Journal of Human-Computer Interaction	1
Industrial Management & Data systems	1
European Journal of information System	1
Journal of Information Technology	1
IEEE software	1
International Journal of Production Research	1

DISCUSSION

In this section, we reflected on our research findings. The seven ERP CSFs are discussed by ranking as follows.

Top Management Support and Championship

Top management support is needed throughout the implementation process. Management support means top management advocacy, provision of adequate resources, and commitment to the project [25]. The ERP implementation must receive approval and support from top management, and top management must in turn publicly and explicitly identify the project as a top priority [22] [5] [7]. Thus, in prior literature, top management support was considered to be the most important critical success factor for ERP implementation [15] [29].

Change Management

ERP implementations may initiate change that may cause resistance, confusion, redundancies, and errors, if not managed effectively [29]. Therefore, change management is important, starting at the project phase and continuing throughout the entire life cycle [23]. Thus, recognizing the need for change in order to stay competitive is very important [12]. Change management includes enterprise-wide culture and structure change management, business process reengineering, user education and training, and so on. The resulting changes may significantly affect organizational structures, policies, processes, and employees.

Project Management

Successful ERP implementation requires that the organization engage in excellent project management [32]. This includes assigning responsibility, clearly establishing project and controlling project scopes, and defining project milestones. The project scope must be clearly defined at the outset of the project and should identify the modules selected for implementation as well as the affected business processes [32]. The project must then be formally defined in terms of its milestones. The success of the project can be gauged by completion dates, costs, quality, and system performance [23].

Systems Analysis, Selection, and Technical Implementation

Software analysis, selection, and technical implementation are essential at the beginning of the project phase. Project managers have to make decisions on the level of functionality and approach in order to link the ERP system to the legacy systems. Enterprises may also integrate other specialized software products with the ERP suite to best meet business needs [19]. Furthermore, one of the first and most important steps in ERP implementation is the selection of an ERP package [4]. In relation to this, Zhang et al. (2005) proposed that enterprises have to find the most suitable ERP packages in the market to ensure perfect match between the ERP system and their specific business industry and requirements.

Table 4
The Distribution of Articles by CSF Attributes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	no	%
1. Business plan and vision			●	●	●	●			●	●		●		●	●	●	10	63
1.1 Business plan/vision			◎	◎						◎				◎	◎		5	31
1.2 Project mission/goals					◎	◎			◎			◎		◎		◎	5	31
1.3 Justification for investment in ERP																	0	0
2. Change management		●	●	●		●	●	●	●	●	●		●		●	●	12	75
2.1 Recognizing the need for change			◎			◎		◎		◎					◎		5	31
2.2 Enterprise-wide culture and structure management		◎	◎			◎	◎	◎	◎	◎			◎		◎		2	13
2.3 Commitment to change-perseverance and determination		◎	◎					◎	◎			◎				◎	8	50
2.4 Business Process Reengineering		◎						◎	◎								0	0
2.5 Analysis of user feedback		◎	◎					◎	◎			◎					6	38
2.6 User education and training		◎						◎									2	13
2.7 User support organization and involvement																	0	0
2.8 IT workforce re-skilling																	0	0
3. Communication				●	●		●		●	●	●	●		●	●		9	56
3.1 Targeted and effective communication															◎		1	6
3.2 Communication among stakeholders																	0	0
3.3 Expectations communicated at all levels																	0	0
3.4 Project progress communication																	0	0
4. ERP team composition, skills, and compensation		●		●		●			●	●	●	●	●		●	●	10	63
4.1 Best people on the team						◎						◎					1	6
4.2 Balanced or cross-functional team													◎				1	6
4.3 Full-time team members													◎				0	0
4.4 Partnerships, trust, risk-sharing, and incentives																	1	6
4.5 Empowered decision makers																	0	0
4.6 Performance tied to compensation																	0	0
4.7 Business and technical knowledge of team members and																	0	0
4.8 consultants																	0	0
5. Project management			●	●	●	●	●	●	●	●	●		●		●	●	12	75
5.1 Assign responsibility																	0	0
5.2 Clearly establish project scope							◎						◎				2	13
5.3 Control project scope																	0	0
5.4 Evaluate any proposed change																	0	0
5.5 Control and assess scope expansion requests													◎				0	0
5.6 Define project milestones																	0	0
5.7 Set realistic milestones and end dates																	0	0
5.8 Enforce project timeliness																	0	0
5.9 Coordinate project activities across all affected parties																	0	0
5.10 Track milestones and targets																	0	0
6. Top management support and				●	●	●	●	●	●	●	●	●	●	●	●	●	13	81

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championship					⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	12	75
6.1 Approval and support from top management												⊙				1	6
6.2 Top management publicly and explicitly identified project as top priority					⊙								⊙			2	13
6.3 Allocate resources																0	0
6.4 Existence of project champion																0	0
6.5 High-level executive sponsor as champion																	
6.6 Project sponsor commitment																	
7. Systems analysis, selection, and technical implementation	●	●	●	●	●	●			●	●		●	●			11	69
7.1 Legacy system			⊙									⊙				3	19
7.2. Minimum customization								⊙								0	0
7.3 Configuration of overall ERP architecture		⊙	⊙													1	6
7.4 Vigorous and sophisticated testing					⊙	⊙					⊙					0	0
7.5 Integration			⊙		⊙	⊙					⊙					5	31
7.6. Use of vendor's development tools and implementation methodologies		⊙				⊙			⊙							0	0
7.7. ERP package selection			⊙								⊙		⊙			0	0
7.8. Selection of ERP architecture													⊙	⊙		3	19
7.9 Selection of data to be converted																0	0
7.10 Data conversion																4	25
7.11 Appropriate modeling methods/techniques																	
7.12 Troubleshooting																	

Business Plan and Vision

It is very important to have a clear vision, goal, and business plan for an ERP project. The project needs a clear vision to guide the ERP implementation. Cleland and King (1983) proposed that the first phase of an IT project should start with the conceptualization of goals and ways to accomplish these. Finally, a clear business plan and vision to steer the direction of the project is needed throughout all stages of the ERP life cycle [19].

ERP Team Composition, Skills, and Compensation

The implementation team is important because it is responsible for creating the initial, detailed project plan or overall schedule for the entire project. ERP implementation teams should be composed of full-time team members, empowered decision makers, and the best people in the organization. The team should be balanced, cross-functional, and performance-tied to compensation [22]. Furthermore, the skills and knowledge of the project team are also important. Somers and Nelson (2004) pointed out that the project team's business and technological competence is a decisive element in the success or failure of ERP implementation.

Communication

Communication is one of most challenging and difficult tasks in any ERP project [34]. As it helps to minimize possible user resistance, communication is viewed as having a high impact from initiation to system acceptance [29]. Communication should include targeted and effective communication, communication among stakeholders, expectations communicated at all levels, and project progress communication. Indeed, effective communication is critical to ERP implementation [12].

CONCLUSION

ERP system implementations are complex undertakings and thus many of them are unsuccessful. It is therefore important to determine what are the critical success factors that drive ERP project success. In this paper, we organized ERP CSFs into seven main categories based on the work of Nah and Delgado (2006). Through the content analysis of 16 articles about ERP CSFs, we found that "top management support and championship" was mentioned the most as a critical success factor for ERP implementation, that is, from 13 papers. The ranking of CSFs for ERP implementation is shown in Table 5.

Insofar as this research only summarized and analyzed the literature, in the next stage of this research in the future, we could send out survey questionnaires to companies and ask them to evaluate the degree of criticality and importance of the success factors identified in the ERP literature. With a better understanding of the issues involved in ERP implementations, management will be able to make critical decisions and allocate resources that are required to make ERP implementation a success.

Table 5
The Ranking of Critical Success Factors for ERP Implementation

Critical success factors for ERP	number of articles	%	ranking
Top management support and championship	13	81	1
Change management	12	75	2
Project management	12	75	2
Business plan and vision	11	69	4
Systems analysis, selection, and technical implementation	10	63	5
ERP team composition, skills, and compensation	10	63	5
Communication	9	56	7

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CUSTOMER STRATEGY IN SERVICES INDUSTRIES

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ABSTRACT

Services industries are diverse, and range from the full service-only dimension through to services that support a product. In almost all cases the service involves capturing, or engaging with, the customer. A Service Value Networks (SVNs) approach offers a new way to engage with the customer. This approach moves the existing business models into the near-real-time customer tracking environment.

This paper discusses complex doorways (elucidated by a SVNs approach) through which competitive new business approaches may be better understood, and developed, in line with customer drift, and/or customer changes in sentiment. The customer decision-making process to engage in a transaction process with the business, and the specific business-customer encounter pathways that ensue, contribute to the final customer engagement decision. The ‘bricks’ (off-line physical) business and to ‘clicks’ (on-line virtual) business both fit within the SVNs approach. This approach may be applied to tertiary institutions and student monitoring.

Keywords: Service value networks, competitive, strategy.

INTRODUCTION

Services industries are diverse, and range from the full service-only dimension, like an educational training program, or nursing, through to the services that support the purchase of a product, like a new car transaction. At the other extreme to services is the product or goods dominant arena like dog food, salt, or clothing [2]. The degree of servicing component required varies inversely in conjunction with the degree of product dominance, with various industries displaying differing levels. For example a fast food store offers both services and products, and both contribute to the customer’s decision making [21].

The services arena captures a range of business solutions that fill a continuum displaying varying degrees of service and/or product component dominance. Levitt [14] suggested that there was no such thing as a service industry, but there were industries whose service components were greater, or less, than those of other industries. Levitt further suggested ‘everybody was in service.’

In order for a service to be effective, the service will, at some stage capture, or engage with, the customer [7][9]. To deliver a customer satisfying outcome, and one that delivers a true value proposition, this engagement will likely deliver something that the customer perceives to be of value [10][11][13]. This completed business-customer solution may be via an off-line (physical transaction) or an on-line (virtual e-transaction) value proposition [4].

SERVICES INDUSTRIES STRATEGIC DELIVERY MODELS

Recent research by the Siegel [22] at US Sloan’s School of Management indicated that all players in an industry benefit from aggregation or sharing of information, ideas, and knowledge. He suggested a wealth of knowledge may be garnished by combining organizational expertise. Aggregation analysis delivers relationships with greater combined competitiveness. It was further posited that it remained prudent for organizations, like the pharmacy industry, to consider their e-strategy, and to add aggregated information and knowledge capabilities into their competitive frameworks [22][27]. This supports emerging new business models involving multiple aggregations like e-pharmacies, and the empirically demonstrated service value networks (SVNs) approach.

Emerging technologies often deliver disruptive solutions that may radically change the status of competition in a services industry [1][5]. Such changes are often followed by changes in service business models. For example, the early railways service models consisted of the customer going to railway station, obtaining a railway travel ticket to a location, and travelling on that specific train. The train schedule was set by the railways management, and was subject to a host of potential delays. This model may be termed a low services integration model, and it exemplifies a rail network, with little or no computerized operations. This model constitutes the oldest and least value adding model. It represents the low service integration model.

The next level of customer engagement informed the customer of how the train scheduling and its inter-connectivity, was operating each day. This involved a degree of networked (and often computerized) operations, as shown in Figure 1. Here the railways business transporters (trains), were linked to the logistics systems and the railways network acted fairly harmoniously whilst providing greater levels of customer information, servicing, and customer perceived value. The management was also better able to monitor its performance. To move from the low service integration model up to this service supply chain integration model required the incorporation of new technologies and systems. This change was not incremental. It required new approaches, and greater sophistication, and it represented a disruptive transition [1][5].

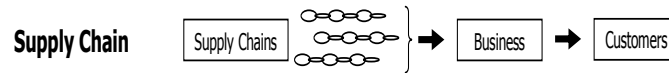


Figure 1: Supply Chain Interconnectivity

Next, many railways moved beyond supply chain models, targeting higher levels of responsive, customer demand-driven solutions, as shown in Figure 2. Here in response to the customer initiated action (labeled ‘1’), a business station assistant aiding a customer was able to search for, and to locate, responses to in-depth customer requests (labeled ‘2’) – by tapping their well-integrated network information systems. Thus the best solutions for the customer were delivered. In addition, the customer-related railways database was gradually updated with each new customer request (and / or variation). Such additions, when assessed by railway management, could then be transcribed into load capacity changes (more transport carriages per train) or even new train schedules. Thus, the response capabilities of the railways moved beyond supply chain towards demand chains systems [6]. Sampson [20] suggested that service supply chains, when engaging with the customer via short-lived, customer generated, two-way communication channels (that generated business responses which were then relayed into customer service), were better termed demand chains. Engaging these demand chains was seen as an additional mechanism to deliver further enhanced customer perceived value.

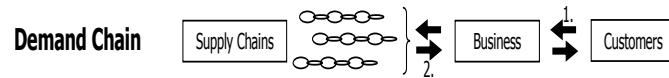


Figure 2: Demand Chain Interconnectivity

The value network, shown in Figure 3, was the next step in delivering customer value. Early value network approaches adopted a value chain approach. These targeted the real-time environment. Further streamlined efficiencies were deliverable. Timmers [24], like Porter [19], noted that the value chain was more than a series of discrete steps, and that technology offered new integrated solutions options. The railways moved down this pathway. The built flexibility into their intelligent, supply chain ‘engines’ [26], interconnected their high level logistics systems, and set about delivering efficient delivery systems that in some cases linked to on-line options [3]. Van Looy, Gemel and Dierdonck [25] considered the value chain as a ‘value constellation’, and proposed a more ‘holistic view of the way innovation processes created value for the final customer.’ Thus the value network approach to a customer request (labeled ‘1’) was established. This is shown as Figure 3. The railways too recognized this approach to be one that was capable of adding value, and set about incorporating other refinements to pick-up on a number of complex value chain relationships [23]. They sought to link strategy, management, investment, operations, marketing, service and the environment [8][16][19], and intangible assets like services [15], and customer segmentation [17] into their value network business model, adding aspects of these capabilities to their customer response kit (labeled ‘2’).

Hence, the value network approach delivered added value solutions in addition to the: value; demand and service chains; and sources external to (and beyond) the supply chains. Higher levels of demand forecasting, accuracy, and faster higher quality servicing were delivered. Occasionally value adds to supplement customer satisfaction – like information guides to events, and rewards were also offered to innovate and trial additional business response capabilities.

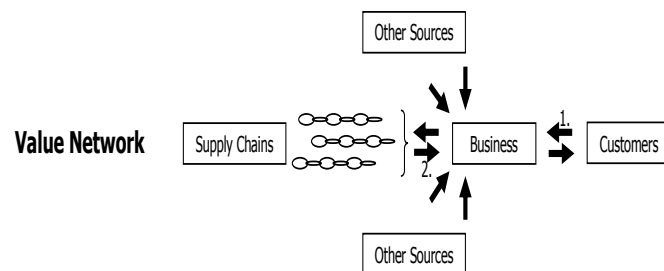


Figure 3: Value Network Interconnectivity

The next level of sophistication in customer engagement business modeling was customer relationship management (CRM). CRM delivered the methodologies, software and internet capabilities necessary to enable the business to manage its customer relationship in an organized way. Here the railways ran customer satisfaction surveys, and then used these as management assessment tools, to adjust their CRM business model incrementally over time. This approach better aligned the business to its customer sectors. The CRM gap analysis approach to improving the business to customer interaction did not deliver the tools to fully customerize or build consistent one-on-one relationships.

The complex CRM approach, shown in Figure 4, was harder to develop, and was not widespread in and across services industries. It aggregated and integrated the business value chain contributions from its input blocks of information (including immediate environmental sources) into a net business package (labeled '2') suitable to meet the customer request (labeled '1'). However, these CRM systems still adjusted for consumer shifts in incremental ways. In Australia, many services businesses still do not achieve this model. For example, across the industry the railways employs combinations of the services, demand and value approaches. QRail offer value adds like Dylan concert and how to get there, but as yet no Australian railways network offers combined on-line and off-line services that approach the CRM model.

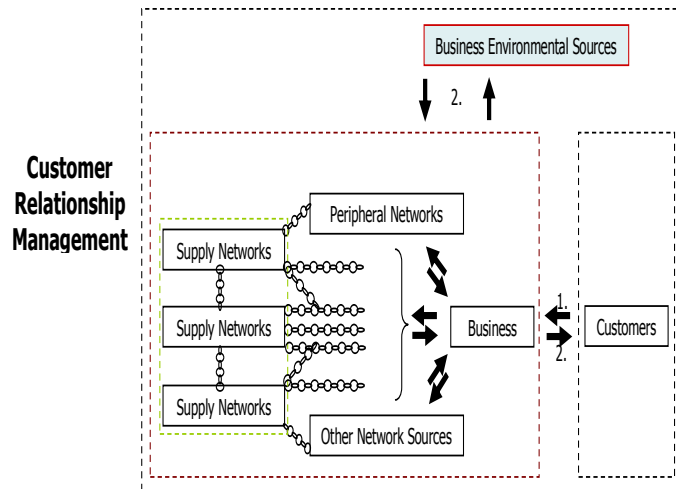


Figure 4: Customer Relationship Management

SERVICES VALUE NETWORKS

Now in its infancy, the industry-wide, environmentally-interactive service value networks (SVNs) approach captured the next level of disruptive services business integration. This model is shown in Figure 5. Here, in response to the customer request (labeled '1'), the business engages integrated, networked, intelligent, computational business and environmental solutions to intelligently deliver (labeled '2') its best customer solution. This solution may be delivered via a customer-serving staff person, or via a business representative connecting by phone, or via direct on-line customer engagement into the on-line business network. For example, in response to a customer generated request, the SVNs engage the business intelligence tools, possible solutions are assessed, and the software system delivers the best agile, dynamic, flexible, customized business-customer encounter possible. This solution may offer 'elevated-services', and / or 'added-value' solutions. These highly complex 'living' networks are built into the complex, disruptive SVNs business model, and remain very different to the above CRM integration model.

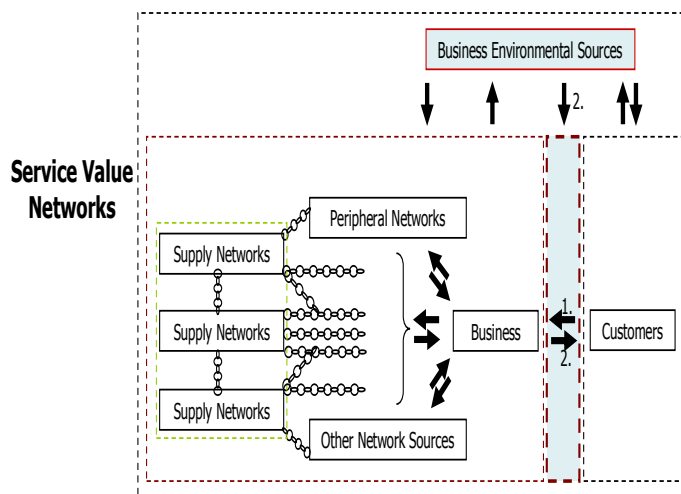


Figure 5: Service Value Networks Interconnectivity

This SVN's model is currently under commercial development by the author for the main customer focused arm of QRail, and is also under early development for a tertiary educational services provider.

Considering the railways, this SVN's approach seems to be a simple step from CRM. However, the SVN's approach builds a near-real-time, highly integrated business solution that is heavily dependent on the business intelligence and data collection and storage systems.

Previously, such broad data sourcing, and subsequent fuzzy logic / artificial intelligence sifting systems have been built on less focused approaches. They have not captured the environmental effectors appropriately, and have not had the capacity to deliver such a SVN's focused customer solution. For example, a CRM approach does not link all the bi-directionality between all the front-end business cells into its customer focused solutions set

Thus a new approach to data capture, data analysis and the construction of a near-real-time system is required, and this is delivered via a SVN's approach.

SMART BUSINESS NETWORKS

One final all-encompassing, business-customer interaction level is yet to be attempted, and that is the smart business networks (SBNs) model (shown in Figure 6). This model is really an extension, or broadening, of the SVN's model. Here, in response to customer demands (labeled '1'), the business or industry, seeks to incorporate an even wider range of business contributing sources, so that it may deliver optimal customer aligned solutions for both itself and its networks, and its customers, and it seeks these solutions under economically acceptable conditions to the business (labeled '2').

The CRM, SVN's and SBMs approaches each draw on new and additional knowledge blocks, which are built on strategically deployed communications and information systems. Thus, each offers a new means to further develop competitive advantage through additional intelligence, and improved software deployment. As these models become more complex, and they are more skillfully used by management, they also become less easy to copy, hence the strategic effects of Porter's (Porter [19] new entrants is often significantly reduced. Provided the business moves in line with changes in its environmental and customer shifts or innovative changes, the business may also be a position where it more likely to retain a sustainable competitive advantage. This does not necessarily secure its business position – as new innovations by a competitor, or the advent of new technologies may institute a major change in customer focus. Thus, a contingent SVN's scenarios set analysis on competitors, technologies, innovation and customer drift is also modeled, monitored, and continually fed back to management. For example, new internet protocol like IPV6, new WEB2 tools, key software upgrades/rewrites, mobile, e-business/e-commerce, 5G systems, and the like may necessitate SVN upgrades, or redesign. However once built a SVN's business model is quite agile, and is generally readily changeable [1][5][11].

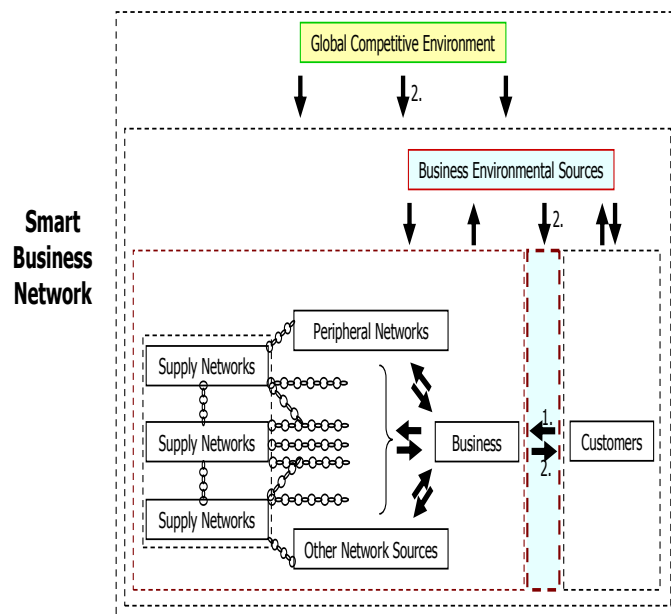


Figure 6: Smart Business Networks Interconnectivity

THE SERVICES VALUE NETWORKS APPROACH

A commonality for the different levels of business integration still exists, in that to enable an exchange to occur, all business and

customer interaction systems funnel into a final front-end business-customer encounter (or the contact divide between the business and the customer).

Understanding the business-customer encounter and its complex interaction pathways (or channels) allows the business to utilize its bi-directional sourcing and transfer systems to enhance its delivered customer specific solutions. This procedure [10][11] allows parameters relevant to the front-end business-customer encounter interface to be captured, sifted, and sorted. Ultimately premium quality business solutions are delivered to the customer under the interacting environmental conditions that prevail at the time. This SVN's generic model developed using structural equation modeling, is depicted in Figure 7, and is explained using a railways SVN's model.

Considering the railways for example, electronic mapping of trains and their availability, e-ticketing, customer requirements, and quality of service all contribute to the final outcome of winning satisfied transported numbers, and delivering maximum positive customer perception solutions. Such a solution involves the development of targeted, price acceptable, innovative service/product solutions.

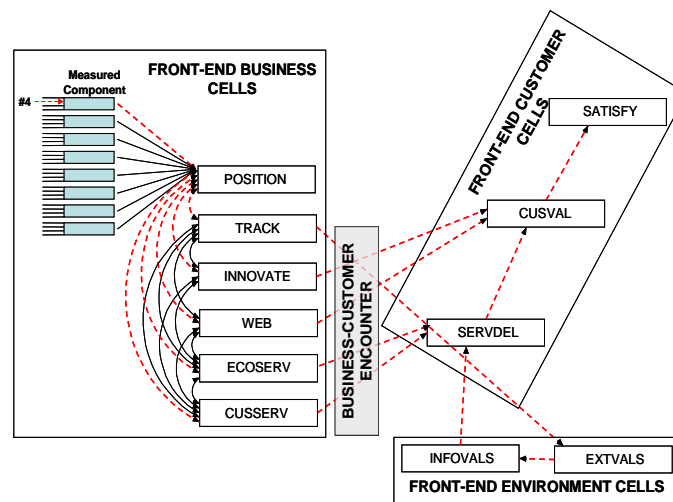


Figure 7: SVN's Empirically Derived Model [11]

This SVN's empirically derived solution captures the operational front-end business cells that house: (1) the executive and management front-end strategic positioning (POSITION), (2) the marketing front-end customer targeting (TRACK), (3) the railways innovative opportunities and inclusions (INNOVATE), (4) the intelligent communicative, web and mobile technologies (WEB), (5) the railways economic imperatives (ECOSERV), and (6) the railways services and products offered (CUSSERV). These six operational front-end business cells engage with each customer via a business-customer encounter, and deliver a measured level of customer perceived: (1) servicing (SERVEL), (2) value (CUSVAL) and (3) satisfaction (SATISFY). This business-customer encounter is also influenced by external environmental factors which are also captured as: (1) local business generated interactors (INFOVALS) or as (2) customer externally sources interactors (EXTVALS).

Each front-end business, customer, and environmental cell block, is built on literature-grounded, empirical, and carefully defined measurement interactors, which are drawn onto their appropriate front-end cell block using factor procedures. The unique services-industry-specific, structural equation model solution presents a series of interaction options. Adjusting an interactor creates a knock-on effect across the system. For example, increasing the influence of the second position interactor creates a network of business effects (shown as dotted lines in Figure 7) that ultimately affect the customer. With some service industry solutions, environmental effects are also detected as a result of such interactor changes. These effects channelling across the business-customer encounter interface to the customer, may then be optimized, and thus a new potentially improved, business model is deliverable.

Considering the railways, these fully integrated SVN's systems build on: (1) existing railways networked back-end logistics solutions, (2) other communications efficiencies, and (3) a detailed assessment of the competitive environment. Thus, genuine threats to the existing, and planned, railways business structures may be incorporated. The railways may use its website to offer e-tickets, and other value adds (like special entertainment and sporting events), to its customers, as a virtual shop front, and as part of its SVN's customer solution set. The e-ticket system may be collaboratively linked to station entry/locality-transport/exit system, and may deliver a customerized (or individual choice) selection. Customer recognition on a later follow-up (or revisit) may be sued to match past transaction to the customer. The business may suggest that if the customer wants the same outcome as last time just press a button – thereby saving the customer time and effort.

Numerous other value additions are being developed including price differentiation for those working in short shifts outside peak travel times, elderly ex train convenience pick-ups to desired localities and returns, shopping centre location servicing, commercialization facilities, late night travel systems and the like. Thus, customer connectivity via bricks (physical contact with station persons) or clicks (internet or virtual station ticketing to normal destinations or to special event) may be jointly captured in this SVNs system, thereby reducing the divide between off-line and on-line customer solutions.

AREAS FOR FUTURE RESEARCH

Thus far the empirically modeled and tested SVNs approach has identified key front-end cells and their measurement interactors, within the pharmacy industry [11]. This SVNs model is now being developed for the railways, and also for a tertiary institution in Australia. The fully-operational management solution is being generated, prior to the complete SVNs solution. Testing to date clearly shows different services industries, applying SVNs approaches may show alternate, different strength, and differing combinations of business-customer encounter pathways. Thus, SVNs do offer a next stage in retaining longer-term competitiveness, and in moving more in-sync with both the customer, and immediate environment and in a near-real-time manner.

The SVNs approach is also under development for the tertiary education sector – particularly as applied to universities and to their student monitoring processes. For example, in analysing international and domestic student intakes currently Australian universities survey measure student entry and exit, and use this data to build a perceived satisfaction measure. Other externalities – like business perceived deliverables, environmental considerations and governmental inputs, may also be captured. The SVNs approach delivers a dynamic solution, which may be built into management approaches, allowing for a near-real-time analysis of the competing business, customer and environmental parameters. Hence, by engaging a SVNs approach at the tertiary level, additional competitive approaches across management, marketing, innovation, communications, and services are released. This in turn may deliver new pathways to tertiary institution strategic positioning – but it remains up to the tertiary institution as to how it selects to absorb and adapt to such SVNs generated competitive information.

CONCLUSIONS

The SVN approach to customer strategy, developed for the pharmacy industry, and being rolled out in the railways services industry, likely has application across most services and products industries.

This SVNs research opens new doorways through which competitive new business approaches may be better understood and developed in line with customer drift or customer changes in sentiment.

It highlights the extremely complex nature of the customer decision-making process, and the considerable encounter pathways that contribute to the final customer decision to engage in a transaction with the business.

Discussion herein shows why SVNs are important to business, and shows how this SVNs approach may better align the business to the customer – delivering a smart business solution!

Management understanding of how strategic direction, targeting, economic reward, and enhanced value-adding solution sets indirectly affect the business-customer encounter shows new pathways to enhancing business performance (capabilities and delivery).

Management may target enhancing customer perception of its offerings by personally targeting individual customers with specific customerized solutions, and hopefully will derive greater customer perceived satisfaction with their offering.

Within the Australian railways industry, new SVNs solutions are currently being developed – delivering improved outcomes like: targeted elevated service offerings; increased customer satisfaction; and minimal business inefficiencies, and greater customer perceived satisfaction measures.

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John Hamilton has extensive business, management, consulting, and research experience, and remains a highly active researcher across both off-line and on-line environments. His current specializations include: strategic innovation; strategic web-based instruments; QFD; business competitiveness; strategic positioning; strategic e-marketing; logistics; service value networks; industry-wide future technologies and solutions; and the performance, value and alignment of customer-business interface

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ABSTRACT

With the advancement of networking and mobile devices, more and more mobile business processes are automated and supported using the technologies. Mobile businesses processes are naturally exposed to uncertainty and dynamic changes that require distributed coordination. In large business organizations, the complexity of the processes also makes central control difficult due to the large number of variables to consider and mobile workers involved. To this end, this paper presents a flexible coordination mechanism for mobile workforce where multiple task assignment models are used together to adapt to dynamic changes and achieve efficiency. The overall system is flexible in that the assignment models are easily added because they are constructed as components, and the switch between assignment models are easy using manual or automated transition between the models. An example application of the model is presented using a real telecommunication organization in Europe where field workers install and repair telecommunication networks for customers.

Keywords: Business process, Mobile computing, Agent, Task Assignment Model.

INTRODUCTION

The ubiquity of network and widespread use of mobile devices allow more and more mobile business processes to be managed using the technologies. With the management of mobile business processes (mBPs), it is expected that mobile work will be performed more efficiently, delivering higher quality services to customers and business partners.

One of the unique and inherent characteristics of mobile business processes is that there is much uncertainty in mobile work compared with stationary work environment. Due to this nature, central planning and coordination often cannot reflect the frequent and dynamic changes in the mobile environment, leading to overall low efficiency of the work [1, 3, 4, 8, 10]

One of the recent trends to overcome the problem is the team-based approach wherein tasks are assigned to a team not to individual workers and the team decides who completes which tasks via a task assignment model (TAM) based on their local knowledge [7]. In line of this, this paper proposes a model of mobile task coordination that uses multiple task assignment models (TAMs) flexibly. By this approach, mobile teams can switch between different coordination methods easily, meeting the changing requirements in the uncertain environment. A novel system architecture called TeamWork is also developed where the TAMs are implemented as components so that mobile devices can receive and use different coordination mechanisms in real time.

This paper is organized as follows. The next section presents the TeamWork architecture. And then we show an illustrative example, which is followed by some details of implementation. We conclude with discussion, summary and future research directions.

TEAM TASK MANAGEMENT MODEL (TTMM)

Design Objectives of TTMM

The overall design goal of TTMM is to create a model for flexible coordination of mobile workforce. Detailed objectives are as follows:

- Multiple TAMs: The model should allow multiple TAMs to be easily created and used for coordination to meet many dynamic and distinct requirements arising in the mobile environment, because different types of mobile work or different characteristics of work environments require different TAMs. The model should also allow easy transition between TAMs so that teams can react to any changes quickly.
- Supporting mobile work: The model should incorporate modelling components that are essential for representing the common aspects of team-based mobile work, such as adjacency information between mobile teams and a pool model of skill and capabilities.
- TTMM as a meta-model: The model should be general to a certain degree so that it can be applied to many different types of mobile work environment.
- Abstraction for component-based architecture: For easy and quick deployment of TAMs, the model should have a proper abstraction that can be easily incorporated into a component-based architecture.

Formal Modelling of TTMM

A team-based task management model (TTMM) defines the structure and coordination processes for the management of team tasks. Team structure describes which roles are involved in the management and a coordination-process the flow of the

interactions among the defined team roles. Meta coordination process defines the sequences among the coordination processes in the task management. A TTMM provides all the participating agents in target system with contextual information on the team working. For the convenience of interpretation of the agents, this paper adopts XML as the basic description language of TTMM. A part of the DTD of TTMM is as follows.

```

<!ELEMENT tmm (team, tam+, ttr+, adj-team+, def-tam)>
<!ELEMENT team (id, name, area)>
<!ELEMENT tam (tlm, role+, service+)>
<!ELEMENT tlm (ini-stat, status+, trans+)>
<!ELEMENT trans(pre-sta, service, post-sta)>
<!ELEMENT ttr (cond+, tam)>
<!ELEMENT cond (attr, value)>
<!ELEMENT adj-team (team-id+)>
    
```

TAM

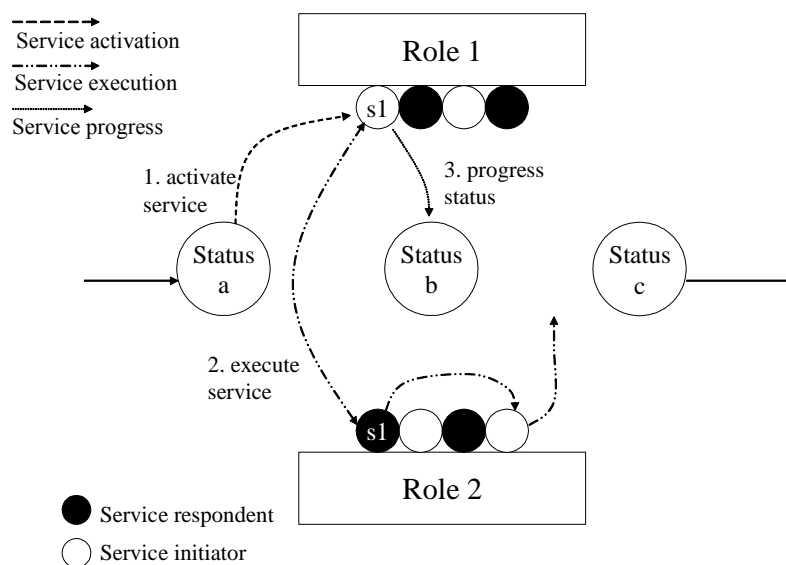


Figure 1 A diagram for a task assignment model (TAM)

A tmm is described with team information such as team id, name and responsible geographical area; adjacent teams (adj-team); task assignment model (tam) that specifies the task delivery path through the roles and related rules defined in the team; default tam (def-tam) that is the default tam that is used when a team starts a working day; and exceptional rules that enforce tasks having specific attribute values are assigned by predefined tams rather than default tam. A tam is described with task lifecycle model (tlm), participating roles and allowed services that are necessary for the management of tasks. A tlm defines the possible transition paths of task status and described with initial status (ini-stat), a set of possible task status (status) and a set of transition (trans) that defines which service can be executed when a task reached to a status and make it progress into which task status. A ttr represents a TAM transition rule where each rule is specified with a condition and a target tam. A tlm provides useful information in determining which services should be accessible by a team member or the leader. For example, in Figure 1, if the status of a task reaches “Status a”, the model informs that any team members who are in charge of role “role 1” can start a coordination service “s1”. Once any instance of role “role 1” starts the coordination service “s1” this may trigger another service “sn”. Once the coordination service is completed, it may update the task status into “status b”. A cooperative service (service) is described with cooperative service components (ccom) and their sequences (seq). The sequence of ccoms is defined by a priori ccom (pre), a posterior ccom (post) and conditions (cond) for the transition from pre to post.

APPLICATION TO A REAL EXAMPLE

A telecom company B in Europe operates about 24,000 field forces to install and manage telecommunication networks. The tasks performed by the workers are diverse, but basically consists of two types, installation and repair. The tasks are further specified by specific requirements by customers and types of errors. Currently, the company is running a centralized WFMS for scheduling and assigning tasks.

The centralized system has, as discussed earlier, the following limitations. First, the central planning and control does not consider incentives to those workers who are more skilled and productive. Second, the central planning is rigid in that the

planning cannot be changed easily at local level to variable local situations, which may lead to overall inefficiency. For this reason, the company is considering the adoption of decentralized team-based management of field tasks. The goal of the decentralized scheme can be briefly described as follows:

1. There are teams and each team has a leader.
2. Teams are usually responsible for tasks within a geographical area.
3. Team managers encourage team members to work more efficiently, but at the same time, tries to improve the overall performance of the team so that purely competitive task allocation may not lead to decrease in the overall team's performance.

For the above scheme, three TAMs were designed as presented in Figure 2. Firstly, they can use existing centralised WFMS. The use of the centralised WFMS can be done in direct-gateway or indirect-gateway-mode. In indirect-gateway-mode, all the tasks are assigned to the team members by the WFMS but the team leader should publish the assignments to make the tasks visible by the team members. Also, the team leader can modify the assignment based on his local knowledge before the tasks are published. In direct-gateway-mode, the assigned tasks by the WFMS are made visible by the team members without the interference (publication) of the team leader. Secondly, the teams can use the first-come-take rule for the team task assignments. In this mode, team tasks are put into the team task pool without any provisional assignment by the centralised WFMS. Every team member has the equal view on the task pool and can reserve any tasks they want to perform based on the first-come-take rule. The team leader can give restriction to this mode, for instance, setting the maximum number of tasks a member can reserve in a day. The team leader should be able to change from one mode into another based on the team's situation. For example, a team leader may become unavailable for a short term. In this case, s/he can either delegate his team leader role to one of the team members or change the working mode into first-come-taker mode. Furthermore, the team leader can use the two or three modes at the same time for different task instances. For example, s/he can configure the team operation so that tasks that have been retained by a team member are delivered to the team member next day via direct-gateway-mode while other tasks are assigned to team members via indirect-gateway-mode.

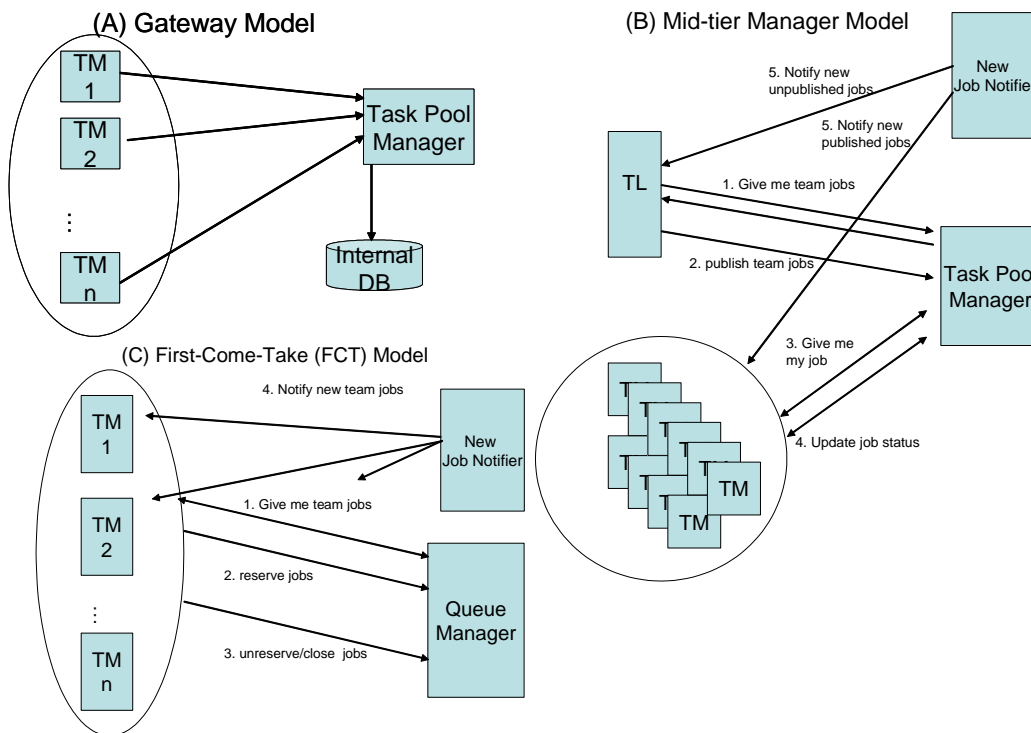


Figure 2 Three Example TAMs the Field Workforce for a Telecommunication Company

IMPLEMENTATION

TeamWork is a distributed architecture that can be used by a team of workers to manage team tasks. The core of TeamWork is a task management model that describes how a set of team tasks can be assigned or re-assigned to team members via cooperation. As a result, TeamWork consists of a task management model, participating role model and their interaction models. In TeamWork, team members can determine a task assignment model, switch to another or change rules of the model flexibly.

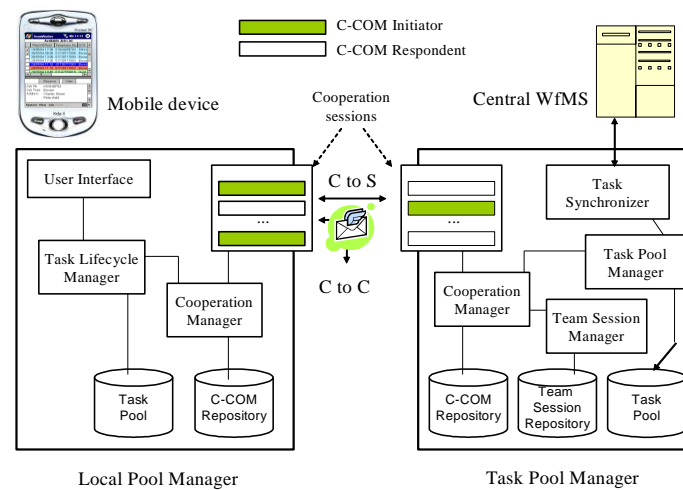


Figure3 Components and their interactions in TeamWork

Two major components of TeamWork are task pool manager (TPM) and local pool manager (LPM). TPM is normally located in the server side and responsible for the management of all the tasks and team members for a mobile business process. On the other hand, LPM is normally located in a mobile device and represents a process actor's view.

The major roles of TPM are to collect tasks from an external source for the team, initiate a task assignment model, notify any new or urgent tasks to the team and update any changes on the attributes of the tasks such as task owner or status. At its launching time, TPM reads a TTMM provided by an administrator and initialises team settings and the task pool. Task synchronizer is a sub component of TPM that connects to an external task source such as a WFMS and collects all the tasks for the team. It has been designed to use a standard interface defined by the WfMC (workflow management coalition) so that it can be integrated with heterogeneous WFMSs. Task synchronizer passes any tasks collected to task pool manager that checks the attributes of the tasks and attach a TAM to each task according to the default TAM value and exceptional rules in the TTMM. During this process, the task pool manager contacts team session manager to have the current default TAM of the team and any changes on the exceptional rules. The team session manager maintains team session repository that keeps all the history information with regard to the team configuration. Once each task is attached with a TAM, the task pool manager executes the TAM so that the task is assigned to a worker. For this purpose, the task pool manager contacts the team session manager to get the contact information of the current team leader or any delegated team member in the absence of the team leader. After that, the execution of the TAM is managed by coordination manager. In TeamWork, all coordination among team members including the team leader is performed via C-COMs [7]. A C-COM is a software component that automates coordination processes among organizational roles. It consists of two or more role components that implement the logics of the roles participating in the coordination process. For example, a C-COM implementing the auction process for a distributed task assignment will consist of two role components: auction manager and auctioneer. The auction manager role component is installed within the C-COM repository of the TPM while auctioneer role component is installed within the C-COM repository of the LPM. The coordination manager gets an instance of the auction manager role component and put into the cooperation session that executes the role component. The execution of the role component triggers a series of message exchanges with counter role components (auctioneer) in mobile devices of the workers.

An LPM is responsible for the interactions with a TPM for the collaborative management of team tasks. At its launching time, it reads the profile of the worker which specifies the worker's team profile and the roles of the worker. Based on the worker profile, it initialises C-COM repository and a task pool that contains tasks that the worker is interested in. Initialisation of C-COM repository includes selecting C-COMs based on the user role and installing corresponding responding role components of the selected C-COMs. Tasks in the task pool are largely classified into two categories: tasks already assigned to the worker and tasks in the middle of an assignment process. The worker has different views on the two types of the task on the user interface. The tasks in the task pool can have different statuses according to the task lifecycle models they are attached to. The tasks and status information are displayed on the mobile device via a user interface. Any messages from TPM are handled by the cooperation manager within the LPM. The cooperation manager identifies the relevant task of the cooperation message, and checks the progress of the cooperation process for the assignment of the task. If the message is about new task which need to be assigned to a worker, then task lifecycle manager is informed with the task information along with the TAM used so that it can create a new TLM history. Once the TLM is settled down (that is, the task is assigned either to the worker or others), then the task is either transferred into his personal task pool or removed from the pool. The message exchanges can happen between an LPM and a TPM (C to S) or two or more LPMs (C to C) depending on the used TAM.

TeamWork has been implemented as a part of mPower project [7] that aims to develop an application framework for agent-based workflow systems for mobile business processes. The major players of the framework are Personal Assistant agents that are installed on mobile devices to support mobile workers and Information Agents that collects tasks or relevant knowledge for the execution of the tasks. Local Pool Manager has been implemented within the Personal Assistant agent for the cooperative task management and Task Pool Manager is one of the core components of an Information Agent. Jade [2] has been used as the implementation platform of the agents. The user interface on mobile devices has been implemented using SWT (Software

Widget Toolkit) to enhance the performance of the overall system.

Figure 4 (b) shows the screenshots of the implementation based on the specification. The first screen shows the coordination status window which displays all the incoming or outgoing coordination items with regard to team tasks management. In the figure, the incoming coordination window has a mini-trading offer from a colleague (Jamie Jones) and it should be responded within about nine and half minutes. If the user selects the item and clicks the “view” button, the systems displays the detail of the trading offer including task information and available choices for the offer (accept, reject or return).

```

<ttm m>
<team id=suffolk>
<default-tam id=indirect-gateway-mode>
<tam id=indirect-gateway-mode>
<role id=TL \>
...
<service name="Job trading">
<ccom id=mini-trade role=ini-resp \>
<ccom id=maxi-trade role=ini-resp \>
<seq><pre>mini-trade</pre>
<post>maxi-trade</post>
<cond><attr>output</attr><val>failed
</val></cond></ service></ tam>
<tam id=first-come-take-mode>
...
<rule><attribute id=max-no-daily-
reserved-job />
<value>10</value></rule></tam>
<exception>
<cond><attr>status</attr><val>retained
</val></cond><tam id>direct-gateway-
mode</tam id></exception>
...
</ttm m>

```



(a)

(b)

Figure 4 (a) The team-based task management policy of B Company (b) the screenshots of the application based on the policy

CONCLUSIONS

The importance of mobile work continues to increase as more technologies and stronger network infrastructure become available. The distributed and mobile work environment requires flexible management of team tasks according to changing and uncertain situations. This paper addressed this problem by suggesting TTMM, Team Task Management Model, that flexibly switches task assignment models according to changing situations. The key contribution and novelty of this paper can be summarised as follows. Firstly, to the authors' knowledge, TeamWork is the first attempt to allow multiple TAMs to be interchangeably used for assigning tasks to workers. Secondly, the TTMM is the first model that abstracts the team dynamics including cooperative role and TAM management. Thirdly, this paper showed how TeamWork can be implemented using a distributed computing platform (a multi-agent platform). Further research issues include supporting easy design, creation, and management of TAMs by field workers and managers.

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SERVICE INDUSTRY BUSINESS-CUSTOMER ENCOUNTERS

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ABSTRACT

This study uses the pharmacy industry to demonstrate the applicability of a service value networks (SVNs) structural equation modeling (SEM) approach as new method to investigate services industries. The author’s theoretically developed front-end business SVNs approach to customer engagement is modelled using observed business, customer and environmentally related variables. The business and the customer engage via multiple significant interaction pathways, which combine to deliver the net business-customer encounter outcome. This SVN SEM approach sheds new light on the complexities in delivering a business-customer exchange, and offers the manager an alignment tool that targets customer satisfaction, customer servicing and customer perceived value. This SVN SEM approach offers a more complex and engaging approach to that of customer relationship management (CRM).

Key Words: Service value networks, structured equation modeling, performance, strategy, competitive.

INTRODUCTION

The author’s literature-grounded service value networks (SVNs) theoretical concept offers a new pathway to strategic and competitive positioning within a services business or across a nation-wide services industry sector. Based on the literature, and particularly empirical studies, an overarching model of the business-customer encounter may be constructed. This model displayed in Figure 1 and initially developed by Hamilton [18][19], shows that at the front-end a business engages: (1) its customer targeting and marketing; (2) its products and services; and (3) its communications and digital convergent content, distribution, and platforms. These three front-end business areas engage with the networked back-end of the business to compile business solutions suitably matched to the customer request. This sourcing may involve tapping the supply chain and also tapping external services to provide latest value adding components to the customer solution mix. These customer solutions may be provided to the customer as on-line, offline or a mixture of both on-line and off-line components. This model also depicts a difference between on-line and offline customers engaging with the business.

Figure 1 is an operations level model and it does not capture other levels of engagement that participate in dealing with a customer such as (1) strategy and competitiveness [25]; (2) management input [10][12]; (3) financial and economic (or value) considerations [38][26]; (4) business orientation towards new ideas, innovation, and markets [10][33][18]; (5) the external inputs generated from mobile, web, media, competitor, and inter-customer sources. These additional engagement areas are often industry specific and are incorporated in Figure 2. Here the business engagement was seen to involve the service or product exchange, the marketing and awareness, the information transmission relevant to the exchange, and the economic exchange. These business-side business-customer encounter areas also exerted influence on each other in a networked approach similar to the back-end networking of the business. All aspects of the business were further influenced by the immediate competitive environment in which the business operated. Thus the business-side of the encounter with the customer is depicted as a networked array of business areas which are termed business cells.

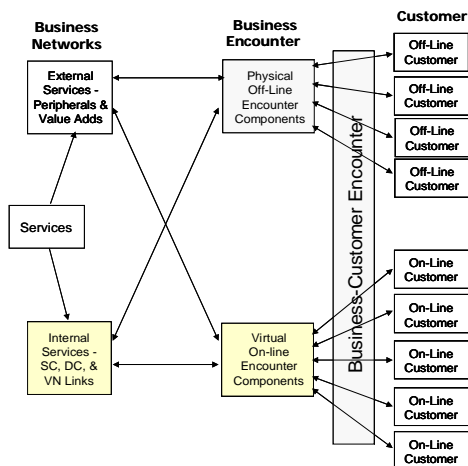


Figure 1: SVN Encounter Framework, adapted [18][16]

The customer side of the business-customer encounter is also complex. It involves on-line and off-line customers, and well as business and end-user customers. These customers seek solutions to their business-directed demands and requests – solutions that match or suitably deliver their requirements. However these requirements may be measured by the customer in a variety of ways. The customer seeks a level of satisfaction, and expects to receive a level of servicing, which the customer deems suitable or in line with their perceived value requirements. In addition the customer is inquisitive and is also driven by new perceptions which may be interpreted as new innovations, ideas, value adds, information, fun, and the like. Hence capturing the whims of customer is not an easy task, and timing is also important. Some encounters occur quickly, whilst others may occur over extensive timeframes and may even require multiple encounters. So the model grows in complexity.

This service industry study engaged the pharmacy industry across Australia. It captured by survey 168 business and customer measured front-end variables, each believed to have direct influence across the business-customer encounter. Over 160 pharmacies and over 600 of their customers responded, and a SEM approach was eventually employed to investigate this complex business-customer interface.

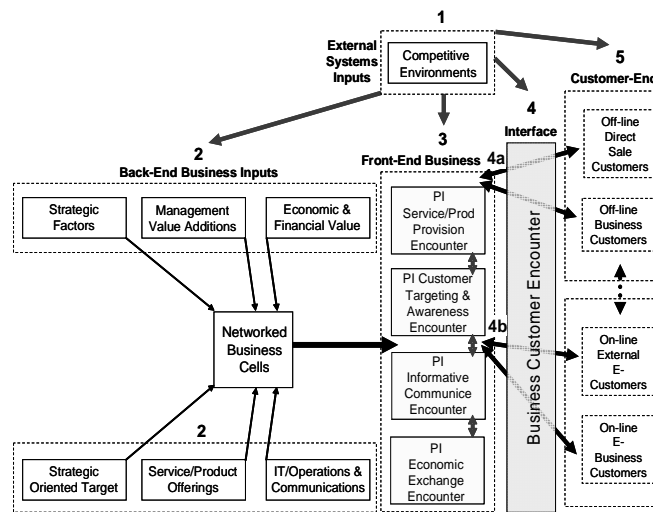


Figure 2 Service Value Network Encounter Model, [16]

SERVICE VALUE NETWORKS

SVNs [18][19][16][22][20][21][17] deliver understanding of what the business is really about – generating an exchange with customers, and doing so at an economically acceptable rate of exchange for both the business and the customer. Thus the business front-end business cells represent the back-end business funnel or channel through which the exchange occurs. This complex service delivery engages two conflicting but concurrent requirements: (1) the business leverages its economies of scale, and (2) the business delivers solutions, specific to the needs of the customer [13]. This process may engage highly-specific customized solutions [4], and bi-directional flows across back-end service supply networks that ultimately deliver customer demands and meet customer value [34]. This interlinking may also involve partnering companies that also target maximizing their combined successes and profitability [6][23].

AUSTRALINA PHARMACY INDUSTRY

Siegel [35] suggests that all players in an industry benefit from aggregation or sharing of information, ideas, and knowledge, and that a wealth of knowledge may be garnished by combining organizational expertise. This aggregation further supports a matrixed highly networked business, and business partnership relationships that all benefit from a shared enhanced competitiveness outcome. Siegel's work also suggested that industries would be wise to closely analyse their 'e' strategies, as this area added to their aggregated information and knowledge capabilities, and into their combined competitive frameworks [37]. This aggregation of linked capabilities to increased competitiveness may be seen in emerging new pharmacy business models like e-pharmacies, and in the proposed concept of SVNs. SVNs deliver a disruptive transition that is radically different to the existing business models [11][7]. SVNs have the potential to radically alter the competitive arena in which the business resides. Where and industry remains dynamic, and responsive to its recognised new challenges of value creation, servicing, and suitable modes of interaction with customers, a new approach is required. Of particular interest is the notion of SVNs [18][16][22][20].

As new business understanding and emerging technologies integration moves have been made, and the business model has progressed to new levels of customer engagement. These progressions have generally been in disruptive jumps rather than via smooth transitions. They are shown in Figure 3 as differing levels of networked, technologies incorporated to support and improve

the front-end business and customer interface encounters, mapped against the increased capacities of the business to better engage with its customers and so improve its customer related performance capabilities and outcomes. Figure 3 depicts the five key business disruptive transitions that have occurred over the past two decades, and prior to SVN's – which using this research approach, now offer the next deliverable model.

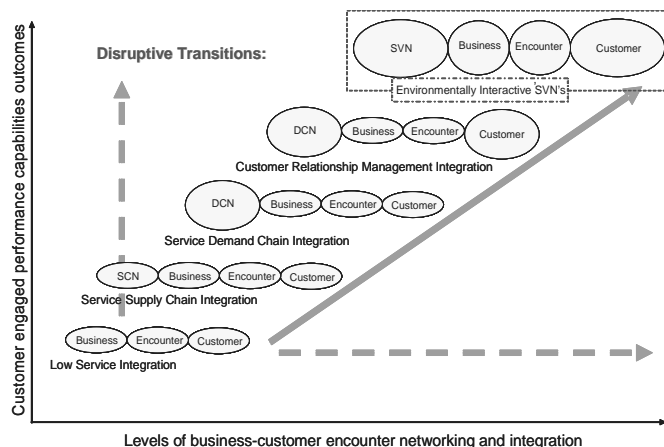


Figure 3: Disruptive Transitions towards the Service Value Network

SVNs network, and bind, all the components required to deliver the business-plotted customer solution. Here, the entire business system is intelligently networked into a matrix of suppliers, partners, peripheral (occasional) partners, and ad hoc logically tapped linkages that in-turn build and shape the (1) business-customer interface; (2) service offerings; and (3) enabling service delivery systems, in a united, customer-coherent manner. Thus a service and value and network solution may be built. This solution involves a disruptive transition from the simpler business models – typically supply chain management (SCM); demand chain management; (DCM) and customer relationship management (CRM). Such disruptive transitions are both costly and often require a significant retooling of the business to a new more complex, and integrated level of smart networking [11][7]. However, this retooling also delivers new competitive benefits like: improved back-end efficiencies, greater customer understanding and responsiveness, and increased knowledge integration. Such changes, if implemented wisely, offer the business a host of flow-on benefits and new possibilities.

Considering the pharmacy industry, the individual pharmacy business typically offers a low service integration model where networked solutions are not integrated. Here, a national prescriptions register is still required, so some networking is necessary, but automatic inventory management (and supply chain integration), marketing, human resources and financial databases options when in use, are rarely incorporated into such business solutions. Hence, this low level integration typifies a busy individual store, with little or no computerized operations, and it constitutes the oldest and least value adding model

Integrating the supply chain into a pharmacy delivers the next level of customer interactivity. Here, the SCM model offers some additional computerized operations are incorporated and key suppliers may have limited access to the pharmacy's activities, and product usage. To build this model from a low integration model requires considerable additional software linking inventory management, transactions and databases into a networked system.

To build the higher level responsive, DCM pharmacy model, sophisticated, well-integrated information systems are used to facilitate in-depth requests, to synthesise and target responses to the customer, and to updated the business's customer databases.

The CRM model delivers the methodologies, software and internet capabilities necessary to enable the business to manage its customer relationship in an organised way. It targets improving the business to customer interaction, but it does not deliver the tools to customerize, or build one-on-one relationships, as it employs gap analysis type procedures to align its business and customer sectors. Even in today's Australian pharmacies this approach was only found in a couple of combined on-line / off-line pharmacies.

The peak disruptive model is envisaged as the industry-wide SVN. Here, fully integrated computerized solutions may be intelligently delivered to the customer, via the serving staff, or the pharmacist, or via direct on-line customer engagement into the business network. The SVN enabled business intelligence tools may deliver agile, dynamic, flexible, customerized business-customer encounters capable of offering 'elevated-services' and 'added-value' solutions in response to customer requests. To deliver such a solution real-time, customer sensitive, industry-specific models must be developed, and this study shows how this

may be achieved.

PHARMACY SVN

The Australian pharmacy industry engages a collaborative network of pharmaceutical companies: health, cosmetics and beauty manufacturers; sports and medical support industries; peripheral suppliers; web channels; hospital, doctors, allied health and pharmacist operations; sales and web channels, large and small chains of stores, warehouses and logistics networks; and the like. Intermeshed with these is the: operational, innovative, marketing, servicing, financial and intelligent communications-data storage networks.

Figure 4 displays a global perspective of the externalities potentially affecting the pharmacy industry. Hamilton [21] further discussed these areas, along with their associations to the industry, and also the overall complexities of the industry. The Australian macro and micro environments, affecting this industry, have shown little variation over the past few years. In 2005 and 2006, Australia was portrayed by the OECD as the second most stable global economy [32], and its external macro and micro, environmental changes were minimal. At the time of this 2006 study the entire Australian industrial climate was deemed stable across the entire industry. However, technological area advancements continued, but only incremental changes emerged. Thus, at both the store level, and the industry level, the global external environmental perspectives impacting on this pharmacy industry SVN study showed little change, thereby reducing the external effects on the SVN system, and allowing a greater understanding of the front-end customer-to-business-to-customer exchanges to be elucidated.

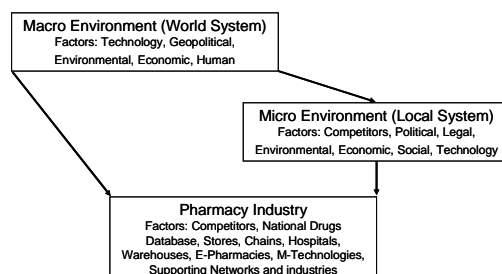


Figure 4: The Service Value Network Externalities

One recent technological change within the industry has been the emergence of several on-line E-pharmacies. To date these exist in conjunction with at least one physical off-line pharmacy (as a ‘bricks (physical) and clicks (virtual)’ model). These models are exhibiting rapid growth, and are filling a void in the marketplace. They incorporate highly sophisticated, integrated technologies may each be considered as operating as a store level SVN, or as a combined industry-wide SVN. At an industry-wide level a government required centralised SVN data storage solution exists. This system is connected to, and accessed by, all pharmacies nationwide, and sets a base level from which a fully nation-wide SVN structure may be delivered [18][16][22][20]. Today, mobile or m-technologies and Web 2.0 technologies [31] also offer new dimensions innovations and interconnectivity for the both the industry and its customers. For example, needing to know if a drug is suitable, a customer may SMS, text or video phone connect and obtain an answer – typically with the pharmacist charging a fee for this service. At the store level, stores, chains, warehouses and the like may be further interlinked, with both customers and stores further interlinked via a web-based pharmacy information portal.

At this industry-wide level the full pharmaceutical SVNs comprises a service related strategy. Here, key defined front-end business cells including: (1) the services/products provision; (2) the customer targeting; (3) the underlying communications information technologies and web related channels; (4) the economic imperative and the (5) innovative value additions engage with the customer, under a business channelled strategic/competitive framework. The resultant business-customer encounter is driven by customer demands and/or requests, and the business seeks and delivers its intelligent and best option solution set back to the customer. For example, to complete a customer’s prescription details, the pharmacy intranet information networks are tapped, checked internally and across other stores, approved, supported with value adding drug taking information (such as safe drug dosages per body weight; possible cross drug mix complications; and the like) and relayed back to the customer. Cheaper generic drug options may also be suggested to the customer – and in a personalized manner, along with usage data, and peripheral alternate solutions. To further enhance business-customer dialogue pathways, additional SVN sourced service-related value-adding options may include: consumer allowable limits, claim options, delivery options, nearest doctor, hospital, medical insurance options, tax benefits, local preferences and the like. Such a SVN system also allows the customer to directly assess a range of innovative or value adds like – sourcing or requesting annual tax return data, linking to a doctor’s surgery to lodge an appointment booking, or for information, downloading personal local hospital information, monitoring health or making a personal pensioner claim. In addition, business intelligence and knowledge/information from suppliers, research, and peripheral sources is also stored on local or centralized industry database drives, but this data also remains accessible to allowed individual pharmacies and their interacting customer(s). This data sharing, and collaboration, allows the business to move closer to its customers, and even allows the

customer to use a variety of pharmacy stores for desired prescriptions, medications, information, and the like. Business stocking level data, linked to suppliers and logistics deliverers, may monitor 'use-by-date' stocks, general stock control, and may add customer generated requests as optional new additions for suppliers to consider. Hence, accurate inventory planning, without bullwhip effects, is deliverable. Both these supply-related efficiencies, along with net cost-of-delivery savings, may be generated [12]. The SVNs approach may, in the future, add interconnectivity into other medical services like: hospitals, doctors, ambulance services, and even police to the deliverable pharmacy systems – thereby creating an efficient, better-informed, integrated medical services information network. Under agreement, peripheral partners including health and ambulance insurance funds, medical researchers, may share information across some general data fields of the SVN. To build such a system requires a key starting point, and in Australia this initiator is likely to be the Pharmacy Guild of Australia – the peak lobby and decision making body for the industry in Australia.

This study seeks to capture the industry as a whole, and to deliver an approach whereby the pharmacy industry at a local, and an industry-wide level, may better understand the pathways by which it may build an effective SVN. The key to delivering SVNs lies in gaining a detailed understanding of the business-customer encounter. Frohlich and Westbrook [14] researched some internal business-to-business/customer effects, and although others [6] had written about the business-to-consumer dyad, until this work no broad scale empirical had been delivered. By understanding the interactions and pathways between the business, and each of its customers, new pathways to competitiveness may be released. For example, recognising that a particular servicing feature enhances the success rate in an exchange and making the appropriate business adjustment(s) to further improve this connectedness may in-turn improve business performance, drive cost efficiencies, and deliver enhanced perceived customer-perceived satisfaction. Thus the business-customer encounter is the focal point of this study and it sets the framework upon which a full SVN approach may be developed.

SVN SEM – PHARMACY RESEARCH

The Australian pharmacy industry is vigorously competitive, yet it also self-regulates to some degree roughly maintaining a pharmacy to every 3000 to 4000 persons. Small independent pharmacies and those operating as a local network of a few stores total around 80% of the industry outlets. Due to government protection from external non-pharmacy competition these stand-alone operations have had little pressure to combine, share their acquired skills and enhance overall efficiencies. This protected business situation will likely change in the near future, with major supermarkets and doctors pressing to access this pharmacy marketplace. This research aimed to show the industry how it could improve its overall business models and efficiencies. At the time of this research each pharmacy business outlet typically managed considerable overheads, large stock holdings (of medicines and complimentary products), quality, security issues, and the like. Each of the eight main pharmacy business models used their own competitive positioning and marketing strategies to grow their markets. They used traditional media including television, radio, newspapers, magazines and mailouts, or they reinvigorated and/or re-modelled stores, or they developed various on-line web sales avenues. However, long term solutions, industry-wide new efficiencies were desired, and there was scant information to indicate that approaches to date would remain successful in the long term. This SVNs research offered a new possibly innovative approach to the industry and its future strategic positioning. As all stores are front-line operations and involved few levels of business this research was able to directly focus on the on the immediate business environment (deemed stable, but with store generated variations), and the remaining three blocks of the SVN associated with the business-customer interface – the business cells and their interactors (or measured variables), the business-customer encounter and the customer cells interactors (or measured variables), and it also targeted new alignment techniques across the business-customer encounter (or interface).

SVN SEM APPROACH

This research successfully surveyed and modelled the Australian pharmacy industry as a SVN. A structural equation modeling (SEM) approach was used. Data grounded in the literature, was: validated, matched, normalized, split into constructs, modelled and further validated. The business-customer encounter was found to be a complex entity consisting of multiple, significant, alignment pathways that enhanced customer perceived measures (like perceived servicing and value and customer satisfaction) to varying degrees. From this study, it is now possible to realign the pathways between each front-end business cell's interactors and its corresponding front-end customer cell's perceived interactors. In addition, it is also possible to better engage the business back-end to its front-end customer engaging cells. These SVN SEM processes are discussed next.

PHARMACY SVN SEM SOLUTIONS

The SVN SEM approach delivers industry specific construct reliability and validity, provides additional fit measures for systems of equations, and allows the estimation of higher order factor analysis (where no observed indicator of these higher-order factors is available). SEM is a powerful enhancement to multiple regression approaches [24]. It accounts for the modeling of interactions, nonlinearities, correlated independents, measurement error, correlated error terms, multiple latent independents (each measured by multiple indicators), and one or more latent dependents, also with multiple indicators.

The pharmacy SVN SEM solution, portrayed in Figure 5, encapsulates the six defined front-end business cells latent constructs (oval), each with a latent variable of interactor measures (rectangle). All fifteen possible covariances between these latent constructs were significant (at 95% confidence). These covariances represent the degree of networking between the front-end business cells. Each network path (covariance) is significant at 95% confidence, and shows a SVN structure does exist at the

front-end of the business. The customer latent constructs (and latent variables) – customer perceived servicing SERVDEL (SVDEL); customer perceived value CUSTVAL (CUSTVALT); and customer perceived satisfaction SATISFY (SATT) representing the front-end customer perceived value cells (which are unobserved by the business), engage with (1) the business latent constructs and its latent variables – business strategic positioning POSITION (POS); business-customer targeting / tracking TRACK (TRAKT); innovation and value adding INNOVATE (INNOVA3); communications, IT and web-use operational components engaged WEB (WEBUSET); economic value ECOSERV (ECOSV) and business services / products delivered CUSTSERV (CUSSVT); and with (2) the external environmental areas latent constructs (and latent variables) – information / value additions INFOVALS (INFOVAD); and external values sourcing EXTVALS (EXVAD). In addition to the above variables sixteen other unobserved error terms – e1, e2, e3, e4, e5, e6, e7, e8, e9, e10, e11, Res1, Res2, Res3, Res4, Res5 are captured Hence, this SEM model encapsulated 38 variables. Each latent business cell, customer cell or external cell variable consisted of between four to six observed measures (with each observed measure displaying significant loadings for its connected latent variable). Each observed variable displayed a kurtosis near zero (between 0.0 and 0.5), and a net multivariate kurtosis of 5.36 (c.r. = 1.68). Being well under 10.0 (and above 3.2) and involving 11 variables a small degree of non-normality was present (Byrne, 2001). To further enhance normality, transformations denoted with a last letter ‘T’ (like TRAKT), were sometimes used. All standardized path coefficients were below 0.7 indicating no significant discriminant validity problems were encountered, and all covariance pathways showed low to moderate influence (< 0.423) and no significant multicollinearity. The eigen elbow also supported 11 variables. The chi-square to degrees of freedom ratio ($\chi^2 / df < 2$), high goodness-of-fit, whilst $p > 0.05$ indicated excellent final model fit, and a minimal (optimal) SVN SEM model. The scalar regression weights, indicated all pathways were significant ($p < 0.05$), and these pathways offered the greatest chance of reproducing the observed data. Covariances engaged with the WEB latent construct were negative because the business (pharmacist) perceives web related communication activities as unimportant, and often do not have a website attached to their business model. In contrast the customers see this communications, IT and web-use operational area as important and providing a significant addition to their perception of their pharmacy. The WEB area warrants further business side investigation.

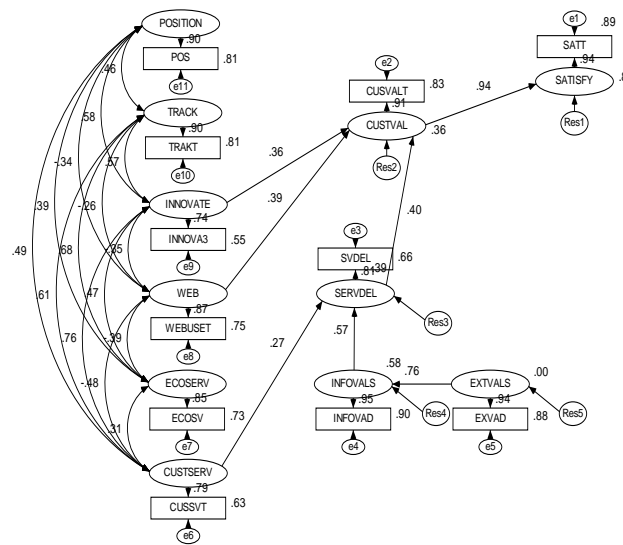


Figure 5: SVN SEM Model (Standardized Estimates)

The business-customer encounter direct engagement pathways are represented by the CUSTSERV-SERVDEL, WEB-CUSTVAL; and the INNOVA3-CUSTVAL linkages. The path standardized loadings indicate the fraction of unit variation exerted on the engaging customer cell. Each pathway value captures the combined direct business cell effects, along with its additional contributing covariant indirect business cell contributors. These business cells exert Pathways influences of around 30%-40%, but the total perceived satisfaction influences total 94%, indicating the SVN SEM model captures its major contributors. The R^2 measures of reliability (or consistency of measurement), and the error variance ($1 - R^2$), showed each latent variable was a significant contributor to the model. Implied correlations matrix, residual covariances and standardised residual covariances correlations also supported this solid SVN model validity. The standardised total effects (direct and indirect) for the customer dependant latent construct (and variable) SATISFY (SATT) showed excellent fit with all its prime effectors: (1) the customer perceived value and its two feeder business pathways, and customer feed; (2) the services experienced with its business feeder pathway and external feed; and (3) the net external information pathways. Factor loadings were in all cases above 0.6, with all loadings delivering convergent validity. Acceptable and minimal bias was shown by all estimated SE-bias values being smaller than their latent variable standard errors (SE). Thus, direct structural relationship between observed variables and associated latent

variables was successfully indicated. Construct validity was readily shown with all goodness of fit measures being excellent. In all cases discriminant validity measures also displayed high acceptability. RMR (0.230), GFI (0.972) AGFI (0.944), RMSEA (0.000) all indicated excellent goodness-of-fit, while the CFI (1.000) and TLI (1.071) indicated excellent incremental fit. Further, considering parsimony PRATIO (0.600) for this small sample size was satisfactory, as was the 84.4 value for the AIC default model – when compared to the saturated model value of 132.0 [3][29][2][15][27][28][8]. Thus, an excellent SVN SEM model fit existed.

To validate this SVN SEM data set bootstrapping (1000 times, maximum likelihood (ML), 95% confidence), verified the data sample was representative of the population, and observations independent. ML charts, and optimized data (KL) charts, indicated a close approximation to normality, thereby avoiding significant calculation misspecifications [30][8]. Lastly, to support sample invariance, a new SVN SEM pathways calibration/validation was investigated, and found to deliver further support to the data quality. This approach involved using a reduced latent constructs model with variable cells directly contributing to the business-customer encounter. This SVN SEM pathways model approach was recently discussed by Hamilton [17], and it is included hereunder as Figure 6. The resultant model displayed excellent fit, as calibration/ validation and under multi-sample restriction invariance analysis approach [5][36]. This SVN SEM pathways model has one additional covariance, which further tightened the fit of initial model, and could be justified as innovation may be derived from a host of sources including those external to the model, hence this additional covariance pathway was accepted. The model, without this additional covariance, also maintained excellent fit.

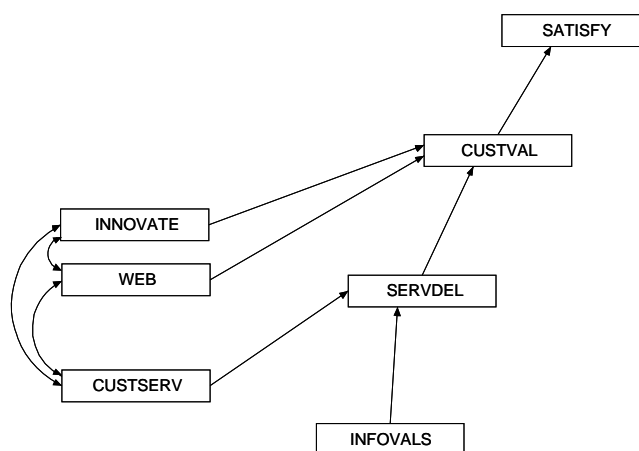


Figure 6: SVN SEM Pathways Sample Invariance Model

DISCUSSION

This empirical study shows the relationship between the business and the customer may be measured, and paths or influence acting between the business and the customer may be determined. This work shows that the front-end business cells (each housing four to six principle measures per variable) are networked together, and all have an influence on the customer's perceived views of the business, and on the options the business delivers in response to its customer's request.

The business responds to the customer's requests in a variety of interlinked or networked ways, and the combination of these network responses, in-turn, influences overall customer perceptions, and the degree of perceived customer satisfaction. The satisfaction driver is the prime and complex variable. It is derived from over twenty measures, and is shown herein to capture the vast majority of customer perceptions regarding the pharmacy business. This work also shows that to better engage with customers, pharmacies need to develop high quality communications channels including information technologies and web-usage components. The customer's perception is directly influenced by both the business, and the immediate micro environment surrounding the customer and the business, but the business exerts the greatest influences.

This study adds understanding to the nature of the business-customer encounter. The encounter is complex, multi-pronged and its interaction pathway influences, once understood, may be built into an intelligent SVN database. This SVN database may then be modelled by business (or software) to derive the optimum business alignment (to its customer requests) solution. This SVN realignment can then be physically implemented with real-time business database updates feeding into the new system. At the same time it can be further tested and measured, with improvements and changes continually added to the operational dynamic SVN pharmacy database. By understanding the SVN business-customer encounter the back-end business matrix networks may be enhanced and a new competitive approach may be delivered – one that is very difficult to copy! To this point in time true customerization (where one business relates individually with each of its customers on a individual and personalized way) has not been possible across industries, but by engaging a SVN's approach this divide may now be overcome. This SVN SEM approach proves the existence of SVN's and it adds another level of competitiveness capabilities to service industries.

Currently this SVN SEM research is developing the intelligent database model solution for the pharmacy industry. Once built, tested statically, and further refined to capture real-time customer updates it will be further tested, repositioned, refined, and eventually implemented as a continuous, artificially intelligent, fuzzy logic learning system that delivers both enhanced perceived

customer perspectives (customer values), and significantly enhanced business economic value propositions.

It is envisaged that the SVN SEM business-customer encounter will show up to six front-end business cells having significant pathways to customer cells. An additional front-end business cell representing 'interactivity' may also be added in the future. Additional customer front-end cells are possible, but are not believed to directly affect the business-customer encounter. This projected future SVN model, and its proposed pathways is shown in Figure 7.

This Australian pharmacy study demonstrates a new networked approach to understand the modern business and its immediate environment. This theoretically developed, and research supported, SVN SEM approach defined the key front-end business cell latent constructs and their measurement interactors which possibly effected, and / or affected, influence(s) across the business-customer encounter. This SVN SEM business-customer encounter model highlighted why this area of study has been poorly investigated. The business-customer encounter is not a simple pathway, but rather a series of multiple pathways that all contribute significantly to the net customer perception result. In addition to the business effects, the external environmental effects, also participate and exert influence on the customer. Each front end business cell consists of a block of interactors (or measures) that may be varied to improve business-to customer outcomes. These interactors may directly and indirectly influence the business-customer encounter pathways and their outcomes. Once understood these business-customer encounter pathways may be used as targeting pathways aimed at better delivering customer demanded requirements. This SVN approach, linked to smart network databases and appropriate intelligent data picking tools, offers near-real-time solutions, and moves the business customer relationship well beyond existing CRM approaches. When used in conjunction with smart networked back-end systems SVN's are seen as the next level of competitiveness (more sophisticated than CRM and earlier models).

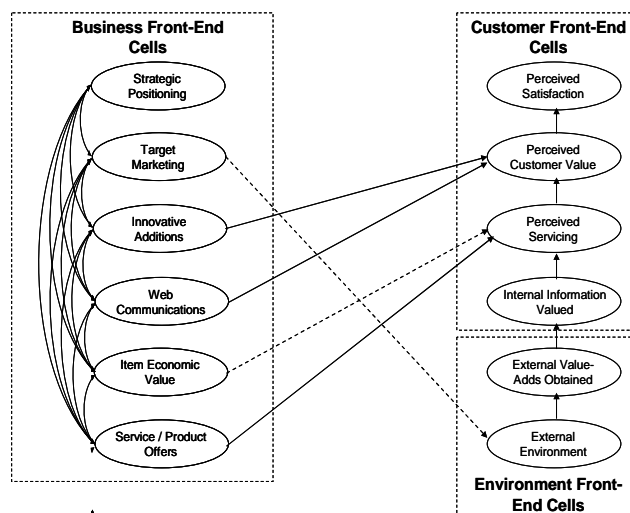


Figure 7: Business-Customer Encounter Pathways for a Services Industry

CONCLUSIONS

The SVN SEM approach clearly delineates areas in which the business may improve its customer contact. If engaged wisely an improved degree of economic reward is likely, along with an improved degree of perceived value enhancement and satisfaction for the customer. This SVN approach is industry specific, country specific and in times of significant turbulence and change, possibly regionally specific. It is an efficient, understandable, and appropriate approach for market leaders, innovators or differentiators.

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AUTHOR PROFILE

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John Hamilton has extensive business, management, consulting, and research experience, and remains a highly active researcher across both off-line and on-line environments. His current specializations include: strategic innovation; strategic web-based instruments; QFD; business competitiveness; strategic positioning; strategic e-marketing; logistics; service value networks; industry-wide future technologies and solutions; and the performance, value and alignment of customer-business interfaces.

THE IMPACT OF WEBSITES CHARACTERISTICS AND PERCEIVED RISK ON THE HEDONICS AND UTILITARIAN MOTIVATION THAT EFFECT ONLINE SHOPPING INTENTION

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ABSTRACT

Electronic commerce has become one of the essential characteristics in the Internet era. In recent year, many of the studies suggest characteristics of website (1) evoke feelings for hedonic and (2) confirm or negate beliefs of utilitarian type of consumers. Although an attitude toward website has been formed through cognitive and hedonic processes, these factors could strengthen or weaken the intention of purchase at the last minutes. The objective of this paper is to synthesize the existing literature to conducting the survey to discover how the difference perception of risk avoider and risk taker shopper whether existed or not in term of these two type of motivation and attitude toward website.

Keywords: Website Characteristics, Hedonic, Utilitarian, Perceived Risk, Purchase Intention

INTRODUCTION

The internet is the most powerful tool to communicate with customers today and it is provided that websites are twenty-four hour available, no access boundaries as it can go across countries and everywhere, cost effective and very dynamic as contents can be updated with not much effort compared to other types of media. Internet not only has become the most efficient tool today that a library could have to distribute information but also its popularity has been increasing in retail business for the past decades. The Census Bureau of the Department of Commerce estimates U.S. retail e-commerce sales for the second quarter of 2007 were \$33.6 billion, an increase of 6.4% from the first quarter of 2007. The second quarter of 2007 e-commerce estimate increased 20.8 percent ($\pm 4.6\%$) from the second quarter of 2006 [1]. Tamimi and Sebastianelli [2][3] stated that the retail e-commerce sales in the United States continue to rise, signaling the pivotal role of the internet as an effective marketing channel. On-line retailing is rapidly emerging as an alternative mode of shopping and is expected to garner a substantial share of the retail market in future. Enhancement of Web site features that facilitate the navigation of the consumer through the purchasing stages is suggested as a means of overcoming these hurdles [4]. Tamimi et al. [5] conducted the most important factors were price displayed adjacent to the product, product description available and out of stock items labeled.

Other researchers also suggested that whether the retail store is real or virtual, customer interactions with the store environment influence their emotional responses and shopping behaviors [4][6]. Monswé et al. [7] who study was based on the constructs of the Technology Acceptance Model (TAM) of other previous researchers extended by exogenous factors and applies it to the online shopping context. His study suggested that not only consumers' attitude towards online shopping that influences the purchase intention; but also there are exogenous factors such as consumer characteristics, product and so on. However, many other researchers provide opinions that there are also other factors that consumers concern about before making a purchase decision. Although an attitude toward website has been formed through cognitive and hedonic processes, these factors could strengthen or weaken the intention of purchase at the last minutes. These factors are such as security of online transactions [8][9], disclosure of their private and financial information [9]. Little of studies have been done to understand other factors that could strengthen or weaken purchase intention of online consumers after stage of attitude establishment. This study will mainly focus on online shopper's motivation, attitude toward website and purchasing intention whether different or not depends on level of perceived risk.

LITERATURE REVIEW

Website Characteristics

Many researchers have studied how a website should be effectively designed so that its appearances, functions and so on create satisfactory perceptions to consumers which ultimately could contribute in stimulating feelings to purchase products from the online retail stores. Song and Zahedi [10] studied measuring the impact of Web-design elements on the beliefs and behavior of Web customers. Their finding was belief reinforcement model indicates that various categories of Web-design elements reinforce Web customers' beliefs, which in turn positive impact attitudinal constructs that lead to changes in their purchase intentions. Tarafdar and Zhang [11] also identified and analyzed important characteristics from five different categories: Retail, Financial Services, News and Information, Search and Portal and Entertainment. Research by Palmer [12] illustrates website success in terms of six critical characteristics of websites and the relative importance of these characteristics varies across categories. Moreover, Web site success is significantly associated with Web site download delay (speed of access and display rate within the Web site), navigation (organization, arrangement, layout, and sequencing), content (amount and variety of product information), interactivity (customization and interactivity), and responsiveness (feedback options and FAQs).

Utilitarian Beliefs and Hedonic Feelings

In the past, many research works focused either utilitarian or hedonic but not both. Consumers are driven by motivations which are both hedonic and utilitarian when shopping from a variety of items ranging from jeans to automobiles. A general view of value recognizing both (1) a utilitarian outcome resulting from some type of conscious pursuit of an intended consequence and (2) an outcome related more spontaneous hedonic responses captures a basic duality of rewards for much human behavior. It reflects the distinction between performing an act “to get something” as opposed to doing it because “you love it” [3]. Hedonic products have been defined as, “those consumed primarily for affective or sensory gratification purposes, and functional products deliver more cognitively oriented benefits” [13]. Hedonic products which provide consumers feelings of more experiential pleasure, fun and excitement like designer clothes, sports cars, luxury watches, etc and utilitarian goods are primarily instrumental and functional with things like microwaves, minivans, personal computers, etc. [14][15]. Kim and Forsythe [16] proved that the hedonic motivation had a stronger positive relationship than functional motivations with the attitude toward using product virtualization technologies. Childers et al. [17] commented that people with utilitarian motivation are concerned with purchasing goods in an efficient way.

Attitude towards Website

Allport [18] defined an attitude as “a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual’s response to all objects and situations with which it is related”. Fishbein and Ajzen [19], whose definition of attitude has been widely used for the past few decades, define attitude as “a learned predisposition needed to respond in a consistently favorable or unfavorable manner with respect to a given object”. A retailer’s success in online shopping and overall is believed to directly tied to the effectiveness of its website in eliciting consumers’ positive attitudes toward the website and toward the company and its products. As a consumer’s attitude toward an object can be recognized by the individual’s positive or negative evaluation of that object, consumers’ positive attitudes toward websites can be drawn from their favourable or unfavorable evaluations of those websites; thus, an effective website can evoke consumers’ positive attitudes toward that website [20]. Shim et al. [21] indicated that an attitude toward a behavior can be recognized by an individual’s positive or negative evaluation of a relevant behavior, which comprises a person’s beliefs regarding the perceived outcomes of performing the behavior. From this perspective, knowledge of consumers’ attitudes can help explain the reasons behind their favorable and unfavorable evaluations of an object or behaviour.

Perceived Risk

Perceived risk refers to “the nature and amount of risk perceived by [a] consumer in contemplating a particular purchase decision” [22]. According to Cox [23], uncertainty comes from identifying buying goals and matching these goals with product or brand offering. Two elements, uncertainty and consequences, may play significant roles in perceived risk. Uncertainty comes from the difficulty of identifying buying goals and matching these goals with product or brand offerings. Consumers search for information to deal with uncertainty and improve the consequences of a purchase decision that is perceived to be risky. Lee and Rao [24] defined perceived risk as an “Expectation of Loss”. The success of an external search relies on the amount of information available [25]. Even though consumers perceive the Internet as offering a number of benefits, the Internet tends to magnify some of the uncertainties involved with any purchase process [26].

Purchase Intention

Purchase intention represents “what we think we will buy” [27]. There are two types of purchase intentions: repurchase intentions and shopping intentions. Repurchase intentions reflect whether we anticipate buying the same product or brand again. Shopping intentions indicate where we plan on making our product purchases. Both internal and external information search may increase consumers’ intentions to shop or to repurchase on the Internet, which generally leads to the purchase stage of decision making [27]. According to Park and Stoel [28], both internal (e.g., brand familiarity, prior shopping experience) and external (e.g., website information) information search may increase consumers’ intentions to shop or to repurchase on the Internet, which generally leads to the purchase stage of decision making. People who had previous experience shopping on the Internet had higher intentions to purchase than those who did not have previous experience [29]. Brand familiarity also played an important role in shopping from the Internet. Consumers who were more familiar with a website’s brand were more likely to intend to purchase than consumers who were less familiar with a website’s brand. Finally, consumers exhibited a stronger intention to purchase from Internet websites that had a greater amount of information available than from those which had a lesser amount of information available [30]. Yoh [29] also found consumers who perceived higher social acceptance of online shopping had greater purchase intentions for products through the Internet compared to those who perceived less social acceptance of online shopping.

The Effects of Web Characteristics toward Utilitarian Beliefs and Hedonic Feelings

Web-site design studies [31][32] recognized that outcomes would be affected by the (hedonic or utilitarian) value derived by the shopper. The goal-oriented or utilitarian shopping has been described by various marketing scholars as task-oriented, efficient, rational, and deliberate [33]. Thus, goal-focused shoppers are transaction-oriented and desire to purchase what they want quickly and without distraction. Babin et al. [3] described utilitarian shopping value as this shopper may find value only if the shopping chore is completed successfully and, even better, if done in a fastidious manner. Utilitarian value may also result from a situationally involved consumer collecting information out of necessity rather than recreation. Perfection in online interface

design is elusive simply because there is no master list of what works. The most basic issue faced when designing a Web page is the amount of complexity versus simplicity [34]. Bad designed websites will make customers less likely to purchase, no matter how the product or brand attract them. Childers et al. [17] have studied in online shopping, utilitarian and hedonic motivations aspects are almost equally important predictors of online attitudes. Ease-of-use, usefulness and enjoyment are another interactive consumer experience at the same time. Mowen and Mowen [35] reported the use of the hedonic concept as one of the key strategies to enhance client-user attention. The conditions necessary to transform online information search into “play”, a highly positive experience capable of delivering intrinsic value in the form of escapism and enjoyment. [36]. Mathwick et al. [37] proposed that the contents of the Internet Websites will impact on consumers’ hedonic and effective experiences. Based on these discussions, the proposed hypotheses as follows:

H₁: Web characteristics is positively effect on the consumers’ utilitarian beliefs

H₂: Web characteristics is positively effect on the consumers’ hedonic feelings

The Effect of Website Characteristics toward Attitude toward Websites

Web-specific features such as virtual and online reservations systems are positive attitudes toward website [38]. Web design is an important factor to catch users’ eyes and retain them in the Web site they are visiting. The site needs to relate to its target audience through its look and feel and must provide relevant, high-quality content. The content also must be easy to find in the design and layout of the site. Content becomes more tangible, relevant, meaningful, and engaging through appropriate presentation factors. As the Web continues to develop and the amount of information increases, it is believed that a site’s information packaging will become increasingly crucial in catching users’ attention and interest [39]. Ghose and Dou [40] referred to the beauty and originality of design as the crucial factors for presenting a Web site. Kim and Eom [41] stated that satisfied customers have a higher chance of purchasing merchandise from the same store and remaining loyal customers. The design of a commercial Web site plays an important role in attracting, sustaining and retaining the interest of a consumer at a site. Researchers discussing the design rules of a commercial Web site emphasize important issues such as ease of navigation of the Web site, and the use of multimedia to develop its visual attractiveness [42]. According to Stevenson, Bruner II, and Kumar [43], simpler webpage backgrounds are more effective than more complex ones and more positive influence on attitude toward a website. Therefore, the following hypothesis is suggested, based on previous research:

H₃: Web characteristics is positively effect on the consumers’ attitude toward website

Relationship between Utilitarian and Hedonic Motivation and Attitude toward Websites

Hedonic differs from instrumental utilitarian, which entails shopping efficiency and making the right product choice based on logical assessment of product information [44]. Optimum stimulation level and recreational shopping (person variables) influenced the role hedonic value played in approach responses toward the website [44]. Within the TAM framework, usefulness of the interactive media can be thought of as reflecting the more instrumental aspects of shopping, while enjoyment embodies the hedonic aspect of shopping. While some consumers may be shopping primarily for instrumental purposes, others may be primarily enjoying these interactive media, and thus both factors can ultimately affect their attitude toward using interactive forms of shopping [45]. This characterization of technology adoption is consistent with research on retail shopping behavior, which has supported the presence of both utilitarian and hedonic motivations. Eroglu et al. [32] found that both pleasure and arousal had significant positive effects on approach responses toward the site, but emotional pleasure had a stronger mediating effect than emotional arousal. According to these discussions, the proposed hypotheses are as follows:

H₄: If utilitarian motivation increases, attitude toward websites will become more positive

H₅: If hedonic motivation increases, attitude toward websites will become more positive

Moderating Effect of Perceived Risks toward Utilitarian / Hedonic Motivation and Attitude toward Websites

A positive emotional state in 3-D advertising plays a positive role in reducing consumers’ performance risk [46]. Specifically, online transactions involve more perceived risk than traditional, face-to-face transactions and online purchasing over the Internet is a more recent information technology-related form of direct marketing, and is similarly perceived as higher risk by consumers [47]. Consumers perceived increase risk and made shoppers bad attitude toward website will avoid purchase from internet [9]. Yoh [29] found that people who had prior experience were willing to purchase through the internet with confidence. Intention to shop online is also influenced by consumers’ internet shopping history [21]. The perceptive risk will effect the consumer’s motivation to purchase on the Internet. When the consumers have stronger perceptive risk to purchase on Internet, the consequences will unpleasant and slow shopping [48]. Therefore, hypotheses are developed as follows:

H₆: Utilitarian motivation is perceived differently between risk avoider shopper and risk taker shopper

H₇: Hedonic motivation is perceived differently between risk avoider shopper and risk taker shopper

H₈: There is no significant different between the attitude toward website of both risk avoider shopper and risk taker shopper

Interrelationship between Utilitarian and Hedonic motivation and Online Purchasing Intention

From the information systems literature [45], the Technology Acceptance model (TAM) was developed to understand workplace adoption of new technology. TAM postulates several conceptually independent determinants of a person’s attitude toward the websites technology, the first determinant is perceived “usefulness” of the technology and refers to the degree to which using the system or technology will improve the user’s performance in the workplace. TAM also postulates a second determinant, the ease of technology use. While usefulness refers to the outcome of the shopping experience, “ease of use” refers to the process leading to the final outcome. When shopping on the web, ease of use can be thought of as the process of using the new media while

engaging in shopping behavior. In the context of hedonic and utilitarian motivation, Okada [49] found that people have different attitude to hedonic and utilitarian goods. People are willing to pay more in time for hedonic goods and more in money for utilitarian goods. A choice task generally favors the option which is higher on the utilitarian dimension when both hedonic and utilitarian dimensions existed as Dhar and Wertenbroch [14] indicated. People may make the purchase decision, mostly, according to the superiority in utilitarian dimension rather than hedonic. Thus, the proposed hypotheses are as follows:

H_9 : Utilitarian motivation has positive influence on online purchasing intention

H_{10} : Hedonic motivation has no significant influence on online purchasing intention

H_{11} : The influence of utilitarian motivation on purchasing intention is higher than of the hedonic motivation

The Effect of Attitude toward Website toward Online Purchasing Intention

Consumers' attitudes are among the good predictors of future shopping behavior [50]. Behavior is determined by intention; this intention is determined by attitude and social norm toward behaving. Attitude plays a major role in shaping consumer behavior, which includes information search behavior and behavioral intention [21]. Many studies have addressed the role of attitudes in consumers' purchase behavior. Belief reinforcement model (BRM) indicated that various categories of web-design elements reinforce web customers' beliefs, which is positively impact attitudinal constructs that lead to changes in their purchase intention [10]. Shim et al. [21] showed that consumers' attitudes toward internet shopping positively affected their intentions to purchase via the internet. According to above discussions, the proposed hypothesis is as follows:

H_{12} : Attitude toward website is positive effect on online purchasing intention

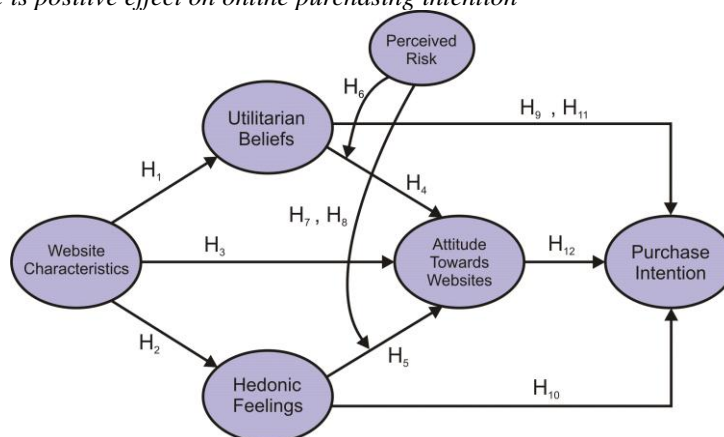


Fig: The propose research model framework

RESEARCH IMPLICATION

Because many apparel shoppers still hesitate to make purchases online and typically prefer shopping in traditional stores, online retailers are utilizing product virtualization technologies and reduce risk to enhance the online environment in order to attract consumers and encourage online purchases. Product virtualization technologies that allow online shoppers to view the product interactively not only deliver product information but also deliver a more entertaining shopping experience than can be obtained by static product images. This research has implications in developing retailer' websites as a valuable channel for selling to, and interacting with, customers, and an important medium for communicating with the general public as well as potential customer. Designing effective websites requires an understanding of how Web shoppers' reactions to websites can change in their belief and behavior. Understanding how online customers are affected by the exposure to website characteristics, potential impact of hedonic and utilitarian effect on consumer decisions whether casual perceived risk relationships exist between the two that helps predict their reactions to websites. Such an understanding promotes the development of more appropriate websites for e-commerce and increases the stickness of websites for Web customers. The propose research model framework can help scholars and organizations to better understanding of the dynamics of online shopping field.

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UNDERSTANDING IOS IMPLEMENTATION PROCESS IN AN AUTOMOTIVE MANUFACTURING COMPANY: AN ORGANISATIONAL MOTIVATION PERSPECTIVE

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ABSTRACT

A leading Australian automotive manufacturing company has introduced an internet-enabled electronic data interchange (EDI) system recently that links the company with its small suppliers. In this paper, we use a scientific case study approach to examine the internet-enabled EDI implementation experience of the automotive company, and explain its implementation process by referring to a theoretical model known as the IOS Motivation Model (IMM) which we have developed based on the notion of 'organizational motivation' for IOS adoption [16]. The case study findings highlight the key role of organisational motivation as a determinant of IOS implementation process undertaken by the company. This finding is useful to e-business practitioners because it provides them with a means of assessing IOS implementation related activities, and for researchers, because it provides a theoretical framework for understanding the role of motivation in the activities conducted when implementing a system.

Keywords: EDI, interorganizational systems, electronic commerce

INTRODUCTION

Interorganizational systems (IOS), which automate boundary-spanning activities of organizations, form the foundation of business-to-business e-commerce operations in many firms. The adoption of these systems in Australia is particularly widespread in the automotive industry, where the number of companies implementing IOS, and the capabilities of those systems have been increasing progressively over the past 25 years [9]. Over that period, a substantial body of research into IOS-related issues has accumulated, with most studies focusing on either the adoption decision [2] [4] [5] or the identification and measurement of benefits associated with using these systems [19]. Despite the volume of research into those topic areas, surprisingly little is known about how companies determine their IOS implementation processes. For example, it has been reported in the IOS literature that different organisations follow different implementation processes even for introducing similar types of IOS technologies [6] [8]. Factors identified as being related in some way to the decision to adopt do not, however, provide a satisfactory explanation as to why companies implementing similar systems may use a different implementation processes. An improved understanding of the IOS implementation process is important, partly because it is fundamental for strategic IOS planning, but also because the process almost certainly has a direct impact on the capabilities and effectiveness of the system implemented [3] [11].

To address this gap in the literature, we study the IOS implementation process of a large Australian automotive company that in recent years has initiated an internet-based EDI solution to trade with its small suppliers. We explain that implementation process by drawing upon a theoretical model of 'organisational motivations' for IOS adoption, known as the IOS Motivation Model (IMM) [15] [16]. By applying that model, we are able to demonstrate that motivation, interacting with intra-organizational and extra-organizational forces, not only influences IOS implementation practices in predictable ways, but that any departure from expected behaviour is a mismatch between intentions and behaviour, and so represents a potential problem in implementation procedures. This study therefore contributes to the IOS literature by highlighting organisational motivation as a driver of the IOS implementation process in organisations, thereby enhancing our understanding of the IOS implementation phenomenon.

IOS MOTIVATION MODEL

The IMM, which we apply in this research, predicts the adoption processes likely to be initiated by an organization in response to that organization's leadership position within the supply chain network (leader or follower), and the type of business benefit sought from the relationship (techno-economic or socio-political). The IMM (Figure 1) is based on two arguments: (1) motives determine many of the activities performed by an organisation when introducing a given IOS application, and (2) conditions within the organization (e.g. existing technology, organisation size) and external to the organization (e.g. available technology and legal requirements and social norms) may constrain some aspects of IOS implementation activities.

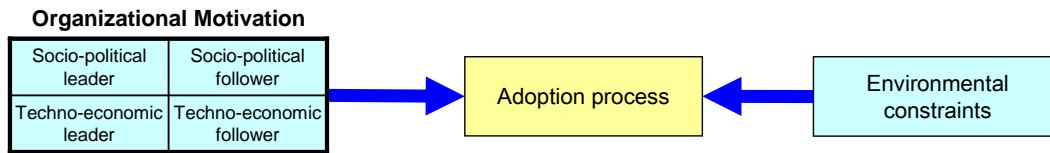


Figure 1: The IOS Motivation Model

The leadership position and business benefit dimensions interact to create four motivation scenarios in which the organization is either a leader or a follower and the primary business benefit sought is either economic or socio-political. It is argued that the leader and follower relationship is actually rooted in the notion of locus of motive. An organisation is motivated to play the role of IOS leader in a supply chain when its motive for IOS adoption (i.e. economic or socio-political) originates within the organisation. In contrast, an IOS follower is motivated by the desires of an external entity (e.g. business partner).

Economic aims include saving costs and increasing efficiency. Socio-political aims include a desire to increase status, control, or security in the relationship. Together, these aims combine with the relationship position (locus of motive) to create four motivational scenarios: techno-economic leader, techno-economic follower, socio-political leader, and socio-political follower, each of which is associated with a specific pattern of activities likely to be performed when an IOS application is introduced.

The IMM is partially based on the principles underlying emergent process (EP) theories [10] [12] which assert that, although systems are generally implemented to achieve specific goals, the actual outcomes observed often do not match those goals exactly due to interactions between forces within and external to the organization. The IMM and EP theories do differ in some important ways, however. For example, EP theories are conceptual lenses that help us analyze past events in terms of motivations and institutional forces without making specific predictions about how either should influence outcomes. Markus and Robey [10], actually refuse to acknowledge a dominant cause of change in their EP theory, claiming that behavior cannot be predicted *a priori* either by the intention of individual actors or by the conditions of the environment. The IMM, in contrast, asserts that different configurations of implementation activities are likely to be observed for each motivation, with the caveat that the external environment and organizational capabilities sometimes moderate the relationship between motivation and outcomes (i.e. implementation process). The high-level schematic overview of the IMM in Figure 1 shows these relationships between intentions, outcomes, and moderating forces (both intra-organizational and extra-organizational). This difference in emphasis means that the IMM, like EP theory, can be used to explain outcomes in terms of goals, influences external to the organization, and organizational (internal) factors. Unlike EP theory, however, the IMM can also be used explore the likely impact of alternative motivation scenarios (what would we expect as outcomes had the organization used a different motivation) and the likely strengths and vulnerabilities associated with each implementation process.

Research Model

In this section we describe the research model. Specifically, we describe the four IMM ‘motivation scenarios’ (shown in Figure 2), and discuss the propositions relating to the implementation activities associated with introducing a given IOS solution by organisations representing techno-economic motivation scenario. Cell I is the “Techno-economic Leader” scenario, characterized by an internal locus of motivation and a techno-economic type of motivation. This scenario occurs when organisations develop a direct economic motive internally, and invest in an IOS project voluntarily, believing that the investment will improve organisational performance with regard to internal efficiency and competitiveness in the marketplace.

Cell II is the “Socio-political Leader” scenario that is characterised by an internal locus of motivation and a socio-political type of motivation. This scenario occurs when organisations invest in IOS voluntarily to realise their own socio-political motives. These organisations initiate an IOS project for reasons other than immediate efficiency gains, but nevertheless with a clear intention of perhaps portraying either a “progressive” or “customer caring” image in the industry, or with the realisation that there is no other way forward, given its trading partner’s IOS adoption strategies. However, the motivation to adopt IOS is conceived internally. Cell III refers to the “Techno-economic Follower” scenario that is characterized by an external locus of motivation and a techno-economic type of motivation. This scenario occurs when an organisation is approached either by its business partners or by any other influential organisation about IOS adoption and, having evaluated the potential economic benefits of the IOS, invests in it voluntarily. Although the motivation to adopt IOS is generated from external sources, the decision is made based on an economic motive. Techno-economic followers generally do not build an IOS, but simply embrace a standard IOS developed either by the business partner that initiated IOS project or by a third party. However, even though techno-economic followers are not the initiators of IOS projects, they remain proactive users of IOS. Cell IV represents the “Socio-political Follower” scenario that is characterised by an external locus of motivation and a socio-political type of motivation. This scenario occurs when an organisation is approached by its trading partner or a third-party organisation to adopt an IOS, and a decision is made based on a socio-political motive. Socio-political followers are the organisations that do not develop an IOS, but embrace an existing IOS solution developed by partners or others parties. Unlike techno-economic followers these organisations are passive users of IOS and introduce IOS for reasons such as legitimacy, compliance, influence or social status. Note that in the IMM two-by-two motivation matrix (left hand side of Figure 1) such scenarios as ‘internal-follower’ and ‘external-leader’ because in relation to IOS

adoption, internal motivation is always assumed to be associated with leadership role in the supply chain. Likewise, for organisations where the locus of motivation is external, the adoption of IOS is often initiated by others and are assumed to follow IOS adoption pace set by others. Hence, they remain as IOS followers.

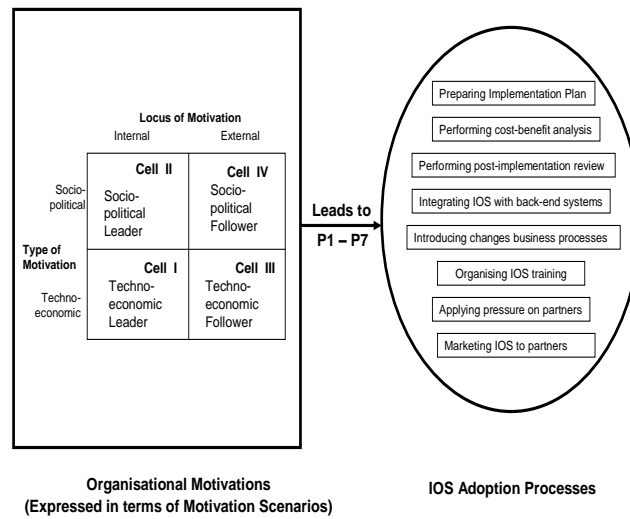


Figure 2: The Research Model

Based on a review of past IOS adoption literature, we also identified a total of eight key activities that constitute the IOS adoption process (see [14] for a detailed discussion of these activities). These activities which are shown in the right hand side of Figure 2 are: (1) preparing an IOS implementation plan, (2) initiating a cost-benefit analysis for IOS, (3) performing a post-implementation review of IOS, (4) integrating IOS with back-end IT systems, (5) introducing changes in the business practices, (6) organising IOS training, (7) applying pressure on business partners, and (8) marketing IOS concepts to business partners. We argue that the sub-set of these activities that will be initiated by an organisation for introducing a given IOS solution is driven by its motivation scenario for that particular IOS solution. In Figure 1, this relationship is depicted as a solid line linking the motivation scenarios with the IOS adoption activities. These propositions are summarised in Table 1, which shows the activity pattern for each motivational scenario just described (see [16] for details).

Table 1: Expected IOS adoption processes for each motivation

Prediction Activities		Techno-economic Leader	Social-political Leader	Techno-economic Follower	Social-political Follower
P1	Prepare implementation plan	Yes	Yes	Yes	No
P2	Cost-benefit analysis	Yes	No	Yes	No
P3	Post-implementation review	Yes	No	Yes	No
P4	Integrate IOS with back-end IT systems	Yes	No	Yes	No
P5	Change business practices	Yes	No	No	No
P6	Organize IOS training	Yes	Yes	Yes	Yes
P7	Apply pressure on partners	No	Yes	Yes	No
P8	Market IOS concept	Yes	Yes	n/a	n/a

Drawing upon the IMM, we posit that techno-economic leaders will seek an improvement in efficiency and competitiveness in the marketplace and therefore use an IOS as part of an efficiency strategy directed at transforming of key business processes. Their IOS projects will therefore tend to be strategic with a much greater focus on integrating systems (P4) and improving the depth and quality of information available to business managers [18]. Because improving the depth and quality of information with partners is considered to be a priority, the focus of techno-economic leaders will be on using data management capabilities of an IOS as the basis for transforming key processes by eliminating non-value adding activities (P5). Introducing changes to their business processes help them to set apart from their competitors. Hence, such business initiatives as Just-in-Time (JIT) and Vendor Managed Inventory (VMI), in which one company uses the IOS as a means to transfer responsibility for some operational inventory management functions to a business partner [1] [7], are often initiated. These leaders will tend to invest substantial resources in building an IOS, and hence are expected to prepare a careful implementation plan to secure support and funding from their senior management (P1). Such a plan enables the management to monitor the progress of the IOS project.

Techno-economic leaders do not rush into an IOS development due to industry hype rather they make a judgement based on a

financial analysis before proceeding with IOS adoption (P2). Techno-economic leaders generally recognise the need to introduce control mechanisms to help them achieve their goals through IOS. This view is consistent with the recommendations of such organisational scientists as Kirsch [7] who argued that organisations often introduce controls to ensure that their information systems projects meet their business objectives. Hence, techno-economic leaders are expected to initiate a post-implementation review of IOS (P3). These leaders also recognise training as an important facilitator to enable their IT staff to successfully complete an IOS project (P6). They are also expected to aggressively promote the notion of IOS to their partners as the lack of the participation of partners would seriously constrain the achievement of their expected economic goals (P8). The promotion of IOS is however based on its perceived economic advantages to the entire supply chains. Hence, these leaders are unlikely to exert any coercive pressure on their partners (P7).

Research Design

We use a scientific case study approach, in which in-depth observations are compared against theory-based predictions, in our analysis. This approach has been selected for two reasons. First, IOS adoption generally takes place in a complex environment because IOS is dependent on infrastructure which may not be within the control of a single organization [13]. Moreover, the complex interplay of resource dependencies and distribution of power amongst supply chain members also adds complexity to the IOS adoption decision making process [6]. Hence, it is critical to capture the experiences of the relevant people and the context of their actions to understand IOS adoption. Case studies are particularly suitable for understanding phenomena within their organisational context [20]. We sought in-depth discussions and rich explanations from multiple sources from the case site. Second, we looked for a revelatory case site that had introduced recently a web-enabled EDI system and was willing to share its experience with us. The automotive manufacturing company we report next is selected as a revelatory case site because it has been historically active in adopting new technologies, is reported to have led EDI implementation in the Australian automotive industry, and is willing to participate in our research.

The case study was conducted using established principles [17] [20] to guide both data collection and analysis. Specifically, in-depth interviews were sought from three senior executives of each company: the chief IT manager, the materials planning manager, and a senior analyst, and additional interviews were sought from the automotive company's third party EDI service provider (and who was closely involved in the development of a web-enabled EDI solution). To ensure transcription and interpretation accuracy, each interviewee reviewed the transcript of the interview and a draft report on the EDI implementation project of the firm.

Reliability was addressed by conceptualising research variables clearly, using a previously pilot-tested protocol and using multiple coders. The interviewees on many occasions granted us access to company documents relating to the company background, IT profile, EDI characteristics, and EDI implementation, which let us corroborate the information provided in interviews. Data collected from the company were analysed using pattern matching logic [20] in which observations were compared to the implementation activity pattern predicted by the IMM.

Description of Case

The participating organisation is a well-known Australian automotive manufacturing company that wholly designs, develops and builds a range of vehicles. The company has several thousand employees who are structured along eight divisions. The IT division, which consists of 13 senior managers and 55 IT developers/analysts, is split into business applications and IT architecture. The company uses an in-house developed material planning system that is integrated with both traditional EDI systems (introduced in the early 1990s) and a web-enabled EDI solution (introduced in 2004 and maintained by a third party service provider).

The core application used by the manufacturing company is known as the Common Materials Management System (CMMS). The CMMS is an in-house global Materials Planning System (MRP) system which was implemented in the assembly plant in the year 2004. The company decided to introduce the global MRP system which had already been running for several years in the parent company's assembly operations in North America and Europe. The decision for moving to the global MRP system was made due to the parent company's desire to standardize and streamline internal operations across its chapters worldwide. The company enters into the CMMS system information about what vehicles it is planning to build in the next 12 months based on actual orders and forecast orders received from a network of dealers. The CMMS then calculates parts requirements associated with those planned vehicles (which form the basis of forecasting at the company) and then automatically generates the schedules for the respective suppliers. This is done with no manual intervention because the CMMS can determine which parts each supplier can deliver. These schedules, which are known as Materials Requirement Specifications (MRS), are produced in flat files and are sent to the in-house EDI hub (on EDI X400 server) where they are translated into a corresponding industry standard EDI format. The translated EDI messages are in turn sent to the suppliers through a proprietary AANX communication network. The CMMS also produces receipts file based on the Advanced Shipping Notices (ASNs) sent by the large tier-one suppliers which are then sent to the accounts payable system. The payment is made at the rate negotiated by the purchasing division.

The introduction of the global CMMS MRP instigated changes to coding patterns and mailboxes in the company's EDI transactions with its large suppliers. Thus, an EDI upgrade was undertaken, which in turn, called for a revision of coding schemes and mailboxes changes with suppliers. According to the chief IT manager:

“We wanted to ensure that our suppliers adhere to certain disciplines with codes they use in their EDI messages. Hence, we had to change all our EDI programs related to materials handling at the assembly plant in order to enable them to communicate with the newly implemented global CMMS system.”

The successful introduction of the global CMMS MRP system however required that all the suppliers of the company were EDI-capable. Therefore, while undertaking the EDI upgrade initiative the automotive company conducted a survey of its local suppliers to find out more about their EDI capability. To the surprise of the company, it discovered that the purchasing department had contracts with many small suppliers with no EDI capability whatsoever as these suppliers were delivering parts at a low cost. However, the non-compliance of EDI by these small suppliers had an ill-effect on the company which was not brought to the attention of the senior management identified before. The materials planning manager commented:

“...our purchasing people have not always ensured this requirement (EDI compliance) as they're driven by the prices of the components, and were less concerned with the EDI-capability of the suppliers. So, over the years, we ended with a number of suppliers who were not EDI-capable, which has had an (adverse) impact on the assembly plant.”

The non-compliance of EDI by many suppliers was affecting the efficiency of the assembly plant operations. The efficiency was affected due to the delayed arrival of ASNs issued by the suppliers. The CMMS runs over-night batch processing to calculate the usage of all the parts in the plant for the next day in relation to the quantity of parts. When the data entry was not completed by the end of the day, CMMS would show a negative inventory balance. According to the materials planning manager:

“When our inventory analyst looks at the negative figures he usually panics straight away! In actual fact, there are parts available in the plant, but they have not been booked off. So, we experience delays like this when suppliers are not EDI-capable.”

Senior management initially did not understand the impact of non-EDI compliance on the assembly plant operations. However, the introduction of the CMMS system provided the materials planning department with an opportunity to convince senior management about the significance of total EDI adoption by suppliers. Senior management understood and strongly supported the idea of putting these non-EDI enabled suppliers onto an EDI network because it presented the company with an opportunity of obtaining further efficiency improvements and enforcing a policy of 100% suppliers EDI compliance.

The EDI survey conducted by the automotive company helped it to recognise that many of the non-EDI enabled suppliers were small companies with limited financial resources and IT expertise. The company further understood that these small suppliers would be extremely reluctant if they were asked to trade with the company through the traditional EDI network which would require considerable investment on the part of these suppliers. The materials planning manager remarked:

“One of the things that I wanted to do was have each and every supplier EDI-capable. I however noticed that some suppliers were pushing back and saying that they were not willing to invest in EDI systems. There is an EDI committee in our company, and I discussed with them about the possibility of a web-based EDI offering.”

Taking into consideration the reluctance of the small suppliers and to reduce the learning curve associated with traditional EDI, the company decided to invest in a web-enabled EDI application that was to be maintained by a third party EDI service provider. The automotive company invested in the web-based EDI system in order to realize further efficiency gains by encouraging the small suppliers to adopt an electronic medium.

The web-enabled solution has several attractive features. First, it no longer ties suppliers to one desktop. It could be used from any desktop that has access to the Internet. The web solution thus greatly improves supplier flexibility. Second, suppliers can automatically “reuse” part of the information from the MRS which the suppliers receive from the automotive company. Using the web-based EDI system, the company could send MRS to the third party provider via the AANX network. Suppliers could then log-in, view the list of MRS using a standard web interface, automatically convert it into an ASN at the click of a button, and send it off to the service provider. Upon receiving an ASN from the suppliers, the service provider would then translate it into a traditional EDI format and forward the EDI message to the automotive company via the AANX network.

Empirical Findings

In this section, we first confirm that the motivation in the case was techno-economic leader and then evaluate each of the eight propositions.

Classifying IOS Adoption Motivation

The opportunity of achieving productivity gains by ensuring 100% EDI compliance of suppliers motivated the automotive company to introduce a web-enabled EDI system. The productivity gains were achieved due to the reduction in time spent by the procurement staff in resolving inaccurate ASNs resulting from the manual receipt of ASNs sent by the small suppliers. Further productivity gains were achieved because the innovative integrated web-enabled EDI system helped the inventory analysts to make improved decisions about the correct level of inventory needed to maintain daily assembly operations. Hence, the motive of the company for introducing the EDI solution can be interpreted to be techno-economic in nature because the company clearly wanted to exploit the novelty of a web-based EDI solution to make further cost savings and improve supply chain efficiency. Furthermore, the notion of introducing a web-enabled EDI solution was conceived during a discussion between the materials planning manager

with the company's EDI committee members. There is no evidence to suggest that the third party service provider has played a role in helping the automotive company in conceiving the EDI solution. The EDI project leader remarked:

"We were approached informally by the automotive company for this. Historically, when the AANX was set up, one of the things the automotive company looked at from an EDI perspective was some sort of web solution. ... So, when we were approached by the car company, we demonstrated the product to them, and they were impressed."

Thus, the web-enabled EDI adoption initiative of the automotive company is an instance of techno-economic leader scenario.

Analysis of Propositions

Techno-economic leaders are expected to prepare an IOS implementation plan (P1). This prediction was supported because prior to the introduction of the web-EDI system, the automotive company was found to have framed an in-depth implementation plan in close collaboration of the third party service provider. An important component of the plan required the company to prepare the key requirement specifications of the web-EDI solution in rigorous consultation with several suppliers. The plan also identified the need to introduce major changes in the interfaces and business rules to be supported by the solution. This was achieved through a consultation process involving selected suppliers. The implementation plan further included an option for testing a prototype. According to the materials planning manager:

"A formal decision-making process was followed before committing our resources to this project. We also prepared an implementation plan (in consultation with the service provider) which called for the need of a pilot test...."

Techno-economic leaders are also expected to conduct a cost-benefit analysis of their IOS projects (P2). This assertion received empirical support as the automotive company conducted a cost-benefit analysis and decided to outsource the development of the system in order to minimise the development costs. The cost structure proposed by the service provider was quite attractive and required a commitment of A\$50,000 from the automotive company and an annual fee to the provider based on the volume of EDI transactions. The benefits were identified in terms of a reduction in the amount of discrepancies in ASNs and subsequent follow-ups, as well as increased efficiency of the entire process of data transmission. A quantitative assessment of the expected gains resulting from improved data quality and faster data transfer was performed which outweighed the cost proposal of the service provider. According to the EDI project leader:

"We have made an attractive commercial proposal to the automotive company and they were convinced based on their own assessment that the resulting productivity benefits from the despatching of ASNs and accuracy of data flows would far exceed our cost proposal."

Techno-economic leaders are likely to initiate a post-implementation review of their IOS projects (P3). This proposition received support as the automotive company had reviewed its internal operations after having undertaken the implementation of the web-enabled EDI system. The review was intended to address three specific issues: a) impact of EDI solution on procurement staff, b) supplier feedback on EDI performance, and c) analysis of suppliers' delivery performance. The company found that manual work was reduced as non-EDI suppliers were now able to transmit documents electronically via the web. Furthermore, once the EDI solution system was up and running, the automotive company sought feedback from the suppliers about the performance of the system. Based on the feedback, the company then worked with the service provider to make further modifications to the solution. The company also reviewed (on a monthly basis) supplier performance which is strongly influenced by the timely and accurate arrival of EDI messages from the suppliers. This sentiment is highlighted by the materials planning manager as follows:

"We are in a better position to analyse their delivery performance. This is because we now receive ANS electronically and no longer receive incorrect data. This has a positive effect on the monthly performance ratings for suppliers. The performance metric is an indicator of how well they shipped parts to us in relation to what was required."

Techno-economic leaders are expected to integrate their IOS projects with their back-end applications (P4). This view is supported because the company integrated web-based EDI solution with its back-end CMMS system to avoid manual intervention for triggering the exchange of MRS and ASN. This integration was essential to help the inventory analyst of the company to make informed decisions upon viewing the up-to-date inventory balance.

Techno-economic leaders are also expected to streamline their business processes (P5), although this proposition was not supported because the task of translating documents from EDI to web formats and vice-versa is now performed by the service provider. Therefore, the introduction of web-EDI services did not bring about any major changes in the internal business processes of the automotive company as it continued to send and receive documents in the usual EDI format. According to the senior analyst:

"No changes in business processes were introduced as a result of the adoption of web-based EDI by certain suppliers. The upgrade was in line with the business processes, which had already been in place."

Techno-economic leaders are expected to organise training on IOS (P6). As the web solution was actually developed by the third party service provider, the automotive company did not conduct any training programs for its own personnel. However, the company participated in designing online training programs which the third party service provider organised for the small suppliers in order to help their staff in operating the web-based application. The EDI project leader commented:

“Of course, we have equipped the product with online demos and tutorials. Personally, I have provided assistance to many suppliers in the usage of the web system.”

Training was also given informally by the automotive company which had held supplier information session at its own premises. Explanations were offered about how suppliers should address issues relating to the enforcement of certain unique business rules which are enforced through the web-based EDI solution. Thus, proposition P6 received empirical support.

Techno-economic leaders are unlikely to apply pressure on partners (P7). This assertion is supported. The automotive company did not exert any pressure on the small suppliers. It did not issue any explicit threats to non-EDI suppliers. It made the web-based EDI solution known to those suppliers that were not EDI-capable, but did not impose it on them. This sentiment is supported when the materials planning manager made the following comments:

“We have not imposed our own dedicated EDI system onto them. I’ve seen large organisations do such a thing, and I reckon it’s a bad way of doing things with trading partners. The web-based system is an open architecture.... no impositions or restrictions are placed on them.”

The non-coercive strategy is further highlighted by the easy to use and low-cost system developed for suppliers to trade through the web-based EDI solution. The EDI project leader commented:

“The automotive company demanded some predictability with the cost of the web-based EDI solution. Hence, we modelled the cost structure in such a way that suppliers would not have an unpleasant surprise with paying extra for EDI messages.”

As well as investing in the development of the web-based solution, the third-party service provider offered technical assistance and guidance to suppliers. In particular, while the translation of documents from the proprietary EDI network into a web-based format and vice-versa was being looked after by the web-EDI provider, small suppliers subscribing to the web services did not have to worry about EDI codes and formats. According to the chief IT manager:

“The main benefit (of web-EDI introduction) is the much lower cost to the suppliers than what we’ve had before with conventional EDI. Another added benefit is the fact that through the same web-based system they are able to communicate with their other trading partners. We have not imposed our own dedicated EDI system onto them.”

Techno-economic leaders are likely to market IOS concept (P8). This assertion received support from the automotive company. The introduction of the web-EDI system was accompanied by a cooperative approach from the automotive company. It was marketed through carefully planned promotional initiatives which emphasised a win-win situation. The company highlighted that the web-enabled EDI solution when accepted by the small suppliers would help them experience an immediate improvement in data accuracy. At the same time, the prompt dispatching of ASNs by the suppliers positively impacted the suppliers’ delivery performance (measured in terms of supplier rating). In short, the web-based EDI solution was promoted as a tool to improve supplier rating and productivity improvement. According to the EDI project leader:

“It is very much a win-win scenario. The small suppliers that have been using the web product noticed the productivity improvement, which then improves the relationships between the suppliers and the car company, and the supplier rating. Suppliers are very much driven by the supplier-rating, and the prompt dispatching of the ASNs and the accuracy of data within the ASNs has a great impact on the supplier-rating.”

This sentiment was also supported by the materials planning manager:

“We promoted the system based on its merits for the suppliers. The main benefit is the much lower cost to the suppliers than what we’ve had before. Another added benefit is the fact that through the same web-based system they are able to communicate with their other trading partners.”

In addition, the company invited the EDI service provider to participate in the promotion of the web-based solution. The launching ceremony was held at the premises of the automotive company and was attended by many small suppliers. During this ceremony, trial runs of the EDI solution were organised and all security features embedded into the solution including encryption and authentication were explained to attract supplier acceptance of the solution. The business analyst commented:

“It is hard to introduce new technologies to suppliers because they claim not to see the advantages. So, it was a challenge for us to show them what the advantages actually are and in what form they come. I invited a number of small suppliers to attend the web-enabled EDI product launching and explained to them how the system could fix their data entry problems for sending ASN. ”

Discussion

Figure 3 shows the pattern of activities observed with the patterns of activities expected for each of the four motivations in the IMM. The pattern observed is very close to the techno-economic patterns, and quite dissimilar to both of the socio-political patterns. Of the two techno-economic motivation patterns (leader and follower), the observed pattern is closest to the techno-economic leader (TEL) pattern, except that business processes were not changed as part of the implementation project.

This question of why processes were not changed becomes important here. Proposition P5, suggests that techno-economic leaders

will make significant business process changes to exploit the capabilities of IOS technology. Three possible reasons why processes were not changed are (1) changing processes was not seen as a priority, (2) the change was not possible due to constraints in the external environment or within the firm, and (3) the requisite changes had already been made as part of an earlier project.

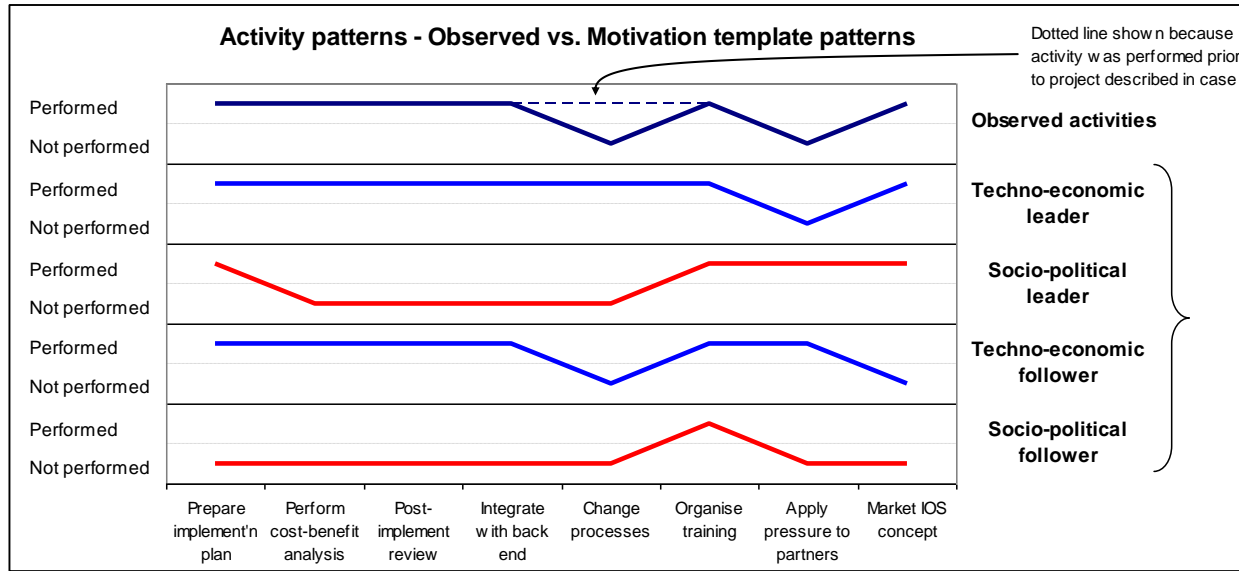


Figure 3: Comparison of observed activity patterns with IMM predicted patterns

Determining the reason for the difference is important. A finding that either of reasons (1) or (2) are true would indicate a potential misalignment of activities with objectives, while a finding that reason (3) holds would indicate that the difference is simply a result of pre-existing affordance in the environment making the activities unnecessary, and that no misalignment has occurred.

Further investigation indicates that reason (3) explains the difference between the observations and the typical TEL activity pattern. That is, because the company had already streamlined its procurement and inventory management processes in a previous EDI initiative — which was undertaken in early 1990s when traditional EDI systems were introduced with large tier-one suppliers. Therefore, extensive redevelopment of processes was unnecessary (although informants indicated that process redesign is an ongoing priority to meet longer-terms goals). In addition, because the task of translating documents from EDI to web formats and vice-versa had been transferred to an external the service provider, the introduction of web-EDI services did not require any major changes in the internal technical capabilities of the automotive company as it was able to continue to send and receive documents in the usual EDI format. We therefore argue that the deviation between the prediction for the proposition P5 and actual experience of this company can be satisfactorily interpreted in terms of situational factors unique to this company. This in turn implies that the logical arguments used in developing those propositions were not challenged.

Regarding generalizability of results, we argue that while a single case does not support statistical generalisation, the logic of analytical generalisation was applied in interpreting evidence for evaluating the research propositions. The IMM was used as a template with which the empirical results were compared. In making comparisons, not only was the prediction offered by each research proposition matched against the empirical evidence obtained from the case data, but the underlying logic for supporting or refuting the research propositions was also considered. Additionally, the arguments that were used to derive the research propositions from the literature made no reference to any specific properties (e.g. organisation size, IT budget) of organisations operating within the automotive industry. Because the research propositions are not organisation-specific, the findings should be applicable to other similar companies.

Conclusion

In this paper, we have reported the IOS implementation experience of a large automotive manufacturing company and found that most of the activities initiated by the company for introducing an internet-based EDI can be described in terms of its motive to adopt the EDI solution. Therefore, the empirical findings offer broad support to the notion that organisational motivations could describe how IOS implementation processes are initiated. This finding contributes to the IS literature by highlighting the role of motivation as a determinant of IOS adoption processes. The practical implication is that, by knowing their own motivations for IOS adoption, the potential IOS adopter organisations can obtain insights about how to initiate adoption processes which in turn can bring a reduction the uncertainty associated with IOS adoption in organisations.

We are currently engaged in a large scale research program that aims to evaluate the IOS implementation phenomenon in the Australian automotive industry, and are interested to determine whether IMM succeeds in successfully explaining IOS implementation processes of multiple supply chains regardless of industry segments within which they operate.

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AN EXPLORATORY RESEARCH ON ONLINE MUSIC PIRACY AND CONSUMER BEHAVIOR

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ABSTRACT

This paper explores consumer behaviour associated with the possibility of online music piracy. A research model has been systematically developed to examine a number of variables in relation to consumer attitudes towards online music piracy. The model has also been tested using empirical data collected from individual consumers. The results show that music content, Internet skill, convenience and potential penalty are major factors of individual attitudes towards online music piracy. In addition, these factors together with subjective norms have significant impacts on individual intentions to obtain music products through unjustified online channels. The findings have practical implications for managing online digital music products and services.

Keywords: Consumer behaviour, online music, piracy, attitudes and intentions

INTRODUCTION

With the advancement of Internet technology and the popularity of digital music products and music players, online music has become very popular in recent years. However, it results in not only considerable challenges to the music products and services, but also unpleasant and unethical behaviours. The music industry is one of the most impacted industries facing the challenges of piracy, unauthorised copying and dissemination [4]. It was reported that the worldwide annual sales of music CD have dropped over ten percent since 2001 [8]. Actually, piracy covers wide activities, such as counterfeiting, pirating, bootlegging, tape trading and files sharing. It is a non-commercial file sharing or sharing of music without exchange for money [6]. As far as the above is concerned, the present paper aims to explore (i) the key factors that make music piracy become prevalent, (ii) the impacts of these factors on individual intentions to pirate music through online music file sharing, and (iii) the strategies of the music industry in response to the challenge of piracy behaviour.

LITERATURE AND RESEARCH MODEL

The theory of reasoned action and the theory of planned behaviour [1] are the theoretical underpinnings of this study. The existing studies show that individual attitudes are influenced by personal integrity, past experience in behaving specific action. In addition, the perception of social punishment to unethical behaviour influences individual attitudes to pirate unlawful properties [2] [3] [7] [8]. Individual behaviour may be under control if one is psychological and mental strong enough. However, social surroundings often influence individual attitudes and intentions. Therefore, a research model is suggested to explore the issues being concerned (Figure 1). In addition, a number of hypotheses are proposed to examine the extent to which the variables influence individual intentions to pirate music through file sharing (Table 1).

Figure 1 Research Model

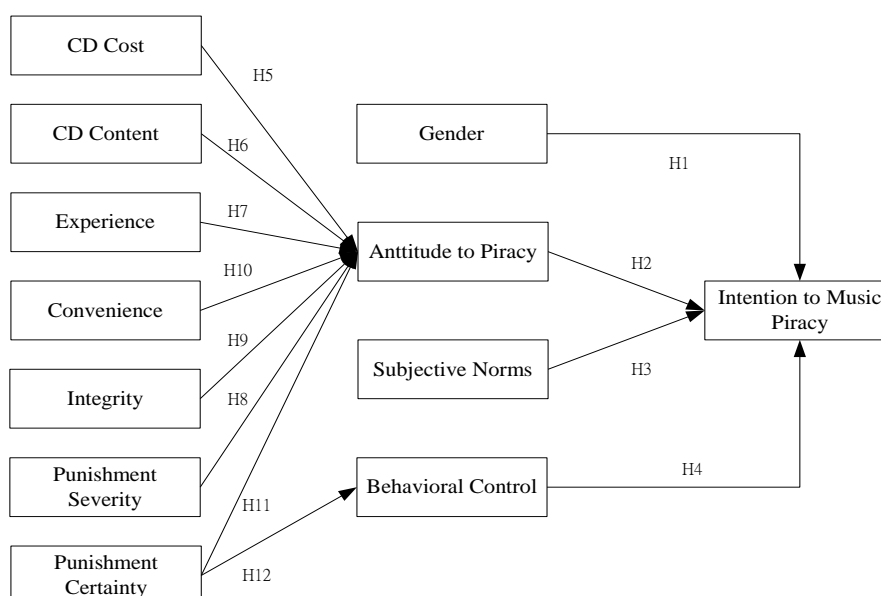


Table 1 Hypotheses

H1	Males have higher piracy intentions than females do.
H2	Attitudes towards music piracy are positively associated with piracy intentions.
H3	Subjective norms are negatively associated with piracy intentions.
H4	Perceived behavioural control is negatively related to piracy intentions.
H5	CD cost is positively related to the attitudes towards music piracy.
H6	Favourable CD content is negatively related to the attitudes towards music piracy.
H7	Experience in listening a pirated music file is positively associated with music piracy.
H8	Punishment severity is negatively related the attitudes towards music piracy.
H9	Personal integrity is negatively related to the attitudes towards music piracy.
H10	Convenience is positively related to the attitudes towards music piracy.
H11	Punishment certainty is negatively related to the attitudes towards music piracy.
H12	Punishment certainty is negatively related towards behaviour control.

RESEARCH METHODS

The research methods include literature review, design of questionnaire, survey and data analysis. Survey questions were generated in the light of the existing literatures. Due to the sensitivity of the issues, we developed the scenarios to clarify the situations of online music piracy. Respondents to the questionnaire were assumed in some scenarios and were asked how and what they were going to do. Selected scenarios are as follows:

A year-two student works as a part-time technician in a company and earns HK\$3,000 monthly. He is very enthusiastic and likes to listen to classical, rock and pop music. His appreciation is very high, and he usually one listens to a few songs in one CD.

By possessing professional computing skills, he knows how to download music from the Internet and break any Internet protection. However, being a reasonable person, he knows it is improper to download music from the Internet, as he heard reports and consequences about downloading music illegally. Therefore, he always buy CD package when there are songs that he wants to listen to.

Yet, most of his friends like to download free music and songs through the Internet because they cannot afford the huge expense as they said. Usually, a classic CD package prices around HK\$100 – 300, which could cost a lot to a student, his friends used to persuade him to download music from the Internet, but he still persist in buying CD even though the expenditure on purchasing CD really costs him a lot.

One day, while he was surfing Internet, he find a song on accidentally. It was an old song in 1950's, and he loved it very much and had looked for it for a long time. The rare CD costs HK\$500 from a shop, and it was really difficult to find that music piece in today's CD shops in Hong Kong.

After a deep thinking and struggle, he changed his mind and downloaded the music from the Internet shop without payment. He believes that it would be safe to download this time, because his friends also download music pieces through the Internet, and they have not been caught or detected so far. In addition, it is first time to download music illegally, and he thinks it might not be very serious when compared with other people.

Now, please stand on your role, complete the following questions or give comments on his behaviour in the questionnaire.

The questionnaire included two sections. The first section composed questions in relation to the variables in the research model, while the second section collected respondents' demographic data. It was randomly distributed to different students, which resulted in 188 useful responses.

ANALYSIS AND RESULTS

All respondents are Internet users with certain computer knowledge. The sample includes 52% female and 48% male. Over 80% of the respondents range from 18 to 25 years old. 75% of them are undergraduate students. 45% of them earn average monthly income from HK\$1,000 to HK\$3,000. We test the sample data using the Statistical Packages for Social Science (SPSS). Firstly, the reliability analysis is conducted to reveal the relationships assumed among the selected factors. Table 2 shows that the selected factors achieve the acceptable level of a Cronbach's alpha value. Secondly, the multiple regression analysis is conducted to reveal the relationships assumed among the selected factors (Table 3).

The results indicate that Gender and Perceived Behavioural Control have insignificant impact on Piracy Intentions. The findings are consistent with research of [3] [4]. It may imply that some may have intentions to pirate music files rather than buy the CDs, the behaviour like the student in the scenario is rare. It is not uncommon that a student may download music online and share the music with friends. The perceived behavioural control is also insignificant to piracy intentions, and this may show the ethical behaviour is low. Since some students are not aware that online download of music files and sharing of such music files with friends are illegal and unethical, they pay little attention to social and economic implications behind a piece of music file.

However, CD Cost is insignificant in influencing students' attitudes towards music piracy. This result is inconsistent with findings of [7] [8]. Basically, music CD in Hong Kong is relatively inexpensive, comparing to that in some cities in the world. Most students should have enough money to purchase music CD. In addition, Integrity is insignificant to Attitudes towards Music Piracy. This finding seems inconsistent with other studies. In this study, Integrity is represented by three variables: honesty, responsibility and self-control. Obviously, it is beyond to say that some students think themselves as responsible, the personal value and indicators of maturity seem not suitable to measure them, and we would suggest for further study that it should not consider them as suitable variables related to students' attitudes.

Table 2 Results of Reliability Analysis

Factors	Number of Items	Cronbach's alpha
CD Cost	3	0.703
CD Content	4	0.738
Attitudes towards Music Piracy	5	0.721
Experience	4	0.714
Punishment Severity	2	0.783
Integrity	3	0.776
Convenience	6	0.818
Punishment Certainty	3	0.705
Subjective Norms	4	0.731
Perceived Behavioural Control	2	0.705
Piracy Intentions	3	0.764

Table 3 Results of Multiple Regression Analysis

Models	Variables	β	t-value	Sig.
Model 1: Attitudes towards Music Piracy ($R^2 = 0.30$)	CD Cost	0.092	1.42	0.156
	CD Content	-0.170	-2.44	0.016
	Experience	0.147	2.13	0.034
	Punishment Severity	-0.214	-3.30	0.001
	Integrity	-0.030	-0.47	0.635
	Convenience	0.241	3.66	0.000
	Punishment Certainty	-0.154	-2.24	0.026
Model 2: Perceived Behavioural Control ($R^2 = 0.45$)	Punishment Certainty	-0.273	4.86	0.000
Model 3: Piracy Intentions ($R^2 = 0.38$)	Attitudes towards Music Piracy	0.286	3.70	0.000
	Subjective Norms	0.212	2.972	0.003
	Perceived Behavioural Control	0.050	0.667	0.500
	Gender	0.027	0.391	0.696

The analysis shows that Experience and Convenience are positively associated with Attitudes towards Piracy. The findings are consistent with previous outcomes, and justify that experience and convenience encourage students' intentions to piracy, especially students' computer and Internet skills, easy to access to music websites, and rareness of music and songs. In order to discourage online music piracy, the service providers are suggested to make online music products at limited costs. They should also reward consumers based on past purchasing records and memberships to encourage moral behaviour. Lastly, Punishment Certainty and Severity negatively significantly affect individual attitudes towards piracy. It has been proved that legal actions are useful to discourage immoral behaviour and make individuals to be careful about illegal deals. Therefore, Punishment is still necessary and effective, although it seems to be a negative means. However, it would be more important to educate people to behave with respect to intellectual property.

CONCLUSION

Our empirical research suggests that Attitudes towards Music Piracy and Subject Norms are significantly associated with students' intentions to music piracy. The present findings are consistent with those in some existing studies. In general, attitudes behave actions. Appropriate attitudes and behaviours are ultimately important. Therefore, education should aim to develop students' mentality and morality. Today, the Internet has been extensively used in different contexts. However, individuals should appreciate the implications, because abuse of advanced technology may lead to social problems.

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COMPETITION AND INTEGRATION STRATEGY ANALYSIS OF ADVERTISEMENT-SUPPORTING ONLINE SOCIAL NETWORK RELATED SERVICES

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ABSTRACT

Social networking related services (SNS) become increasingly popular communication and interaction mediums over internet. As most of the SNS are free, the providers generate revenues from advertising and other extension services. This paper investigates the advertising strategy and the strategic of compatibility and co-opetition between two social networking related services. Utilizing game theoretic model, we show that the providers will benefit from both service and business integration, however, the users are always worse when SNS services are compatibly connected. The users will always gain from the quality (features) competition, however, brand competition may hurt the customers as more disturbing ads will be exerted. In general, business integration will result in a higher diversity if ads exerted in two IM services.

Keywords: Social networking, Co-opetition, Compatibility, Advertising, Network Externalities. Brand loyalty, Competition.

INTRODUCTION

By the development of Internet technology, people are connected to the internet where they communicate, interact and share information to each other. Social Networking Related Services (SNS) becomes increasingly popular communication mediums over internet, which focuses on the building and sharing of online social networks for communities of people who share knowledge, interests and activities [10]. As a result, a virtual relationship or social network is formed and gradually evolves from interactions. These web-based and interact oriented services include Instant Messenger (IM), email, video, voice, file sharing, social bookmarking, discussion groups, online album, and so on. In general, social networking related services, allow users to create a profile for describing themselves and build their friend network by SNS. Such as Myspace, Facebook, Google Orkut and Friendster, they allow users to list their interests and link to their friends, sometimes annotating these links by or quantitative ratings for selected friends [12]. For making business contact, users on LinkedIn can find new job or recruit personnel on it. And Flickr provides comprehensive online album services, Youtube provides video blogging services. Sites like LiveJournal, Blogger and Blogpulse act as blogging service aggregators, serving some useful tools and statistics data about blogging. These web-based SNS emerge extremely fast and plentiful, which is accompanied with more and more furious competitions.

Internet advertising is one of the most profitable revenue streams. SNS providers tend to derive the bulk of their revenues from information transmitters (advertisers) rather than information receivers (SNS users). Most SNS are free for users. For instance, Yahoo! Messenger charges the firms who wish to conduct advertisements to promote their products/services, but permits users to access the IM services for free [1]. In this paper, we assume that the revenue of the Internet advertising comes from the number of ads impressions, though several types of advertising contracts are developed. Therefore, the revenue is associated with the amount of the ads and the number of SNS users. The SNS providers can increase revenue by putting more ads on the services, however ads may be harmful. The higher level of adverting activities, the more users will switch to the opponent SNS channel. As a result, the overall revenue from the ads impression may decline. Therefore, it is very important to study the appropriate advertising strategy to pursue the objective of profit maximizing.

Compatibility of SNS is associated with the impact of network externality. Network externalities are positive external consumption benefits, when it is significant, so too are the benefits of having compatible products, the benefit that a consumer derives from the use of a good often depends on the number of other consumers purchasing compatible items [3]. SNS fits the classic definition of a service imbued with externality (network) effects, in which the value to each customer depends upon the number of other customers (and who they are) who also use the service.

In this paper, utilizing game theoretic model, we develop a parameterized model to analyze the advertising strategy and the strategic of compatibility and co-opetition between two social networking related services. We found that the impact of service compatibility and business integration are significant. While gaining the benefit from contacting more people, the users are always worse when SNS are compatibly connected. The providers will benefit from both service and business integration. The users will always gain from the quality (features) competition. However, brand competition may hurt the customers as more disturbing ads will be exerted. In general, business integration will result in a higher diversity if ads exerted in two SNS.

The remaining sections are organized as follows. Section 2 lists previous works and section 3 introduces the game setting and models the related parameters. In Section 4 we investigate the advertisements conducting quantity and SNS channel allocation equilibriums. In section 5 we analyze and compare results under incompatible and compatible situations between two SNS providers. In section 6 concludes our findings and future research directions.

RELATED LITERATURES

Social networking related services have drawn significant press from the business and academic boundary. These services are

spreading interdisciplinary. Social network analysis related approaches are applied to blog network structure analysis, online recommendation system domain and online communities, and so on. In recent year, as the emergence of concept of web2.0, person interactive oriented services gradually replace traditional websites. More and more innovations and technology progresses focus on these SNS which help users find a piece of information that may be held by a friend of a friend (social tagging or bookmarking services). Previous study about behavioral into social network services, such as Myspace, Flickr and Facebook, has been performed by survey [24][4] or empirical study [2]. In this study, we focus our attentions on economical analysis of social networking, which discuss these competing services providers and analyze the impact of integration (service compatibility and business alliance) on the resulting advertising strategy and demand distribution.

Network externality plays an extremely role in social networking related services, which is a significant factor affects the profitability of SNS providers. [6] utilizes a example of telephone to demonstrate that the utility derive from the consumption of these goods is affected by the number of other people using similar or compatible products. Especially in the market of online social networking services, once the users of certain service cross the point of “critical mass”, the utility of provider will exponentially increases with the number of service users. The influence of network externality widely presents in domains ranging from traditional industries: telecommunication, hardware and software industries and market of information [6], to internet service providers, such as all kinds of social networking related services or product. Network externality indeed influence both on providers and users. Digital version of products will increase the sales in stores if the externality effect is significant [5]. Yet, the size of network externality affects consumer’s demand and/or willingness to pay [9].

Compatibility is especially a crucial factor in information network industries, and the value will be limited without compatibility in networking or communication related services. Typically, firms can choose whether to produce compatible products or services for the purpose of benefit improvement. A few research have be conducted on the compatibility decisions of hardware and software, for example, Gerald Brock and Robert Kurdle (1975) have targeted on the compatibility of mainframe computer and farm machinery industry. For SNS services, whether compatible or incompatible between two SNS services play an important role in evaluating the users’ utility and providers’ corresponding strategy. In this paper, we utilize game theoretical model to analyze the impact of service compatibility and business integration on the adoption of advertising strategy.

THE MODEL

We consider a market with two social networking related services (SNS) in which users can utilize the service to communicate and share knowledge with other users. The total number of SNS users is η_0 and the total number of users of these two SNS channels are $\forall i \eta_1$ and η_2 respectively ($\eta_0 = \eta_1 + \eta_2$). For analytical convenience, in this model, we assume a user choose only a SNS channel as their major bridge to communicate with other users, though people may use two channels simultaneously because they may have different groups of friends on two channels. Such as, in fact most of users use two of more IM channels to communicate [7] with others due to their different preferences on these IM services. Let parameter β_i stand for brand index about SNS i determined by images of SNS channels. The users are heterogeneous on the impact of the brand when selecting the SNS. Brand index of channels could be described as brand reputation which is determined by strength of brand. It’s a degree of influencing power, we could quantify it by the average images scores of users. That is, we consider β_1, β_2 as the influences of brands on most users. In contrast to traditional setting of brand index, we found that it’s more suitable to employ the brand index in representing the likeness degree toward SNS. In other words, the difference is that positive utility of brand index is used to replace the traditional one which models brand index with a negative utility.

Variable θ_i stands for the individual type toward the brand of SNS, and is uniformly distributed with an interval [0,1]. It’s a relative indicator. Notable, a user with higher value of θ_i has more love tendency to use SNS channel 1, vice versa. The user with value of θ_i near $\hat{\theta}$ is indifference when selecting SNS channels. That is, he/she has similar preferences toward two channels. The user will choose one channel eventually whether the facts that he/she may use the other channel simultaneously. Intuitively, $\theta_i \beta_1$ stands for brand loyalty of user i toward channel 1 and $(1 - \theta_i) \beta_2$ means brand loyalty of user i toward channel 2.

Parameter f_i means functions (or features) of SNS i determined by their own service quality level (such as services accessibility, the familiarity of user interface, system stability, and file transferring capacity). Since the users prefer to a SNS with larger number of users because he/she can communicate with more potential users utilizing the same SNS. We describe the effect of this type of externality by parameter α . Higher α indicates stronger effect of the externality. Finally, parameters a_i is the advertising quantity conducted on SNS channel i .

Individual And Demand Functions

Incompatible SNS Services

Considering the above factors (brand loyalty, features, externality, and ads disturbance), the utility of user i in a market with incompatible independent SNS providers can be formulated as

$$U_i^n = \begin{cases} \theta_i \beta_1 + f_1 + \alpha \eta_1 - a_1 & \text{if subscribe to SNS 1} \\ (1 - \theta_i) \beta_2 + f_2 + \alpha \eta_2 - a_2 & \text{if subscribe to SNS 2} \end{cases} \quad (1)$$

Let $\hat{\theta}$ denote the user type who is indifferent between using two channels. From the utility function, we can get

$$\hat{\theta}^n = \frac{\beta_2 - \Delta f - \alpha \Delta \eta + a_1 - a_2}{\beta_1 + \beta_2}, \quad (2)$$

Where $\Delta f = f_1 - f_2$ and $\Delta \eta = \eta_1 - \eta_2$. The users with type indexed by $\theta_i \in [0, \hat{\theta}]$ will use SNS channel 2, whereas the users with type indexed by $\theta_i \in [\hat{\theta}, 1]$ will prefer SNS channel 1. According to conditions $\eta_2 = \hat{\theta}^n \eta_0$ and $\eta_0 = \eta_1 + \eta_2$, we get the demand functions of two channels:

$$\eta_1^n = \frac{\eta_0(\beta_1 + \Delta f - a_1 + a_2 - \alpha \eta_0)}{\beta_1 + \beta_2 - 2\alpha \eta_0}, \eta_2^n = \frac{\eta_0(\beta_2 - \Delta f + a_1 - a_2 - \alpha \eta_0)}{\beta_1 + \beta_2 - 2\alpha \eta_0} \quad (3)$$

And the difference of demand between two SNS channels are obtained as

$$\Delta \eta^n = \eta_1^n - \eta_2^n = \frac{\eta_0(\beta_1 - \beta_2 + 2\Delta f - 2a_1 + 2a_2)}{\beta_1 + \beta_2 - 2\alpha \eta_0} \quad (4)$$

Compatible SNS Services

Now we consider two SNS channels are compatible, that is, the users of one channel could communicate with users of another channel, vice versa. For example, currently SNS like Yahoo and MSN messengers can contact each other's users after utilizing specific bridge software. In the case, both users could benefit from the aggregate externality effect, $\alpha(\eta_1 + \eta_2)$. The utility of a typical user i is rewritten as

$$U_i^c = \begin{cases} \theta_i \beta_1 + f_1 + \alpha \eta_0 - a_1 \\ (1 - \theta_i) \beta_2 + f_2 + \alpha \eta_0 - a_2 \end{cases} \quad (5)$$

Similarly, we can obtain the use type who is indifference in using SNS channel 1 and SNS channel 2, under compatible situation,

$$\hat{\theta}^c = \frac{\beta_2 - \Delta f + a_1 - a_2}{\beta_1 + \beta_2} \quad (6)$$

Then, the demand functions of two channels are derived as

$$\eta_1^c = \frac{\eta_0(\beta_1 + \Delta f - a_1 + a_2)}{\beta_1 + \beta_2}, \eta_2^c = \frac{\eta_0(\beta_2 - \Delta f + a_1 - a_2)}{\beta_1 + \beta_2} \quad (7)$$

, and the difference of demand between two SNS channels are obtained as

$$\Delta \eta^c = \eta_1^c - \eta_2^c = \frac{\eta_0(\beta_1 - \beta_2 + 2\Delta f - 2a_1 + 2a_2)}{\beta_1 + \beta_2} \quad (8)$$

Comparing $\Delta \eta^n$ and $\Delta \eta^c$, as intuitive, we can find the provider with stronger brand, more features (high quality), and less ads will acquire higher market share in both market environments. However, in a market with incompatible service strategy, we could observe that the difference of the demand of heterogeneous SNS increase as the externality effect α increases, whereas if network effect α has no impact on the demand distribution if these two SNS services are coordinated to be compatible.

$$\partial |\Delta \eta^n| / \partial \alpha > 0 \text{ and } \partial |\Delta \eta^c| / \partial \alpha = 0.$$

Profit Functions

SNS such as instant messenger do not earn any revenue from the IM subscribers but derive revenue commonly from online advertising, LBS (Location-Based Services), IVAS (Internet Value Added Services) such as online dating and data storage services, avatars (virtual icons representing user identity) and casual games, and MVAS (Mobile Value Added Services), such as subscription service for IM message forwarding to mobile phones [8]. In this context, only advertising revenue is considered and modeled as profits of providers. We especially focus on what is the impact of integration (service compatibility and business alliance) on the resulting advertising strategy and demand distribution.

The advertising spaces of SNS channel are divided into several AD slots, each advertisement statically occupied a slot (space) in a period of time, so advertising quantity in a certain time means the number of advertisements (slots) which was conducted on the SNS channels. Denote φ the fee (price) of unit advertisement (for example, per ads impression) charged to the sponsors by SNS providers. Notice that the benefit of operating SNS include directly benefit (such as revenue generated from advertising) and indirect one (for example, IM service is strategically provided to retain the visitors and receive future gain from the lock ins). The payoff functions of the two SNS providers in the long run can be formulated as

$$\begin{aligned}\pi_1 &= \eta_1 a_1 \varphi + K(\eta_1) - c(\beta_1, f_1, \eta_1), \\ \pi_2 &= \eta_2 a_2 \varphi + K(\eta_2) - c(\beta_2, f_2, \eta_1)\end{aligned}\quad (9)$$

, where $K(\eta_i)$ stands for the indirect benefit (asset) of the services which is associated with the number of the users of the SNS services. The cost function of SNS services $c(\beta_i, f_i, \eta_i)$ include the investments of brand promotion, functionality and quality development, the operational cost to accommodate and coordinate the activities of the users. Here, we first consider the model for the operation in short run. That is, in the short run, the costs of branding, product development and capacity are sunk cost and focus on the decision of appropriate advertising strategy and corresponding profit. We reduce the profit (only revenue is consider here) function as

$$\pi_1 = \eta_1 a_1 \varphi, \quad \pi_2 = \eta_2 a_2 \varphi \quad (10)$$

THE SNS MARKETS

In this section, according to the service functionalities (brand loyalty, service quality, and compatibility) and business activities (competition and integration), we analyze advertising strategies of the SNS providers. We derive subgame perfect Nash equilibrium (advertising level and channel distribution) with respect to different market environments. Various market structures discussed in our model are described in Table 1.

Table 1: Market Structure

	Technology Independent	Technology Integration
Business Independent	NO (section 4.1)	Only Technology integration (section 4.3)
Business Integration	Only Business Integration (section 4.2)	Both Technology and Business Integration (section 4.4)

On business integration dimension, section 4.1 and 4.3 emphasize on independent services providers under different strategy of compatibility. However, section 4.2 and 4.4 focus on merged providers (business integration). On technology integration dimension, section 4.1 and 4.2 issue on incompatible service of each channel and section 4.3 and 4.4 centre on technology integration where two channels are compatible.

Independent Providers And Incompatible Services

First, we consider two incompatible SNS operated by independent providers. In this business scenario, the providers decision his own advertising strategy to maximize his own profit and either side of users can access only the users of networks he/she registers. Thus, the objective function of each SNS provider can formulated as

$$\begin{aligned}\max_{a_1} \pi_1 &= \eta_1 a_1 \varphi = \frac{\eta_0 \varphi (\beta_1 + \Delta f - \alpha \eta_0 - a_1 + a_2) a_1}{\beta_1 + \beta_2 - 2\alpha \eta_0} \\ \max_{a_2} \pi_2 &= \eta_2 a_2 \varphi = \frac{\eta_0 \varphi (\beta_2 - \Delta f - \alpha \eta_0 + a_1 - a_2) a_2}{\beta_1 + \beta_2 - 2\alpha \eta_0}\end{aligned}\quad (11)$$

Solving first order condition, $\partial \pi_1 / \partial a_1 = 0$ and $\partial \pi_2 / \partial a_2 = 0$ simultaneously, we get the Nash Equilibrium results:

$$a_1^n = \frac{2\beta_1 + \beta_2 + \Delta f - 3\alpha \eta_0}{3}, \quad a_2^n = \frac{\beta_1 + 2\beta_2 - \Delta f - 3\alpha \eta_0}{3}\quad (12)$$

, and we have overall ads amount in the market $\sum a_i^n = a_1^n + a_2^n = \beta_1 + \beta_2 - \alpha \eta_0$ and the difference of ads amount two SNS $\Delta a^n = a_1^n - a_2^n = (\beta_1 - \beta_2 + 2\Delta f) / 3$.

Plug a_1^n and a_2^n into demand function η_1^n and η_2^n , the demand functions are written as

$$\eta_1^n = \frac{\eta_0 (2\beta_1 + \beta_2 + \Delta f - 3\alpha \eta_0)}{3(\beta_1 + \beta_2 - 2\alpha \eta_0)}, \quad \eta_2^n = \frac{\eta_0 (\beta_1 + 2\beta_2 - \Delta f - 3\alpha \eta_0)}{3(\beta_1 + \beta_2 - 2\alpha \eta_0)}\quad (13)$$

Finally, the profits of SNS providers are obtained:

$$\pi_1^n = \frac{\eta_0 \varphi (2\beta_1 + \beta_2 + \Delta f - 3\alpha \eta_0)^2}{9(\beta_1 + \beta_2 - 2\alpha \eta_0)}, \quad \pi_2^n = \frac{\eta_0 \varphi (\beta_1 + 2\beta_2 - \Delta f - 3\alpha \eta_0)^2}{9(\beta_1 + \beta_2 - 2\alpha \eta_0)}\quad (14)$$

Proposition 1. (Independent Providers and Incompatible Services)

(a) Increase the service features and quality will decrease the ads level of his opponent, however, increase the investment on the branding will result in the rise of both providers' ad level. That is $\partial a_i^n / \partial f_j < 0$ and $\partial a_i^n / \partial \beta_j > 0$, where $i \neq j$.

(b) Both providers' ad level will decrease as the size of the market increase and the intensity of network externality increases. That is $\partial a_i^n / \partial \eta_0 < 0$ and $\partial a_i^n / \partial \alpha < 0$, $\forall i$.

(c) The difference of ad level between two SNS providers was determined by users' brand loyalty and service features but is

independent with the total number of the SNS users. That is $\partial \Delta a_i^n / \partial \eta_0 = 0$.

(d) The total amount of ads exerted in the SNS market is positively associated with the strength of both brand loyalty, negatively associated with the network externality effect, but is independent with the features of the SNS software provided. That is, $\partial \sum a_i^n / \partial f_i = 0, \forall i$.

Independent Providers And Compatible Services

Next, we consider the situation that these independent providers make the services compatible. Solving first order condition of profit function, $\partial \pi_1 / \partial a_1 = 0$ and $\partial \pi_2 / \partial a_2 = 0$ simultaneously, we get the Nash Equilibrium results

$$a_1^c = \frac{2\beta_1 + \beta_2 + \Delta f}{3}, a_2^c = \frac{\beta_1 + 2\beta_2 - \Delta f}{3} \quad (15)$$

, and

$$\sum a^c = \beta_1 + \beta_2, \Delta a^c = (\beta_1 - \beta_2 + 2\Delta f) / 3. \quad (16)$$

Then, the demand functions can be obtained as

$$\eta_1^c = \frac{\eta_0(2\beta_1 + \beta_2 + \Delta f)}{3(\beta_1 + \beta_2)}, \eta_2^c = \frac{\eta_0(\beta_1 + 2\beta_2 - \Delta f)}{3(\beta_1 + \beta_2)} \quad (17)$$

Consequently, we have profit of SNS providers:

$$\pi_1^c = \frac{\eta_0 \phi (2\beta_1 + \beta_2 + \Delta f)^2}{9(\beta_1 + \beta_2)}, \pi_2^c = \frac{\eta_0 \phi (\beta_1 + 2\beta_2 - \Delta f)^2}{9(\beta_1 + \beta_2)} \quad (18)$$

Proposition 2. (Independent Providers and Compatible Services)

(a) Both SNS providers exert higher level of ads if their service are compatible (can communicate with the users in other networks). That is $a_i^c > a_i^n, \forall i$, hence

(b) Both SNS providers earn higher profit. That is $\pi_i^c > \pi_i^n, \forall i$.

(c) The market size has no impact on the ads amount exerted on both SNS. That is $\partial a_i^c / \partial \eta_0 = 0, \forall i$.

(d) The difference of ads level between two SNS providers keep unchanged after the SNS become compatible. That is $\Delta a_i^c = \Delta a_i^n$.

(e) The total amount of ads exerted in the SNS market is only positively associated with the strength of both brand loyalty. That is, $\partial \sum a_i^n / \partial f_i = 0, \partial \sum a_i^n / \partial \eta_0 = 0, \forall i$.

Incompatible Services Operated By A Single Merged Company

Duo to the market strategies of earning market share or segmentation, the merged firms may consider operate duo-brands related services to earn more profits. Now, we consider a business scenario that two incompatible SNS providers are integrated as a company or SNS provider or form a strategic alliance to maximize joint profit. Since $a_1 = \hat{\theta}\beta_1 + f_1 + \alpha(1-\hat{\theta})\eta_0$ and $a_2 = (1-\hat{\theta})\beta_2 + f_2 + \alpha\hat{\theta}\eta_0$, we plug a_1, a_2 into the objective function and replace η_1, η_2 with $(1-\theta)\eta_0$ and $\theta\eta_0$ respectively. In the following analysis, we assume the amount of SNS 1 is lower that that of SNS 2 ($\Delta a^n < 0$). Then, we rewrite the objective function as

$$\max_{a_1, a_2} \pi_{1+2} = (\eta_1 a_1 + \eta_2 a_2) \phi = \left((\hat{\theta}\beta_1 + f_1 + \alpha(1-\hat{\theta})\eta_0)(1-\hat{\theta})\eta_0 + ((1-\hat{\theta})\beta_2 + f_2 + \alpha\hat{\theta}\eta_0)\hat{\theta}\eta_0 \right) \phi \quad (19)$$

where lowercase 1+2 of SNS provider payoff function means integrated channel of two SNS providers. Notice the new profit function includes only one variable $\hat{\theta}$, we solve $\partial \pi_{1+2} / \partial \hat{\theta} = 0$ instead of solving the first order condition with respect to a_1

and a_2 , then we directly yield the $\hat{\theta}^{n*}$,

$$\hat{\theta}^{n*} = \frac{\beta_1 + \beta_2 - \Delta f - 2\alpha\eta_0}{2(\beta_1 + \beta_2 - 2\alpha\eta_0)} \quad (20)$$

Then optimal ads levels of SNS 1 and SNS 2, $a_1^{\hat{n}}$ and $a_2^{\hat{n}}$ will obtain,

$$a_1^{\hat{n}} = \frac{\beta_1 + \beta_2 - \Delta f - 2\alpha\eta_0}{2(\beta_1 + \beta_2 - 2\alpha\eta_0)} (\beta_1 - \alpha\eta_0) + f_1 + \alpha\eta_0$$

$$a_2^{\hat{n}} = \frac{\beta_1 + \beta_2 + \Delta f - 2\alpha\eta_0}{2(\beta_1 + \beta_2 - 2\alpha\eta_0)} (\alpha\eta_0 - \beta_2) + f_2 + \beta_2 \quad (21)$$

And the difference of the ads level is

$$\Delta a^{\hat{n}} = (\beta_1 - \beta_2 + \Delta f - 4\alpha\eta_0) / 2. \quad (22)$$

Then we direct yield optimal channel allocation of SNS channel 1 and 2 as below

$$\eta_1^{\hat{n}} = (1 - \hat{\theta}^{n*})\eta_0 = \frac{\eta_0(\beta_1 + \beta_2 + \Delta f - 2\alpha\eta_0)}{2(\beta_1 + \beta_2 - 2\alpha\eta_0)}, \eta_2^{\hat{n}} = \hat{\theta}^{n*}\eta_0 = \frac{\eta_0(\beta_1 + \beta_2 - \Delta f - 2\alpha\eta_0)}{2(\beta_1 + \beta_2 - 2\alpha\eta_0)} \quad (23)$$

Compatible Services Operated By A Single Merged Company

Last, we consider the situation that two SNS providers make its SNS channels compatible with each other, each user of either side could communicate with the other side. The utility of each user is remaining unchanged as the situation of compatible market structure as these two SNS services are coexisting. Similarly, we rewrite the objective function as

$$\max_{a_1, a_2} \pi_{1+2} = (\eta_1^c a_1 + \eta_2^c a_2) \varphi = \left((\hat{\theta}\beta_1 + f_1 + \alpha\eta_0)(1 - \hat{\theta})\eta_0 + ((1 - \hat{\theta})\beta_2 + f_2 + \alpha\eta_0)\hat{\theta}\eta_0 \right) \varphi \quad (24)$$

After solving $\partial\pi_{1+2} / \partial\hat{\theta} = 0$, we have optimal $\hat{\theta}^{c*}$,

$$\hat{\theta}^{c*} = \frac{\beta_1 + \beta_2 - \Delta f}{2(\beta_1 + \beta_2)} \quad (25)$$

Then the optimal ad levels are,

$$a_1^{\hat{c}} = \frac{\beta_1(\beta_1 + \beta_2 - \Delta f)}{2(\beta_1 + \beta_2)} + f_1 + \alpha\eta_0, a_2^{\hat{c}} = \frac{\beta_2(\beta_1 + \beta_2 + \Delta f)}{2(\beta_1 + \beta_2)} + f_2 + \alpha\eta_0 \quad (26)$$

$$\text{The difference of the ads level is } \Delta a^{\hat{c}} = (\beta_1 - \beta_2 + \Delta f) / 2. \quad (27)$$

Thus, corresponding demand functions are obtained as

$$\eta_1^{\hat{c}} = \frac{\eta_0(\beta_1 + \beta_2 + \Delta f)}{2(\beta_1 + \beta_2)}, \eta_2^{\hat{c}} = \frac{\eta_0(\beta_1 + \beta_2 - \Delta f)}{2(\beta_1 + \beta_2)} \quad (28)$$

CONCLUSION

In this paper, we discuss the adoption of advertising strategy on the SNS based on four types of market structures on. Utilizing game theoretic model, we analyze the impact of integration (service compatibility and business alliance) on the resulting advertising strategy and demand distribution. We have shown that the impact of service compatibility and business integration is significant. While gaining the benefit from contacting more people, the users are always worse when SNS are compatibly connected. The providers will benefit from both service and business integration. The users will always gain from the quality (features) competition, however, brand competition may hurt the customers as more disturbing ads will be exerted. In general, business integration will result in a higher diversity if ads exerted in two SNS.

For the ease of modeling, firstly we assume user's benefits are negatively associated with the number of advertisements while the service provider's profit increases with it. Although these service providers are now trying to alleviate the disturbance of advertisements by inserting ad tabs on the side or dividing a separated ad section for users to view. This may cause the users match with the proper ads with a higher probability. For future extensions, we will refine the parameter of ad by multiplying an extra variable which uniformly distributed from -1 to 1. In order to closer to the reality, we will adjust the advertisement variable by making it not always a negative utility for users. That is $U_i = \theta_i\beta_i + f_i + \alpha\eta_i - \nu_i a_i$ where $\nu_i \sim U[-1,1]$.

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E-BUSINESS VALUE CREATION: AN EXPLORATORY STUDY

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ABSTRACT

Value creation is one of the most important issues in formulating e-business strategies. Value is a construct that is hard to define and even harder to model and understand. This paper provides a framework of theoretical analysis that helps the scholars to think about the concept of value creation in the new digital economy. Researchers and practitioners are struggling to identify factors that contribute in creating e-business value. This paper also evaluates these factors with a focus on value creation from adopting e-business in the firms. The presented evaluation is mined from the literatures and from our own experience in e-business strategies. The paper provides a theoretical survey for exploring the common ground between factors that create such a value. The introduced survey covers perspectives, definition, sources and drivers of e-business value creation.

Keywords: e-business, e-business value, value creation, value sources/drivers, e-business model, value appropriation, value chain.

INTRODUCTION

E-business is the use of Internet to conduct or support business activities along the value chain [5] [40] [23]. It offers new marketplaces, revenues and commercial models. E-business is redefining the way organizations conduct their business activities, and creating an economic value by application of information & communication technology (ICT), and supporting Internet technologies.

E-business, continually, optimizes firm's value proposition and value-chain position by taking advantages of the connected marketplaces. Marketplaces open new opportunities, redefine relationships of customers and suppliers and transform the interaction among the market and its firms, brands, products and services [1].

In the context of e-business strategies, the concept of value creation deserves special attention because many Internet start-ups that ended up in bankruptcy at the end of the Internet boom years did not pay enough attention to this issue. Instead, they were frequently concerned mainly with customer acquisition and revenue growth, which was sustainable only as long as venture capitalists and stock markets were willing to finance these firms.

Nowadays, however, in a harder and more turbulent business environment, it is imperative that strategies focus on what value to create and for whom, as well as how to create it and how to capture the value in form of profits. In economic terms, value created is the difference between the benefit a firm provides to its consumers and the costs it incurs for doing so.

The concept of value creation is at the core of what a firm does, since only superior value creation vis-à-vis rivals opens up the opportunity for superior profitability. Value creation is viewed as a collaborative, creative, synergistic processes rather than purely mechanistic or a result of command-and-control.

E-business value could be defined as applying e-business to improve the business performance of firms in terms of its impacts on sales, services, marketing, internal operations, procurement and coordination by means of transactional efficiencies, market expansion, information sharing and integration [42].

This paper attempts to identify the sources and drivers of value creation in e-business. Specifically, it reviews how value is created from different perspectives such as entrepreneurship, strategic management, economics, finance, IS/IT strategies, e-business and e-commerce.

Henceforth, the terms "source of value creation" and "value driver" (which are used interchangeably in this study) refer to any factor that enhances the total value created by an e-business. This value, in turn, is the sum of all values that can be appropriated by the participants in an e-business transactions [6].

Furthermore, this paper handles the creation of e-business value, where value may be expressed as the ability of e-business to enhance the business performance of the enterprise. Hence, we constrain our measurements of value creation through e-business to changes in three related dimensions of firms' performance—(1) impact on commerce (increasing sales, improving customer services, and widening sales and marketing channels); (2) impact on internal efficiency (increasing employee

productivity and internal processes efficiency); and (3) impact on coordination (reducing transaction costs with business partners, and improving coordination with business partners or suppliers). Hence, the e-business value construct represents an integrative measure of the level of Internet-enhanced business performance along these three dimensions.

Researchers discuss four dimensions related to the e-business value creation, these dimensions are:

- Perspectives on E-business value creation.
- Definition of E-business value.
- Sources and drivers of E-business value creation.
- Appropriation of E-business value

Hereafter, we will present the problem and importance of study. Section 2 sheds the light on some perspectives of E-business value. Section 3 defines E-business value creation. Section 4 discusses the sources and drivers of E-business value. Section 5 addresses the appropriation of E-business value. Section 6 presents the discussion and concluding remarks. Suggestions for future researches will be elaborated in section 7.

RESEARCH PROBLEM AND IMPORTANCE

Problem: E-Business Value Creation

Lately, skepticism about the ability of e-business to create a business value has been renewed due to the gap between substantial firm spending on IT—particularly on Internet-related technologies—and the widespread perception about the lack of value from e-business. Various factors affect the business value impact of e-business strategy. The most important factor is the alignment between Information Technology (IT) and business processes, organization structure, and strategy. [Nicholas Carr, 2003] triggered a wave of debate over the new “IT value paradox.” Today more than ever, researchers face challenges in proving e-business value creation [41]. This renewed paradox will have important implications for the way firms approach IT investment and management [20].

In essence, strategy formulation revolves around the concepts of value creation, its sources, drivers, impacts and capturing. During the Internet boom years, Internet ventures often did not pay enough attention to these fundamental economic concepts. Nowadays, though, economic viability of any e-business venture is of paramount importance to managers and investors alike. The concept of value creation is at the core of what a firm does, since only superior value creation vis-à-vis rivals opens up the opportunity for superior profitability. This is why we devote our efforts to conduct this study.

Much of the existing research about understanding of e-business innovation has focused on the adoption decision and on measures such as “intent to adopt” and “adoption versus nonadoption” [13]. Thus, we need to view e-business diffusion, use, and value as a multistage process that starts at adoption and extends to usage and value creation [13] [10]. In particular, what is missing in the existing literature is: (1) a solid theoretical framework for identifying factors that shape e-business value, (2) a research model for studying the relationships of these factors to e-business value.

Generally speaking, Our review indicates that the existing literature is mainly focused on technology adoption. Only a few studies have been done to directly examine how e-business value creation factors affect on firm performance. Potentially, future developments in e-commerce and e-business will have some significant and major implications for value creation in enterprises. There is a need for research to describe and explain the economic impacts of these changes for managers and policy makers. The research reported here seeks to address some of these needs.

E-BUSINESS VALUE PERSPECTIVES

A literature review was done to capture how the scholars perceive e-business value creation as strategy to support and enhance the competitiveness of organizations. In this review we are also trying to clarify the different theories of e-business value creation.

Jelassi and Enders (2005) presented the concept of value creation in e-business from strategic and economic perspectives. According to them, strategy formulation revolves around the concepts of value creation and value capturing. They said that during the Internet boom years, Internet ventures often did not pay enough attention to these fundamental economic concepts. Nowadays, though, economic viability of any e-business venture is of paramount importance to managers and investors alike. The concept of value creation is at the core of what a firm does, since only superior value creation vis-à-vis rivals opens up the opportunity for superior profitability. This is consistent with the work of Amit and Zott (2001) who viewed e-business value creation from the strategic management and entrepreneurship perspective where the ultimate goal of any strategic decision for firms is to create economic value where they proposed the business model construct as a unifying unit of analysis that captures the value creation arising from multiple sources.

On the other hand, others, such as Christensen and Methlie (2003), Barua et al. (2001) assumed that value creation through e-business is expressed from financial and economic views in terms of changes in the economic and financial indicators of enterprises.

All of the above scholars agreed with Porter (1985) who stated that there are economic implications of value that is created through value chain activities at the firm level where some aspects of value are measured by total revenue. Whilst Brandenburger and Stuart (1996) claimed that value is created by all the agents involved in a particular ‘virtual market chain’ based on traditional strategic network theory perspective which assumed that the locus of value creation may be the network rather than the firm (Gulati, Nohria et al., 2000). While (Kriger et al, 2002) proposed a Kite framework that contribute to e-Value and explains additional dimensions of value, in order to understand inductively how e-businesses are competing at multiple levels, ranging from the more macro (economically) to the meso (in terms of social processes and competencies) to the micro (psychologically in terms of personal competencies and perception of space and time). But (Williamson, 1989) introduced the concept of value creation based on transaction cost economics theory where transaction efficiency as a major source of value. While Schumpeter presented the innovation as a major source of value creation based on creative destruction theory. Whilst (Barney 1991) viewed that resources and capabilities are the source of value creation based on the resource-based theory which is rooted in the strategic management literature.

On the other hand, Turban et al. (2004) viewed from business and marketing point of view that business plans include a value proposition statement in their business model where a value proposition defines how a company product or service fulfills the needs of customers, as value proposition is an important part of the marketing plan of any product or service.

In this context we adopt the strategic management perspective on E-business value creation, in the sense that, organizations are endeavoring on the long run to create economic value and achieve sustainable profitability through implementing e-business strategies. We believe that this strategic view of e-business value creation is holistic view where it combines the views from other theories on e-business value creation where it comprises efficiency from the transaction cost theory, innovation from the schumpeter theory, resources and capabilities from the resource-based theory, and networks from the strategic network theory. In that respect, the ultimate goal of the strategic decision toward adopting an e-business initiatives is to achieving the value which can be expressed either economically -on micro level- in terms of financial indicators or at organizational level –on macro level- in terms of improvements on organization performance.

DEFINITION OF E-BUSINESS VALUE

According to (Zhu et al. 2004) E-business value refers to the impact of e-business use or conduct on firm performance, which is measured by three major activities along the value chain : downstream sales (i.e., increasing sales and improving customer services), upstream procurement (i.e., reducing inventory and procurement costs and improving coordination with suppliers), and internal operations (i.e., increasing employee productivity and making internal processes more efficient), Turban et al. (2004) agreed with (Zhu et al. 2004) as they stated that value proposition refers to the benefits, including the intangible, nonquantitative ones, that a company can derive from conducting operations such as from using electronic commerce.

While Jelassi and Enders (2005) defined the value created in e-business as the difference between the benefits that consumers get from using a product and the costs that are incurred to produce the product. also, they asserted that the value created must be positive, i.e., the costs must be lower than the benefits it provides to consumers. and must be higher than the value that is created by competitors, on the same direction Prahalad and Ramaswamy (2000) observed that by electronically supplying information in real time, customers can even ‘co-create value’.

congruent with Jelassi and Enders (2005) were Brandenburger and Stuart (1996) who defined value as the difference between the value of the product and the cost of the inputs used to make that product. Porter (1985) Agreed with Jelassi and Enders (2005) as he defined value as the amount buyers are willing to pay for what a firm provides them, value is measured by total revenue where a firm is profitable if the value it commands exceeds the costs involved in creating the product.

But according to Christensen and Methlie (2003), e-business value refers to the value accrued to the economic players of the value system, i.e., mostly business firms. Hence, they constrain measurements of value creation through e-business to changes in the economic and financial indicators of enterprises. This is consistent with the approach taken by Barua et al. (2001) where they developed a model of business value for Internet enabled business transformation. Their model suggests that Internet enabled business performance is judged by traditional financial performance measures such as revenue per employee, gross profit margin, return on investments, etc. Furthermore, the model posits that improved financial performance is a result of operational excellence in business conduct.

on the contrary, Amit and Zott (2001) see that total value is created in transactions regardless of the role of value-creating Participant, but they contradicted Brandenburger and Stuart (1996) who assumed that the total value created by an e-business is the sum of all values that can be appropriated by the participants in e-business transactions where the term ‘value’ refers to the total value created in e-business transactions regardless of whether it is the firm, the customer, or any other participant in the transaction who appropriates that value but Prahalad and Ramaswamy (2000) had extended Brandenburger and Stuart (1996) approach by positing that total value created through a business model equals the sum of the values appropriated by all the participants in a business model, over all transactions that the business model enables.

Amit and Zott (2001, 2002) described the potential of value creation in e-business in four interrelated dimensions: efficiency, complementarities, lock-in, and novelty. Efficiency describes possible reductions in transaction costs and is mainly derived from lower costs due to faster transactions, increased automation of the company's operations, and the ease with which clients can research relevant information, whereas complementarities describe the value potential from combining products and services, technologies and activities in new and innovative ways, they are mainly concerned with the bundling of resources and technological capabilities, as well as the bundling of products and services of various partners in one electronic network. Lock-in describes the potential value in creating switching costs from arrangements that motivate customers and business partners to repeat and improve transactions and relationships, by locking in to a particular reliable technological solution, a company gains approval and trust among its client base. Novelty describes value creation resulting from innovations in the way business is conducted (e.g. web-based auctions, etc.). It refers to the design and adoption of new operational methods in a given sector that link up new or existing participants, or introduce new products and services.

On the other hand, Parker and Benson (1988) base their concept of IT value on Porter's value chain (Porter 1985). Value, in their definition, may be summarized as the ability of IT to enhance the business performance of the enterprise. Wiseman (1992), develops Parker and Benson's ideas by differentiating between value and benefits, asserting that value is both larger and more important than benefits. He argues that, for example, users can develop a strong attachment to an old system. It can thus acquire a sort of value, despite the fact that it may be out of date and inefficient (although one could argue that it is still delivering 'benefit' in the sense of user comfort). Deitz and Renkema (1995) define value as the outcome of financial and non financial consequences of the IT investment – a flexible definition, but one which still leaves the fundamental nature of value untouched.

In this context we believe that the value concept is more broader and comprehensive than benefits concept that can be accrued from conducting online business. In the sense that, the value refers to improvements and enhancements in business performance of firms in terms of tangible and intangible, quantitative and nonquantitative, financial and nonfinancial benefits through conducting e-business initiatives. In that respect, the e-business value construct represents an integrative measure of the level of Internet-enhanced business performance along firm activities.

SOURCES AND DRIVERS OF E-BUSINESS VALUE CREATION

(Zhu et al. 2004) identified the antecedents and sources of e-business value creation, and the extent of e-business use by an organization as well would be influenced by its technological, organizational, and environmental contexts within the TOE (Technology-Organization-Environment) framework which was developed by Tornatzky and Fleischer (1990). While Jelassi and Enders (2005) identify first, the virtual value chain, which suggests that information captured in the physical value chain should be used as a new source of value creation to enhance the quality of customer service, and second, resource-based view which builds on the core competencies (resources and skills) that cut across different activities as a second source of value creation.

But Porter (1985) stated that drivers of product differentiation, and hence sources of value creation are policy choices (what activities to perform and how), linkages (within the value chain or with suppliers and channels), timing (of activities), location, sharing of activities among business units, learning, integration, scale and institutional factors. While Teece (1987) adds that the effectiveness of protective property rights and complementary assets can add to the value creation potential of innovations. But Goshal and Moran (1996) observed that innovation and the reconfiguration of resources are fundamental sources of value.

In respect to the theoretical framework developed by Porter (1985), the adequate unit of analysis for measuring value creation would be activities, while for resources-based view's scholars would be resources (Barney, 1991), networks for strategic network theorists (Gulati, Nohria et al., 2000), innovation is the source of value creation in Schumpeter's theory, transaction efficiency and cost reduction are major sources of value creation as identified in transaction cost economics (Williamson, 1983), and capabilities for other scholars (Teece, Pisano et al., 1997). This diversity in unit of analysis is an important obstacle when measuring online value creation.

While Rayport and Sviokla (1995) observed that Value creation opportunities in virtual markets and e-business may result from new combinations of information, physical products and services, innovative configurations of transactions, and the reconfiguration and integration of resources, capabilities, roles and relationships among suppliers, partners and customers. Whilst (Kruger et al, 2002) proposed a Kite framework which consists of four overall dimensions that organizations use to engage in strategic process in the information economy, they are technological invention, relationships, time, and aesthetics. Their Kite framework brings new and important elements that contribute to e-Value and explains additional dimensions of value.

But (Gordijn and Akkermans, 2001) proposed three different types of logic can be identified as having a significant impact on the success of e-business and the creation of value, they are: Business logic takes into account the different roles and business models of the various participants in the supply chain (clients, contractors, suppliers). Market logic deals with whether the enterprise can expect clients to be interested and willing to pay for an e-business offering. and Technology logic refers to

whether the technology and e-business needs suffice in terms of functionality, reliability, and availability and whether the enterprise has the required corporate technology competencies.

Whereas Zhu and Kraemer (2005) distinguished between e-business use and e-business value where they stated that anecdotes of e-business use are technology competence, firm size, financial commitment, competitive pressure, and regulatory support. While both front-end and back-end capabilities contribute to e-business value. But Grey et al (2003) are of the opinion that much of the value associated with e-business comes not only from improvements in the technological infrastructure but from business and organizational transformations.

On the other hand, Jelassi and Enders (2005) presented two strategy options for value creation in e-business and market spaces are: cost leadership and differentiation strategies, this is congruent with Porter (1985) where he assumed that value can be created by differentiation along every step of the value chain, through activities resulting in products and services that lower buyers' costs or raise buyers' performance. On the same direction, Porter and Millar (1985) argue that information technology creates value by supporting differentiation strategies.

Whilst Earle and Keen (2000) posited that value in e-business is created if and only if firms adopt e-business models that respond to relevant e-value drivers. This is consistent with the work of Amit and Zott (2001) who emphasize the value creation through activities or structures described by a business model where a business model depicts the design of transaction content (exchanged goods and information), structure (the links between transaction stakeholders), and governance (the control and management of the flows of goods, information and resources) so as to create value through the exploitation of business opportunities. Amit and Zott (2001) suggested that using the Internet to conduct business can enhance value creation, so they identified four major value drivers for Internet business models: novelty, lock-in, complementarities and efficiency. For these authors, innovative business models create value through capturing latent consumer needs and the business model becomes the locus of innovation. The value-creating potential of a business model also depends on the extent to which it can motivate customers to engage in repeat transactions.

like Amit and Zott (2001) was Bakos (1991) who identified similar values are: reduced search cost, significant switching cost, economies of scale and scope, and network externality (the tendency for consumers to place more value on a good or service as more of the market uses that good or service), but they contradicted with Stahler (2001) who dividing Internet business models into a number of different elements: the value proposition is that part of the business model which concentrates on the customer needs on the one hand, but also on the needs of the other partners in the value chain. The architecture of goods and services are the elements which build the basis for a promising product- market combination in relation to the internal and external necessities. And the revenue model defines the ways the company plans to make money.

Agreed with Stahler (2001) were Bieger, Rüegg-Stürm and von Rohr (2002) who identified a further categorization of Internet business models, taking all the important components of traditional business models and combining them into different concepts which, together, build an online business model. The authors have developed a business model with eight important elements: the goods and services concept concentrates on the question of which value is relevant for which customer, the communication concept focuses on the goods or services which are communicated to the market, the revenue concept is responsible for the sources of income in the Internet company, the growth concept defines which growth concept will be pursued, the competence configuration which describes the core competencies of the business model, the form of organization implies the company's coverage, the cooperation concept lays down which partner or partners are needed, the coordination concept defines the coordination model to use. Rayport and Jaworski (2001) agreed with Stahler (2001) as they introduced that Value proposition is one of the key components of an organization's business model. It is a specification of an organization's choice of target segment(s), choice of focal customer benefits and rationale of competitive edge in delivering value to its target customers. It represents an organization's view on what value can be created and how it can differentiate itself from others.

Whereas McKinsey and company (2000) found that e-marketplaces create value by providing information and capabilities that support decision-making during the entire sourcing process who proposed a classification of marketplaces based on how they create value along the supply chain, so they agree with Jelassi and Enders (2005) who observed that information in the virtual value chain and competencies in the resource-based view as sources of value creation.

Far from McKinsey and company (2000), Jelassi and Enders (2005) opinions was Porter (1985) who observed that value creation in e-business goes beyond the value that can be realized through the configuration of the value chain. Rather, he identified four steps along the value chain to analyze value creation at the firm level are: defining the strategic business unit, identifying critical activities, defining products, and determining the value of an activity.

Agreed with Porter (1985) are Normann and Ramirez (1994) who introduced that a value constellation shifts the focus from the actual activities performed by a firm –the value chain- to the activities that should be performed and add to customer value. But Stabell and Fjeldstad (1998) found the value chain model more suitable for the analysis of production and manufacturing firms than for service firms where the resulting chain does not fully capture the essence of the value creation mechanisms of the firm.

Congruent with Jelassi and Enders (2005) was Rayport and Sviokla (1995) who proposed a 'virtual' value chain that includes a sequence of gathering, organizing, selecting, synthesizing, and distributing information. While this modification of the value chain concept corresponds better to the realities of virtual markets, and in particular to the importance of information goods (Shapiro and Varian, 1999), there may still be room to capture the richness of e-business activity more fully.

Porter (2001) had asserted that an organization creates value through performing activities through which products or services are created and delivered to customers in the value chain. It includes activities that are directly related to transactions like marketing and sales as well as support activities such as accounting and human resources.

In sum, Amit and Zott (2001), stated that e-commerce may have numerous potential sources of value creation that might be difficult to capture through a unique particular paradigm. Trying to solve this problem, they proposed the 'business model' as a unit of analysis in order to unify existing theoretical frameworks.

In this context we believe that there are several sources and drivers for e-business value creation that could contribute in creating that value through conducting online business. We assume that there are two types of sources are: hard sources (concerning firm) which combine technological, organizational, and environmental factors. and soft sources (concerning e-business technology) which include skills, competencies, capabilities, efficiency, complementarity, lock-in, innovation, information, processes, strategies, and resources. In that respect, the two types of sources for e-business value creation are supported by two capabilities of Internet are: reach and richness because we are talking about e-business as an international phenomenon built on Internet as a global platform.

APPROPRIATION OF E-BUSINESS VALUE

Jelassi and Enders (2005) went beyond the creation of value and stated that value creation by itself does not provide any information about how the value is distributed between consumers and producers. This distribution takes place through the price that a firm can charge for the product or a service. Price splits the value created into two separate entities: the producer surplus in form of profits and the consumer surplus which represents the difference between the consumer benefit, which is the maximum willingness to pay, and the price the customer has actually paid for a product. They asserted that a firm needs to be able to create higher value than its rivals, it also needs to be able to capture the value that it creates in the form of prices that exceed its costs. If a firm can charge high prices for its products or services, then it captures large parts of the value it creates. If, on the other hand, prices are driven down by competition, then consumers will capture most of the value.

On the other hand, Porter (1998) proposed a five-forces framework, which outlines the main factors determining a firm's ability to capture the value it creates. In essence, this ability is determined largely by the attractiveness of the industry in which a firm competes. Obviously, the advent of the Internet has profoundly impacted the structure of many industries.

While Brandenburger and Stuart Jr. (1996) distinguished between the concepts of creation and appropriation of value. They start analyzing how different players along a market chain create value, As the value of the product depends upon buyers' perception, they expressed value creation as the difference between buyer's willingness-to-pay and suppliers' opportunity costs. Consequently, value creation is an outcome of the efforts carried on by all the agents involved in a transaction. By contrast, value appropriation depends on each of the players involved in the production of a particular good or service, particularly in each player's bargaining power. According to this interpretation, the players with high added value are the ones who may appropriate value since their bargaining power is high; on the contrary, the players with low added value will not capture any and may be substituted by others without threatening the value created in the market chain. By extension, if the bargaining power of a player changes, his ability to capture value changes as well.

As regards value appropriation, (Amit and Zott, 2001) suggested the revenue model as the appropriate unit of analysis: 'a revenue model refers to the specific modes in which a business model enables revenue generation'. The business model and the revenue model are complementary, yet different concepts. while the business model refers primarily to value creation, the revenue model is primarily concerned with value appropriation. However, the definition of the revenue model makes no reference to costs and, therefore, it will hardly be a good mechanism to measure how value is appropriated since rents may dissipate if the costs of providing the product exceed the revenues generated.

Our opinion concerning appropriation of E-business value take in consideration the new environment of businesses which is the Internet. On the Web there are different forces that could determine who can appropriate the value created from conducting online business either suppliers (firms) or buyers (customers). We conceive that firms will capture the largest part of value because they have the tools, mechanisms, processes, and strategies for conducting online transactions. Hence, they will appropriate the value created from e-business in form of profits and revenues through the improvements and enhancements in their performance. Generally speaking, we contend that appropriation of e-business value is a further step that require, first, ensuring the complementarity of information technology infrastructure and e-business capability, next, the adoption and use of e-business, and finally creating value from implementing e-business strategies.

DISCUSSION AND CONCLUDING REMARKS

Based on literature review and previous theoretical perspectives, we conceive that e-business value creation concept could be viewed from a strategic management perspective where organizations are endeavoring on the long run to create economic value and achieve sustainable profitability through implementing e-business strategies. This holistic view combine the views from other theories on e-business value creation as it comprise efficiency from transaction cost theory, innovation from schumpeter theory, resources and capabilities from resource-based theory, and networks from strategic network theory. By the way, the ultimate goal of the strategic decision toward adopting e-business initiatives is achieving the value which can be expressed either economically -on micro level- in terms of financial indicators or organizationally -on macro level- in terms of improvements on organization performance.

We contend that value concept is broader and more comprehensive than benefits concept that can be accrued from conducting online business. In the sense that, value refer to improvements and enhancements in business performance of organizations in terms of tangible and intangible, quantitative and non-quantitative, financial and non-financial benefits through conducting e-business initiatives. Hence, the e-business value construct represents an integrative measure of the level of Internet-enhanced business performance along organization activities.

We conceive that there are several sources and drivers that could contribute in creating value through conducting online business. We assume that there are tow types of sources are: hard sources which combine technological, organizational, and environmental factors. and soft sources which include skills, competencies, capabilities, efficiency, innovation, information, processes, strategies, and resources. By the way, the two types of sources for e-business value creation are supported by two specific properties of Internet are: reach and richness because we are talking about e-business as an international phenomenon built on Internet as a global platform.

We contend that appropriation of e-business value should take in consideration the new environment of businesses, which is the Internet. On the Web there are different forces that could influence on determining who can appropriate the value created from conducting online business either suppliers (firms) or buyers (customers). We conceive that firms will capture the largest part of value since they have the tools, mechanisms, processes, and strategies for conducting online transactions. Hence, they will appropriate the value created from e-business in form of profits and revenues through the improvements and enhancements in their performance. Generally speaking, we contend that appropriation of e-business value is a further step that require first ensuring the complementarily of information technology infrastructure and e-business capability, next the adoption and use of e-business, and finally creating value from implementing e-business ventures.

FUTURE WORK

Researchers will develop strategic framework for e-business value creation that combines our own perspective as regards the concept of e-business value creation, its definition, sources and drivers, and appropriation of that value that is created from conducting online business. This framework for e-business value creation can help IT professionals, finance experts, and business operations planners to coordinate and communicate more effectively in their efforts to improve e-business processes.

Thereafter, researchers will test and apply the proposed framework empirically to explore the value creation from e-business either in certain sectors that adopted e-business (e.g. , financial, retailing, education, health, manufacturing, travel, ...etc), or to investigate the value that is created from adopting specific e-business applications (e.g., e-Banking, e-CRM, e-SCM, e-Learning, e-Marketing, e-health, e-government, ...etc).

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EVALUATION ISSUES IN MANAGING AND REALIZING BENEFITS IN B2BEC/IT INVESTMENTS

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ABSTRACT

Organizations have invested substantial amount of financial resources in information technology (IT) over the last few decades. However, there is still a lack of understanding of the impact of IT investment evaluation processes and practices in these organizations. This study extends the Limits-to-Value model to examine the relationship between the levels of IT maturity and the adoption of IT investment evaluation and benefits realization methodologies as well as their effects on B2BEC benefits. The study has found that IT maturity has a direct positive relationship with the adoption of these evaluation methodologies. A number of issues and problems have also emerged from the analysis of the data collected. These findings will assist organizations in making better evaluation of B2BEC/IT investment.

Keywords: IT evaluation, IT investment, B2BEC, IT maturity, evaluation methodologies

INTRODUCTION

The extent of investment in information technology (IT) is one of the major factors determining the success or failure of organizations in implementing business-to-business electronic commerce (B2BEC) projects (Love et al, 2005). Yet, senior IT managers have found it increasingly difficult to justify rising IT expenditures and are often under immense pressure to find a way to measure the contribution of their organizations' IT investments in relation to the performance in B2BEC, as well as to find reliable ways to ensure that the business benefits from IT investments are actually realized (Bannister and Remenyi, 2000). There are many researchers who argue that such productivity gains and losses may be attributed to, among other things, the inappropriate use of IT evaluation methodologies (e.g., Tallon et al, 2000) and, moreover, it is unclear whether the ability to evaluate IT investments in B2BEC has something to do with the organizations' levels of IT maturity (Hackbarth and Kettinger, 2004). There are two types of methodologies that organizations need to undertake in order to ensure that IT investments in B2BEC are properly planned, evaluated, and monitored, and that expected benefits are eventually realized. An IT investment evaluation methodology (IEM) is concerned with making investment decisions about IT projects (Ballantine and Stray, 1999). In this domain the concern is about selecting the project or projects that at the outset seem to offer the greatest returns or benefits for the outlay. The other domain is an IT benefits realization methodology (BRM) and can be seen to extend investment evaluation further into the project life cycle by ensuring expected benefits are realized once a decision to invest has been taken (Changchit, 1998). This involves planning how and when benefits will be realized and deciding who will be responsible for achieving benefits as well as actually overseeing the realization of benefits (Ward and Daniel, 2006).

Given the above analysis, it can be concluded that, in general, organizations that employ BRMs would be likely to also employ IEMs but the converse would not necessarily be the case. Behind this assertion however, is a more fundamental observation concerned with the underlying 'IT maturity' of an organization in terms of its willingness and cultural capability to use formal or semi-formal processes explicitly as part of its decision-making. In other words, it will be asserted in this paper that organizations that are more mature in IT are more likely to display more willingness to use evaluation processes. Closely connected with this is this notion that it is possible to define and record an organization's IT maturity against some predefined benchmark or benchmarks and in so doing provide a basis for organizations to plan to towards greater IT maturity. IT maturity refers to an organization's capability to utilize its existing IT infrastructures to lever further business benefits (Galliers and Sutherland, 1991). Therefore, this paper sets out to examine the relationship between the levels of IT maturity and the use of IEMs and BRMs on business-to-business electronic commerce (B2BEC) benefits. This relationship is rarely researched before. This paper will explore this relationship in some depth by applying the Limits-to-Value Model proposed by Chircu and Kauffman (2000) and then validate the relationship by one survey and two case studies. In the next section, relevant literature regarding IT evaluation and IT maturity is briefly discussed. Following that, the research approach used is described. The main section of the paper then discusses the research findings. Research and managerial implications are also presented.

LITERATURE REVIEW

IT Investments Evaluation Methodologies (IEMs) and IT Benefits Realization Methodologies (BRMs)

As mentioned earlier, many IT managers still do not understand the importance of the IT investment evaluation and benefits realization methodologies (e.g. IEMs and BRMs) (Lin et al., 2005). For example, Sohal and Ng (1998) found that in large organizations the potential of IT has not been utilized to meet the competitive challenges due to inadequate evaluation of the IT investment projects. Moreover, they reported that 45% of the responding organizations do not evaluate whether IT systems are

still consistent with business objectives and 59% do not determine whether expected benefits are being achieved. Therefore, the inability of many organizations to measure and apply IT both, inter-and-intra organizationally is resulting in missed opportunities and a lack of business value on B2BEC (Lin and Huang, 2007). Fortunately, there are many methodologies that can help to evaluate IT investments in B2BEC and deliver expected B2BEC benefits. Renkema and Berghout (1997) have found that there are more than 65 currently available IEMs and several BRMs. IEM is about selecting, evaluating and monitoring the project or projects that at the outset seem to offer the greatest returns or benefits for the outlay whereas BRM involves planning how and when benefits will be delivered and deciding who will be responsible for achieving benefits as well as actually overseeing the results. According to the literature, organizations that make extensive and effective use of IEMs or BRMs had higher perceived IT benefits (Melville et al., 2004). For example, according to Tallon et al. (2000), as IT is used for more strategic purposes, the use of IEMs provides a means for organizations to undergo routine, recurring and systemic evaluation of their IT investments in B2BEC. In addition, the effective use of BRMs helps organizations to gain higher B2BEC benefits by having a constant focus on the expected benefits and by making sure that the project remains aligned with business goals as well as to make strategic adjustments in resources in a changing environment (Ward and Daniel, 2006).

IT Maturity

Various stages of growth models have been presented by researchers to describe the evolution of organizational information systems (e.g. Nolan, 1979). Despite some criticism of these models, they provide an insightful organizing framework for thinking about IT change in organizations. The revised stages of growth model by Galliers and Sutherland (1991) is meant to overcome some of the limitations by introducing a means of bringing together a range of key elements associated with the operation and management of an organization. The revised model of Galliers and Sutherland (1991) can be represented as six stages, each with its particular set of conditions associated with the seven “S” elements. The seven elements are strategy, structure, systems, staff, style, skills, and superordinate goals. The six stages of the revised model are: ad hococracy, starting the foundations, centralized dictatorship, democratic dialectic and cooperation, entrepreneurial opportunity, and integrated harmonious relationships. The seven “S” elements provided a rich set of conditions upon which we could analyze an organization’s maturity in terms of its IT infrastructure.

Limits-to-Value Model

The Limits-to-Value Model proposed by Chircu and Kauffman (2000) showed that possible IT investment constraints included valuation barriers (i.e. industry and organizational barriers) and conversion barriers (i.e. resource, knowledge, and usage barriers) to realize B2BEC benefits. Many of the components discussed in the model relate to the organization's ability to use IT effectively and this can potentially be one important constraint to IT investments (e.g. Chiru and Kauffman, 2000). Organizations need to overcome these constraints to obtain as much realized B2BEC value from IT investments as possible. In addition, organizations need to have sufficient IT infrastructures such as complementary assets to overcome these constraints to realize the benefits of IT investments. Organizations are often unsuccessful in obtaining full value from their IT investments because they fail to invest sufficient complementary assets (Teece, 1987). The complementary assets include new organizational processes, work routines, organizational knowledge, and responsibility structures. IT investment constraints appear when organizations fail to invest in the requisite complementary assets. This research focus on how the organizational valuation barrier and knowledge conversion barrier affect the realization of B2BEC benefits in IT investments. This model implies that organizations’ levels of IT maturity determine the amount of their organizational valuation barrier that needs to be overcome before they can assess the potential B2BEC benefits. According to Galliers and Sutherland (1991), organizational IT maturity can be measured in terms of the seven elements (strategy, structure, systems, staff, style, skills, and superordinate goals). These seven elements represent the organization’s degree of readiness to effectively utilize IT. Organizations which have higher levels of usage of IEMs and BRMs are likely to minimize the knowledge conversion barrier, retain the potential B2BEC benefits, and therefore, maximize the realized benefits. Therefore, we extend the argument that organizations investing in B2BEC/IT need to first increase their levels of IT maturity by overcoming their organizational valuation barrier and maximize their potential B2BEC benefits, and then implement IEMs and BRMs by minimizing knowledge conversion barrier.

RESEARCH APPROACH

This study adopts a pluralist research approach by using survey and case study methods. According to Mingers (2001), the results will be richer and more reliable if different research methods are combined together because they are likely to increase the reliability of the data and the process of gathering it. The survey was conducted as a means to obtain an overview of the current industry and government practices and norms in realizing IT benefits and evaluation. Case study 1 was then conducted and the interesting and important problems and issues (identified via survey) were investigated more closely in a large Australian organization. Case study 2 was conducted in another large Australian organization to further investigate these revised problems and issues (identified in case study 1).

Survey

The initial survey focused on Australia’s largest organizations. A list of chief information officers (CIOs) of the largest 500 Australian organizations by gross revenue was prepared and used in this survey. The structure of the questionnaire addressed many aspects of IS/IT benefits management and included Likert scale, nominal scale and open-ended questions. It was derived from an existing study by Ward et al. (1996) and its validity and reliability derived from their acceptance in the literature. The aim of this survey was to investigate many aspects of IT investments evaluation and benefits realization processes and practices in large Australian organizations. Specifically, the survey sought to: (a) determine how B2BEC benefits from IT

investments in B2BEC are identified, evaluated and realized by organizations; (b) determine what criteria and methodologies are used to evaluate as well as to realize appropriate and adequate benefits by organizations from their IT investments in B2BEC; and (c) determine how organizations in Australia attempt to deal with the IT investment barriers with their current evaluation and benefits realization processes and practices.

First Case Study: Semi-structured interviews, observation, and document review were used to gain a deeper understanding of issues surrounding the current practices and norms in managing B2BEC/IT benefits and investments evaluation in a large Australian organization. In total, ten interviews were conducted with seven senior executives from a large Australian organization (“Organization 1”), and three contract managers from the three major external outsourcing contractors. The questions asked during the interview were related to the Organization 1’s three major outsourcing contracts, the contractual relationship between Organization 1 and the contractors, IT investment evaluation methodology deployed, benefits realization process used, and the management of the contract transition period.

Second Case Study: Semi-structured interviews, observation, and document review were also used in this second case study to gain a deeper understanding of issues and problems identified in the survey and the first case study and other general issues surrounding the current government practices and norms in managing B2BEC/IT benefits and investments evaluation. In total, ten interviews were conducted with five senior executives from another large Australian organization (“Organization 2”), and five contract coordinators and managers from its two major external outsourcing contractors. The questions asked during the interview were related to the formal benefits realization methodology used by the Organization 2, major outsourcing contracts, contractual relationship between the Organization 2 and the contractors, and IT investment evaluation methodology or technique deployed.

RESEARCH FINDINGS

This section reports on the findings of the survey and two case studies which reveal a number of aspects of these practices that confirm much of the (non-Australian) literature (Bannister and Remenyi, 2000; Kim and Umanath, 2005; Ward et al., 1996).

The Relationship between IT Maturity, IEMs and BRMs

Through analysis of the data collected via the survey and case study, we were able to conclude that those organizations which employed a BRM were more likely to: (a) use formal processes for their investment evaluation and benefit realization activities; (b) be more confident about what they did in their IT activities; (c) have better integration of their IT functions; and (d) manage their projects or contracts to achieve better results and with less problems and hence, at a higher level of IT maturity. Given the discussion previously about stages of growth and maturity, it seemed reasonable to conclude that organizations with high IT maturity would be more likely to be able to implement a benefit realization methodology while low IT maturity organizations would be less likely to. This was corroborated by the research data. The results showed that while most responding organizations had used some sort of IT investment evaluation methodology, only a relatively small percentage of organizations employed a benefits realization methodology. For example, in Organization 2 where a formal BRM had been employed, greater control over its outsourcing contracts and better IT integration within the organization was experienced than Organization 1 which had not use any BRM. Therefore, we concluded that an organization’s IT maturity was highly likely to be positively associated with the usage of an IEM and/or a BRM. It was also concluded that organizations with higher IT maturity were more likely to adopt a formal BRM. However, such a simple dichotomy was felt to be insufficient to embrace the richness of detail that had been uncovered especially in the case studies and so a deeper analysis was performed by plotting the 7 “S”s in Galliers and Sutherland’s model (1991) against the two case studies. Our results show that Organization 2 was at a higher IT maturity stage than Organization 1. The case study results indicated that both organizations failed to adopt a formal IEM (although an informal process was used) and also had problems in understanding what constituted an IT investment evaluation. However, since Organization 2 had adopted a formal BRM and it had fewer problems than Organization 1 which had not adopted such a methodology. All of Organization 1’s seven elements were mostly at stage 4 whereas Organization 2’s seven elements were mostly at stage 5. From the results above, we are able to conclude that organizations with higher levels of IT maturity possessed higher degree of readiness to address these seven elements and therefore, were more likely to be able to effectively eliminate or minimize the organizational valuation barrier arising out of IT investments in B2BEC.

Some IT Investment Evaluation Problems from the Survey and Case Study Results

These IT investment evaluation problems (e.g. focus on quantitative IT investment evaluation measures and conflicting motivations for outsourcing) were uncovered via the analysis of survey and case study results. These problems were mostly caused by the lack of attention to the IT investment evaluation. We have grouped these problems in accordance with: (1) the seven elements from the revised stages of growth model by Galliers and Sutherland (1991); and (2) the two major IT investment evaluation barriers identified by the Limits-to-Value Model (Chiru and Kauffman, 2000). Suggestions and recommendations for resolving these problems were also given below. In addition, attempts were also made to link the literature with what was actually happening in practice in real organizations (via survey and case studies).

Organizational valuation barrier

“System” problem: Lack of commitment by contractors.

Suggestions: In order to minimize the lack of commitment by contractors, genuine partnership and an open book relationship should be struck. It is critical to involve all stakeholders (including external contractors) throughout the whole evaluation process. A study by Lee and Kim (1999) indicates that partnership quality may serve as a key predictor of outsourcing success.

Partnership quality was found to be positively influenced by factors such as participation, communication, and information sharing, and negatively affected by age of relationship and mutual dependency (Lee and Kim, 1999). For example, the use of a formal BRM by Organization 2 allowed it to continuously monitor and improve its relationship with external contractors. On the other hand, Organization 1 did not adopt a BRM and was having problems with some of its external contractors.

“Superordinate goal” problem: Conflicting perceptions of the stakeholders.

Suggestions: Organizations have to make sure that they not only educate the stakeholders and users about the concepts of benefits realization but also other organizational goals and objectives such as motivations for outsourcing and criteria for determining success of the outsourcing contracts. There are potential disadvantages for not adopting a formal IEM and/or a BRM. These include outsourcing for the wrong reasons, losing control of the resource, losing staff who have been trained in the organization, and in particular, the risk that the outsourcing contractors may not be able to achieve the desired benefits or may fail in providing critical services. Organization 1 was a good example of not having a clear objective for outsourcing and, as a result, having conflicting motivations for outsourcing and criteria for determining success of the contracts.

Knowledge conversion barrier

“Strategy” problem: Lack of strategy for understanding of the IT investment evaluation and benefits realization practices and concepts by senior management.

Suggestions: All IT investments in B2BEC should be guided by a strategy for undertaking formal evaluation methodology (Tallon et al., 2000). Not only would formal IEM and BRM provide proper evaluation of investment risks and benefits but also enhance the understanding by the organizations of investment evaluation and its importance during the IT outsourcing and systems development processes. For example, even the Organization 2 with a formal BRM but without a formal IEM was unable resolve some problems and issues faced.

“Skill” problem: Lack of skills to adopt benefits realization processes.

Suggestions: Skills should be developed to adopt a formal BRM by the organizations involved in IT investments. Not only would this ensure the delivery of the proposed benefits but also enhance the organizations’ understanding of benefits realization practices and its importance during the systems development processes (Ward and Daniel, 2006). More importantly, having the skills to adopt a benefits realization methodology is crucial in determining the success of an outsourcing contract because a BRM can constantly remind the organization of its goals and objectives. This can also encourage the organization to support and carry out the necessary changes within the organization. For example, one participant in Organization 2 said a formal BRM “clearly highlights to you what was proposed in the first place why the project was commenced..... I have found the main benefits in this methodology is that you continually go back and revisit the original business plan of what you have been telling people so in 2 years’ time when you do deliver you keep promises, unlike politicians.” On the other hand, the participants in Organization 1 did not know anything or care about the benefits realization process. They were generally less enthusiastic about the IT investments than the participants from Organization 2.

IMPLICATIONS AND CONCLUSION

One important theoretical contribution of the paper is the extension of Limits-to-Value model with organizational factors such as the levels of IT maturity, and the use of IEMs and BRMs. This enables organizations to examine their relationships in the context of benefits realization of IT investments in B2BEC. As can be seen from the model presented earlier, the paper argues that the failure in eliminating or minimizing IT investment constraints is likely to lead to unsuccessful realization of B2BEC benefits. In particular, the eliminating or minimizing of organizational valuation barrier and knowledge conversion barrier is the most important and yet often ignored issue. In order to obtain the required B2BEC benefits, organizations need to increase their levels of IT maturity, and usage of IEMs and BRMs. Otherwise, more IT investment constraints will arise. Therefore, this paper has stressed that organizational valuation and knowledge conversion barrier should be carefully evaluated before implementing a B2BEC/IT investment. Once it is decided to implement B2BEC/IT investment organizations should operate and execute it with caution with following our guidelines. In addition, organizations should fully assess the different sources of barriers when undertaking B2BEC/IT investments. The survey and case study results indicate that organizational valuation barrier and knowledge conversion barrier are the two most common types of IT investment constraints. Our findings also clearly demonstrate that lower levels of IT maturity are likely to result in higher levels of organizational valuation barrier whereas knowledge conversion barrier arises from a lack of skills and understanding in adopting IEMs and BRMs. Organizations should attempt to improve their levels of IT maturity in order to increase their ability to effectively eliminate or minimize the organizational valuation barrier arising out of investing in B2BEC/IT projects. Similarly, organizations should also put in place a strategy to increase the understanding of IEMs and BRMs processes throughout their organizations as well as to equip the necessary skills for IT managers to adopt IEMs and BRMs. Finally, organizations should try to getting rid of organizational valuation barrier first before eliminating knowledge conversion barrier during the course of maximizing their realized B2BEC benefits.

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A DEMAND-SIDE EVALUATION OF WEB ASSURANCE SERVICES: AN EMPIRICAL STUDY ON AICPA/CICA WEBTRUST SERVICE

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ABSTRACT

WebTrust service uses an approach similar to financial statements attestation to provide assurance services to web hosts. Prior research generally supports CPAs' qualifications and abilities in offering such services, but rarely explains the limited success of this endeavor. Based on a conceptual model, this study evaluates the demand side of web assurance services. Research questionnaires were used to gather information from consumers and business firms in Taiwan via the Internet. Our results show that consumers have fundamental understanding of web assurance seals and recognize the importance of web assurance services. However, only a portion of consumers are willing to pay additional costs for the assurance provided by web seals. In addition, CPAs have advantages in credibility and objectivity over other web assurance providers, and are more suitable in providing privacy assurance. An expectation gap exists, however, between consumers and web assurance providers. When offering such services, a provider may face the potential risk of lawsuit and should address the issue properly. The above results have implications for the WebTrust service providers in realigning their strategies in the web assurance market.

Keyword: WebTrust, web assurance services, web assurance seals

INTRODUCTION

The WebTrust service was created through a joint effort between the American Institute of Certified Public Accountants (AICPA) and the Canadian Institute of Chartered Accountants (CICA) in 1998. WebTrust uses an approach similar to the attestation of financial statements and provides assurance services to Web hosts. Utilizing the CPAs' reputations and independence and more complete coverage of its assurance services, WebTrust aims to establish its presence in the Web assurance market.

Prior research had concentrated mostly on the supply side of WebTrust service. Their results generally support the CPAs' qualifications and abilities in offering these services. It does not, however, help to explain the AICPA/CICA limited success with WebTrust. The purpose of this study, therefore, is to evaluate the demand side of web assurance services and to provide evidence on the feasibility of WebTrust service. The rest of this paper is organized as follows. Section II briefly reviews the literature on electronic commerce risk and web assurance services. Section III discusses the research design and methods for data collection and analysis. Section IV presents the empirical results. The final section provides conclusions of this study.

LITERATURE REVIEW

With the rise of electronic commerce (EC), more businesses and consumers are using the Internet as one of their major transaction platforms. Consumers generally have, however, concerns over a number of EC issues, for example, integrity of business practices of web hosts, protection of consumer privacy, and protection of transaction data. [6] The above concern mostly results from the information asymmetry between the seller and the buyer due to their lack of knowledge with each other. One solution to this problem is the use of third-party assurance, such as a web seal, by Web hosts to signal the quality of their products and/or services to consumers. [4] [5]

Prior studies show mixed results on the effect of web seals as signaling tools. Miyazaki and Krishnamurthy [2] indicated that a third-party assurance seal did affect a consumer's trust and willingness in providing personal information to a web host. Kimery and McCord [1] found, however, that consumers were not familiar with three major web seals and the effect of these seals on consumer behavior was limited. That is, it would be difficult for consumers to appreciate the value of a web seal before they understand the purpose and functioning of web assurance services.

As a newcomer to the web assurance market, AICPA and CICA developed the WebTrust service in 1998. Their main strategy was to provide a fuller scope of services with coverage over three aspects of EC: business practice, transaction integrity and information protection. Two additional dimensions, i.e., legal environment and WebTrust seal management, were added later to account for the globalization of EC. The niche of WebTrust was to utilize CPAs' reputation for independence, objectivity and professionalism in providing assurance services.

The WebTrust service, however, did not meet the expectations of AICPA and CICA. Only a limited number of Web hosts are using the WebTrust seal. The main reasons for this lack of success include: (1) insufficient understanding of WebTrust by consumers and businesses due to ineffective marketing efforts, (2) expensive cost for obtaining and renewal of the WebTrust seal, and (3) stringent WebTrust service standards. By mid-2003, WebTrust was merged with another seal, SysTrust, into Trust services. [3] Past research focuses mainly on the supply side of web assurance services and may not provide a complete account for the above development. It is, therefore, worth studying the demand side of web assurance services to gain additional insights into the working of this market.

RESEARCH METHODS

Research Design

In providing web assurance services, WebTrust covers a wider spectrum of areas than other web seal providers, including security, availability, transaction integrity, confidentiality, and privacy. The value of WebTrust, however, depends on consumers' recognition and acceptance of web assurance services. Table 1 presents a matrix for the interaction of consumers' acceptance, WebTrust seal, and other web seals.

In scenario A, WebTrust and other web seals are in a competitive market for web assurance services. WebTrust must differentiate itself from other competitors to gain consumers' acceptance. If WebTrust provides new services not offered by others, as in scenarios B and C, then its major challenge would be to gain consumers' acceptance of such offerings. Scenario D indicates that WebTrust and other web seals do not provide the web assurance services valued by consumers. An expectation gap may result from such mismatch.

TABLE 1: Research Design

		Consumers' emphasis on specific web services		
		By WebTrust seal	By other web seals	Yes
Specific types of web services provided?	Yes	Yes	A	
		No	B	C
	No	No	D	

Data Collection and Analysis

Research questionnaires were used to collect data from the potential users (consumers and business firms) of web assurance services via the Internet. This study used a demand-side model of web assurance services, as depicted in Figure 1, to develop the structure of and specific questions in the questionnaires.

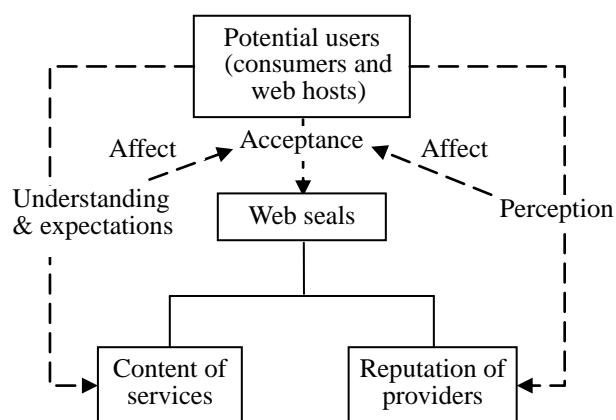


FIGURE 1: The Demand-side of Web Assurance Services

In the above model, any potential user's acceptance of a specific web seals depends on his/her perception of the provider's reputation as well as his/her understanding and expectations of the content of web assurance services. Therefore, the research questionnaires were divided into three sections. For consumers, the first section includes questions to determine the subject's knowledge and perception of web seals. Secondly, the subject is asked to evaluate the importance of five aspects of web assurance services to his/her Internet transactions and/or activities. He/she also indicated his/her willingness to pay for the above services and in what amount (in terms of percentage of the price of product/service attained). In the third section, the subject indicates his/her approval rating (on a 5-point Likert scale) of the chosen web seal regarding the provider's competitiveness in five dimensions. The subject was also asked to provide the following information for further analysis: age, gender, occupation, household income per month, hours spent on the Internet per week, and experience in Internet shopping.

The questionnaire for business firms was similar to the one for consumers with the following changes. Three irrelevant questions were removed from the first section. The second section asks the subject firm, instead, to evaluate consumers' emphasis on the five aspects of web assurance services as well as consumers' willingness to pay for such services. The third section includes an extra question on the subject firm's perception of CPAs' advantages over other web seal providers in offering different aspects of web assurance services. The subject firm also indicated its industry classification on the questionnaire.

In this study, the Cronbach α and pre-tests were used to check the reliability and validity of research questionnaires. The statistical methods for our empirical data analysis include descriptive statistics, t-test, and ANOVA.

EMPIRICAL RRESULTS

Validity and Reliability of Research Questionnaires

To enhance the validity of research questionnaires, a number of graduate students with majors in Accounting and Management Information Systems were asked to pretest the questionnaires. Their suggestions were used to modify the questionnaires. For the questions with the Likert scale, their Cronbach α values are between 0.714 and 0.932. Its acceptable value is generally 0.70 in social science. Therefore, the questionnaires are, in general, reliable.

Subject Profiles

The research questionnaire for consumers was posted on the Internet to solicit responses from Internet users. To encourage responses, the respondent received a lottery number for gifts to be drawn at the end of whole survey. A total of 206 valid responses were collected. Table 2 summarizes the profiles of subjects.

TABLE 2: Subject Profiles

Panel A: Age					
< 18	19-24	25-30	31-40	>40	Total
15	70	62	40	16	203
7.4%	34.5%	30.5%	19.7%	7.9%	100%
Panel B: Gender					
Male		Female		Total	
99	48.5%	105	51.5%	204	100%
Panel C: Occupation					
Students	Self-employed	Business	Workers	Others	Total
81	37	30	23	35	206
39.3%	18%	14.6%	11.2%	17.4%	100%
Panel D: Monthly income					
< NT\$30,000	NT\$30,000 ~ NT\$49,999	NT\$50,000 ~ NT\$100,000	> NT\$100,000	Total	
102	61	26	14	203	
50.2%	30%	26%	6.95%	100%	
Panel E: Weekly hours spent on the Internet					
< 1 hr.	1-5 hrs.	6-10 hrs.	11-15 hrs.	>16 hrs.	Total
23	36	46	27	71	203
11.3%	17.7%	22.7%	13.3%	35%	100%
Panel G: Experience in Internet shopping					
Yes		No		Total	
181	89.2%	22	10.8%	203	100%

Table 2 shows that 65% of the subjects are between the ages of 19 to 30. It is consistent with the general findings that most Internet users are of younger generation. Most of them are students and, therefore, have low monthly income. There is no difference in gender. About a half of the subjects spend more than 10 hours per week on Internet and 89% of all subjects have experiences in Internet shopping. Therefore, the subjects, as a whole, have good understanding of EC and should be able to comprehend the questionnaire.

Knowledge and Perception of Web Seals

The value of a web seal depends on users' knowledge and acceptance of its functions. If consumers are not aware of web seals or do not appreciate the assurances provided by them, then the market for web assurance services is limited. The first section of our questionnaire was, therefore, used to determine the subject's knowledge and perception of web seals. Over 70% of the subjects have correct ideas about the purpose, function and certification process of a web seal. They have more trust on a web host with proper seals. However, about a half of subjects do not know whether a web host has to pay for a web seal and 19% of them believe that the service is free.

Value of Web Assurance Services and Cost Consideration

To succeed in the web assurance market, a web seal provider must consider users' perception of the seal's value and cost. Oversupply of services tends to increase the cost to a level that deters potential users. The second section of questionnaire aimed to determine the subject's valuation of five aspects of web assurance services, i.e. security, availability, integrity, confidentiality, and privacy. The average scores and t-test for these items are shown in Table 3.

TABLE 3: Valuation of Web Assurance Services

Item	N	Mean	Rank	Standard deviation	t-value
Security	199	4.20	2	0.89	18.88*
Availability	199	4.08	5	0.74	20.93*
Integrity	203	4.19	3	0.72	23.68*
Confidentiality	203	4.13	4	0.96	16.80*
Privacy	203	4.23	1	0.82	21.38*

* p-value < 0.01.

For all the items in Table 3, their mean scores are above 4 (on a 5-point Likert scale). It shows that the subjects recognize the importance of these services. The item, “privacy”, receives the highest rank, followed by “security” and “integrity”. In addition, the subjects were asked to indicate the additional cost that they would pay for products or services offered by the web store assured with a web seal(s). Table 4 presents the results.

TABLE 4: Cost Consideration for Web Seals

Panel A: Would be willing to pay extra for products or services offered by assured web stores?						
Yes		No		Total		
97	49.2%	100	50.8%	197	100%	
Panel B: Additional cost to pay in percentage of the price of a product or service?						
< 5%		6-10%		> 11%		Total
82	84.5%	13	13.4%	2	2.1%	97 100%

As shown in Table 4, when there is an extra cost to consumers for web assurance, only about a half of the subjects would be willing to pay. And most of them prefer the additional cost to be less than 5% of the price of a product of service. As a result, web hosts may find difficult to transfer the cost of obtaining web assurance services to consumers. Since WebTrust provides a broader range of services with frequent renew, it usually costs higher than competitors. Therefore, the above results may, to some extent, help explain the limited success of WebTrust. To overcome the status quo of WebTrust service, AICPA and CICA may consider the realignment of their strategies toward the web assurance market, for example, by dividing WebTrust service to smaller parts, engaging more marketing efforts, and forming alliances with other web assurance providers.

CPAs' Competitiveness in Providing Web Assurance Services

To evaluate CPAs' competitiveness in providing web assurance services, the research questionnaire provides two local web seals, namely HiTrust and TWCA, with the WebTrust seal to the subjects. Each subject was asked to evaluate only one of the seal providers in regard to its credibility, objectivity, experience, professional skills, and EC knowledge (i.e., the qualification factors). Table 5 presents the overall ratings of these three providers.

TABLE 5: Overall Ratings for Three Web Seal Providers

Panel A: Descriptive statistics					
	Seal			Total	
	HiTrust	TWCA	WebTrust		
No. of obs.	63	59	63	185	
Mean	3.76	3.69	3.83	3.85	
Std. dev.	0.53	0.49	0.49	0.75	
Panel B: ANOVA					
Source	SS	DF	MS	F-value	p-value
Within- group	0.473	2	0.236	0.804	0.449
Between-group	53.472	182	0.294		
Total	53.945	184			

Based the results from ANOVA in Table 5, there was no significant difference in the overall ratings among the seal providers ($p=0.449$). The average overall ratings range from 3.69 to 3.83 (close to the level of “agree”). In addition, each subject indicated whether the seal provider is suitable for providing web assurance services in security, availability, integrity, confidentiality, and privacy. WebTrust significantly outscores the other two providers in the approval rating for “privacy” and is more competitive in “credibility” and “objectivity”.

Expectation Gap

To determine whether there is any expectation gap between WebTrust service providers (i.e., CPAs) and consumers, our questionnaire asked the subjects to express their perception of the interrelationship among web seals, product quality, and the

financial health of web hosts. The subjects, in general, believe that a web seal provide guarantee to product quality as well as the financial health of a web host, with approval ratings of 3.92 and 3.28. In reality, most web assurance services do not cover these two aspects of web hosts. It implies that consumers may overly expect the coverage of web assurance services without obtaining sufficient information from the web seal providers. The existence of such an expectation gap may represent a significant challenge to the providers in offering their services.

Responses from Business Firms

A total of 21 business firms replied to our research questionnaire (a response rate of 21%). The knowledge and perception of business firms on the importance of web assurance services is, in general, similar to those of consumers. Business firms believe, however, that CPAs are suitable in providing all aspects of web assurance services and have competitive advantage in the qualification factors for such services.

CONCLUSION

Security, privacy and trust are among the important cornerstones for EC. Numerous web assurance providers offer certification of web hosts regarding their security and integrity. AICPA/CICA jointly launched the WebTrust service as a strategic tool to explore this new market with limited success. This paper empirically explores the demand side of web assurance market using the WebTrust service as an example. Our results show that consumers have fundamental understanding of web assurance seals and recognize the importance of web assurance services. However, only a portion of consumers are willing to pay additional costs for the assurance provided by web seals. In addition, CPAs have advantages in credibility and objectivity over two other web seal providers, and are more suitable in providing privacy assurance. There are expectation gaps, however, between consumers and web assurance providers. When offering such services, a provider may face the potential risk of lawsuit and should address the issue properly. The above results have implications for the WebTrust service providers in realigning their strategies in the web assurance market.

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ELECTRONIC INFORMATION SYSTEMS SECURITY

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ABSTRACT

The current global network infrastructure of the e-business has brought the information security systems to a new frontier. A detrimental destruction to an organization's information system can be done electronically through the Internet without the time restriction and from everywhere in the universe. Therefore, the security of protecting the information resources has become an essential management issue in any organization. This research attempts to determine how organizations are currently viewing the objectives of their information security systems and describing their relative success with the use of the available counter measurements against the traditional thieves and electronic crimes through a survey questionnaire.

Keywords: security

INTRODUCTION

In the last two decades of the 20th century, the affordable and powerful computer hardware and software along with the advanced telecommunication technology have laid a solid foundation for the emerging and popularity of the Internet. The individual and organization have quickly adopted the Internet as a communication tool for transmitting the data, information and service since it is fast, simple and convenience without the limitation of distance and time.

The organization promptly understands the benefits offered by the Internet and establishes a new sales and supply channel named e-business to gain the competitive edge. The function of the e-business is to electronically connect the organization with its client and supplier forming a global business partnership network using the capability of the Internet. Consequently, the establishment of the e-business has changes the surrounding conditions of an organization's information system in term of two aspects. First, the closed private network becomes an open public network within the community of the organization. Second, the proprietary computing architecture has been replaced by a standard and distributed client/server computing architecture in the organization that can be easily comprehended and penetrated by a smart network system professional.

On the other hand, any threat or terrorism is only a click away through the Internet that can significantly damage the data and paralyze the information system of the organization. In addition, the Transmission Control Protocol and Internet protocol (TCP/IP) required to transmit the information over the Internet was developed without the security consideration [1]. Not only the identification of the sender and receiver addresses, but also the transmission data can be easily intercepted, interpreted and altered under the fingertip of an unauthorized information hacker if no additional security measure for the transmission is used.

This global network infrastructure of the e-business has brought the information security system to a major concern of the IT executives [2]. The risk of theft, loss of privacy and the detrimental destruction to the data and system within the organization can be done electronically through the Internet communication without time restriction and from everywhere in the universe.

Therefore, a research study was considered to be necessary to attempt to determine how organizations are currently viewing the objectives of their information security systems and to describe their relative success with the use of the available counter measurements against the traditional thieves and current electronic crimes. A questionnaire was constructed to collect data about how the information security systems are being developed in organizations and to learn what types of results are being achieved. This paper was written to present the findings of this research effort for the information of MIS practitioners and MIS academics.

The paper begins with an overview of what is believed to be the major attributes including objectives, resources, threats, and counter measurements that form the information security system strategy. Next, the research method is described. Findings are presented which describe the extent and the manner of the various threats and the counter measurements in organizations.

OVERVIEW OF THE INFORMATION SECURITY SYSTEM ATTRIBUTES

The fundamental attributes in analyzing and dealing an organizational information security system can be identified as objectives, resources, threats and countermeasures. The objectives are a set of benchmarks to measure the effectiveness of the implemented security system. They also serve as guidelines to determine the required counter measurements to protect the information resources and assets from the physical and electronic threats.

Objectives

The seven most common objectives [3, 4] to implement an information security system in the organization include (1) confidentiality - to prevent the disclosure or exposure of the data and information to the unauthorized individual or system; (2) integrity - to maintain the data and information at a state of currency, consistency and accuracy; (3) availability - to provide the service at an acceptable level of quality without any interference and obstruction; (4) authentication - to verify the real identity of the information system user; (5) authorization - to control and manage the right of individual and system to access the data and information; (6) accountability - to assure the non-repudiation of the communication between the message sender and information receiver; and (7) privacy - to guard against unauthorized collection, storing, distribution, and usage of the personal information for preserving the right of individual.

Resources

The resources of the organizational information system can be classified as physical assets, processing functions, data and information. The physical assets include computer hardware, network equipment, system software, middleware, application software, and other physical facilities to house the information systems. The processing functions are the logistic operations to gather and transform the input data to useful output information for management. The data and information composes the database where stores the interrelated data files as a central depository and allows the organization to search the information for its decision makings, opportunities and competitive advantages.

Threats

In general, the sources of all threats to a computerized information system can be grouped into five major categories that include accidental, deliberate, Mother Nature, technical failure, and management failure. The accidental treats are generated by the careless operation behaviors of the information system staffs and end users. The deliberate threats are produced by the disgruntled internal employees within the organization or by the external malicious hackers located in the universe. The Mother Nature such as hurricane, fire, flood, earthquake, etc. can create catastrophes for a serious destruction to the information systems without any warning sign. The technical failure is due to the malfunction of the hardware, bugs in the software and disruption of the telecommunication network. The management failure comes from the incomplete or missing security policy and procedure defined by the organization to protect the information systems.

Flaws in the information security systems to permit the unauthorized access, modification, use, and destruction of hardware, software, data, or network resources can generate severe damage to the routine process of the information systems and/or to the ultimate survival of the organization. The consequences of the actual threats to a computerized information system can be corrupted operations, compromised systems, loss of assets, loss of service, loss of data integrity, loss of information privacy, loss of customer trust, loss of sales and loss of profit.

Counter Measures

The countermeasure is a set of controls or approaches to prevent damage generated by any potential threat to the organizational information system resources. The organization can implement three layers of controls including, administration layer, technical layer, and operational layer to fully secure its information system resources from the accidental or deliberated events.

The administration level establishes a management framework of security policy and procedure for the entire organization. It composes of (1) the security policy for defining the information system security standard and guideline; (2) the risk management for determining the counter measures to protect the information resources in terms of cost benefit analysis; and (3) the recovery plan for recovering the data and information system from any human incident and the Mother Nature attack.

The technical level utilizes the advanced computer hardware and software technologies to protect the organization's private intranet and telecommunication. That includes the authorization and authentication for system access control, data encryption and decryption for transmission confidentiality, digital signature and electronic certificate for increasing trust and accountability, network monitoring program for operation availability and security, and the firewall for blocking intruders to the organization's intranet.

The operational level utilizes the physical devices established in the technical level to properly monitor the computing facilities, routine performance and access controls for avoiding any malicious vandalism or theft. It also follows the security standards and guidelines developed in the administration level to perform the personnel management and inventory control of documenting the information system resources.

THE RESEARCH

An extensive questionnaire (10 pages) was developed to survey computer information system users about their approaches to the current information system security. The primary purpose of the research was to collect the data about the adopted management infrastructure, the embraced objectives, the resources to be protected, the threats encountered, the counter measures implemented, and the results being achieved of the information security systems by organizations under the current global telecommunication environment in the United States.

Methodology

Questionnaires were sent to the top level information management staff, both in the private and public sectors, throughout the United States. The survey target was the chief information officer of the state government offices, local government offices, and corporations. The on line state publication directory and distribution list of the California Multiple Award Schedule were used to randomly select the organizations for sending the questionnaires.

326 questionnaires were sent out to the organizations via U.S. Postal Service. 137 emails were sent out using an academic organization address to request the organizations answering the questionnaire that was posted on a college related web site. Unfortunately there is a zero response rate via the combination of the email and the Internet. Only thirty two usable questionnaires via U.S. Postal Service (about nine percent return rate) were returned and provided the data which are presented and interpreted in this paper.

The Findings

The purpose of this research was set to collect detailed data about how an organization deploys information system security. Because of the volume of data collected, only a summary of the organization profile, management personnel, objectives of the information security system, types of resources to be protected, the major threats encountered, and the counter measures implemented in terms of administration, technology, and operation to against threats are presented in the followings. It should be noted that some responders did not complete all the appropriate section of the questionnaire due to the concern regarding security and privacy issue.

The organization profile which responded to the survey is summarized in Table 1.

Table 1 Organization Profile

Characteristic	Low Value	Median Value	Average Value	High Value
Annual Revenue (millions)	1.3	130	1,189	175,000
Total Employees	6	590	7,458	60,000
IT Employee (percentage of total employee)	0.01	0.05	0.36	1.00
E-business Employee (percentage of IT employee)	0	0.03	0.08	0.60

In the questionnaire, responders were asked to check the type of executive staff involved in the decision making process for the information systems security within their organizations. Table 2 indicates that the chief executive officer, privacy officer, and information security officer have been heavily engaged in the organizational security decisions. Clearly, the security is now regarded as one of the most important routine operational issues and it needs a top down uniform strategy to guard the information and its physical resources for the entire organization. The results also reveal that the chief financial officer is the least executive manager involved in the security decision. This aligns with the facts that the existence of the security systems and their funding decisions cannot be evaluated only based on the financial return rate generated by the security investment due to the significant impact of their intangible costs and benefits.

Table 2 Management Personnel Involvement in Security Decisions

Management Personnel	Number Reporting	Percentage Value
Chief Executive Officer	16	0.57
Chief Financial Officer	5	0.18
Chief Security Officer	7	0.32
Information Security Officer	9	0.43
Privacy Officer	12	0.11

The summary of the primary objectives for the implementation of the information security systems in the responding organizations is presented in Table 3. As expected, the confidentiality was reported to be the key objective for the information systems security since the data and information are the vital sources and powerful weapons for any organization to make proper business decisions for surviving and/or gaining competitive advantages. The privacy and integrity were selected as the next two important objectives for the information security system. This rating reflects the current legal requirements imposed by the federal and state governments to restrict the organization regarding the collection and usage of individual data and information. The availability, accountability and authentication were also relatively rated high by the responders. These three objectives are the essential and required factors for organizations using the Internet and other networks to properly and legally conduct daily on line business with their customers and suppliers.

Table 3 Security Objectives (1 – Not Important; 5 – Very Important)

Security Objective	Low Value	Median Value	Average Value	High Value
Confidentiality	2	5	4.6	5
Integrity	0	5	4.4	5
Availability	3	5	4.3	5
Authentication	0	4	4	5
Authorization	0	4	3.9	5
Accountability	1	4	4.1	5
Privacy	2	5	4.5	5

The majority of the responders (twenty four out of thirty two) stated that the data and information were the primary organizational resources to be protected by the security systems as presented in Table 4. The physical assets were ranked the least important information resources for protection by the security systems. This is not surprising since the intangible damage of unsecured data and information cannot be easily replaced or repaired as the other processing functions and physical assets. The damage data and information definitely have the invisible power to ruin an organization's reputation, survival and existence.

Table 4 Resources to be Protected

Resource Type	Number Reporting	Percentage
Physical Assets	6	0.21
Processing Functions	9	0.32
Data/Information	24	0.86
All	5	0.18

The responders were asked to identify the likelihood occurrences of the different threats using a scale of 1 to 5 where 1 is unlikely and 5 is the most likely. Table 5 presents the summarized statistical values in terms of median and average. It was some what surprising to learn that inadvertent/accidental and technical failures are the top two threats encountered by the responders. This implies that the current security systems are lacking to include some routine training for preventing unintentional mistakes in handling and processing information system resources by the employee within the organization. In addition, the current security system does not have adequate technical equipment configurations to provide the organization with a flawless routine operation. The management failure and deliberate received the two lowest averages. This result indicates that organizations do have sufficient policy, procedure and prevention method to stop the damage of information resources from the unauthorized intruder.

Table 5 Threat Sources (1 – Unlikely; 5 – Most Likely)

Threat Type	Median Value	Average Value
Inadvertent/Accidental	4	3.5
Deliberate	3	3.1
Mother Nature	3	3.2
Technical Failure	3	3.3
Management Failure	3	3

Organizations with the information security systems were asked to ascertain the consequences generated by threats in their institutes. Table 6 summarizes the percentage of each threat consequence in term of three categories that include possible occurrence, actual happening and not applicable. It is interesting to note that the actual happening of the threats are less likely to strike the organizations compares with the expected or possible occurrence of threats by the organization in most cases. This reflects that the responders do recognize the malicious consequences of the threats toward their organization assets. Therefore, the responding organizations have implemented some effective security systems to protect their information resources and prevent the actual occurrence of threats. The percentages in the not applicable category are due to diverse business practices of the responding organizations that will produce dissimilar threat consequences.

Responders were asked to indicate their implemented threat incident identification mechanisms when their organization encountered any security threat. Table 7 presents the statistical average value for each detection method corresponding with the number of reporting organizations. The detection devices and monitoring tools are the most widely used methods to report the security threat incidents. This is not surprising since these two approaches are either software or hardware. They can

monitor and detect the security violation automatically after their installation by the organization without any human intervention.

Table 6 Threat Consequences (Percentage Value)

Threat Consequence	Possible	Actual	Not Applicable
Corrupted Operations	0.46	0.21	0.32
Comprised Systems	0.43	0.21	0.36
Loss of Service	0.32	0.43	0.25
Loss of Assets/Resources	0.50	0.11	0.39
Loss of Data Integrity	0.61	0.07	0.32
Loss of Information Privacy	0.68	0.11	0.21
Loss of Customer Trust	0.50	0.07	0.43
Loss of Customer	0.32	0.04	0.64
Loss of Sales	0.21	0.00	0.79
Loss of Profit	0.29	0.00	0.71

The system downtime and audit logs have the second highest usage score. They are semiautomatic methods with some human intervention. These statistical reports generated by the software program installed in the information systems require the security personnel to interpret records and take action. The internal incident reporting process has scored the third highest rank among the eleven incident identification mechanism. This suggests that the manual process such as policy or procedure is also a successful mean to identify the security invasions. It also implies that most of the responding organizations do implement a well defined reporting policy and procedure for its employee to follow whenever he/she encounters a security problem related to a threat.

Table 7 Threat Incident Identification Mechanism

Identification Mechanism	Number Reporting	Average Value
Audit Logs	15	0.47
Detection Devices	22	0.69
Monitoring Tools	22	0.69
Internal Incident Reporting Process	13	0.41
External Incident Reporting Process	3	0.09
Advance Warning by Authorities	2	0.06
Advance Warning by Other Entities	6	0.19
Denial of Service	8	0.25
Data/Information Corruption	5	0.16
System Downtime	15	0.47
Termination of Communication	6	0.24

Organizations that have come across security threats in their organization were requested to identify specific threat counter measures in terms of three different levels that have been deployed in their institution. Table 8 presents the summary results of the threat counter measures implemented in the administrative level by the responders. The result indicates that less than half of the responding organizations conduct security risk analysis or management control. This implies that more than half of the organizations do not practice the security risk analysis and management control. In addition, some responding organizations had not established any security police, security plan, disaster recovery plan, or operational plan in the administrative level even the security is an essential top management issue for the entire institute in the current century.

Table 8 Counter Measures: Administrative Level

Administrative Counter Measure	Number Reporting	Average Value
Security Policies	20	0.63
Security Plan	15	0.47
Risk Assessment	13	0.31
Disaster Recovery Plan	17	0.53
Operational Recovery Plan	16	0.50
Management Control	13	0.31

The summary results of the threat counter measures implemented in the technical level by the responding organizations are illustrated in Table 9. More than two third of the responding organizations have adopted technical counter measures to protect their information resources. This result reveals two facts about the current security hardware and software technologies. First,

they can automatically monitor the information system and effectively block the undesirable intruders. Second, their implemental costs are affordable by most of the responding organizations regardless of the size.

Table 9 Counter Measures: Technical Level

Technical Counter measure	Number Reporting	Average Value
Firewall/Routers/Switches	26	0.81
Demilitarized Zone	20	0.63
Intrusion Detection System	22	0.69
Network Monitoring	22	0.69

The threat counter measures implemented in the operational level by the responding organizations are summarized in Table 10. It is interesting to note that twenty six out of the thirty two responding organizations have well established the operational security procedures for personnel hiring and terminating processes. This appears that the employees are the most important security origin and foundation in the responding organization. It is understandable that a high percentage of the responders have some routine physical and procedure controls to protect their information resources since they are the vital success factor for any organization.

Table 10 Counter Measures: Operational Level

Operational Counter Measures	Number Reporting	Average Value
Personnel	26	0.81
Physical	24	0.75
Procedure	24	0.75
Inventory	12	0.38
Monitoring	21	0.66

As indicated, the inventory control is the least operational counter measures against the threats among the responders. This can be interpreted as the fundamental logistic process that separates the functions of purchasing and operating information resources to different department in the most responding organizations. Most likely, there is no centralized unit is charged with the responsibility to document the existence and change of the physical information resources. This result might be due to the short life cycle of the hardware and software in the information industry.

CONCLUSION

The results of this research strongly suggest that (1) organizations today are implementing some security systems to protect their information resources; (2) the top management personnel such as chief executive officer does involve in the security decision making process; (3) the major objectives for the organizational security systems are information confidentiality and data privacy; (4) the most important resources to be protected are information and data in the organization; (5) the inadvertent/accidental incident is the most occurred threat; (6) loss of service is considered as the major consequence among all threats; (7) the automatic hardware and software tools are the most popular mechanisms to detect threats; and (8) the administrative controls are the least threat counter measures comparing with the technical and operational controls.

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**PEER TO PEER MOBILE COUPONS:
ADDING INCENTIVES WITHOUT SACRIFICING SECURITY**

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ABSTRACT

Mobile commerce is flourishing today due to the advance of the mobile technology. Many conventional marketing activities are moving their ways to the mobile environment. Efficient marketing instruments such as the paper coupons and the electronic coupons are also evolving into the mobile coupons. In comparison with conventional coupons, mobile coupons are personalized and suitable for peer to peer delivery. Coupons are commonly issued by the merchants, used by the interested customers, and discarded by the uninterested receivers. Raising the redemption rate of the coupon will increase the sales of the promoted items. The raise can be accomplished by forwarding coupons from uninterested receivers to potentially interested customers. The ease-of-use exchange mechanism in mobile devices pushes the delivery in the peer to peer environment. Moreover, the characteristic of personalization inspires trust into mobile coupons. Thus, adding the incentives of coupon forwarding, such as a reward bonus, may activate the movement of stationary coupons and eventually increase the redemption rate of mobile coupons. Nevertheless, the incentives adding may bring the threats of alterations and forgery; if the adding mechanism is improperly made. Additionally, complicated security means are hindered by the limitations of storage space, computation power, and communication bandwidth of mobile devices. Therefore, we propose a scheme that uses digital signatures for verifying the incentive-added coupons and design a hash chain to detect possible forgery. The proposed scheme may increase the use of peer to peer mobile coupons without sacrificing the security.

Keywords: Electronic commerce, mobile coupon, peer to peer, security.

INTRODUCTION

Coupons have long been used as a powerful instrument in marketing and are presented in different forms in the information age. Electronic coupons (E-coupons) are commonplace now to be downloaded, printed, and used as traditional paper coupons. A modern substitute of the paper coupon, or e-coupon, is the appearance of the mobile coupon, which can be transmitted and used on-the-go. The potential of mobile coupons for sales promotion is promising due to the convenience of coupon issuing and redemption.

In general, e-coupons are published in the Web for free downloading and printing before redemption in a physical store. The merchant constructs a coupon downloading Web-page and saves the dispatching of coupons. Nevertheless, the additional costs of searching and printing for the consumers are introduced, not to mention the willingness to surfing the Web for coupons. The alternative of emailing e-coupons is easy for both the issuer and the receiver but the probability of being treated as spam mails and discarded could be high. Moreover, the need-to-printout e-coupons is hard to remember and less portable in use. Although e-coupons are popularly used as an advertising tool with the prevalence of Email and Web, its usage is still limited.

Mobile coupons are electronically issued from a merchant to the mobile devices of targeted customers. Mobile devices are generally considered as personal devices for the portability and availability today. Hence, mobile coupons are just right at hand while using without having to be printed out in advance. In addition, mobile coupons are suitable for peer to peer delivery since the ad hoc communication capability is built-in for most mobile devices. The ease-of-exchange mechanism may push the delivery of mobile coupons a step further in the peer to peer environment. Furthermore, recommendations of the coupon-promoted products from friends through their mobile devices represent certain trust so that the potential of coupon redemption is increased. The movement of the stationary coupons can be activated and the redemption rate of the coupons is raised eventually. Thus, the effect of word-to-mouth marketing can be achieved via mobile message sending. The value and the practice of the mobile coupon can be increased within the community of the mobile coupon receiver, provided that certain incentives are rewarded to the coupon forwarder.

A bonus point model was proposed in [7] that adding the incentives to the e-coupons in the mobile environment. When the providers send out e-coupons, which are passed from user to user, they may receive bonus points if the coupon is redeemed. A general model and an optimal strategy for users to determining the claiming bonus points were presented in the paper. However, the protection mechanism and the integrity of the incentive-added coupon were not addressed. Now that the coupon bears potential bonus, an alternation or forgery of the forwarding history, and even the coupon itself, is greatly possible. Extending mobile coupons with assured security that can protect the value of the coupon and reward bonuses to the actual forwarders is desirable as a result.

Therefore, we propose a scheme that adds incentives to the peer to peer mobile coupons without sacrificing the security. The contents of the coupon, including the incentive and forwarding history, need to be protected. Most systems use asymmetric key cryptosystem to fulfill the security requirements. However, the storage capacity and computing power of most available mobile devices are too limited to perform asymmetric key cryptosystem. Thus, we use the digital signatures for the integrity verification of the mobile coupons. A hash chain is designed to detect any possible forgery of the incentive-added coupon. The proposed scheme may increase the redemption and promotion effect of the peer to peer mobile coupons, with the security assured

incentives.

RELATED WORK

Peer to Peer Environment

Forwarding electronic coupons without proper identifications usually are considered as spam [11]. Random spreading of coupons thus will not occur in the P2P environment since the parties in the environment is trusted in general. In comparison with broadcasting electronic coupons in traditional client/server models, mobile users may find the peers more easily, so that forwarding mobile coupons can be conducted effectively in the P2P environment, especially with the trusted interactions. Furthermore, the P2P mobile coupon has an intrinsic property of interpersonal interactions so that the receiver will have more confidence on using the received coupon. A coupon received from the forwarding of known persons generally will not be ignored by the receivers. The promotion thus will be more likely successful in such a forwarding of coupons. The redemption rate will be increased since the forwarding is intentionally made by the forwarder, who knows more about the potential receivers. However, a mobile user who participates in the P2P environment has to provide his/her resources, e.g. the storage space of the mobile devices, the bandwidth of communications, and the required computations [7]. To activate the volume usage of this operation, lightweight computations are preferred. In the proposed scheme, each mobile user needs to pay the transmission cost only once. Fair bonuses are rewarded to those who have participated in the forwarding of the mobile coupon in the P2P environment.

The Incentive Mechanism

The e-coupon may promote the sales not much without proper targeting of the potential customers. Not every receiver of the e-coupon is a consumer. Without incentives, the receiver generally discards the e-coupon so that the promotion effect is limited. If we can provide incentives to the forwarder of the coupon, the receiver who has no intention to use the coupon might transfer the coupon to who will potentially use the coupon. That is, to encourage the forwarding of the previously stationary coupons, incentives have to be added to the coupon forwarders. Therefore, the incentive mechanism can promote the redemption rates of the e-coupons and reduce the possibility of the stationary e-coupons.

Kangasharju and Heinemann proposed an incentives mechanism for e-coupon system [7]. In the mechanism, the incentives will be offered to the forwarder, e.g. frequent flyer miles are rewarded after the e-coupon is redeemed. The mechanism emphasizes on the distributions of the incentives. The total amount of incentives is set in the initial phase. Each forwarder can take at least one bonus point. No forwarding is allowed if the bonus point is just one point. In the proposed scheme, the incentive can be offered is depend on the agreement between the provider and the merchant, and set up in the initial phase.

Shojima and Ikkai, and Komoda proposed an incentive mechanism for P2P e-coupon system. In that mechanism, each e-coupon can record the information about the forwarder becomes distribution history information [11]; according to the distribution history can easily computes the incentive can be obtained for each forwarder. The distribution history is the basis information for the incentive mechanism, hence must be protected [12]. Shojima et al. adopt the asymmetric key encryption and computation the hash value, and embed the hash value into the image as digital water mark to protect the basis information.

The Electronic Coupon

The electronic coupon is an efficient instrument for advertisement and marketing when developing electronic commerce [6]. Advertising is considered an effective manner to promote the commercial affairs; however, promotion means stimulate the amount of purchase is a familiar and efficient manner of advertising. Any consumer can have a discount or additional gift when he/she use the e-coupon to purchase the advertisement merchandise. According to the viewpoint, the e-coupon is an instrument of marketing to stimulate the amount of purchase and attach the advertisement value.

Currently, the actual exercise of the e-coupon needs the consumer prints it, and redeems in the realistic store [1], or directly redeems in the virtual store on the internet [2]. Nevertheless, the amount of the redeemed e-coupon will influence the profit of the merchant; the appropriate amount of the redeemed e-coupon can make the maximum profit to the store. Contrarily, the excessive amount of the redeemed e-coupon might reduce the profit or even make a loss. Due to the electronic information can easily make a duplicate; but in order to make the maximum profit must control the amount of the published e-coupon, hence, in this kind of research prevent double-redemption is the preferential considering and then control the amount of the redeemed e-coupon smaller than the published amount. Nevertheless, since the e-coupon is an implement to help with complete the transaction of the merchandise or service; hence prevent the included contents information be altered is the main purpose. Currently, majority of this kind of research utilize the asymmetric key cryptosystem to protect the contents of the e-coupon from the alteration; or through the third party to do encryption and verification; by way of the mechanism also can detect the double-redemption.

However, the mobile coupon is applied to the mobile devices. On the mobile devices operate the asymmetric key cryptosystem is a heavy load; or by the method of through the third party will increase the cost of transmission medium for the mobile user. Chang and Wu, and Lin proposed a secure e-coupon system for mobile users [4]. Though the design construct with the hash function just needs the simple computation, but in the forward phase needs the third party to do the verification and redesign the coupon for the new receiver to complete the forwarding action; this mechanism not match the main spirit of the P2P: the sharing between the peer to peer. Shojima et al. proposed mechanism, though apply to the P2P mobile environment; but operate the RSA public key cryptosystem needs compute the large amount of factorizations on the mobile devices; however, the computation of the mobile devices is very weak; hence, the efficacy of the actual operation needs to examine. Therefore, the proposed scheme modifies the concept of the hash chain from the electronic payment system [9][10], and adopts the skill of digital signature to

protect the mobile coupon to attain the excellent efficacy.

THE PROPOSED INCENTIVE ADDED MOBILE COUPON SCHEME

The proposed scheme enables the mobile coupon to be used in the P2P environment and to have incentives added, with the consideration of the limitations of the mobile devices. The components of the mobile coupon are shown in Figure 1. The *Coupon* represents a delivered coupon in the transmission. The *C* represents the identity of the mobile coupon and having the details about the coupon. The *SN* is the serial number, such as M00009183, on the mobile coupon. The amount of published mobile coupons can be controlled by the *SN*. The *ID_R* represents a merchant, such as CYUT 3C, who can accept the mobile coupon. The *P_{ID}* is the content about the merchandise, such as CYUT 22" LCD (FP 222 W). The *Discount* records the discount such as 20% off. Finally, the *EXD* is the expiration of the mobile coupon, such as 2007/12/31. Table 1 presents the notations used in this paper. A mobile coupon is described as *Coupon C*{ *SN*, *ID_R*, *P_{ID}*, *Discount*, *EXD* }.

The Framework of The Mobile Coupon System

Figure 2 depicts the proposed scheme utilizing digital signatures and hash chains. The mobile coupon provides with an incentive added in P2P environment. In the framework, the merchant (*M*) and the mobile coupon provider (*P*) define the settings and the parameters of the mobile coupon initially. Then, the mobile coupon provider establishes the database to record the status of the mobile coupon and delivers the mobile coupon to the target mobile users (*MU_i*). The mobile user may either redeem the mobile coupon or forward it to another mobile user. If the mobile user redeems the mobile coupon from the merchant, the merchant will use the database to verify the validity of the mobile coupon. If the mobile user wants to forward the mobile coupon to another mobile user, the mobile user will add his/her digital signature, compute the corresponding *R* value, and combine both with the mobile coupon. In this way, the receiver can verify the coupon upon receiving. The mobile user can use the hash function to compute the *R_{i+1}* from the *R_i*, but cannot use the reverse engineering to compute the *R_{i-1}*. With regard to the protection of the mobile coupon, the mobile coupon provider (*P*) uses another hash function *H'* to compute the *H'(R₀)* from the *R₀*, and the value will be a proof of the verification. The detection of alteration and the query of incentives can be efficiently performed. The participated mobile users are assumed to have registered and own the key pair in the proposed scheme.

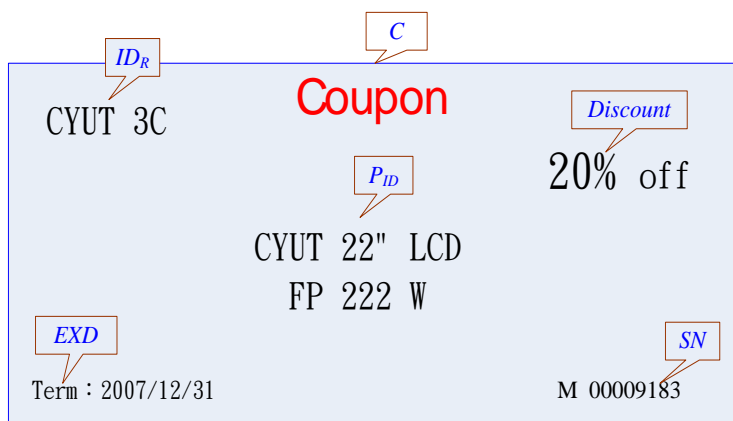


FIGURE 1: Illustration of a Coupon

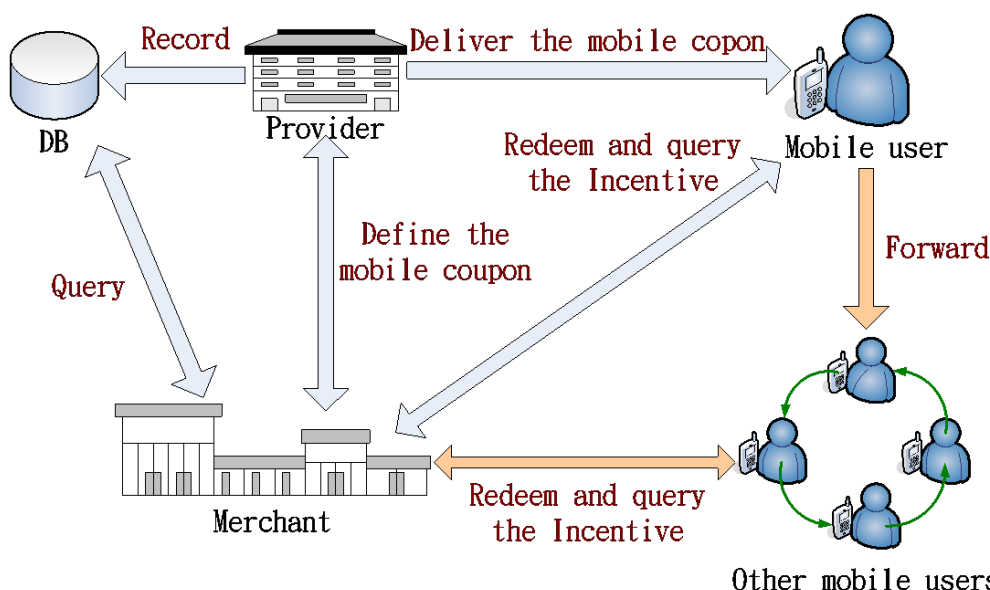


FIGURE 2: The Framework of the Incentive Added Mobile Coupon in P2P Environment

TABLE 1: Notations Used in this Paper

Notation	Representational content	Notation	Representational content
C	Coupon	S_i	The signature of i ※ $i=MU_1\sim MU_n, P, R$
P	Provider of the mobile coupon	PK_i	The public key of i ※ $i=MU_1\sim MU_n, P, R$
M	Merchant	SK_i	The private key of i ※ $i=MU_1\sim MU_n, P, R$
MU	Mobile user	$H()$	One way hash function
IDi	The identity of i ※ $i=MU_1\sim MU_n, P, R$	$H'()$	Another one way hash function
R_0	Random number	S	The process of signing
$R_1\sim R_n$	Seed chain	$ $	Connection

Issuing Phase Of The Mobile Coupon

The P generates a coupon and a random number R_0 . Using another one way hash function, the value of $H'(R_0)$ is computed and combined with C , then were signed using the digital signature S_p , by the SK_p on the mobile coupon. The random number R_0 also computes the value of R_1 through the one way hash function. Finally, they are combined into a mobile coupon to be delivered to the mobile user. The process is shown in Figure 3.

Forwarding Phase Of The Coupon

When MU_1 obtains the mobile coupon from P , he/she might redeem it or forward it to another mobile user to gain some incentives eventually. Assume that the MU_1 wants to forward the mobile coupon to his/her friend who might redeem the coupon, he/she may forward the mobile coupon to MU_2 via MMS (Multimedia Messaging Service) bluetooth, or infrared ray; as presented in Figure 4. The MU_1 computes his/her digital signature S_1 , and computes the R_2 using the one way hash function from R_1 , and embeds them into a mobile coupon to be delivered to MU_2 .

When the MU_2 receives the mobile coupon from MU_1 , he/she will use the attached PK_p to verify the digital signature S_p , and uses the attached PK_1 to verify the S_1 . Finally, he/she compares the R_2 to the output computed from R_1 by the one way hash function. The mobile coupon is secure and valid if the result is equal. MU_2 may forward the coupon and obtain certain reward bonus if he/she has no desire to redeem. The procedures of signing the digital signature and generating the R_3 , for the third receiver and beyond, are similarly performed.

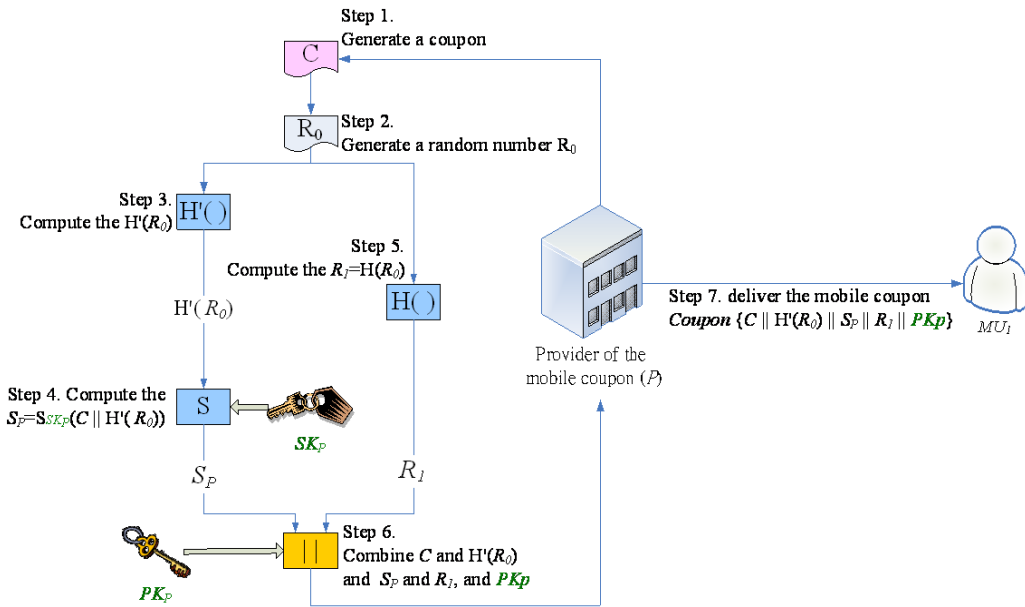


FIGURE 3: The Mobile Coupon Issuing Phase

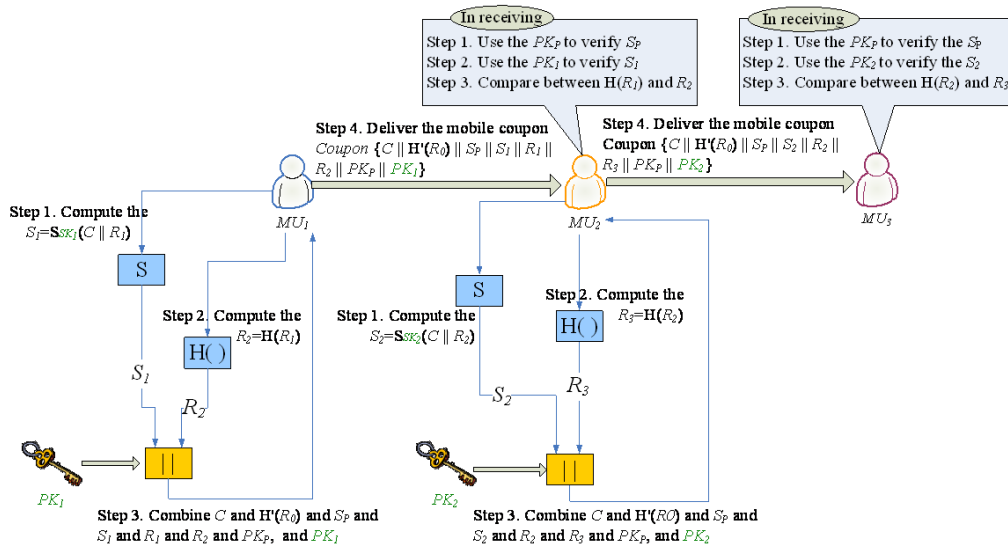


FIGURE 4: The Mobile Coupon Forwarding Phase

Redemption Phase Of The Coupon

Figure 5 shows the redemption phase. The mobile coupon is forwarded to a redeemer MU_n , who stops forwarding and proceeds to the redemption phase. If MU_n decides to redeem the mobile coupon upon receiving of the mobile coupon, MU_n will present the mobile coupon to the merchant. The merchant will verify the embedded digital signature, and the value of R_n in the mobile coupon. The merchant also verifies by computing the output through the one way hash function from R_0 and comparing the result with the R_n . The mobile coupon is not altered and the information integrity is preserved during the forwarding phase if both values are equal. That is, the mobile coupon is valid for redemption.

After verifying the mobile coupon, the merchant examines whether the mobile coupon is redeemed. If the mobile coupon has not been redeemed yet, the merchant will provide the recorded discounts or services on the mobile coupon for the redeemer, and record the redemption status of the mobile coupon. Otherwise, a double-redemption message is sent to MU_n .

Querying Phase Of The Coupon

The MU_i has forwarded the mobile coupon, then he/she might want to know the amount of reward bonuses. The MU_i delivers the forwarded mobile coupon to the merchant to query whether the mobile coupon was redeemed and the amount of the bonuses. Figure 6 details the procedures. The merchant receives the query and examines the redemption status of the coupon. If the mobile coupon was redeemed, the incentive (bonus) is computed according to the record in the database and returned to the mobile user. The user will receive no bonus if the mobile coupon is not been redeemed yet.

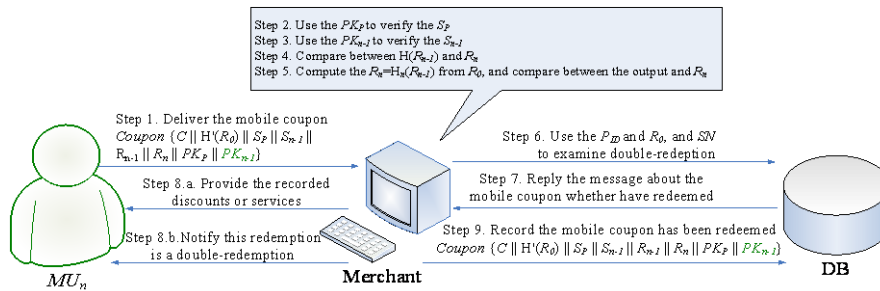


FIGURE 5: The Mobile Coupon Redemption Phase

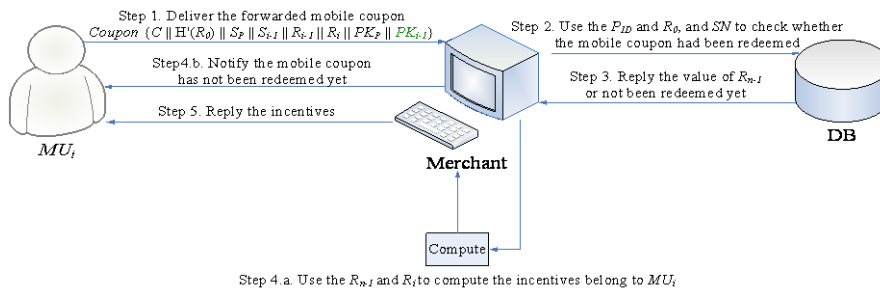


FIGURE 6: Query the Incentive Phase

ANALYSIS ON ASPECTS OF SECURITY AND PERFORMANCE

In the mobile P2P environment, the incentive mechanism can be realized through the proposed scheme. The merchants may reach more potential consumers for advertising, discover new consumers, and enhance the loyalty of the registered consumers. The mobile coupon receiver who uses the coupon may enjoy the discount. The coupon forwarder may receive reward bonuses. Therefore, the proposed scheme can make the win-win situation for both the merchants and the mobile users. The proposed scheme may avoid potential threats and satisfy the security requirements, as discussed below.

Considering the confidentiality aspect, the receiver knows only the identity of the forwarder, without the knowledge of the upstream users of the forwarder, in the proposed scheme. The forwarder and the receiver have to establish a connection channel during transmission in the P2P environment. Hence, the forwarder is excluded in the requirement of confidentiality. If the receiver forwards the mobile coupon to another mobile user, the new receiver cannot know the identity of the original forwarder. Thus, the confidentiality of the original forwarder is secured.

Considering the authentication aspect, the transmitted mobile coupon has the digital signature and the public key of the forwarder. The receiver can utilize the public key of the forwarder to verify the digital signature, and confirm that the mobile coupon was actually delivered from the forwarder.

Considering the integrity of the coupon, in the issuing phase, the provider has signed on the content to generate a digital signature S_p in the mobile coupon. The S_p can be generated only by the private key of the provider (SK_p), and only the provider knows the SK_p . A malicious mobile user cannot forge a mobile coupon or alter the information recorded in the mobile coupon since the malicious user does not know SK_p . Besides, if a mobile user receives an altered mobile coupon, the receiver may detect the alteration by using the public key of the provider (PK_p) to verify S_p and the content of coupon C . The integrity of the mobile coupon is assured.

Considering the verifiability of the coupon, each coupon has a digital signature S_p and the corresponding public key PK_p . Hence, a receiver may use the PK_p to verify the mobile coupon. Furthermore, the merchant may perform the hash function to compute the R_i from R_0 , and verify R_i through R_i .

Considering the non-repudiation aspect, the provider can not deny they had published the mobile coupon because each mobile coupon is associated with the digital signature S_p . The transmitted mobile coupon has the digital signature of the forwarder, so the forwarder cannot deny the forwarding.

Considering the double-redemption aspect, the merchant examines whether the coupon is redeemed by using SN, PID, and R_0 . Thus, a redeemed mobile coupon was recorded in the database so that double-redemption is avoided.

Considering the forgery of the mobile coupon, a mobile coupon is appended with the digital signature of the provider in the issuing phase and becomes an incentive added mobile coupon. A malicious mobile user cannot forge a mobile coupon since the SK_p is unknown. Furthermore, the mobile coupon has R_i , which is computed from R_0 using the one way hash function. The forge will fail to generate a valid R_0 that can pass the verification in the redemption phase.

Finally, the performance of the scheme is described here. Common mobile devices have several inherent limitations on operating complicated security mechanisms. A list of the operations in each phase is shown in Table 2. It confirms that the scheme is efficient.

The size of a mobile coupon in the proposed scheme is 2048 bytes, including SN (128 bytes), ID_R (128 bytes), PID (1280 bytes), $Discount$ (384 bytes), and EXD (128 bytes). The size of the public key and that of the digital signature are both 512 bits. The size of the one way hash function value is 160 bits. Hence, the maximum size of the mobile coupon is merely 2364 bytes.

The digital signature in the scheme is computed from the private key encrypted output of the one way hash function. Hence, it can be efficiently obtained than that generated by using the public key to encrypt the 2048-byte coupon. Besides, in the forwarding phase, the maximum size of the mobile coupon is fixed at 2364 bytes. Therefore, the proposed scheme is efficient and suitable for the mobile devices.

TABLE 2 : Statistics of the Operations in Each Phase

Phase	Processor	Action	Times
Issue	P	Hash function	2
		Sign	1
Forward	MU_n	Hash function	1
		Sign	1
Receive	MU_{n+1}	Verifying	2
		Hash function	1
Redeem	M	Verifying	2
		Hash function	2

CONCLUSIONS

Conventional coupons are shifting towards mobile coupons. Utilizing the mobility and exchangeability of mobile devices, trusted societies may circulate mobile coupons widely. The trust between the sender and the receiver strengthens the recommendation so that the mobile coupon could move toward potential customers. The receiver will probably use the coupon or forward it to who is possibly interested. Adding the incentive to the mobile coupon will eventually increase the redemption rate of the mobile coupon and improve the sales. The uninterested coupon receiver will be more willingly to forward the coupon, which might be discarded without incentives, in our proposed scheme.

The proposed scheme is characterized in the security integration of the incentive-added coupons in the peer to peer environment. The content is secured by the employment of digital signatures. The threats of alternations and forgery are resolved by the integrity of the signature accompanied with the coupon. Furthermore, the scheme provides the necessary security protection without complicated security mechanisms so that it can be effectively adopted in the common mobile devices, which are short of strong computation power and large storage space. Both the verification and the claim of reward bonuses can be efficiently performed with the coupon-forwarding chain, protected by a hash chain technique. The distribution history of the coupon is well protected from potential forgery.

In addition, the merchant may easily control the total amount of the mobile coupons and the upper bound of the reward bonus. In comparison with the paper coupons and those e-coupons requesting print-out before use, the cost of publishing and distribution is reduced. The mobile coupons can actually reach the potential customers either by direct sending or trusted forwarding in the scheme. Merchants, the consumers, and the coupon forwarders will all benefit from the peer to peer mobile coupons in the proposed scheme.

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AN EMPIRICAL STUDY ON THE FACTORS INFLUENCING THE UTILIZATION AND THE EFFECTIVENESS OF ENTERPRISE INSTANT MESSENGER

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ABSTRACT

Communication technology has been recognized to play an important role in boosting organization's competitiveness and viability by facilitating efficient communication and information sharing. Lately, many organizations began to actively adopt the self-developed Enterprise Instant Messenger (EIM) as a common organizational communication medium after experiencing security problem with public messengers like MSN.

Its utilization and tangible benefits of EIM, however, vary. There's an urgent need to understand how each organization embraces EIM and to empirically evaluate whether active use of EIM can result in a better communication, eventually leading into better business productivity. In this research we try to investigate those antecedents which may have affected the high use of EIM and a better decision making efficiency.

Theoretical justification of research variables and causal relationships of our research model are mainly based on Technology Acceptance Model (TAM), media selection theory, and social influence model. Through a survey data analysis of 171 EIM users, it was found that perceived usefulness, social influence, the externally-orientated organizational culture had a significant effect on the high use of EIM. In addition, the use of EIM was found to have a significant effect on the efficiency in the decision-making process.

Keywords: EIM, TAM, Media Selection Theory, Social Influence Model, organizational culture, frequency of usage, decision-making, information dissemination

INTRODUCTION

The Backgrounds and The Objectives

Information society can be defined as a society that can raise the value of information socially and economically through wide utilization of Information technology.

The communication's sub-structure that can support the production and the stream of information in the information society will be a very important social asset, and this will be technical backgrounds that can make it possible to be advent of information society. [1]

Along with the traditional communication technology such as e-mail has crucially affected a company's competitiveness through an information sharing and a vitality of communication. The instant messenger is widely used as a main communication tool recently. This communication tool is called Computer Mediated Communication (CMC).

All company are evolving rapidly because it has to interact with the constantly changing external environments, so the inter- and intra- communication is needed to be expedited further than usual. And recently, companies have adopted the instant messenger in order to achieve more efficient and fast communication activation and spontaneous decision making.

The previous researches on the instant messenger have focused on the public messenger such as MSN, NATE ON, AOL, BUDDY BUDDY, showing the critical limitation to understand the internal, business-oriented use of instant messenger within a company at the same time, this sub-structure will be an indispensable technical fundamental for the advent of Information Society.

It would be more valid to confine the research fast on the Enterprise Instant Messenger in order to make a valid verification about the result of using instant messenger as a way of communication with the company and to understand social factors and organizational culture factors related to the instant messenger use. In fact, many companies prohibit public messengers due to a security problem and have developed their own Enterprise Instant Messenger.

In this research, we attempted to understand critical factors toward a successful sue as an Enterprise Instant Messenger. Additionally, we study how much does the instant messenger contribute to the organization's accomplishment in the aspect of the quality improvement of information distribution and the enhancement of decision-making effectiveness on Instant Messenger.

Theoretical Background

Researches on factors that affect the acceptance of Instant Messenger (IM) are largely divided into three topics: research on the acceptance of information technology; research on Media Selection Theory and research on organizational culture and the acceptance of information technology.

First, researchers have examined the factors that allow IM to be accepted within an organization with Technology Acceptance Model (TAM) and the Theory of Reasoned Action (TRA) that are used to explain the factors that enable users to accept

information technology. TRA suggests that outcomes of actual behavior are determined by a person's behavioral intention to perform the action, while behavioral intention depends on attitudes and subjective norms. (Ajzen&Fishbein, 1975)TAM, which is based on TRA, is a model to predict and explain a user's acceptance of information technology, which suggests factors that would have the most impact on a user's perceived ease-of-use and perceived usefulness [3].

Second, researchers have explained the factors that affect the acceptance of IM on the basis of media choice theories. Previous studies on communication media choice generally falls into two categories: media richness theory in which a richer format that a medium itself has is the most important factor in choosing a medium for communication; and, the Social Influence Theory which claims that people's attitudes, norms, and culture would influence media choice more than the richness of media itself. The theory of social influence that examines social variables that affects media use argues that social environment has a direct impact on the choice and use of media.

According to the theory of social influence, media choice is determined on the basis not only of objective technical characteristics but also of colleagues' statements, behaviors, attitudes, decisions, and evaluation as well as of organizational norms for media use and vicarious learning through other people's experiences and observation of a particular medium (Fult et al. 1987,1990). In his study on social variables that affect the use of IM at work, Hwang confirmed that particular characteristics of media, that is media richness, are not the only factor for media choice.[4] Yang and Choi examined the variables that affect Internet use and revealed that, even though less than perceived usefulness and perceived ease-of-use, social variables do have significant effects on Internet use.[5]

Third, research has found that the factors of organizational culture have significant effects on the successful acceptance and performance of IM within an organization. Lee.M and Olfman and Weber and Weber & Pliskin [6] argued that organizational culture is one of the most important success factors for the performance of information system because organizational culture functions as an internal factor for organizational members in information system. Zammuto and O'Conner [7] suggested that the success of IS depends on organizational culture and organizational structure, while Suh et al. [8] attributed the success of IS to organizational culture and leadership (Jang, Won-Kyung, Kim, Tae-Kyun, 2003). Lastly, Han, (2003) showed that innovativeness, supportiveness, and outcome-oriented of organizational culture have significant effects on the use of IM.

Based on these three research frames, this study examines the variables that affect the acceptance of IM as a communication medium within an organization with focus on perceived ease-of-use and perceived usefulness in TAM, Social Influence Theory in media choice theories, and organizational culture based on previous studies on the relationship between the acceptance of information technology and organizational culture. Also, this study shows the effect of the use of IM as an official communication channel within an organization on the increase of effectiveness in decision-making process within an organization.

While previous studies on IM deal with the effects and the factors of acceptance of generic messengers, this study examines corporate messengers. As many companies and public agencies that implemented corporate messengers have shown noticeably different utilization of messengers, they also have varied outcomes of using messengers.

In examining the factors that affect the use of corporate messengers, this study focuses on the difference in the acceptance of information technology depending on usefulness and ease of use as well as on social perception of relatively informal and unofficial communication medium and organizational culture. In addition, when estimating the outcomes of messenger use, this study is distinguished from previous studies as it attempted to verify more substantive effects with a notion that the effectiveness of decision-making process is derived from the improvement of quality in information distribution.

LITERATURE REVIEW

Instant Messenger as Computer Mediated Communication

The development of information technology has led the incorporation of communication and computer, which basically affected the existing communication media. Computer Mediated Communication (CMC) is to use computer as a basic medium for communication. This term, CMC is found in "The Network Nation: Human Communication via Computer" by Hiltz and Turoff [9], in which CMC is defined as communication processes that allow 1-1, 1-many, or many-many transactions through printed messages via computer (Kim, You-Jung, 1998). In other words, CMC can be defined as communication phenomena or processes that are performed through computer as a medium, and in this phenomenon, transactions occur when senders and receivers connected through computers enter messages to communicate without meeting each other at the same physical place.

According to the capacity of CMC, Katherine (1999) divided them into: one-way CMC such as audio, video, and the World Wide Web (WWW); asynchronous two way CMC such as electronic-mails and bulletin boards; and, synchronous two-way CMC such as chatting and video conference. The subject of this study, Instant Messenger (IM), is basically a synchronous two-way CMC, but it also combines all three characters above.

Efficient communications within an organization is a critical element in a fast-changing management environment. The advancement of CMC technology has drastically changed organizations. In companies, the construction of information system has been developed as an area to support decision-making processes based on the promotion of communicative elements. Communications within an organization allows exploring and analyzing an environment that an organization faces and performing such roles as mediation between departments, establishment and dissemination of objectives and rules and support in decision-making process. CMC has innovatively improved these functions and made a considerable contribution to vitalizing organizational communication.

David and Danny [10] define Instant Messenger (IM) as follows:

First, status on a network: IM is one of carrier infrastructures that exist on a network. Second, the messaging: IM is a real-time messaging solution. Third, indication of user status: IM indicates the current status of friends or colleagues. Fourth,

interoperability of information processing: IM is a communication tool that is not restricted by Phone, PDA, or PC and is conveniently to be embedded in information appliance or mobile device.

In summary, IM is one of computer-mediate communication systems that provide various functions through computer such as instant transmission of messages, indication of a receiver's status, and management of friends, file transfer, and video chatting.

IM has become widely known with the acquisition of ICQ (I Seek You) by AOL in 1998; and, especially in South Korea, various generic messengers including MSN and NATE have made it more and more popular. As generic IM has become common, many companies begun to point out such problems as virus transfer through generic IM and security issues including information leakage in order to address the problems, such as information leakage, virus infection, and work productivity, which are derived from the use of generic messengers (e.g. MSN and NATE) within a company, corporate messengers have been developed and implemented and now many companies are actively using these convenient and efficient messengers as an official communication tool within an organization. It is expected that the domestic market of corporate messengers will be almost doubled from 3 billion won last year to 5 billion won this year (eWeekly, 2006.2.6). According to a market research company, about 135 million people are currently using messengers in their offices around the world and it is expected that the number will be increased to 477 million people by 2009 (Inews, 2006.2.22).

In addition to general functions of generic IM, corporate messengers provide functions such as organization management (member search), bulletin boards, and in-company news through the linkage to the existing group ware such as KMS or ERP. IM assists to strengthen collaborations and accumulate, organize, and redistribute information within a company. Currently in 2006, various functions including text-based chatting, video chatting, file transfer and screen sharing continue to be added to IM. Various attempts have been made to build faster and more efficient networks for corporate messengers, and messenger services incorporated with advanced technology are introduced to add various communication tools such as phone and webcam functions to messengers.

Currently many companies, governmental offices and public agencies develop and utilize their own messengers, and this trend is spreading. Messengers are actively utilized in financial industry, especially stock markets, while schools also use messengers as a way to deliver] messengers to students. Central administrative agencies and local governments are also building their own corporate messengers to vitalize communications among agencies.

This study examines corporate messengers that are developed and utilized by a company. Many studies have shown that IM increases communication efficiency and productivity in many organizations and helps strengthen a company's competitive power through efficiently sharing information. Lee and Hwang [11] demonstrated that the use of messenger increases intimacy within an organization and improves individual performance, and Hwang [4] also revealed that the use of IM at work could increase the effectiveness of decision-making process in an organization. Jeong examined how IM is used in tourism industry in order to enhance work efficiency, and especially that IM increases time-space economical efficiency among travel agencies and encourages information sharing. [12]

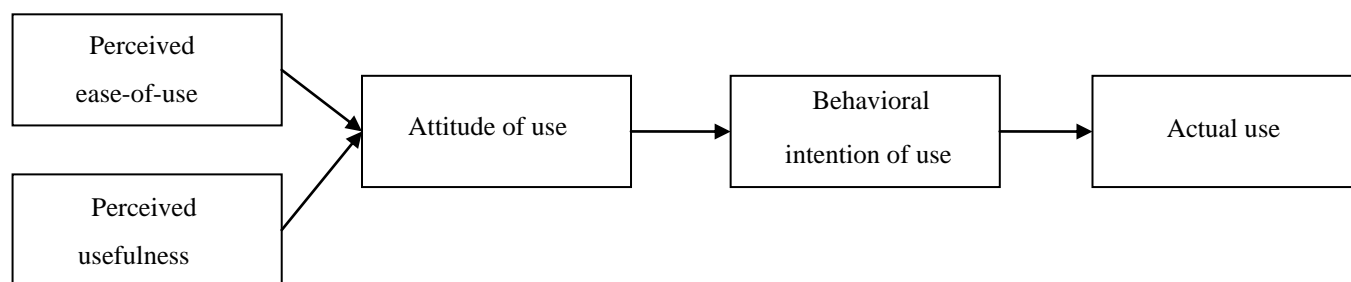
Technology Acceptance Model

Theory of Reasoned Action (TRA)

Theory of Reasoned Action (TRA) is a model widely studied in social psychology with regard to decision factors of consciously intended behaviors [2]. According to TRA, the outcome of a person's actual behavior is determined by behavioral intention to perform a behavior, and behavioral intention is guided a person's attitude and subjective norms. Here attitude is a person's valuation on his or her wish to use a system and subjective norms means an individual's perception who feels social pressure to perform certain behaviors. This idea that attitudes and subjective norms are connected to intentions and behaviors provides a general yardstick which allows combining users' processes to accept information technology. Thus, TRA becomes a theoretical basis for many researchers of management information system (Jang and Kim , 2003.)

Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM), based on TRA, is to predict and explain users' acceptance of information technology, and it suggests that perceived ease-of-use and perceived usefulness are the factors that most significantly affect technology acceptance. This model explains that: when two behavioral beliefs – perceived ease-of-use and perceived usefulness – affect behavioral intention through a parameter called attitude, they eventually reach actual behaviors. Perceived ease-of-use in TAM is a category to assume that it is easy to use a certain system, while perceived usefulness is a category to believe that using a certain system allows making accomplishments. TAM, which is a model that is most frequently cited in governmental technology acceptance, is used in this study to analyze if perceived ease-of-use and perceived usefulness of a messenger affect on the actual use of a messenger.



[Figure 1. TAM]

Media Selection Theory

Media Richness Theory

The concept of media richness was first presented in order to address a question “why an organization processes information.” [13] According to Daft and Lengel, an organization processes information in order to minimize uncertainty and ambiguity. In processing information to reduce uncertainty and ambiguity, communication occurs using a communication media.

In Media Richness Theory, communication media is divided rich media and lean media by its ability to share meanings among people. The degree of richness is determined based on the following four categories: First, is immediate feedback possible?; Second, can it multiple clues such as voice, gesture, words, numbers, and graphics?; Third, how much does it secure language varieties to deliver meanings in various ways?; And, fourth, how much personal feelings can be injected to Attitude of use Behavioral intention of use communication media with personal focus? These four criteria determine the degree of media richness, and media richness decreases in the order of face-to-face communication, telephones and documents with senders (e.g. memos, letters) and documents without senders (e.g. bulletin boards and filters). Media richness theory contends that richness of a media has a critical effect on media selection. That is, when an organization processes information to reduce uncertainty and ambiguity, a medium with high richness would clearly deliver information, increasing a potential to be selected as communication medium within an organization [13][14][15].

Social Influence Model

The Social Influence Theory was introduced originally as a model on technological use and it views that personal perception and use of the media is partially socially constructed (Fulk, Stienfield, Schmits&Power, 1987; Fulk, Stienfield & Schmits, 1990). The model premises that media characteristics such as richness are not objective characteristics inherent in the media but subjective ones that are variably perceived by social factors including a user’s attitude, circumstances, and others’ influences. Thus, while objective media richness affects individuals’ use and perception of the media, these characteristics are only part of what determines media perception and use. Moreover, the recognition of richness varies by individuals. The theory of social influence can be seen as connected to the perspective of social information processing theory [14].

From the perspective of social information processing, Huang compared perceived richness of various forms of the media. It was found that the groups that have shared goals for the same media had the high degree of perceived richness than the groups that do not share goals, which suggests that the degree of richness is not unique attributes inherent in the media but could be changed by social environment [16]. That is, as in the Media Richness Theory, the Social Influence Theory contends that the media is selected not only for its richness appropriate for the characteristics of tasks but also for social factors including a user’s attitude, circumstances, and others’ influence.

This study applies the Social Influence Theory regarding the factors in selecting IM as communication media and examines the effect of social environment on the acceptance of instant media.

Organization Culture And Information Technology

The Meaning of An Organization Culture

Scholars have defined organization culture in various ways and emphasized its different aspects; it can be generally defined as “patterns by which activities are carried out in an organization.” (Kennedy, 1982) As a comprehensive concept that encompasses values, beliefs, ideology, issues, knowledge and technology shared by members of a company, organizational culture is an element that affects members’ behaviors and a factor that directly influences the performance of a company[17]. Here it also includes intangible system such as management styles and problem-solving methods as well as external symbols including uniforms, office arrangements and logo [15].

Organizational culture could have a positive effect on the process to introduce new information technology and its success, but also cause resistance and conflicts. Therefore, the success of information technology differs by whether it is appropriate to organizational culture or style [18] , and when information technology supports organizational culture and styles, an organization could maintain balance and harmony. This kind of organizational culture is a factor that dominates behaviors of a company and has a significant effect on the performance of a company.

Regarding the types of organizational culture, Quinn and Kimberly (1984) and Quinn and McGrath (1985) discussed Competing Values Framework. These studies identify four types based on the flexibility-control dimension and the internal-oriented and external-oriented dimension.

The flexibility-control dimension indicates preference of organizational structure. In other words, a system that prefers

flexibility emphasizes decentralization and differentiation, while a system that is oriented toward control focuses on centralization and integration. The second internal-external dimension is concerned with the organizational value system with which whether an organization emphasizes socio-technological system or competitive position under an external environment.

According to two dimensions, organizational cultures are divided into group culture, developmental culture, hierarchical culture and rational culture. Group culture considers flexibility and internal orientation important and specifically emphasizes coherence, teamwork, family-like human relations, morale and development of human resources. Developmental culture characterized with flexibility and external orientation stresses creativity, entrepreneurship, flexibility, adventure, and innovation.

On the contrary, hierarchical culture marked with stability and internal orientation values order, rules, procedures, and regulations, which is also called bureaucratic culture. Rational culture in pursuit of stability and external orientation attaches importance to goal attainment, competition, and performance [19].

Organization Culture And Information Technology

A theoretical examination of the relationship between organization culture and information technology was carried by Zammuto and O'Conner [7]. They pointed out that the use of AMTs(Advanced Manufacturing Technologies) in information technology failed because the elements of organizational culture were overlooked. On the basis of Competing Values Framework for organizational culture, they formulated hypotheses on the associations among organizational culture, organizational structure, and performance of information manufacturing technology and showed the relationship between information technology and organizational performance.

In addition to this study by Zammuto and O'Conner[7], many previous studies examined the effect of organizational culture on the use of information system (IS) (Lee, M. and Olfman, 1997; Weber & Pliskin, 1996; Suh et al, 2000; Jang, Won-Kyun, Kim, Tae-Kyun, Cho, Young-Bok).

In their research on the effect of organizational culture and leadership on the success of information system, Suh et al. [23] demonstrated that organizational culture affects the commitment to the development of IS as well as the use of IS, contributing to individual performance, while Jang and Kim (2003) showed that perceived organizational culture affects the acceptance of Internet.

Other studies deal with organizational culture and the use of Instant Messenger (IM). Han (2003) verified that the elements of organizational culture (innovativeness, supportiveness, outcome-oriented, analytic tendency, and aggressiveness) have significant effects on the use of IM. A study by Lee and Lee (2003) examined the effect of Confucian values on Korean's use of IM and revealed that Confucian culture concerning "propriety" and "face (reputation)" has a limitation in using IM as a communication channel in a hierarchical structure. Taking a close look at previous studies on the effect of organizational culture on the use and success of information technology, two frameworks are used in defining and assessing organizational culture.

The first research group including O'Reilly et al. (1991) measures organizational culture by using 8 variables including Innovativeness, Attention to Detail, Outcome Orientation, Aggression, Supportiveness, Emphasis on Reward, Team Orientation, and Decisiveness.

The second group is based on Competing Values Framework proposed by Quinn and Kimberly (1984) and Quinn and McGrath (1985), which studies four types of organizational culture categorized by the flexibility/control dimension and the internal-oriented and external-oriented dimension. This group includes Zammuto and O'Conner (1992) and Suh et al..

As IM is characterized as simplicity and informality as information technology for organizational communication, the culture with high degree of autonomy and flexibility has higher probability in using IM than the culture that emphasizes regulations and procedures. Thus, it is assumed that the types of culture in the flexibility-control dimension have a significant effect on the acceptance of IM.

When an organization places more importance on maintaining the existing social information system or competitive location in an external environment, it is deemed that an organization would stress efficiency over formality in accepting communication-related information technology, and that the internal-external dimension would have a significant effect on the use of IM.

In this study, the hypothesis that the degree of flexibility and external orientation of an organization would affect the use of IM within an organization will be tested.

Organizational Communication and Decision-Making Process

Organizational communication is defined as "two or more people send and receive messages in order to consciously form and maintain a system of a series of activities" (Tompkins, 1984). Organizational communication is generally defined as communication among members within an organization, but there exists communication that occurs beyond a boundary of a certain organization. That is, organizational communication is a concept that includes all forms of communicative activities within and between organizations.

In the 1980s, a study of the top 100 out of 500 U.S. companies pointed out the following problems with the communication structures of these organizations (Goldhaber,1990). For example, workers do not receive sufficient information on the company and workers' opinions are not reflected in making important decisions. Also, senior management does not quickly respond to workers' messages, or frequently messages are delivered too late to be taken into consideration. The current management does acknowledge the problems in organizational communication in their companies, so they are examining ways to promote various communication channels [15].

Research on organization communication started from the aspects of business management such as organizational task

performance, goal attainment and management efficiency. Most significant areas of organizational communication research are decision-making process, conflict management, and information distribution. According to Gouran [20], when members are engaged in active communication in the introduction stage, the early stage of the decision-making process, probability of making uniform decisions increases. Also, Leathers [21] claimed that when members experience the high level of positive feedback in the decision-making process and receive the information on task performance and organizational maintenance at appropriate times, they are more likely to make desirable decisions.

Another important issue of organization communication is information distribution. In order to efficiently manage an organization, information should be distributed quickly and richly, for which organizational communication should be actively performed. In defining the quality of information distribution, King and Epstein (1983) applied the variables of information quality such as an information delivery, information sufficiency, and the reduced time for information distribution. Instant Messenger (IM) makes it easy to send messages in 1 – 1 or 1 – many, and to form and manage friend groups, so it is expected that information delivery and speediness will improve. However, it is possible to have problems including excess of unnecessary information such as spam messages.

As communication media that is rapidly spreading, Enterprise Instant Messenger (EIM) has a positive effect on the vitalization of organizational communication, through which it would increase efficiency in making decisions and accelerate the speed of information distribution.

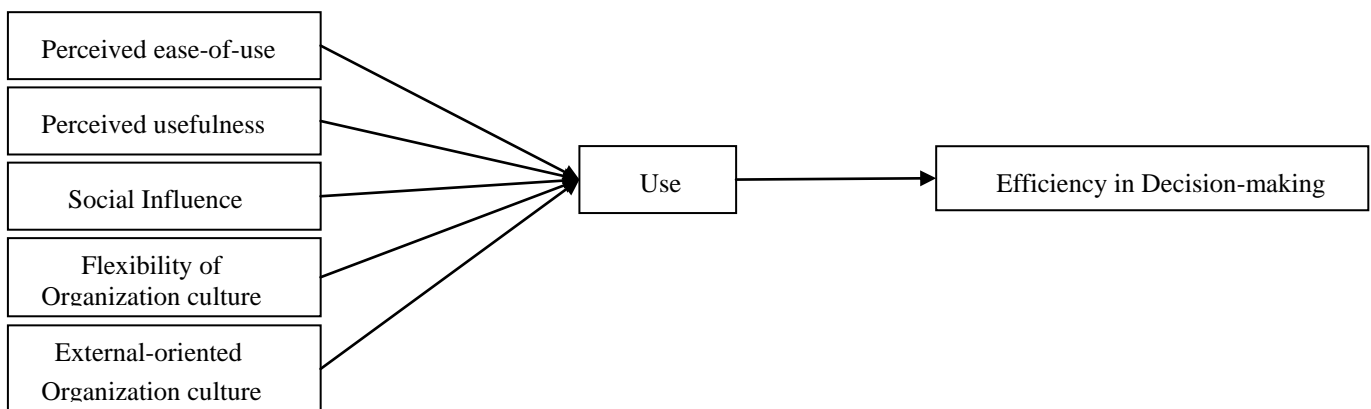
RESEARCH METHODOLOGY

Research Model

Many organizations have implemented corporate instant messengers, but its use and performance differs by organization. Thus, with focus on this difference, this study aims to examine the factors that affect the acceptance of EIM. Furthermore, this study tests the hypothesis that the use of EIM vitalizes organizational communication and further increases the efficiency of organizational decision-making.

In the research model, perceived ease-of-use and perceived usefulness from TAM, organizational culture and social influence variables from the theory of social influence are used as independence variables and the use of EIM as a dependent variable, in order to empirically test the factors that affect the acceptance of corporate EIM as an official communication medium, and to examine the effects of the use of corporate EIM on the efficiency of decision-making process and the increase of information distribution.

And here is the research model.



[Figure2. Research Model]

Hypothesis

Hypothesis1. Perceived ease-of-use of Enterprise Instant Messenger significantly affects the use of messenger.

Hypothesis2. Perceived usefulness of Enterprise Instant Messenger significantly affects the use of messenger.

TAM designed by Davis [22] is a model to predict and explain a user's acceptance of information technology, which is based on TRA in the area of social psychology. In this model, two behavioral beliefs – perceived ease-of-use and perceived usefulness – affect behavioral intention through a parameter called attitude, and they eventually influence the use of information system. By using TAM, this study tests the hypothesis that perceived ease-of-use and perceived usefulness for corporate messenger have an impact on the use of IM.

Hypothesis3. Social Influence of Enterprise Instant Messenger significantly affects the use of messenger.

Fulk et al. (1987; 1990; 1993) argued that social variables have direct effects on the selection and use of communication media.

A work group that a user belonged acts as an influential group for each user. Therefore, general attitude and use pattern of the system within work group would have a significant effect on a individual members' use of the system. Based on this theory of social influence with regard to media choice, it is hypothesized that the rate of messenger use in a given department, members' perception of messengers, and a boss's use and perception of messenger would have a significant effect on the use of messenger.

Hypothesis4. More flexible organizational culture in a company leads into to the wider use of EIM.

Hypothesis5. External-oriented organizational culture leads into to the wider use of messenger.

Grounded in Quinn's Competing Values Framework on organizational culture, Zammuto and O'Conner [7] hypothesized the relationship between organizational culture, organizational structure and performance of information-manufacturing technology and demonstrated the relationship between information technology and organizational performance. With consideration of the elements of organizational culture that would affect the use of corporate messenger, this study inquires how the degree of external orientation and flexibility level in a company affect the acceptance of corporate messenger. As information technology for organizational communication, corporate messengers are characterized as a simple, instant, informal means. Thus, it is known that the culture with high degree of autonomy and flexibility tends to prefer more flexible, spontaneous, quick information than the formalized culture with emphasis on regulations and procedures. In addition, the external-oriented culture that prioritizes competitiveness also needs more dynamic information exchanges than the internal-oriented culture that rely on the routine maintenance.

Hypothesis6. Wide use of Enterprise Instant Messenger leads into a better decision-making efficiency.

In research on the decision-making process in an organization, one of the most important elements is the relationship between communication and the quality of decision-making process. According to Gouran [23], when members are engaged in active communication in the decision-making process, probability of making valid decisions increases. Also, when members experience the high level of positive feedback in the decision-making process and receive the information on task performance and organizational maintenance at appropriate times, they are more likely to make desirable decisions. [21] Based on these previous studies on communication and the decision-making process, it was hypothesized that the vitalization of communication and the fast and sufficient attainment of information via corporate messenger would have a positive effect on the efficiency in the decision-making process.

EIM' functions such as making announcements, sending messages to friend groups, and 1-1 conversations, would facilitate distribution of information in an unprecedented speed and alleviate the imbalanced distribution of information within an organization. Especially, corporate messengers can vitalize horizontal and downward communications along with downward. It may vary by organizational culture, but it was also found that the use of messenger encourages upward communication, transmitting information from the bottom to the top (Lee,Eun-Mi, 2005).This study aims to empirically demonstrates that corporate messengers as an official channel for organizational communication would improve the quality of information distribution within an organization with better information delivery, information sufficiency, and speediness, and to further advance the efficiency of the decision-making process.

Operational Definitions of Research Variables

The operational definitions of variables used in this study are as follows:

Perceived Ease-of-Use And Perceived Usefulness

Measures of perceived ease-of-use and perceived usefulness are based on Davis (1989)'s study. Validity and reliability of these variables have been confirmed through many previous studies. Perceived ease-of-use and perceived usefulness are core concepts of TAM. Perceived ease-of-use is "the degree of an individual's belief that a certain system is easy to use." In this study, a person's perceived ease-of-use in using EIM is "the degree of belief that it is easy and not cumbersome to use EIM" which consists of three measurements – the degree of easiness to learn to use a corporate messenger, the degree of easiness to use a messenger and the degree of easiness to attain proficiency. Perceived usefulness is defined as "the degree of a person's belief that using a certain system would improve a person's work performance." For the purpose of this study, it is defined as "the degree of a person's belief that the use of EIM would be useful for work performance and organizational communication," with four items of improved speed of work performance, increased productivity, improved efficiency and the degree of usefulness in making work easy.

Social Influence

Measurements for social influence that would affect the use of EIM include the rate of messenger use in a group that a user belongs to, the degree of (positive/negative) perception of a group on the use of messenger, and a senior worker's attitude toward the use of instant messenger and utilization. (Fulk et al. 1987;1990;1993).

Flexibility of Organization Culture, And External-Oriented Organization Culture

Operational definitions to measure organizational flexibility were; the degree of an individual's perceived autonomy and permitted discretion, the degree of demand for official documentation in performing tasks, and the degree of emphasis on hierarchical order. [7]

The degree of organizational external orientation was measured with the degree of competition with external organizations and the degree of pressure for internal innovation by changes of external environment.

Use of EIM And Efficiency of Decision-Making

The use of corporate messenger was measured with the frequency, frequency of daily use. Additionally, the pattern of messenger use was examined in terms of the purpose of messenger use.

Leathers [21] showed that when members experienced the high level of positive feedback in the decision-making process and received the information on task performance and organizational maintenance at appropriate times, they were more likely to make desirable decisions [15].

To measure efficiency in the decision-making process through the use of corporate messenger, Huber's (1984) and Chidambaram and Jones (1983) instrument were used. Four operational definitions to measure the efficiency for the decision-making process proposed in the studies by Huber (1984) and by Chidambaram and Jones (1983) include timeliness and speediness of decision making, the effectiveness of work, and cost reduction in making decisions [4]. Also, the variables related to the concept of information quality presented by King and Epstein (1983), information sufficiency and time reduction in information distribution were additionally applied. (Park, Hae-Youn, 2004)

Measurements and operational definitions of each variable are summarized in Table 3-1.

[Table3-1 Operational Definitions and measurement of Variables]

Variables	Operational Definition	Measurements (Operational Definition)	No. of Items
Perceived ease-of-use	Degree of belief that it is easy and not cumbersome to use a corporate messenger	Degree of easiness to learn how to use	3
		Degree of easiness to use	
		Degree of easiness to attain proficiency	
Perceived usefulness	Degree of belief that the use of corporate messenger is useful for work and organizational	Improved speed of work	4
		Increased productivity	
		Improved efficiency	
		Degree of usefulness in making work easy	
Social influence	Social influence that affects messenger use including a group's perception of and attitude toward messenger	the rate of messenger use in a group	4
		Degree of a group's perception on messenger use	
		Superior's perception on messenger	
		Degree of a superior's messenger use	
Flexibility of org. culture	Degree of permission of autonomy and discretion rather than regulation and norms	Degree of permitted autonomy and discretion	3
		Degree of formulation	
		Degree of emphasis on hierarchical order	
External orientation of org.	Degree of emphasis on competitive position in an external environment	Degree of competition with outside organizations	2
		Degree of pressure for change and innovation	
Use	Degree of pressure for change and innovation	Frequency of daily use	1
Efficiency in decision-making	Degree of efficiency for fast, timely and effective decision making through obtaining information	Timeliness of decision making	6
		Speediness of decision making	
		Effectiveness of work	
		Cost reduction in making decisions	
		Information sufficiency	
		Time reduction in information distribution	

DATA COLLECTION AND ANALYSIS

Sampling And Data Collection

In order to examine the factors that affect the use of corporate messengers and its effectiveness, the nine sample sites were chosen when they are currently using corporate messengers. Sampling sites in Korea include employees of governmental offices and ministries, telecommunication companies, and banks, including the Ministry of Justice, Fair Trade Commission, the Ministry of Patriots and Veterans Affairs, National Emergency Planning Commission, Korea Telecommunication, SK Telecom, LG Telecom, KTF Co. Ltd., and Kookmin Bank.

Survey questionnaires include multiple-choice questions on demographic information and the use of corporate messenger, and other measurements in Likert 7- point scale from 1 – “never”/ “strongly disagree” to 7 – “always”/ “strongly agree.” Total 171 questionnaires were completed and used for data analysis.

Data Analysis

Characteristics of The Samples

Respondents consists of men 57% and women 43%. In terms of age, relatively diverse respondents participated in the study with 16% in their 20s, 59% in their 30s, 23% in their 40s, and 2% in their 50s and over. Respondents' positions were 25% employees, 38% assistant managers, 22% managers, and 2% deputy general managers. Regarding their divisions, 14% worked in sales, 66% in office, 16% in computers and communications, and 2% in others, showing the majority of respondents were office workers. In terms of their areas, 32% of respondents were in governmental offices, 60% in telecommunication industry, and 4% in finance, indicating that the sample is composed of most people in governmental offices and telecommunication industry. Demographic characteristics of respondents are shown in Table 4-1.

[Table 4-1 Sample profile]

Variable	percentage	
Sex	Male	57%
	Female	43%
Age	20s	16%
	30s	59%
	40s	23%
	50s above	2%
Position	Staff	25%
	Deputy managers	38%
	Managers of sections	22%
	Vice-chiefs of departments	13%
	Managers of departments	2%
Work	Marketing	14%
	Clerical employees	66%
	Communication/computation	16%
	Research	2%
	Etc.	2%
Types of businesses	Government offices	32%
	Finance	8%
	Communication	60%

Descriptive Statistics

Descriptive statistics of measured values of variables were examined. The mean values and standard deviations are as follows: The mean value of perceived ease-of-use is 6.14 and its standard deviation is 0.834, indicating that the measured values are inclined to very high values. In other words, the majority of participants answered that their perceived ease-of-use is very high.

[Table 4-2 Statistical Analysis]

Descriptive statistics

	N	Mean	Std. Deviation
Perceived usefulness	171	6.14	.834
Social Influence	171	5.61	1.207
The Flexibility of organizational culture	171	5.08	1.273
The External-oriented organizational culture	171	3.80	.833
The validity of decision-making	171	5.10	1.287
Valid N (listwise)	171	5.12	1.157

Validity Analysis

In this study, factor analysis was performed to test the construct validity. Orthogonal rotation of Varimax Method was performed with eigen value of 1 were extracted. The results of factor analysis are shown in Table 4-3.

[Table 4-3 Analysis Result]

Rotated Component Matrix (a)

	Component					
	1	2	3	4	5	6
Ease-of-use 1	.131	.173	.886	.039	.090	.027
Ease-of-use 2	.173	.258	.883	.088	.129	.029
Ease-of use 3	.216	.129	.792	.148	.165	-.018
Usefulness 1	.411	.742	.322	.208	.188	.085
Usefulness 2	.391	.795	.218	.261	.209	.080
Usefulness 3	.439	.769	.275	.228	.175	.097
Usefulness 4	.443	.760	.215	.231	.181	.089
Social Influence 1	.382	.161	.386	.625	.188	.290
Social Influence 2	.352	.404	.358	.714	.263	.242
Social Influence 3	.393	.216	.192	.754	.047	.143
Social Influence 4	.210	.274	.033	.830	.171	.080
Flexibility 1	.415	.123	.124	.036	.487	-.194
Flexibility 2	.141	.121	.022	.338	.255	.715
Flexibility 3	.120	.060	.015	.007	.064	.891
External-oriented 1	.198	.126	.131	.245	.833	.099
External-oriented 2	.145	.224	.192	.041	.851	.132
Validity 1	.715	.231	.220	.109	.139	.190
Validity 2	.665	.365	.286	.122	.171	.070
Validity 3	.801	.235	.145	.236	.172	.062
Validity 4	.874	.225	.111	.204	.141	.022
Validity 5	.782	.328	.141	.263	.174	.112
Validity 6	.789	.285	.137	.217	.138	.209

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 6 iterations.

The use of EIM was excluded from the factor analysis since factor was measured with one item. Thus, five out of six variables, excluding the use, were loaded from the factor analysis. It was found that all research variables but flexibility of organizational culture was loaded as expected, showing the construct validity of each variable. Since one measurement, flexibility of organizational culture, could not be loaded, it was excluded from the research variables.

Reliability Analysis

Reliability means the possibility to obtain the same or similar values when a construct is measured by comparable, independent methods, and it implies stability, consistency, and predictability. When Cronbach's Alpha is 0.6 and higher, it is considered that reliability is relatively high. Reliability was tested for five variables loaded from the factor analysis, and all variables showed more than 0.8 Cronbach's coefficients.

The findings are shown in Table 4-4.

[Table 4-4. Result of the Reliability test]

Variable	No. of Items	Cronbach's Alpha
Perceived ease-of-use	3	.8976
Perceived usefulness	4	.9753
Social Influence	4	.8664
External-oriented	2	.8528
Validity of decision-making	6	.9444

Testing Research Hypotheses

To test this study's hypotheses, regression analysis was performed for the 171 sample data by using SPSS 11.5.

First, regression analysis was performed for perceived ease-of-use, perceived usefulness, social influence, organizational culture on the dependant variable, use of EIM to reveal the factors that affect the use of corporate messenger. This test was to support for Hypotheses 1, 2, 3, and 5.

And here is the model summary

[Table4-5 Final Result of the stepwise Regression Analysis 1]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.558(a)	.311	.307	1.332
2	.585(b)	.342	.334	1.306

Model		Sum of Squares	df	Mean Square	F	Sig.
Step wise Regression	Regression	157.124	3	52.375	31.418	.000(c)
	Residual	278.397	167	1.667		
	Total	435.520	170			

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	-2.080	.510		-4.079	.000
	Social	.414	.116	.330	3.584	.000
	External	.202	.091	.163	2.228	.027
	Usefulness	.271	.122	.205	2.217	.028

The second regression analysis was performed to test Hypothesis 6 on the correlation between a parameter, the use of corporate messenger, and a dependent variable, the improvement of efficiency in the decision-making process after using a messenger.

The regression result is summarized in Table 4-6.

[Table4-6 Result of the Regression Analysis 2]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate		
1	.497(a)	.247	.242	1.007944486415933		
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	56.184	1	56.184	55.302	.000(a)
	Residual	171.696	169	1.016		
	Total	227.880	170			
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.197	.147		28.608	.000
	Use	.359	.048	.497	7.437	.000

a Dependent Variable: Validity

The results of regression analyses for this research model are summarized as in Table 4-7.

[Table 4-7 The results of hypothesis tests]

No.	Hypothesis	P	Selection
H1	Perceived ease-of-use of Enterprise Instant Messenger significantly affects the use of messenger.	.524	rejected
H2	Perceived usefulness of Enterprise Instant Messenger significantly affects the use of messenger.	.028	supported
H3	Social Influence of Enterprise Instant Messenger significantly affects the use of messenger.	.000	supported
H4	More flexible organizational culture in a company leads into to the wider use of EIM.	.027	supported
H5	External-oriented organizational culture leads into to the wider use of messenger.	.000	supported
H6	Wide use of Enterprise Instant Messenger leads into a better decision-making efficiency.	.000	supported

As reported in Table 4-7, out of 6 hypotheses drawn from the initial research model, one hypothesis was dropped due to low reliability, and five hypotheses were supported, while Hypothesis 1 were rejected.

CONCLUSION

Research Result And The Implication

This study examined the factors that affect the use of corporate messengers, which are nowadays widely used in companies, governmental offices and public agencies, and the effect of messenger use on the efficiency of decision-making process.

The findings of this study can be summarized as the followings:

First, perceived usefulness of corporate messengers have a significant effect on the use of corporate messenger. That is, as people realize usefulness, the use of messenger increases.

Second, social influence for the use of corporate messenger has a significant effect on the use of corporate messenger. It implies that in order to use the EIM, a critical mass should be established. In addition, a widespread positive perception on EIM among group members and high-ranked worker' proactive uses should be prevailed.

Third, the external orientation of organizational culture also had a significant effect on the use of corporate messenger. It means that an external-oriented organization is highly likely to select the more flexible and efficient communication media such as EIM due to the pressure from changes of external environment and the aggravation of competition, and the hypothesis was empirically confirmed.

Fourth, the use of corporate messenger was found to have a significant effect on the efficiency in the decision-making process. This means that corporate messenger enhances the efficiency in an individual's decision-making.

Lastly, it was found that perceived ease-of-use on corporate messenger did not have a significant effect on the use of messenger. The results of the survey showed that most respondents gave high scores on the easiness to use a messenger. That is, regardless of their actual use of corporate messenger, people think it is easy to use a messenger, which is interpreted as not having a significant effect on the use of corporate messenger.

Many companies have prohibited using a generic commercial messenger at work because of security issues like computer virus and information leakage. As an alternative, corporate messengers are introduced and many companies have actively adopted to take advantage of this newer media. In actuality, most companies have linked messengers to the existing infrastructure such as KMS or intranet, reinforcing messenger functions. While these corporate messengers are not much different in terms of their functions, use and performance of messengers considerably varies; so, this study attempted to examine the factors that affect this variance in the use and the effects of using a corporate messenger.

Considering its findings, the study suggests the followings.

First, unlike generic messengers, corporate messengers are the communication media officially recognized by organizations. Usefulness of EIM must be proactively educational through a few realistic example cases.

Second, one of the findings regarding the importance of social influence variable would have an important insight. Communication forms a network and as the size of user groups for the network is bigger, benefits one can gain from the medium also increase. And this is the network effect. This study indirectly proves that: When an organization implements a corporate messenger as communication media, the use of corporate messenger is promoted intensively at the early stage, and when the number of users reaches critical mass, the use of messenger rapidly spreads due to network effects.

Third, another finding that an external-oriented organization actively utilizes a messenger demonstrates that corporate messengers are competitive communication media appropriate for organizations that have fierce competitions and fast changes absorbing the necessary external information and sharing them internally.

Fourth, this study has presented an empirical finding on the outcome of widespread use of EIM by showing that the use of corporate messenger could process tasks speedily through reducing the time to obtain and distribute information and support making decisions efficiently.

In conclusion, an effective, wide use of EIM can be an unknown competitive advantage for a company of user creational contents.

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SUCCESS FACTORS FOR WEB APPLICATION DEVELOPMENT RESEARCH FINDINGS FROM THE INITIAL PHASE

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ABSTRACT

This paper reports the research findings from the initial phase of a research project for success factors of Web application development. From the initial sample data we collected, multiple regression analyses show that among the 100 independent variables, the following six factors significantly affect the success of Web application development: (1) computing infrastructure effectiveness, (2) end users' feedback about functionality, (3) creative brief or concept creation as a development phase, (4) operations and business process design as a development phase, (5) activity diagram as a development tool, and (6) political reasons. A preliminary path analysis indicates the following significant chain relationships: (1) "computing infrastructure effectiveness" affects "success of Web application development" via the moderator variable of "Web modeling language as a methodology", (2) "end users' feedback about functionality" influences "success" via "creative brief or concept creation as a development phase" and "operations and business process design as a development phase", and (3) "political reasons" determines "success" via "Web modeling language as a methodology" and "activity diagram as a development tool".

Keywords: Web application development, development methodologies, documentation tools and techniques

INTRODUCTION

This research project defines a Web application as a software system that relies on the Web as its interaction medium with the end users to create, exchange, and modify data for transaction requirements. This research project has three objectives. First, identify the methodologies, techniques, and tools being used by practitioners to develop Web applications. Second, identify the problems encountered by practitioners when they use existing methodologies, techniques, and tools for Web application development. Third, develop new methodologies, techniques, and tools to overcome the existing problems experienced by Web developers. Methodologies for application development are defined as the step-by-step procedures to carry out the development activities consisting of different phases in a system development life cycle. A methodology has its own assumptions about the reality, techniques to support working principles and enforce discipline, and tools to generate the deliverables for activities. In other words, there are a collection of techniques and tools for a certain development methodology. As Web application development is different from traditional information system development in terms of user recognition, user environment, communication control, testing requirements, and functionality design, existing methodologies for information system development may not well suit for Web applications. What are the methodologies being used by practitioners to develop their Web applications when there are no solid guidelines? Are practitioners using some heuristic methods developed by themselves, some modified methodologies from the literature, or not using any methodologies at all? It is the above question that provides the first objective for this research study. The second objective follows the first research question. If practitioners are using some methodologies for Web application development, are there any problems? What are those problems? How do those problems affect Web application development? What do practitioners need in order to solve those problems? The findings to the first two research objectives in this study will provide input to the last research objective, which is to develop a comprehensive methodology and its associated techniques and tools that can support an effective and efficient Web application development life cycle. This paper does not cover all the research questions but reports the findings from the initial sample data set we have collected.

LITERATURE REVIEW

There are four research directions in the literature for Web application development, namely, development life cycle, documentation tools, special issues such as security and accessibility, and Web services as imported components in a Web application. Table 1 (omitted) summarizes the research results from selected studies for the direction of development life cycle. Table 2 (omitted) summarizes the research results from selected studies for the directions of documentation tools, special issues, and Web services. The literature review indicates that practitioners and academia in Web application development are not exchanging their experience and ideas. While some studies recognize the importance of methodologies in Web application development, they have the following limitations. First, most research projects in the literature have conceptual model building as their objectives, which fall short of empirical verification. Second, all research projects with empirical evidence are case studies, which provide specific knowledge only for theory building. Third, the discussion on methodologies is on the conceptual level rather than the implementation level that incorporates the utilization of techniques and tools. Findings from this research project can fill the above knowledge gap in the literature.

THEORETICAL RESEARCH MODEL

Figure 1 depicts the theoretical model for this research project. We hypothesize that company characteristics, evaluation factors for Web application development, adoption factors for methodologies/tools/techniques, and failure factors for Web

application development affect the importance of different methodologies, development phases, tools, and techniques for Web application development, which further determine how successful Web application development is in a company. Methodologies, development phases, tools, and techniques are considered as moderator variables in our research model. The ultimate dependent variable is SR, the successful rate of Web application development. The definitions of all variables for each factor group can be found in the questionnaire in Appendix I. For example, there are seven variables AF1 – AF7 for the adoption factors for methodologies, tools, and techniques including improve overall quality of applications (AF1), improve maintainability of applications (AF2), improve management of development process (AF3), improve team member communication (AF4), improve communication with end users (AF5), reduce cost (AF6), and reduce development time (AF7). In this paper, because of the sample size, we cannot test the full structural equation model. Instead, we select some significant variables from each factor group to test the path analysis model as shown in Figure 2. The purpose of carrying out the initial analyses in this paper using the preliminary sample is to test the validity of the research model and also to fine tune the questionnaire based on the preliminary findings.

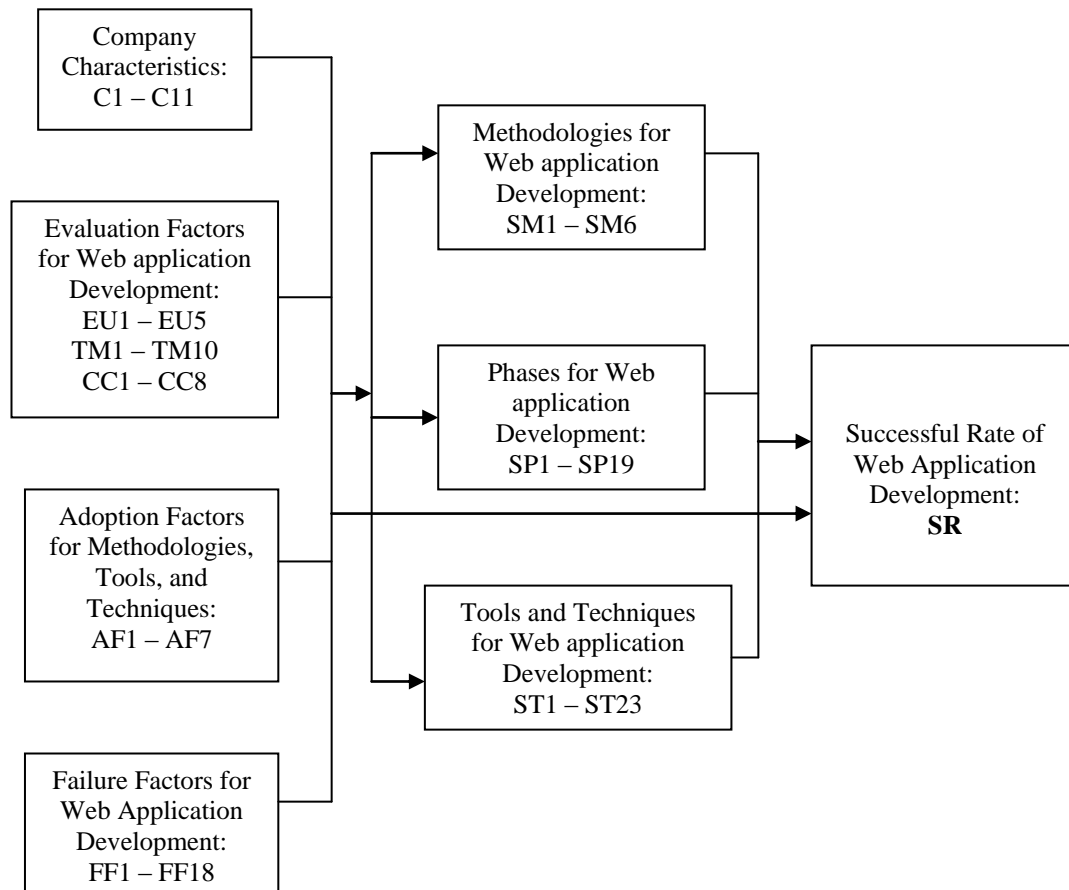


Figure 1. Theoretical Research Model

RESEARCH METHODOLOGY

We developed a preliminary questionnaire based on the research model. The preliminary questionnaire was submitted to 10 Web developers for pretest. Feedback from pretest was used to revise the questionnaire in terms of meaning clarification, format change, re-ordering questions, and question addition. The final questionnaire is given in Appendix I. A sample of about 5000 potential respondent contacts was collected from several Internet database brokers. The sample includes Chief Computing Architect, CIO, VP for eBiz/Internet, VP for IT, VP for Network, VP for Quality Assurance, VP for Software Development, Director for eBiz/Internet, Director for IT, Director for Network, Director for Software Development, Manager for Quality Assurance, and Chief Technology Officer. Basically, we included contacts who involve in any phases of Web application development. The questionnaire was delivered via an Internet survey company.

During the initial phase of data collection, we sent out email invitations to 1500 contacts in our sample requesting their participations in the survey. To provide incentive for participation, the invitation email mentioned that \$10.00 will be donated to charity organization for each of the first 100 completed surveys. We received 116 responses out of which 51 are completed and usable. The response rate for usable surveys out of the 1500 invitations is 3.4%. One objective of carrying out the initial phase is to determine the response rate. If it is low, we will try to revise the questionnaire according to the response patterns as well as initial analysis results for correlation and significance. The response rate of 3.4% is lower than our expectation of 5% - 10%. We noticed that about half of the respondents who did not finish the survey completed about 1/3 of the survey, and the other half completed about 2/3 of the survey. There was a higher response rate from "Officer" and "VP" contacts than from

"Director" or "Manager" contacts. About 80% of the completed surveys are from small to medium companies. In order to obtain a higher response rate and a more balanced sample in terms of company size and respondents' job positions, we will do the following for the next phase of data collection: (1) obtain more contacts from large companies; (2) move critical questions such as successful rate of Web application development, importance of methodologies, tools, and techniques toward the beginning of the survey; and move descriptive questions such as company revenue toward the end of the survey; and (3) delete questions which are highly correlated with others such as number of employees, annual sales, annual profit in your company; average cost for developing a Web application, the total number of Web applications developed, and the total number of Web application being used.

For the initial sample of 51 completed cases, we used four pairs of variables to check the reliability of respondents' answers, including TM1 (development team members' feedback about functionality) and TM8 (development team members' feedback about how well the system performs required tasks), CC6 (whether the application is maintainable) and AF2 (improve maintainability of application), CC5 (whether the application delivers the overall quality as expected) and AF1 (improve overall quality of applications), and CC3 (whether the application is delivered within the approved timeline) and CC8 (whether different deliverables are on time). We first checked the difference along the seven-point Likert scale for the two variables in each pair. Any difference of 3 points or more will be flagged. If a respondent has 2 or more flagged pairs out of the 4 pairs, we deleted that respondent from our sample. Using the above procedure of reliability checking, we deleted one respondent from the initial sample yielding a total of 50 respondents in the final sample.

In order to carry out the full structural equation modeling, according to the rule of thumb of having 10 respondents for each variable in a factor, we will need at least 230 respondents since the "largest" factor is "Tools and Techniques for Web Application Development" that has 23 variables of ST1 – ST23. Though we cannot perform the full structural equation modeling for our initial sample of 50 cases, we adopted a multi-step analysis procedure as follows.

Step 1: We used multiple regression analysis with the backward method to identify significant predictors in each factor group (as shown in Figure 1) for the dependent variable of Web application development success.

Step 2: All significant variables identified from Step 1 were entered into a final regression model. This step generated the final list of significant predictors.

Step 3: Using the most significant variables we obtained from Step 2 above to represent factor groups respectively, we developed a path analysis model as shown in Figure 2. Though SM4, importance of Web modeling language as a methodology, is not a significant predictor from Step 2, we added that to the path model to check its moderating effect. To specify the model, we assigned the regression weight of 1 to the error terms e1 – e5 for SM4, SP1, SP7, ST9, and SR in the path analysis model.

Table 3. Multiple Regression Results for Predicting Success Rate for Web Application Development (SR) Using the Backward Analysis Method

All Predictors for Analysis	Predictors in Final Model	Standardized Coefficients	Beta Sig.	Model Sig. for F	Adj. R ²
C7 – C10	C10	0.3	0.034	0.034	0.071
EU1-EU5, TM1-TM10, CC1-CC8	EU1	0.385	0.006	0.006	0.13
SM1-SM6	SM4	-0.302	0.033	0.033	0.072
SP1-SP19	SP1	0.387	0.005	0.001	0.243
	SP7	-0.263	0.059		
	SP18	0.379	0.006		
ST1-ST23	ST1	-0.339	0.034	0.036	0.144
	ST9	0.316	0.038		
	ST16	-0.25	0.087		
	ST21	-0.262	0.089		
	ST23	0.292	0.063		
FF1 – FF18	FF12	-0.282	0.047	0.047	0.06
AF1 – AF7	No AF variables are significant in predicting SR.				
C10, EU1, SM4, SP1, SP7, SP18, ST1, ST9, ST16, ST21, ST23, FF12	C10	0.248	0.037	0	0.369
	EU1	0.381	0.005		
	SP1	0.259	0.044		
	SP7	-0.267	0.04		
	ST9	0.24	0.055		
	FF12	-0.332	0.01		

INITIAL RESEARCH FINDINGS

The research results for Step 1 are given in Table 3. There are no significant variables from the adoption factor group (AF). In the final regression model, C10, EU1, SP1, SP7 (-), ST9, and FF12 (-) are significant predictors. The final model is highly significant at the p-level of 0 and adjusted R square of 0.369. C10 is an organization's computing infrastructure effectiveness, which has a coefficient of 0.248 in the regression model affecting Web application development success. EU1 is the importance of end users' feedback about functionality, which has the largest coefficient of 0.381. SP1 has a coefficient of 0.259 representing the importance of the development phase creative brief/concept creation. ST9, with the coefficient of 0.24, is the importance of activity diagram as a development tool. SP7, the importance of operations and business process design as a development phase, has a negative coefficient of -0.267. FF12, the importance of political reasons as a failure factor for Web application development, has a negative coefficient of -0.332.

Figure 3 shows the analysis results from Step 3 using AMOS, revealing the significant paths for the path analysis model in Figure 2. The path analysis statistics for regression weights and model fitness are provided in Table 4. The CMIN, NFI, CFI, and RMSEA all indicate that the path analysis model is highly significant and has good model fit. The standardized direct effects, standardized indirect effects, and standardized total effects of variables are also shown in Table 4. The path model reveals that C10, EU1, and FF12 all have direct and indirect effects on SR.

The effect chain for C10 is: the higher the computing infrastructure effectiveness, the less important the Web Modeling Language as a methodology; the more important the Web Modeling Language as a methodology, the less success for Web application development; and the higher the computing infrastructure effectiveness, the more success. Computing infrastructure effectiveness stands out among all company computing characteristics as a significant variable for Web application development success. Its negative relationship to Web Modeling Language as a methodology is interesting. It may imply that if a company has effective computing infrastructure, formal methodology does not have much a role in successful Web application development. That echoes how practitioners do not use formal methodologies advocated by academia. Instead, practitioners may rely on effective computing infrastructure to facilitate their Web application development activities.

The effect chain for EU1 is: the more important end users' feedback about functionality for evaluation of Web application development success, the more important the creative brief/concept creation and operations/business process design as development phases; the more important the creative brief/concept creation, the more success; the more important the operations/business process design, the less success; and the more important end user's feedback about functionality, the more success. The positive association of end users' feedback about functionality to creative brief/concept creation and operations/business process design as development phases are intriguing. Creative brief/concept creation, as a unique phase in Web application development, certainly claims its importance in Web application development success. There seems to be the following message: when we start to develop a Web application, its unique presence on the Web as a concept or idea must be defined or created for its enduring success. The negative relationship between operations/business process design and success is puzzling. It can be due to the fact that our sample consists mainly of small or medium companies. Since small or medium companies do not have great deal of complicated business processes to handle, they do not show their importance in our initial sample. We will check whether this negative relationship persists in the full model from the complete data set in the future.

The effect chain for FF12 is: the more important the political reasons as a failure factor for Web application development, the more important the Web Modeling Language as a methodology and the more important the activity diagram as a development tool; the more important the Web Modeling Language, the less success; the more important the activity diagram, the more success; and the more important the political reasons, the less success. The phenomenon of political reasons as an important failure factor being associated with Web Modeling Language as a methodology as well as activity diagram as a development tool may have significant practical meaning. It may mean that methodologies and development tools are more used to deflect or solve political problems during Web application development process in organizations rather than because of their real practical values. This speculation has to be confirmed in the full data set we will collect in the next stage.

CONCLUSION

This paper reports the research findings from the initial phase of a research project. From the initial sample, we identified a significant path model showing computing infrastructure effectiveness, end user's feedback about functionality, and political reasons as the exogenous variables influencing Web application development success through the moderator variables of Web Modeling Language as methodology, creative brief/concept creation and operations/business process design as development phases, and activity diagram as a development tool. The most influential variables are end users' feedback about functionality and political reasons, which have path coefficients of greater than 0.3. The initial findings alert academia to pay attention to the relevance of methodologies and tools. Among all the UML diagrams developed by academia, it seems that only activity diagram has gained a foothold in practice. Web Modeling Language, the only significant one among all formal methodologies proposed by academia, actually has a negative impact on Web application success. Though the findings are based on a small

sample, they may carry significant meanings. The next phase of collecting the full data set for a complete structural equation model will provide further evidence for analyses.

Table 4. Statistics for Path Analysis

Regression Weights: (Group number 1 - Default model)

	Standardized Estimate	Estimate	S.E.	C.R.	P
sm4 <--- c10	-.228	-.393	.231	-1.700	.089
sp1 <--- c10	.094	.125	.177	.708	.479
sp7 <--- c10	.085	.133	.206	.644	.519
st9 <--- c10	.001	.001	.265	.004	.996
sm4 <--- eu1	-.121	-.316	.349	-.906	.365
sp1 <--- eu1	.348	.703	.267	2.632	.008
sp7 <--- eu1	.359	.844	.310	2.718	.007
st9 <--- eu1	.036	.107	.399	.269	.788
sm4 <--- ff12	.236	.244	.138	1.767	.077
sp1 <--- ff12	-.115	-.092	.106	-.869	.385
sp7 <--- ff12	.097	.090	.123	.737	.461
st9 <--- ff12	.342	.403	.158	2.552	.011
sr <--- sm4	-.195	-.110	.060	-1.818	.069
sr <--- sp1	.280	.203	.079	2.581	.010
sr <--- sp7	-.261	-.162	.068	-2.396	.017
sr <--- st9	.256	.126	.053	2.389	.017
sr <--- c10	.195	.189	.101	1.867	.062
sr <--- eu1	.338	.495	.168	2.939	.003
sr <--- ff12	-.282	-.163	.064	-2.533	.011

Chi-Square Measure Fit

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	27	4.847	9	.847	.539
Saturated model	36	.000	0		
Independence model	8	65.691	28	.000	2.346

NFI and CFI Measure Fit

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.926	.770	1.073	1.343	1.000
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA Measure Fit

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.000	.000	.091	.890
Independence model	.166	.114	.218	.001

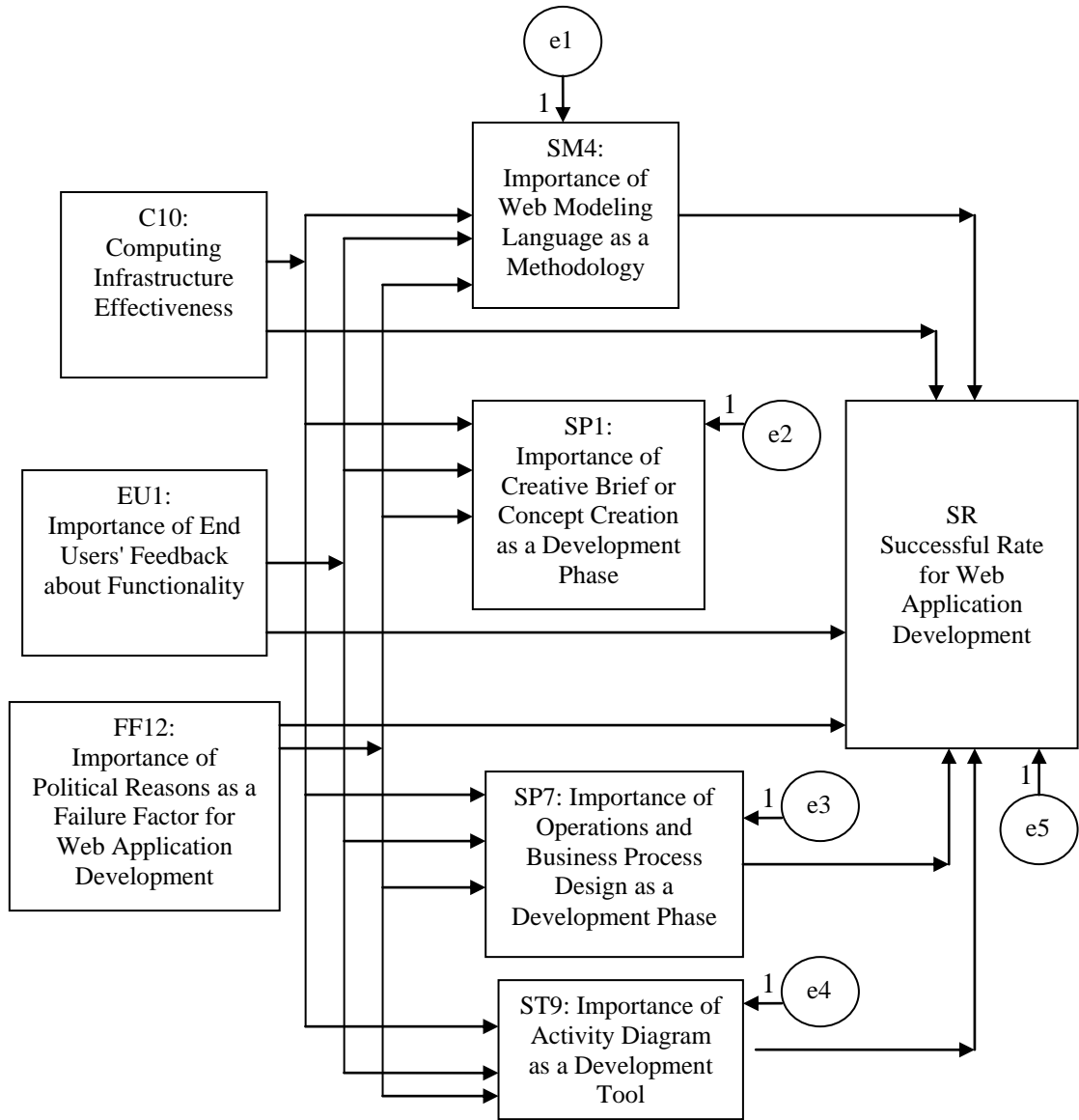


Figure 2. Path Analysis Model for Web Application Development Success

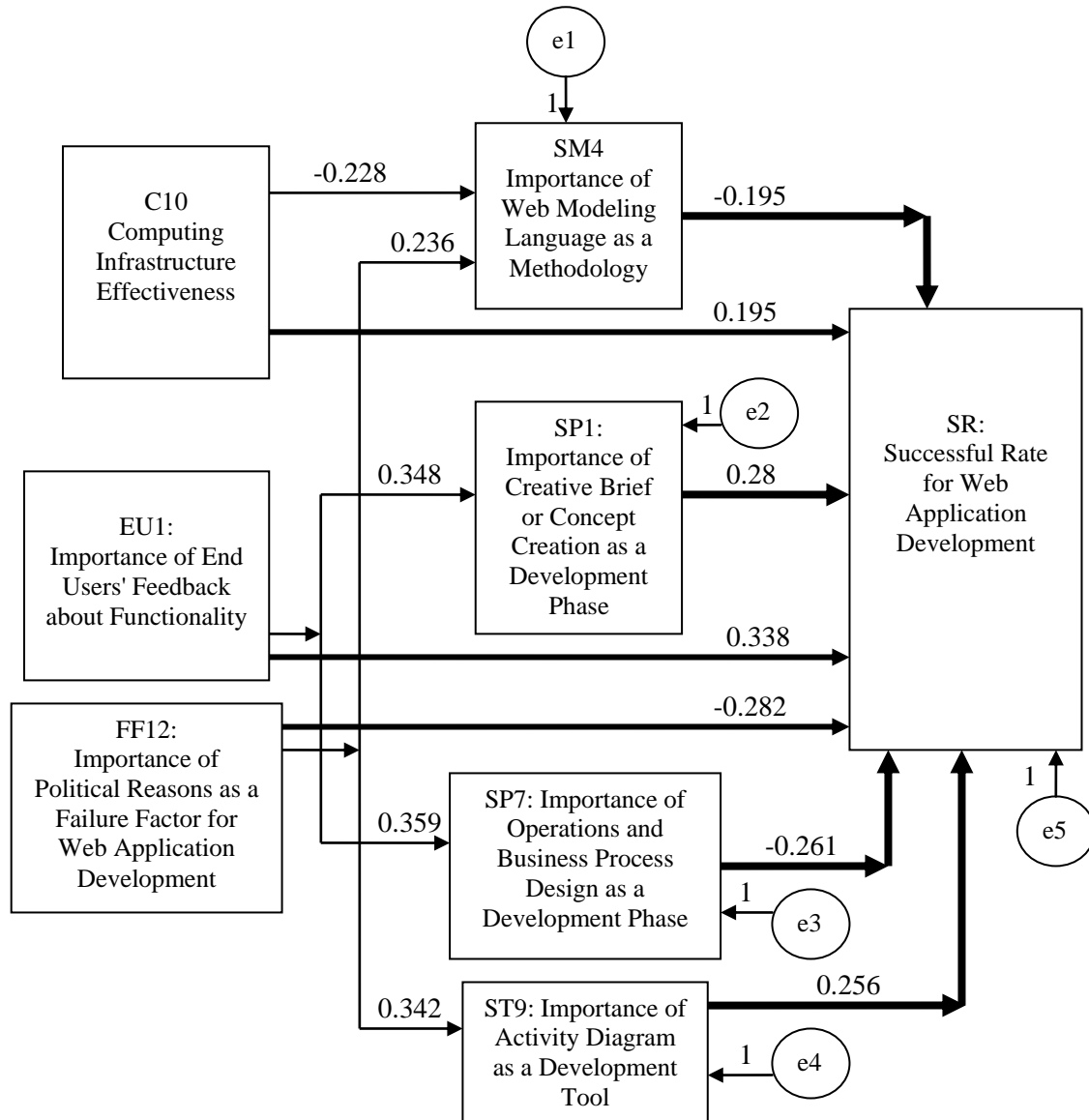


Figure 3. Significant Paths for Web Application Development Success

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DEVELOPING STRATEGY MAPS FOR THE FORMULATION OF DIGITAL DIVIDES STRATEGIES

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ABSTRACT

Prior investigations commented that almost no country is completely ready to bridge digital divide due to the absence of the balance between strategizing, coordination and action. In the e-government sector, the links among strategic objectives, action plans, and performance measures related to strategies for reducing digital divides had been constantly overlooked. This paper aims at adopting and combining the concepts of strategy map and the balanced scorecard to fill up the absences. A generic model of digital divide strategy maps is presented and the steps of developing strategy maps are illustrated in detail as well.

INTRODUCTION

As the internet dominates most of the activities of human lives, governments and businesses have tried their best to take advantages of the advanced information and communication technology (ICT) to offer better services as well as to improve the service qualities. On the other hand, accompanying with the fast ICT development, side effects also emerge from phases of economic, social and even political developments and operations. Governmental policy towards digitalization might provide more opportunities for citizens to access digital equipments and contents, but in the meantime, it might also widen the digital gaps among social groups in accessing and utilizing ICT environment and applications [23]. The literatures have indicated that the development of digitalization and the generation of digital gaps are in the contrary manners [12][23][29][31][32]. For specifying digital gaps, the term Digital Divide (DD) refers to the inequality of each individual or party sharing the benefits from digitalization [25].

In fact, investigation commented that almost no country is completely ready to bridge DD due to the absence of the balance between strategizing, coordination and action [2][4][30]. Ambiguous strategies coupled with the independence of the strategies and actual actions will make the efforts towards reducing DD more difficult, and the success of converting digital divide into digital opportunity will surely be stalled. In order to mesh the objectives, actions and finally the performances with strategies, adopting or adapting suitable strategic management approach for directing the strategy formulation and performance evaluation processes is essential. Moreover, the lack of an appropriate strategic management methodology in the public sector is another reason why DD strategic efforts have often been hung back in practice.

Aiming at filling the literature absence, we adapted and integrated the balanced scorecard (BSC) and the strategy map methods to form an effective platform for DD strategic management. The balance scorecard has been considered as effective approaches for strategic management [9] and has emerged its successful implementations in the public sector [1][18][19][20]. To illustrate the logics of the strategies in a simple and understandable way, building the strategy map is the most significant step on developing the BSC. The BSC then complements the strategy maps by providing the targets, initiatives, and measures to gauge success on the strategic objectives [24].

The rest of this paper is organized as follows. Section 2 reviews the concept of strategic management, the BSC, and the strategy maps. In addition, we explain why the BSC and the strategy map are integrated to form the platform for redeeming DD strategies. Section 3 describes the steps for developing DD strategy maps. The models generated from each step are considered the generic models. In section four, the models are applied to Taiwan. The last section contains summaries and concluding remarks.

LITERATURE REVIEW

The Strategic Management

The purpose of strategic management is to harmonize all resources regardless of tangible or intangible, financial or non-financial, human or material assets. Strategic management should involve not only an effective strategic planning system but also strategic thinking [21], and strategic thinking should precede strategic planning [11]. Moreover, the actual implementation of strategies and the evaluation of strategy effectiveness are believed to be the momentum and passage a business/organization move toward achieving its goals [3]. Thus apparently, strategic management consists of four important phases including strategic thinking, strategic planning, the execution and the evaluation of strategy performances. Strategic thinking envisions the future and aims at discovering the paths that will lead to the future ends. Strategic thinker is always thought to be more inventive and creative. Whether a strategy is effective or not is determined by its relevance to the issues that are to be dealt with. To ensure the qualities and effectiveness of the strategies, the strategic thinker should probe into the issues omni-directionally. Basically the concept of strategic planning is to help management specifying strategic objectives effectively, formulating strategies, and allocating

resources for those formulated strategies. It was expected to improve the outcome of strategic thinking and to specify strategic objectives as well as to develop actionable plans [11].

Regarding the development of strategies for minimizing digital divide, the missions and activities of DD related strategic planning should be extended in several ways. First of all, the scopes and models of DD assessment should be fully specified, which was identified as one of the shortcomings in the previous DD research works [30]. Secondly, the perceptions and expectations of citizens, customers, employees, businesses, and government agencies, as well as the avenues to improve the organizational and national learning for reducing DD should all be considered. Thirdly, DD strategy planners should fully understand the actual objectives of each strategy and establish the cause-and-effect relationships among strategic objectives and action plans. In the final two steps, major tasks are to implement and to evaluate strategic plans.

Earlier strategic management techniques emerged different shortcomings. For example, Hoshin, developed in the mid-1960s and later evolved into total quality management (TQM), were either more financially or process oriented [8]. [22] indicated that the institutional research and radical learning approaches were lack of stability and cohesiveness in performance measurement; the multidimensional stakeholder approaches were not linked to long-term performance aspects and to strategic priorities and objectives as well. The SWOT (strength, weakness, opportunity and threat) focuses on the process of the formulation of strategies and does not serve sufficiently establishing the interrelationships among strategies.

The Balanced Scorecard

The BSC was first introduced by Kaplan and Norton in 1992. It then has been recognized by industries and governments as one of the most adopted tools in introducing process reengineering and pursuing organizational competitiveness [6][7][10][28]. The BSC, when used in the business domain, contains four controllable perspectives, including financial, customer, internal process, as well as learning and growth. In the beginning, the BSC was thought to be a new performance measurement system, only its views were multifaceted. Kaplan and Norton argued that the BSC is by no means a substitution for an organization's existing measurement system, but should be deemed a new strategic management tool for translating strategies into results [14].

Niven explained, and might be the most proper illustration, that the BSC was indeed covering three subjects, namely the measurement system, the strategy management system, and the communication tool respectively [24]. Moreover, the BSC is characterized by (1) its clarification of the strategies and consistence of agreement, (2) its opportunities to broadcast and communicate the vision of the organization, (3) its parallelism between the strategies and the organization or individuals goals, (4) its cooperation with the budget and non-financial goals of an organization, and (5) its valuable feedbacks obtained from a continuous reviewing process [26]. These characteristics are equally meaningful when the BSC is applied to the business or the public sectors.

Kaplan and Norton found in their research that, although most non-profit organizations or governments always documented their strategies well, they did not fully understand how and what they were able to achieve [16]. This same problem is also shown in the efforts of reducing digital divide. In other words, showing the links between strategic objectives, actions, and finally the performances of DD strategies remain as a challenge to all DD related policy makers and researchers.

The Strategy Maps

Strategies are in fact the hypotheses of causes and effects. Each strategy has its own objectives and the strategy is to be translated into real actions to accomplish these goals. As causalities are clearly explained, the strategies can be carried out smoothly [14]. The strategy map specifies cause-and-effect relationships between organization's present positions and desirable future positions [15]. It aims at linking all potential activities together to achieve the visions and missions of the organization [13]. The purpose and the imprints of strategic thinking can then be found upon developing strategy map. In addition, the effectiveness of strategic management is usually finalized by examining the outcomes of a performance measurement system. Adopting the strategy map can be expected to help ensuring the tightly relations between identified performance indicators and proposed strategies.

Although the applications of the BSC are varied in the literatures, the steps to develop strategy maps can be summarized as follows [17][24][27]:

1. Identifying visions and missions. The visions illustrate the future position of the organization. The missions indicate what the organization bears in order to achieve the visions.
2. Identifying key success factors (KSFs). Based on the visions and missions, the next process should then involve identifying critical success factors to guide the organization making proper endeavors, and to ensure the achievement of future organizational goals. The KSFs that aim at similar targets are further grouped together.
3. Defining BSC perspectives. Once the key success factors are identified, the BSC perspectives can then be determined, named and defined to match the classes of the KSFs as well as to fit the divergence of the contexts.
4. Modeling chains of cause-and-effect. Cause-and-effect links are a series of if-then statements that explore all possible activities towards achieving the strategic objectives. The links are to be identified first within and then between the BSC perspectives.
5. Design strategy maps to show the cause-and-effect links among strategies.
6. Reviewing and refining strategy maps. At this stage, we ask questions such as: Are the strategy maps complete? Are the links seemed logical? Will the links lead to achieving the objectives? Are the links too complicate to understand? etc.

DEVELOPING STRATEGY MAPS FOR REDUCING DD

Identifying Visions And Missions

In order to identify the generalized vision and missions for bridging DD, this research collected and analyzed the secondary data. Visions and missions that were documented in the research papers, official reports of well-known international institutions as well as white papers of the outstanding countries in terms of their performances in the DD efforts are collected.

Recall that mission explains why an organization exists and in the meantime, mission leads all activities toward a more definite direction. Vision is, on the other hand, a brief statement which confines the mid-to-long term objectives of an organization within the extent of reasonable and understandable [14]. After analyzing the collected data, we notice that the missions for reducing DD could be grouped into four categories. Firstly, all the chosen countries and the international organizations have recognized that the major responsibility to bridge DD is to ensure the potent infrastructure of ICTs. For example, APEC asserted that environment for infrastructure investment and technology development should be facilitated; World Summit of Information Society (WSIS) takes the improvement of the infrastructure as its first mission; Japan and Korea tried to establish their profile in the international information industry by galloping the development of ICTs. Secondly, the missions guarantee that the IT infrastructure would be spread to every corner and each individual would have the accessibility to ICTs. For example, the report of the Bridge.org emphasizes the empowerment of the underserved populations with ICT; WSIS pays attention to the requirements and the needs of all users; one of the missions of Infocomm Development Authority (IDA) of Singapore is to empower the disabled, etc. Thirdly, most countries and the organizations consider that constructing a well-formed information society is also an important mission to bridge digital divide. The missions include “enhance human capacity building and promote entrepreneurship” (Bridges.org), “create digitally literal Europe” (EU), “enhance the education of information” (WSIS), “upgrade to a more enabling environment” (Japan) and “create good environments for innovative practices” (Sweden). Finally, the mission of bridging digital divide is also set to improve the competitiveness of a nation. For instance, APEC advises its members to create an environment for strengthening of market structures and institutions; OECD encourages the sharing of members’ experiences with the “new economy”; Korea wants to facilitate the market entry of tech companies in Southeast Asia; Demark promotes effective ICT markets via competition and innovation.

The four categories are in consistent with the integrated framework for analyzing domestic and international digital divide proposed by [30]. The framework consists of four dimensions namely ICT, equal opportunities, information society as well as national competitiveness, respectively [30]. In order to further categorize the missions into the four DD dimension, this research analyzes each of the mission. The approaches are first, each mission is parsed so that the mission statement is clearer and contains only one task. For example, the mission “Ensure consumer trust and strengthen social cohesion” is divided into two missions. We then compare the mission with the definitions as well as the criteria of the DD four dimensions.

By examining the missions compiled by this research, we notice that the governments are expected to utilize the ICTs in everyway to provide their people the equal opportunities to access to all the e-services, to benefit from digitalization and to leverage national capabilities and competitiveness. In conclusion, the missions of bridging digital divide are “to integrate ICT into society in an equal, effective, sustainable way to improve human lives, to advance the quality of the information society, and to gain more competitiveness”. The four dimensions are explicitly stated in the mission statement.

Unlike the for-profit organizations, the determinants of governmental success are not solely related to profits but to the ability of innovation, the ability to compete with other countries, the potential to make progress, as well as the ability to provide people with minimum requirements of life and better quality of services. Finally, this research concludes that the vision of bridging DD is to “form an information society that provides the real access to information; that is built with knowledge; that is filled with digital opportunities; that captures the benefits of new emerging economy and ultimately, the digital divide is bridged”.

Identifying Key Successful Factors

To identify the KSFs, this research collects all the factors, which have been documented or suggested in the literatures, in regard to their critical impacts on the success or failure of bridging DD. Finding and gathering KSFs would provide a comprehensive structure to examine the performances of an organization [28] and is one of the important procedures in architecting strategy maps [6]. Once the KSFs are determined, the organization has more definite objectives and knows what strategies should be initiated. The strategies are translated into actual action, the KSFs will monitor if the actions are on the right track and in turn, the actions will always master the KSFs and magnify the impacts of the KSFs and furthermore, to achieve toward the objectives.

However, during the analysis, although the objectives are listed, the mappings between the objectives and the KSFs are not clear. To redress the shortcomings, the KSFs are further analyzed and compiled. To establish the logic links between the KSFs and the DD dimensions, we regroup the KSFs based on the criteria defined in the DD four dimensions. We further notice that the objectives of the collected DD strategies are compendium and are difficult to actually mesh with the KSFs. This research fills up this gap by analyzing the objectives, comparing them with the missions as well as the KSFs and elaborates the objectives.

Defining Proper Perspectives And Their Contents

To reduce digital divide, governments have to comprehend the following themes:

1. Which group(s) should own the opportunities to benefit from digitalization?
2. What actions should government takes to magnify the opportunities?
3. How would government do to strengthen itself, and in turn, to initiate more respectable actions and projects.
4. What and how resources government should be integrated in order to support all the programmes.

To answer the first question, apparently civilians, businesses as well as the governments themselves are the groups that will be benefited from digitalization. They are referred as the “Beneficiaries”. The missions in this perspective indicate that the governments would take proper actions to advance the economy as well as to gain more competitiveness by taking advantages of the impacts of the development of ICTs. Secondly, the governments have to upgrade their functions and reengineer their processes to magnify the opportunities to succeed. Hence, the first purpose of the second perspective is to retain and excel governmental functions. The second purpose is to propose tactics that would promote and to leverage the performances of a government and in turn, to create advantages for beneficiaries to a better state [31]. This perspective is named “Governmental Functions and Processes”. A nation needs uninterrupted learning to retain its competitiveness. The third perspective is named “Nation-Wide Learning and Growth” perspective. This perspective provides governments the chances to retrospect their national capabilities and functional productivities so that the qualities of the ICT and the literacy of the society would be improved. Finally, the “Financial” perspective is always necessary whatever the application is upon applying the BSC. To support all the projects that will be taken to reduce DD, the missions include seeking for new resources, looking for international opportunities and integrating all the resources.

In summary, this research proposes four perspectives namely Beneficiary, Governmental Functions and Processes, Nation-Wide Learning and Growth, and Financial. In the issue of reducing DD, the governments or international organizations bear more responsibilities [3]. Therefore, the BSC is adapted to fit non-profit organizations and public sectors. In the non-profit organizations or public sectors, to provide the best services and gain the most interests for their customers are more essential than making profits. Hence, unlike the traditional BSC, the “Beneficiary Perspective” is elevated to the first level.

The next step is to initiate effective strategies for each perspective. The strategies should be critical [17], meaning that once a strategy is selected, it is expected to create substantial values [24]. In addition, although there might be hundreds of strategies, most of the strategies aim at the same purpose. Therefore, most of the strategies can be rephrased by a few strategic themes that are simple and easy to understand [5] and the name of the strategic theme always consists of a verb and a noun [24]. Based on the rules, this research first collects the famous actions that have been actually implemented by the aforementioned countries and international organizations. The objectives of these actions are analyzed and compared with the missions, KSFs, as well as the objectives of the KSFs to determine the appropriate strategic themes and the strategic objectives.

Table 1 integrates the results from each step and form a complete DD-BSC. The missions, strategy themes, strategic objectives as well as the KSFs are homed into the proper grid. Each of the DD dimension carries its missions; the missions drive the initiation of the strategies; each strategy has its strategic objectives and the strategy is implemented by appropriate actions to achieve the objectives; the performances however, are evaluated by the critical success factors. To conform to the constitution of the BSC, the DD dimension will not be shown in the DD-BSC framework in the rest of the research, nevertheless, by following the steps proposed in this research, it is easier to trace back of what the strategies are and how they should be carried out and be evaluated.

Modeling Chains of Cause-And-Effect And Constructing The Strategy Map

As stated before, strategies are the hypotheses of causes and effects, and can be expressed by a series of if-then statements. The if-then logics should be established before making the strategy map, and furthermore, the logics are identified both within and between the perspectives. [30] indicates that in the integrated DD framework, ICTs lays the foundation of the other three dimensions; and once the ideal of equal opportunities have been reached and information society is well formed, a nation will own more competitive advantages. Therefore, in the strategy map, ICTs strategies are placed at the lowest level of each perspective in the DD-BSC framework and the logics between strategic themes will be established accordingly and easily. The if-then logics of strategies within and across each perspective are described below:

Beneficiary perspective: If users are satisfied with the advanced infrastructures and new technologies, the governments would then ensure the diffusion of ICTs; thereby, information literacy will be upgraded and information content will be improved. Furthermore, a nation will have more confidence and opportunities to cooperate with other countries and establish partnership.

Governmental functions and processes perspective: If governments put more efforts on impetus new technologies, providing diversify services and amending market-based policies, they would foster the equity among societies and promote their own capabilities. In turn, the governments will build stronger administration, to transform into a leader and gain more competitiveness.

Nation-wide learning and growth perspective: If governments continue optimizing ICTs infrastructures and industries, they would be aware of its potential and opportunities. In turn, it would be easier to set benchmarks and take proper actions to revitalize IT and social structures as well as to provide overall opportunities. Surely, the merits of multilateral co operations will be doubled.

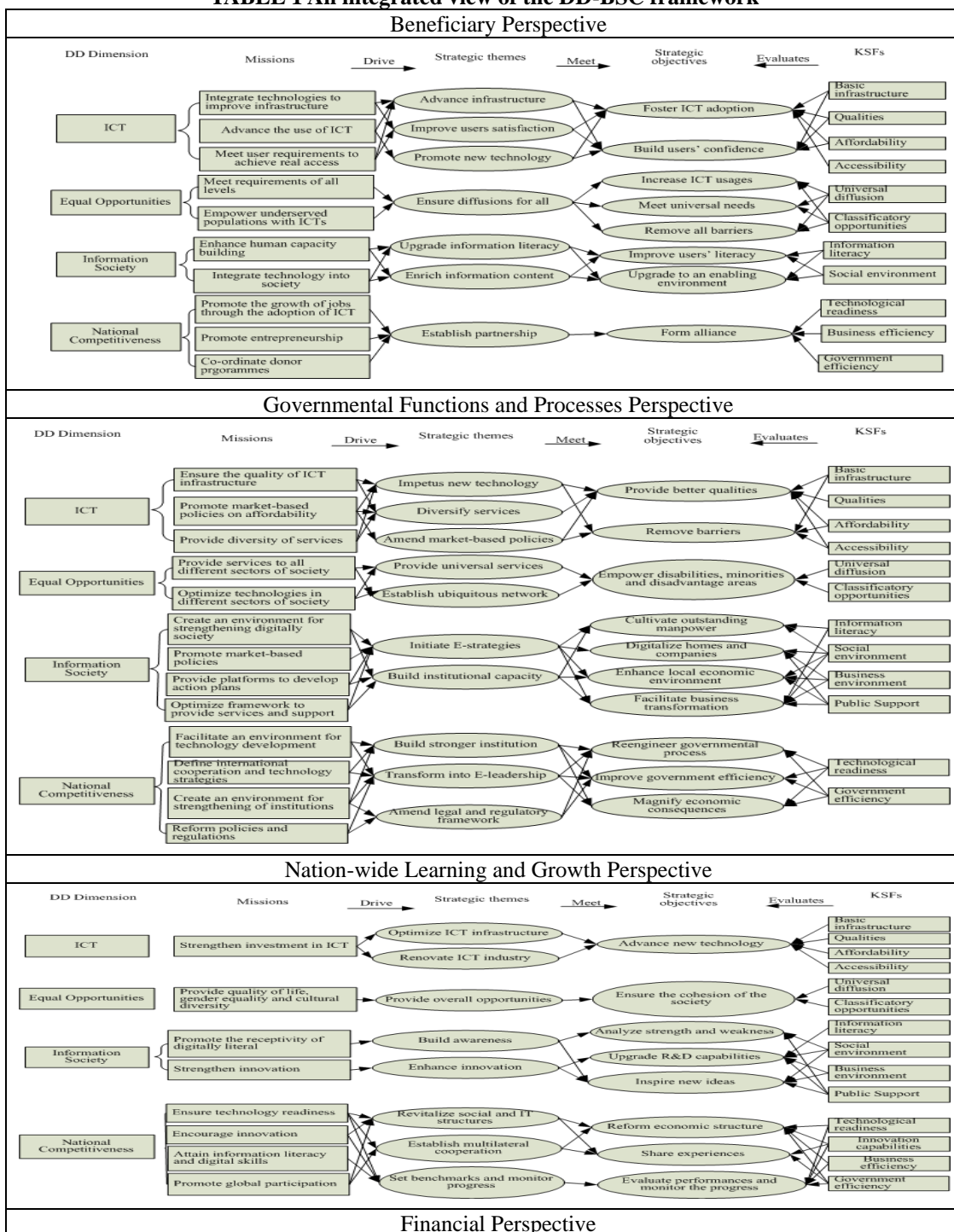
Financial perspective: If the governments could control budget and amend outmoded laws, it will smooth the promotion of and establishing incentive systems. They will also facilitate the implementation of reviewing pricing system, promoting international co operations and integrating resources. Eventually, the infrastructure would be upgraded to speed the entry to the market of the ICT industry and to accumulate the economic strength of the country.

Based on the if-then relationships, this research presents the strategy map as shown in figure 1. Figure 1 also demonstrates the if-then relationships across perspectives. Although we have referred to the four perspectives in the order of “Beneficiary”, “Governmental Functions and Processes”, “Nation-wide Learning and Growth” and “Financial”, “Financial” perspective is the first perspective to be explained while establishing the logical links between perspectives. Basically, all the strategies in each perspective certify the fulfillment of the missions of that perspective. The arrows at the right of each perspective indicate that if the strategies in a perspective are well performed, the perspective would support and smooth the implementations of the

strategies at the upper-level perspectives as well.

In addition, some of the strategies have direct effects on the implementations of the strategies at the upper-level perspectives. For example, if the outcomes of “Initiate E-strategies” and “Build institutional capacity” in the “Governmental Functions and Processes” perspective are superior, it will expand the opportunity to “Establish partnership”. If “Impetus new technology”, “Diversify services” and “Amend market-based policies” in the “Governmental Functions and Processes” perspective are well executed, they will provide more advantages for beneficiaries on adopting the ICTs. If the governments are aware of “Provide overall opportunities” would ensure the cohesion of the society, the efforts they put would then upgrade universal services and provide more chances to establish ubiquitous network. “Building awareness” as well as “Enhance innovation” in the “Nation-wide Learning and Growth” perspective will smooth the implementation of “Initiate E-strategies” and “Build institutional capacity”. “Promote international cooperation” and “Reviewing pricing system” in the “Financial” perspective supply more power to implement “Provide overall opportunities” strategy in the “Nation-wide Learning and Growth” perspective as well.

TABLE 1 An integrated view of the DD-BSC framework



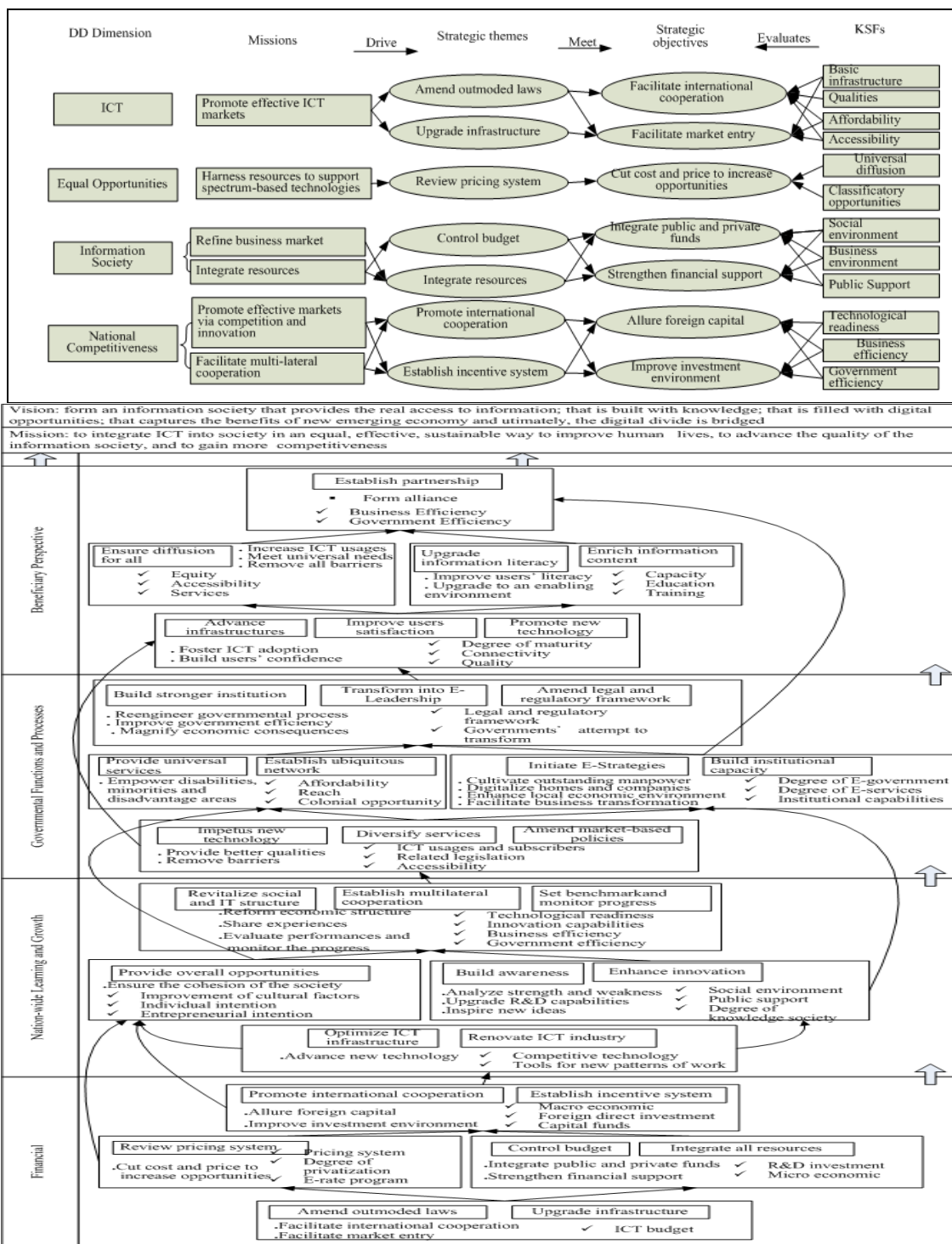


FIGURE 1 The generic model of DD-BSC strategy map

THE CASE OF TAIWAN

The outcomes generated from each step are considered general to all countries. A nation is suggested taking the generic models as the foundation and developing its own DD strategy maps. In the case of Taiwan, the four dimensions and the four perspectives in the DD-BSC framework are entirely applied to Taiwan. According to the Research, Development and Evaluation Commission (RDEC, Executive Yuan of Taiwan), the vision of bridging DD at Taiwan is to “Bridge digital divide, create digital opportunities”. We notice that the vision is already covered in the generic model. The mission documented in RDEC is the same as what has stated in the generic model, i.e. “to integrate ICT into society in an equal, effective, sustainable way to improve human lives, to advance the quality of the information society, and to gain more competitiveness”. Since the generic models are taken as the foundation, it is much easier to classify the strategies into a perspective. Figure 2 shows the links both within and between the perspectives. The oval indicates that the strategy “Evaluate performance” is specific to Taiwan and is not included in the generic model. After comparing the strategies, the objectives and the strategy maps of Taiwan with the generic models, the following facts are revealed:

1. Missing strategies. The ideal strategies are not found in the case of Taiwan. For instance, in the “Governmental Functions and Processes” perspective, strategy “Build stronger institution” is not documented.
 2. Specific strategies. The strategies are not listed in the generic model but are specific to Taiwan. For example, a merit system to review the performances of public servants has been in operation in Taiwan for years. The strategy “Evaluate performance” (represented by oval in figure 2) is listed in the “Governmental Functions and Processes” perspective.
 3. Objectives are not clear. For example, the objectives of the strategy “Set benchmark” in the “Nation-wide Learning and Growth” perspective indicate that although Taiwan has the same strategy as most of the other countries, the objectives in the generic model are not fully documented in the case of Taiwan. As a result, the government of Taiwan may overlook the problems and not to take proper actions in time.
 4. Specific objectives. The objectives are recorded in the documents of Taiwan and are specific to Taiwan. Such as “Provide E-services” of “Diversify services” in the “Governmental Functions and Processes” perspective.
- The strategies and objectives in the generic maps are extracted from selected countries and international organizations; they indicate the unified opinions in terms of reducing digital divide. Still, it will not be appropriate to conclude that the generic maps are thorough or the strategy maps of Taiwan are inadequate. Further studies will need to reexamine the strategy maps with more qualified approach.

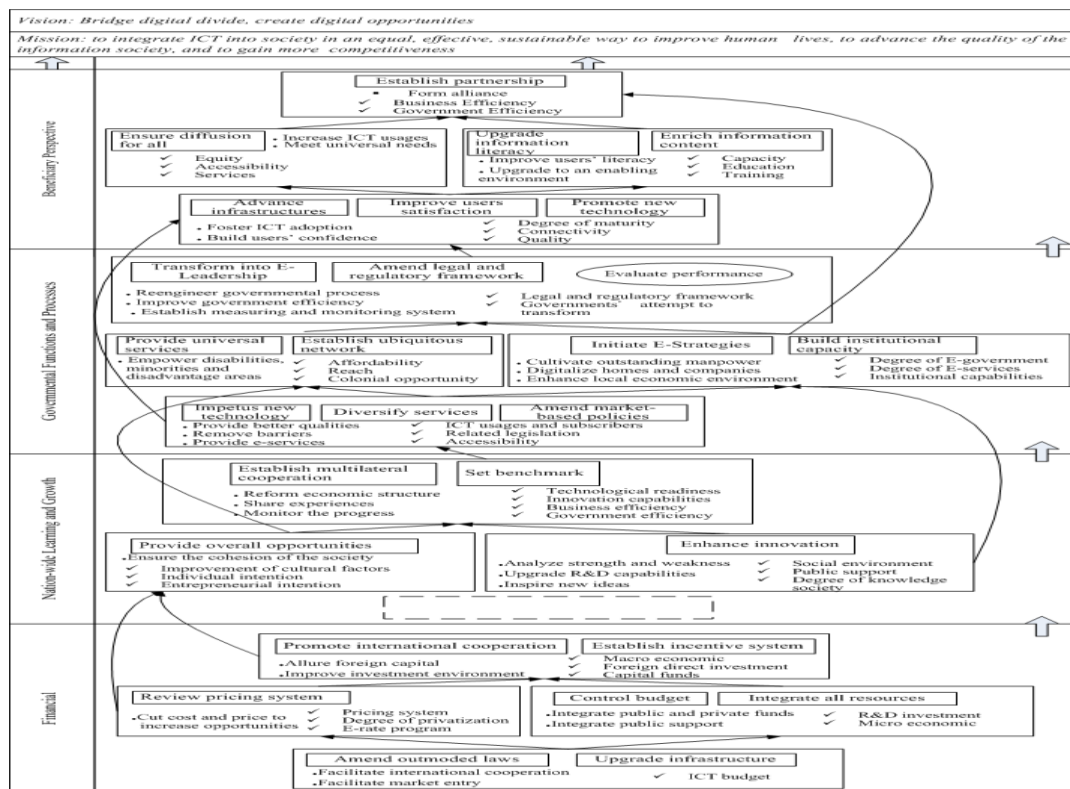


FIGURE 2 The strategy map of Taiwan

CONCLUSIONS

This research contributes the following findings of our work:

1. Research findings suggested that governments are conscious of the laggard improvements on minimizing digital divides and have tried to work towards achieving the targets set, however, the first stage failed to identify a clear vision and recognize what the missions are. This research analyzed the needs and the previous works of many countries and international organizations and declared the vision and missions of bridging DD with a statement that was brief but complete and easy to understand.
2. Although the strategies, the strategic objectives as well as the KSFs in the generic models were documented in the documents as well as the research papers this research collected, the linkage between strategies, objectives and the KSFs are not established. As a result, the government would double the efforts but gain the minimum returns. The results would not be evaluated properly and the major causes of failure would not be identified. This research closes the gaps by proposing the integrated view model of the relationships of vision, mission, KSFs, strategy and strategic objectives, and the strategy maps to show the cause-and-effect relationships between strategies within a DD-BSC perspective and across perspectives as well.
3. The actual application of the models generated in this research reveals two facts. First, the steps of the development of the strategy maps are presented in orderliness; they pave an unhindered and correct way for the government to develop their own DD-BSC and the strategy maps. Second, the generic models can be adopted as the contrast. Any missing strategy or flawed objective would be identified easily.

4. No matter in the generic or specific strategy maps, although the links were established, they were linked according to what had been done or had been documented. However, do the strategies cover the whole spectrum of DD? Are the objectives faithfully reflecting the real problems? The strategy maps emerge gaps both in the case of Taiwan and in the generic models. In this paper we adapted the BSC approach to link government strategies for reducing DD. The templates of strategy maps have been constructed to bridge the gaps between strategies and objectives. The ideas and results of this research contributes to the literatures and practices in several aspects including steering policy makers toward more logical thinking about strategic planning, to supply government a blueprint for governing the programmes of reducing DD; and to provide mechanism for examining and reevaluating the effects of DD strategies and projects. The research also conducted a case study based on the template of strategy maps. The purpose was to adapt the proposed strategy maps so that it would fit the actual status of Taiwan. The actual application showed that by following the steps and the generic models this research generated, it would be much easier and save a lot of time on developing the own DD-BSC for a nation. Nevertheless, as stated in the research findings, gaps might be concealed for various reasons. Proposing a powerful means to identify and evaluate the gaps, to adjust the strategies and objectives as well as to refine the strategy maps are in strong desire. Further studies will focus on constructing and presenting an acceptable tool to fill up the absences. In addition, how to transform the KSFs collected in this research into a measurement tool so that the performances of the strategies could be monitored and reviewed is another important lesson.

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APPLYING E-LEARNING TECHNOLOGIES TO TEACH COMPUTER PROGRAMMING: A CASE STUDY

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ABSTRACT

Recent developments in the quality of e-learning tools now made it a possible to integrate such technology into teaching programs to provide added value to the learning experience. This paper describes the experiences of Victoria University in adopting e-learning technologies to complement the teaching of SAP's ABAP programming language to students in Singapore. Computer programming still remains an important part of most Information Systems courses. The involvement of SAP relates to Victoria University integrating Enterprise Resource Planning (ERP) systems into their curricula and research programs through a strategic alliance with SAP. The SAP technical infrastructure facilitates the development of courses using Internet and e-learning technology.

To assist with the delivery of offshore ERP education an ERP e-Learning model has been developed that integrates synchronous and asynchronous content. Asynchronous e-learning does not involve the presence of a teacher. Typically the learning content is located on a web server that students can access using the Internet. Synchronous e-learning requires the learner and teacher to be present in the event at the same time. It is a real-time, instructor-led online learning event in which all participants are available at the same time and can communicate directly with each other. Recently a pilot was conducted using a synchronous e-learning tool to deliver several programming classes to students in Singapore. A successful evaluation of the pilot was conducted and it is planned to integrate web technology and synchronous e-learning sessions in a more permanent way to offshore courses.

Keywords: Enterprise Resource Planning Systems, e-learning, Application Service Provider, synchronous learning, asynchronous learning, virtual classroom.

INTRODUCTION

Computer programming still remains an important part of most Information Systems courses. However the emphasis today is on teaching programming concepts and style and using programming languages to support this objective. Most Information System courses include an introductory subject on basic programming concepts and basic problem solving. Educationalists believe that the language chosen should be based on its ability to convey enduring concepts and to demonstrate fundamental programming techniques [4]. Once students have grasped a basic understanding of programming concepts and techniques, such skills can be used as a basis to learning application development in its various guises from developing database applications using SQL to designing web applications using Java.

The Information Systems discipline has a business focus where information systems requirements are matched to an organization's objectives. It is important for students to realise the link between organizational objectives and application development, and IS curriculum should reflect this link. It is often difficult to extend a student's basic knowledge of programming techniques into a business setting. Providing a business environment would allow students to apply and extend their algorithm and problem solving techniques; however such environments are not usually available to university students.

SAP R/3 is a type of software classified as Enterprise Resource Planning (ERP) Systems software. ERP systems offer a solution that handles an enterprise's total information system needs in an integrated fashion. Such systems have seen a tremendous growth in the last decade in the US, Europe and Australian markets with emerging growth in the Asian region.

SAP is the leading ERP vendor with 70 percent of the market. SAP is the largest client/server and mainframe ERP software vendor. Over 400 companies in Australia use SAP. SAP has formed partnerships with universities around the world and part of that arrangement is the free provision of their software to universities for inclusion into their curriculum. Many universities have identified the value of incorporating ERP systems into their curriculum. ERP systems can be used to reinforce many of the concepts covered in the business discipline [2] [3]. The vendors argue that their products incorporate "world's best practice" for many of the business processes they support making them an ideal teaching tool [7].

SAP R/3 incorporates its own unique programming language called ABAP. ABAP is an event-driven fourth-generation language. It is a language that is constantly evolving with recent releases incorporating object-oriented capabilities (ABAP Objects). The robustness of the language is evident in the wide range of functionality and high performance capabilities within the R/3 system, allowing applications to process huge amounts of customer data [5]. SAP R/3 provides an environment rich in tools for developing business applications using the ABAP programming language.

While ABAP is not one of the universally used programming languages like C or Java, it is an excellent language to extend

students comprehension of programming concepts in a powerful business environment. Thus it is ideally suited to IS students.

USING E-LEARNING TECHNOLOGIES IN TEACHING ABAP PROGRAMMING

Teaching a programming language such as ABAP in the SAP R/3 environment does present both teaching staff and students with a number of difficulties. For staff there is the requirement for training, the long timeline for curriculum development and the management of student accounts and assessment. For students there are the difficulties of gaining SAP access and the initial learning curve in working in the SAP environment. We have addressed some of these issues by making use of some web-enabled technologies. There is a growing trend amongst academics to use the Internet to increase access to educational materials in a variety of ways to support the learning process [1]. Application Service Provision (ASP) enables access to the ERP system while the Virtual Classroom technology provides access to the curriculum.

Application Service Provision

An Application Service Provider is a third party service provider that supplies organizations with a complete solution to their computing needs [6]. Application Service Provision is a technology that provides the necessary technological infrastructure and support to host a particular software product. This enables the clients of the ASP to remotely access the software via the Internet. One of the barriers for our students was accessing our SAP system outside university class times and the university environment. The ASP model combined with the infrastructure of the Internet provides a solution to overcoming this barrier.

Victoria University has configured several of its SAP servers to support the role of an ASP and provide access to SAP, not only to local students but also students enrolled in our offshore program running in Singapore. Students can access the SAP software via the Internet once they have installed the SAPgui software on their local PC's. This means students can access SAP at their leisure to work on programming exercises and assignments without the need to physically attend the university computer laboratories.

Synchronous E-learning

Synchronous E-learning technology is Internet based and allows the two-way delivery of education in real time. Students are able to log into a virtual classroom based at Victoria University. They hear the lecturer's voice in real time while viewing lecturer controlled slides on their screens. If a student has a query, they can "alert" the lecturer via the Synchronous E-learning tool and the lecturer can then appropriately respond to the query. This two-way communication facilitates the interaction between the lecturer and student thus enhancing the learning process.

The technology allows lecturers to teach the necessary programming concepts and then demonstrate these concepts using the SAP system via the Synchronous E-learning technology. The lecture can also be recorded and replayed at a later stage, however this option does not support the advantages of two-way interaction. Once students have completed the lecture they can access the SAP system via the ASP to practice programming concepts that were covered in the lecture. This technology is most suited to distance learning and was the subject of a trial in an offshore program running in Singapore.

WebCT

WebCT is a learning management system used as a single point of entry for students to access online material and media. It is used to supplement face-to-face teaching. The tool allows students to view and download subject outlines, assignments, past examination material and lectures and to execute e-learning modules. Students can submit assignments via the tool and then view their results once the assignments have been marked. Teaching staff can interact with students via a discussion board and chat facilities to enable students to discuss set tutorial questions and discuss issues they have encountered. Staff can also communicate with students by direct email links and global email facilities.

SINGAPORE CASE STUDY

The Master of Business in ERP Systems is conducted by Victoria University in Singapore. Each subject in the program has 36 total contact hours of which 12 hours are delivered in person by the Victoria University lecturer travelling to Singapore and teaching in a condensed mode format over three days. The remaining 24 hours are delivered by a local lecturer in weekly 3-hour sessions.

To test the suitability of using a synchronous e-learning tool to complement the teaching of the ABAP programming subject to the Singapore class, two "live" events were conducted with students and an on-line evaluation carried out. The events programmed were a review of the second practical programming assignment and an exam preparation session. Each event was one hour in duration and attended by the 16 students enrolled in the programming subject.

The synchronous e-learning tool was facilitated by the Saba Corporation virtual classroom software called Symposium which provides the capability to deliver live, instructor-led classes direct to student desktops using fully integrated voice-over-IP technology. Lesson delivery includes integrated full-duplex audio, interactive whiteboards, application sharing, online surveys and evaluations. The technology allowed the events to be recorded for playback.

The first stage in using this technology involved the lecturer developing the lesson in Microsoft PowerPoint format and then loading it onto the appropriate Symposium server. The lesson was then scheduled and the details distributed to the students. To

access the lesson students require a PC with an internet connection and a set of headphones and microphone. After logging onto the server and the specified lesson a software wizard calibrates the audio settings.

The screen is divided into a number of components. The Media Window displays the PowerPoint slides while the Agenda window displays the all the slides in the presentation. The additional windows are used to identify the presenter and other participants in the lesson. As the presenter conducts the lesson and progresses through the slides the students' screens change according to the slide and they hear the presenter's voice in real time. The presenter can also use the Media Window to demonstrate and share an application such as SAP R/3 with participants. If a student has a query, they can "summon" the lecturer via the Virtual Classroom and the lecturer can then appropriately respond to the query. See Figure 1 below.

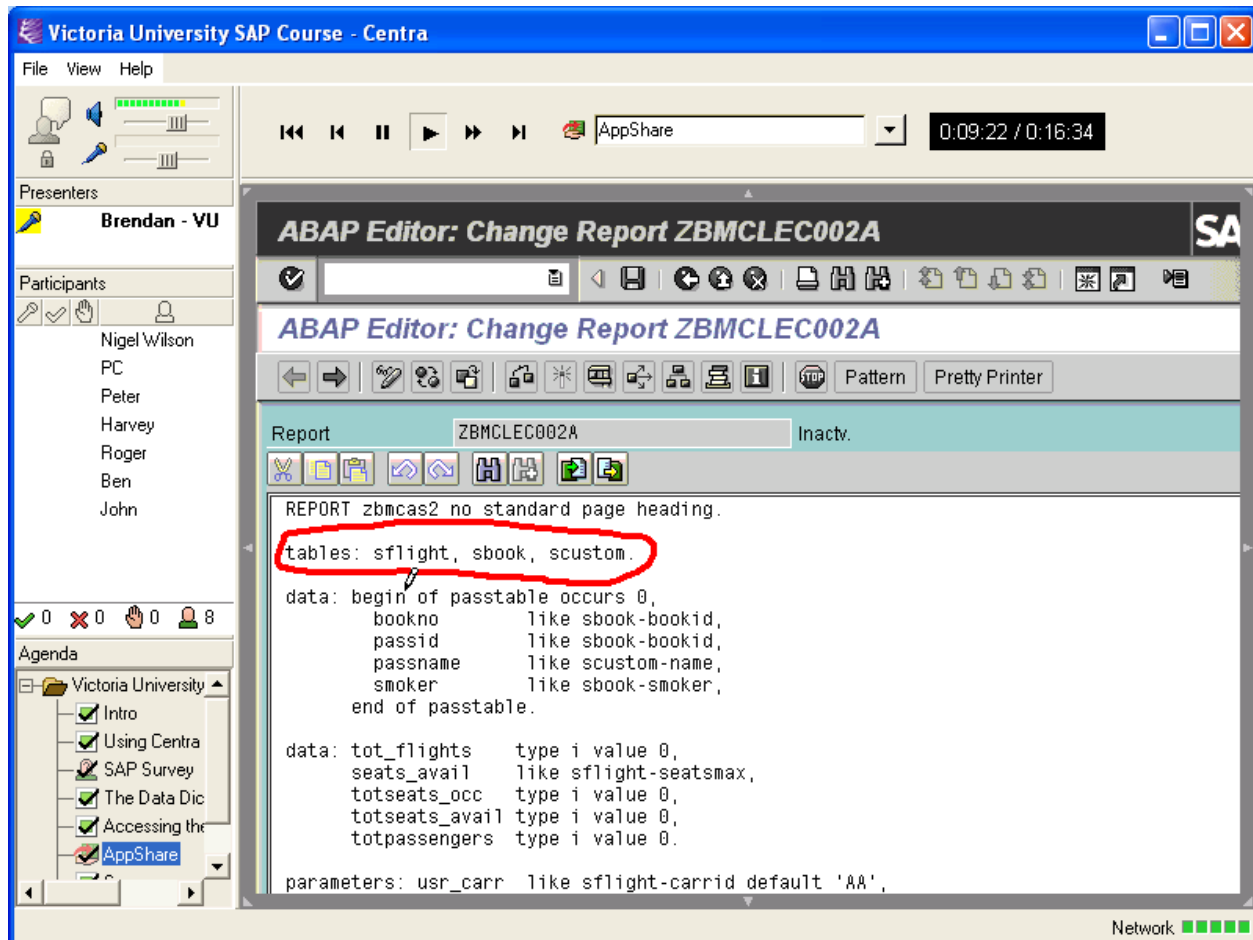


Figure 1: Symposium Participant Screen

After the two events were delivered, an on-line survey was conducted with the following results:

Question	Excellent	Very Good	Good	Fair	Poor
How would you rate the visual design/layout of the software?	50%	30%	20%		
How would you rate the user interface/ease of use of the software?	30%	50%	20%		
Additional comments on user interface/ease of use	- Very easy to pick up and use.				
The session content was appropriate to my needs	60%	40%			
The material transmitted smoothly during the session	40%	60%			
The audio was clear and unbroken during the session	30%	60%	10%		
The session duration was appropriate.	40%	60%			
What did you feel were the most positive aspects of the e-learning session?	- Very convenient to use from home. - Was able to replay session after completion.				
What did you dislike about the e-learning session?	- I would like the presentation material beforehand - Become distracted after a while				
Rate your overall satisfaction with the e-learning session.	30%	50%	20%		

The evaluation provided was overwhelmingly positive to the use of a synchronous e-learning tool to complement the delivery of the programming subject. Students clearly suggest the software was easy to use and the sessions added value to the learning experience.

CONCLUSION

The e-learning technologies outlined above are not unique but combining these technologies to complement the teaching of ABAP in an SAP environment does address some of the barriers facing students coming into this programming subject. They provide an avenue for learning programming concepts and techniques using a variety of methods to cater for students' differing needs and learning styles and given the rather complex nature of the SAP environment. Students are able to maintain the relationship formed by the visiting Victoria University lecturer beyond the normal forms of communication such as email. Such technologies could be used to maintain our offshore commitments where regional instability may lead to a ban on travel.

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DEVELOPING A SCORM-BASED U-LEARNING LMS SYSTEM

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ABSTRACT

An integrated content and learning management system (LMSs) which has the characteristic of being ubiquitous is the most essential component of U-Learning. However, most modern learning management systems have different architectures, which makes it's difficult to integrate the numerous learning resources, and reusability is hard to achieve. Otherwise, most learning resources read on mobile platforms are still restricted to electric books or digital learning materials. So, it's not easy to manage the learning progress and immediately information providing or interactions between learners and instructors are impossible. A research is proposed in this paper to develop a SCORM compliant blended U-Learning LMS system, which emphasizes the content compilation, content packaging and the implement of SCORM run-time environment to have learning materials being reusable and interoperable.

Keywords: U-Learning 、 E-Learning 、 SCORM 、 LMS 、 PDA

INTRODUCTION

With the growth of wireless LAN and the development of 3G telecommunication technology, Internet access is no more being restricted in wired networking [3], so as to provides a ubiquitous environment for E-Learning. Computer-assisted instruction which integrates with wireless LAN and learning theories has becoming indispensable recently.

The concept of ubiquitous campus (u-campus) [7] [8] was placed importance on followed the gradually development of handheld learning assistants, such as tablet PC, pocket PC or smart phone. Using the handheld appliances ubiquitously is possible due to the smaller volume with higher operating capability of them. In recent years, u-campus is becoming the critical technique of national information technology development in many countries. Take an example of Asia Pacific Zone, Japan is improving a plain named "U-Japan" to achieve Ubiquitous Japan in 2010. Also Korea stared "IT839" integrating related technologies on the way to achieve U-Korea in 2007[4].

In traditional learning condition in the classroom, learning activities were usually restricted, and it was easily tended to passive learning attitudes with low-level learning motivation. Due to the convenience of the information access and transaction through Internet, E-Learning has become a popular learning ladder. World Wide Web (WWW) communication technology in general, offers education institutions opportunities to improve learning, the campus community and the complete learning experience. The recent evolution of u-campus infrastructure further enhances the educational technologies by integrating instruction, learning theories, and information technologies seamlessly, and it's also increases the amount and the categories of resources that are available to instructors and learners.

This paper proposes a research to develop a blended ubiquitous learning management system (LMS) based on SCORM (Shareable Content Object Reference Model) standard. Its ambit covered the principles of the learning contents design, the construction of content packaging and the implement of the SCORM LMS run-time environment to enhance the reusability and interoperability. Learning theories and real time communication software on handheld devices are also applied in the system to achieve the high-level requirements of U-Learning. The implicates are as follows :

1. Recording learning progress to analysis learners' capability to straighten out learning disorders and this also serviceable to result a personal learning plan and situated learning activities in real world.
2. Providing a learning environment integrating virtuality and reality to help instructors to fully utilize the advantage of U-Learning in practice teaching to promote students' capability to investigate, analyze and address problems.
3. Providing strategies to manage learning materials and learning progress in the blended LMS system. Learning activities would become more complex in the past and recording learning progress was not easy as a result of the integration of virtuality and reality. It's considered deriving SCORM as the standard to achieve the goal to have the learning materials being reusable and interoperable.

The methodology used in this research including learning theories, system framework and leaning situation are described in section 2. Section 3 presents system flow and construction. Section 4 summarizes conclusions of this paper and the feature works.

METHODOLOGY

The system framework proposed in this paper was developed based on the social learning theory, the inquiry-based learning theory [5][6] and the situated learning theory. Learning environment is also blended in this system to practice outdoor situated learning. Finally, we define the relationship between the learning environment and the LMS system.

The social learning theory of Bandura emphasizes the importance of observing and modeling the behaviors, attitudes, and emotional reactions of others [1]. And it explains human behavior in terms of continuous reciprocal interaction between personal, behavioral, an environmental influences. The system was designed based on the simulation of practicing an inquiry-based learning activity on vegetation. During the learning of different inquiries, diversified learning styles are accomplished across the interaction between the three important elements in social learning theory. The element, people, is defined as the learners, whereas behavior and environment presents the communication and the learning situation in this research, respectively. Fig. 1 figures the conception of inquiry-based learning theory and social learning theory applied on U-Learning.

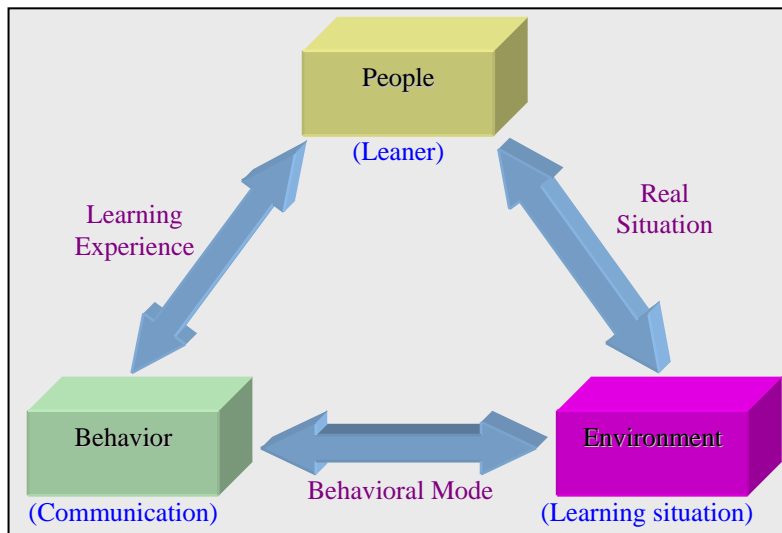


Fig.1 U-Learning based on inquiry-based learning theory and social learning theory

Situated learning theory and knowledge acquirement are outcome across interaction between the learners and the learning situation, which is necessarily provided to meet the real world to have students taking participate in learning activities. This system is designed for outdoor learning activities, and the learning materials are instructed according to the learning objects to provide simulate learning situation.[2][9]

System Framework

Students can learn ubiquitously via connecting with LMS server through 3G broadband transmission or wireless LAN with handheld devices. The learning situation will be aware by delivering the subjects to LMS server to have the appropriate learning contents being accessible. Take an example of paying a visit in the botanical garden, appropriate learning contents are accessible by submitting the scientific name of the plant on the handheld appliances. Its serveable to merge learning activities into life through wireless communication technology and learners could attain to real time learning environment in the circumstance that all the appropriate and any other related learning contents are acquirable.

Learning contents are designed according to international code of botanical nomenclature (ICBN) to construct domain knowledge and destructed the learning materials base on SCORM standard. JSP and Java Servlet are used to develop a web-based U-Learning LMS system in this paper to address the arduous problem of un-interoperability due to the specific system design built for different platforms. Related learning contents will present on the browser on handheld devices at right time with learning progress and behaviors recorded and transmitted to LMS server to enhance the situated learning. System framework represents as Fig. 2.

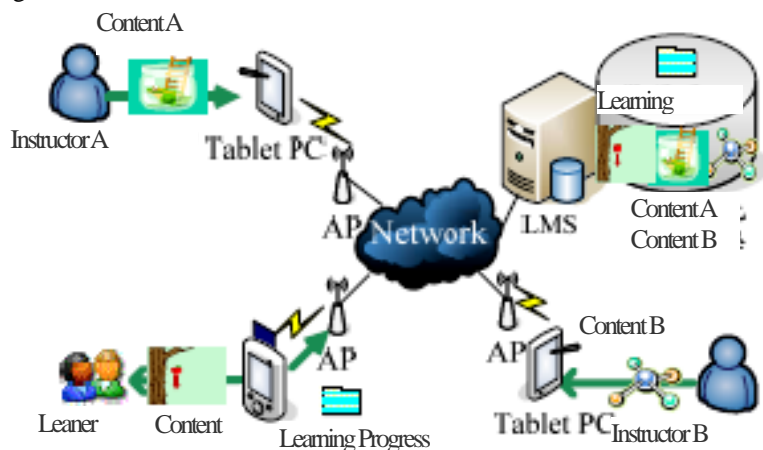


Fig.2 LMS system framework

Learning Situation

It was not easy to completely record learning progress in outdoor situated learning activities so as to analyze learning efficiency and advance the pedagogies in the past. In this system, learning progress of a learner is recorded as learner profile in the learner database during his course to provide personal learning environment to improve learning efficiency. And a recommendation list of learning content could also be generated to a learner in the feature system development. Fig. 3 signifies learning environment.



Fig. 3 Learning environment

Give an instance of taking a ubiquitous learning activity in the botanical garden on a PDA (personal digital assistants) with Pocket PC 2002, 3G telecommunication and wireless LAN. Situated learning can be accomplished by delivering learning environment related learning contents to learners when making requests to LMS server. U-Learning, which operates in coordination with situated learning and inquiry-based learning, can transfer the characteristics of E-Learning, any time, any place and any information to right time, right place and right information respectively.

SYSTEM DESIGN AND IMPLEMENTATION

The system design and implementation of U-Learning are based on handheld devices such as PDA and smart phone which are usually small and portable. Using these kinds of mobile appliances as learning assistants, appropriate learning contents in content server which meet learning environment can present on browser at right time through wireless LAN.

The characteristics of this system are as follow; situation related learning contents can be delivered to learners' handheld appliances at right time to achieve situated learning when making requests to LMS server. Learners can also sign up what they want to learn according to their interests and learning efficiency. Learning progress, moreover, can be transferred as data model and recorded in LMS server through wireless LAN on the go to provide personal learning environment. This system, which implicates database and XML parsing design, contains content presentation and learning progress management module, content management module and authority management module. System flow is showed in Fig. 4.

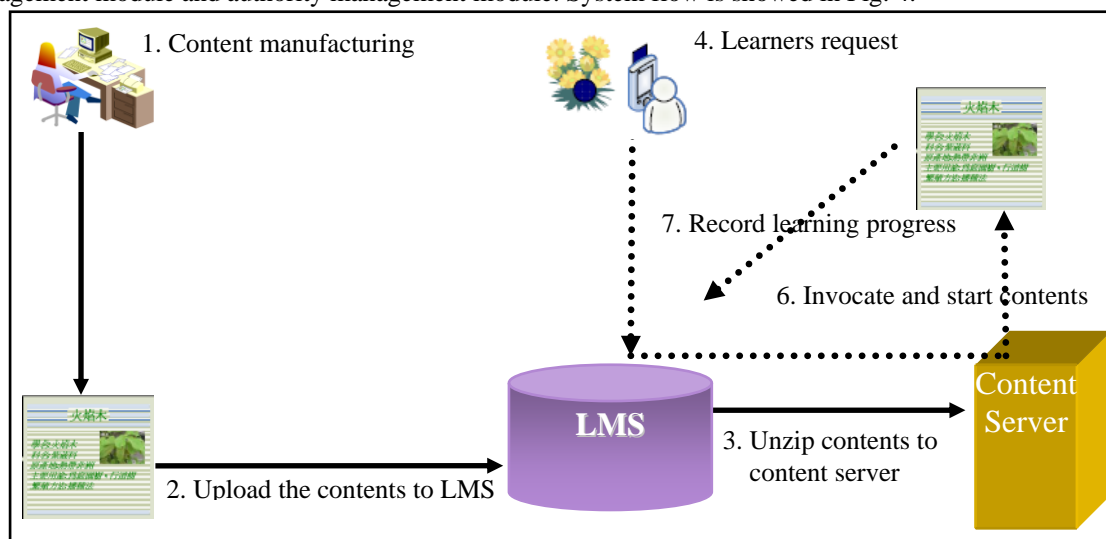


Fig. 4 System flow

Content Presentation And Learning Progress Management

The content presentation and learning progress management module is the core of this U-Learning LMS system. Learning progress is set as data model, being defined in the white book of SCORM run-time environment, to record the interaction between learners and learning contents present on browser. Database design is the most critical task during this phase of

system development. Microsoft® Access 2003 is adopted as the database management system in our system, with the object oriented compiling language, JAVA, we can track learning behaviors and store related patterns into database by object access. Fig. 5 represents the flow of this module.

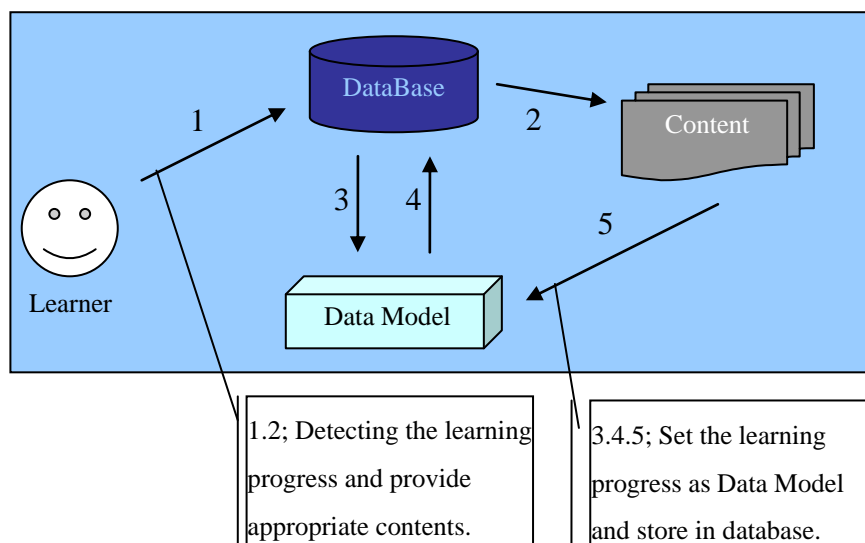


Fig.5 Contents presentation and learning progress management

Learning Contents Management

The learning contents management module includes three important functions described as follows:

1. Course submission : Instructors can submit new instructed learning contents with related information, such as the subject and instructor of the course, which are compressed into a .zip file and upload to the LMS server.
2. Course permission : The ZIP file of a new submitted course will be stored in a temporary database, and the checkers can publish the course being examined and approved. The published learning contents will be extracted into the database.
3. Course import : The published course will be imported into the content server and present on the web pages in user interface.

Database Design

Fig. 6 shows the E-R model of the database in our system. The entities in SCORM are defined as learner and instructor, content, SCO, item, which includes the related information about SCO and interaction. We establish 13 tables, including the intermediary tables, which are designed to take the responsible for communication between entities to provide the common information in the database.

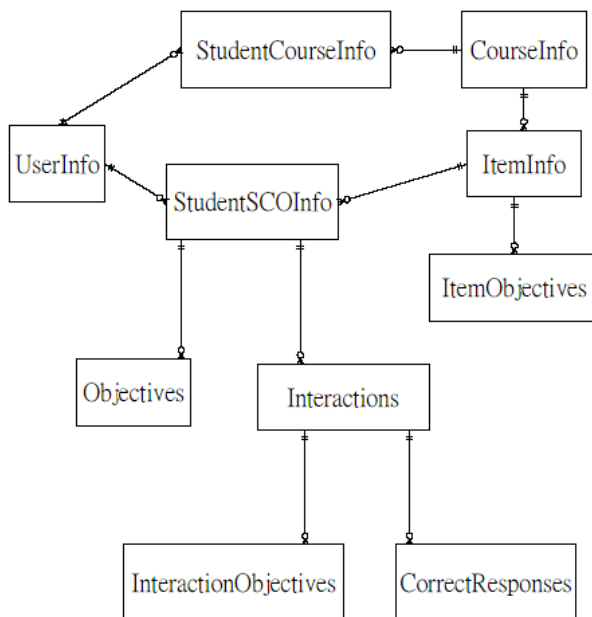


Fig. 6 E-R Model

XML Parsing

The LMS system have to provide a function to obtain the related information about a learning content and to identify the

resources included, which is defined as XML parsing. A XML file will be generated to record the status, usage and the related information while manufacturing a learning content. The two kinds of the related information are as follows :

1. Meta-data : To record and describe the assets, SCO and content aggregation included in SCORM content model. The segment represents the context independent.
2. Content Packaging : This segment describes the context specific.

For example, if a learning content contains 7 chapters, the chapter specific related information is represented in the Meta-data segment and the learning sequence of these chapters is defined in the content packaging section. The XML structure of content packaging shows in Fig. 7.

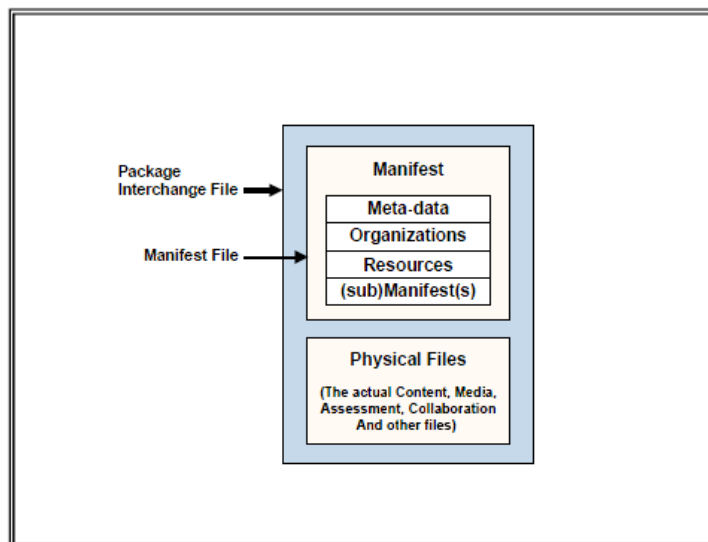


Fig.7 XML Content packaging

The purpose of content structure is to provide the content developer with the means to author collections of learning resources into a cohesive unit of instruction, apply structure and associate specific behaviors that can be uniformly reproduced across LMS environment.

Finally, the user interface design must obey the principles of being friendly and convenient to provide an inviting learning environment to user.

CONCLUSIONS AND FUTURE WORKS

This research proposes a SCORM compliant Web-based U-Learning LMS system to address the problem of being interoperable in different platforms and provide a ubiquitous learning environment on handheld devices at right time and right place. This system, moreover, is design to take on-line learning activities on handheld appliances, and it's possible to provide a more flexible, personal and self-determining learning way to improve teaching effects and learning efficiency in contrast with traditional off-line reading.

Learners can not only interact with LMS system but also integrate learning situation to acquire related learning contents base on social learning theory and situated learning theory. For example, transferring the learning situation from classroom to the foot of an aged banyan outdoor during the course of botany to have learners to observe, to touch and to feel the objects in real world, with the learning contents present on the handheld appliances, which are conceptualized can be changed into the reserve of concrete knowledge to achieve situated learning. In the future, the learners' preference, usage and learning progress can be attached on our system to improve the adaptive capability and flexibility.

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E-LEARNING INSTRUCTION GENERATION APPROACH IN TERMS OF EXPERIENCE ECONOMY

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ABSTRACT

With the trend of service innovation and experience economy, innovative services with mass customization is the right way to shift into the Experience Economy. Nowadays, E-Learning services development is limited and digital learning material inadequate is one of the most important issues in this area. By taking rapid instruction prototyping into consideration and implementing the modular architecture that offer mass customization services and rapid, then the E-Learning in terms of Experience Economy will realize rapidly. This study proposes an innovative service concept with efficiently offering reusable learning assets for accelerating learning material development. The innovative approach of E-Learning instruction generation services is illustrated and the conceptual model of proposed service framework is outlined. The major findings of this study are: E-Learning instruction generation model for effectively utilizing course contents in Web 2.0 website; conceptual model for dynamic componentization of learning assets. Finally, discussion direction for further research is proposed.

Keywords: E-Learning, Web2.0, learning assets, mass customization, experience economy

INTRODUCTION

The service sector is currently the main contributor to the economy in many developing or developed countries. In American, it employs 82.1 percent of the U. S. workforce and 69 percent of graduates from technological university. Service sector growth is limited despite its economic importance because of the Baumol effect and other factors [9]. Consequently, the innovation and development of service sectors are very important.

Consumer experience greatly contribute to service innovation with three aspects [3] : increasing the values between consumers and service providers, improving life of consumers and service providers by new service solution, and establishing good reputation of company by service innovation. To development a new service should consider the experience of consumer as early as possible. With the trend of service and experience economy, experienced services accelerate experience economy development rapidly.

To shift into the Experience Economy, Mass customizing services offers a great way [4]. When someone purchases an experience, he will get memorable events in a personal way, and this differs from buying goods and services. However, how does service providers offer personalized service to thousands of consumers? Mass customization offers the solution— producing standardized modules that combine in different ways for different buyers, like Lego building blocks. Mass Customization offers an effective way to create unique customer experiences. A set of modules and a linkage system are two basic elements for mass customizing your services [4]. To define the modular architecture that equips a company to offer mass customization services, then the Experience Economy will realize rapidly.

Education service is among the most growth service sector according to a service research report [21]. With the trend of information technology application, E-Learning service develops rapidly. Many countries set up E-Learning programs to level up national competitive capability in Economical Era. However, the goal of learning for all is limited because of low production of digital materials. (1)Most developments and discussions in E-Learning focus on the integration and improvement of LMS (Learning Management System) in different architectures. There already existed many SCORM compatible learning platforms, such as CyberLink's CTMS (CyberLink Training Management System) and ADL's Sample Run-Time Environment. However, most commercial software claimed to support E-Learning development not only cost much but also took time to familiar with operation interface, the quantity and quality of learning material outputs still fell behind and were hard to achieve the goal of learning for everybody. (2)Besides, learning courses must follow international standards in many national plans, such as NPLP in Taiwan, especially the SCORM model recommended by ADL (Advanced Distributed Learning) Initiative. The SCORM defined an xml file, called Manifest file, which contained four elements: Metadata, Organization, Resources and Manifest in SCORM standard. The most trivial and boring procedure in course production maybe is to connect Organizations and Resources element with course structures and physical files. This results in low productivity and needs to bring more focus on the challenge of learning courses shortage.

In conclusion, issues of material low production cause E-Learning services development are limited. However, innovative services with mass customization accelerate the Experience Economy coming. This study proposes an E-Learning instruction generation approach for realizing innovative services with mass customization. Therefore, E-Learning services development rapidly by such innovative E-Learning services. The objectives of this paper are as follows:

- (1)To illustrate the innovative approach of E-Learning instruction generation services.
- (2)To outline the conceptual model of proposed service framework and the connection with mass customization.

(3) To propose a service concept for accelerating E-Learning services development.

This study first performs an in-depth literature review to E-Learning and Instructional Design model, Web 2.0, service innovation, mass customization in the experience economy. Next, the approach of the E-Learning instruction generation for innovative services with mass customization is explored and link up the service conceptual model with mass customization. The final section summarizes the implications of this study and discusses directions for further research.

LITERATURE REVIEW

E-Learning and Instructional Design Model

Rosenberg defines E-Learning as a networked phenomenon allowing for instant revisions and distribution and it is delivered using standard Internet technology [20]. Though present learning websites and platforms claimed as E-Learning ready, they might face two primitive challenges. One is that learning resources were hard to integrate and interoperate; the other is learning effect was hard to evaluate. We believe that it will not be easy to solve these issues effectively without adapting international standards.

With a number of researches try to present their E-Learning practices to transfer the ideas of innovation, many initiatives try to propose their E-Learning specification to transfer the benefits of standardization as well. Among various kinds of standards, SCORM defines a model for packaging learning content to facilitate content delivery and might be the most widely accepted model of multimedia E-Learning today. The model has three main parts: the “Content Aggregation Model (CAM)”, “Run-time Environment (RTE)” and “Sequencing and Navigation (SN).” In Content Aggregation Model, it defines the inclusion of metadata for describing the course content [5]. For example, filling <item> elements in <organization> sections with asset item references (item1, item2, item3 ...) and fill <file> elements in <resources> sections with asset file locations (item1.html, item2.html, item3.html ...). But it was considered too toilsome and laborious in this procedure without producing these mapping automatically or by related tools.

Instructional Design as a process is defined by Berger and Kam [2] as “the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction”. It includes development and evaluation of instructional materials and activities. Various models for such a systematic design have been proposed, but ADDIE maybe is a commonly used approach. It is an acronym referring to the five major processes. The Analysis phase is the process of defining what is to be learned and is the foundation for all the other phases of instructional design. The Design phase is the process of specifying how it is to be learned. This phase is to plan a strategy for developing the instruction and to outline how to reach the instructional goals. The Development phase is the process of authoring and producing the materials. This phase is to generate the lesson plans and lesson materials. The Implementation phase is the process of installing the project in the real world context. The Evaluation phase is the process of determining the adequacy of the instruction. This phase measures the effectiveness and efficiency of the instruction. The above processes could be sequential and iterative, as depicted in Figure 1 [15].

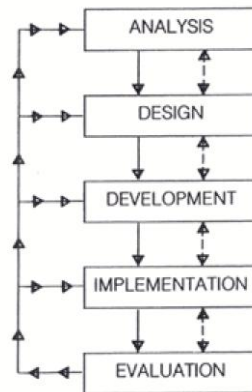


Fig. 1. An instructional systems development model featuring the ADDIE processes

Given the similarities between software design and instructional design, some researches argue that rapid prototyping is a viable model for instructional design, especially for computer-based instruction [13].

Web 2.0

Web 2.0 incorporated different service and technology and became distinct from traditional Internet and the breakthrough come from innovations in business model, communication and organization. O'Reilly formulated the paradigm shift of Web 2.0 and concluded the important slogan “Data is the Next Intel Inside” [17]. Among all the phenomena, the E-Learning course production can benefit from several episodes to improve productivity. First is the way of data integration changed from screen scraping to web services. Second is the way information organization evolved from directories (taxonomy) to tagging (folksonomy). Third is the information can be aggregated in syndication rather than stickiness.

Web service, as defined by the W3C Web Services Architecture Working Group, was “a software system identified by a URI, whose public interfaces and bindings are defined and described using XML”. It also should be “services” similar to those in

conventional middleware. Not only they should be “up and running”, but they should be described and advertised so that it was possible to write clients that bound and interacted with them [1]. In other words, Web services were components that could be integrated into more complex distributed applications.

Folksonomy was a way of user generated, involved and guided to organize information and its particularity is open, sharable and dynamic refresh [10]. Free meant anyone could use customized tags to categorize web contents they interested. Sharable meant users could discover related resources by a given tag instantly and see other tags that this person shared. Through the creation and usage of different tags to make up and retrieve web resource, some tags would fade in and some would fade out. This dynamic refresh often point out hot spots and interesting trends of applications. Moreover, many websites or “blogs” constitute various learning contents which can be accessed and aggregated by means of tagging and syndication. For example, much radio news are managed and played using MP3 files and Rich Site Summary (RSS) for updates and distribution in efficient way through the Internet.

Service Innovation and Experience Economy

Comparative economic studies indicate that the service sector is now the driving force of economic growth in every developed economy [22]. By 2004, the service sector comprised 68.7% of GDP while manufacturing had fallen to 29.6%. Due to the Baumol effect and other factors, service sector growth is limited despite its economic importance [9].

Gallouj (1997) [7] mentioned service characteristic, properties of service activities (“fuzzy” nature of their output, difficult to measure them by the traditional economic methods and to detect improvement or change). Following on from Hill (1977), has helped to bring into general use the definition of a service as a set of processing operation (...) carried out by a service provider (B) on behalf of a client (A), in a medium (C) held by A, and intended to bring about a change of state in the medium C.

The importance of service innovation pushes research institutes and companies to discuss subjects such as service engineering, service management, and service science from the perspective of service innovation. According to many researchers, service can be characterized as intangible, simultaneous and heterogeneous [12]. The emerging information technology services are unique in four aspects: they are information-driven, customer-centric, e-oriented and productivity-focused [9]. SerHertog proposed in 1999 a four-dimensional-model of service innovation for explaining and analyzing service innovations [18]. The four proposed dimensions were new service concept, new client interface, technological option and new service delivery system.

Consumer experience greatly contribute to service innovation with three aspects [3]: increasing the values between consumers and service providers, improving life of consumers and service providers by new service solution, and establishing good reputation of company by service innovation. The design of innovative services requires careful consideration of the overall experience of users, including past experience and experience using the new service [14]. A useful method of service innovation is “experience prototyping” [14]. In this approach, the initial process of developing service innovation is finding the key service user and using a pilot system to study his or her feelings towards the new service to ensure a successfully designed service innovation.

The Experience Economy is inevitable as the trend of social development. The production pattern of experience economy is mass customization based on the user involvement [23]. To surpass competitors in the Experience Economy, Mass customization is the right way [3]. Mass customization offers customer customization and personalization of products and services for individual at a mass production price. Customization and low cost cannot achieve simultaneously. However, the core of mass production is to provide low cost but personalize service [23]. Further, to create a memorable experience to the consumers. Mass customization produce uniformed modules that combine in different ways for different buyers. This way is like Lego building blocks. Two basic elements of mass customization are a set of modules and a linkage system that dynamically connects them. To define the modular architecture equips a company to offer mass customization services. [4]

E-LEARNING INSTRUCTION GENERATION APPROACH

E-Learning Instruction Generation Model

Kandil, El-Bialy and Wahba once proposed a system for massive course generation [11]. They used a prepared script of the course and its organization to produce hierarchical structure of chapters that includes pages. The instructor needs to describe its contents in terms of multimedia components, such as text, sound, image, and video. Its implementation lack of flexibility and proprietary output format was hard to reused and share.

With further analysis environments of Web 2.0, it was easy to discovery that learning material resources already existed, but appeared in incompatible, inconsistent or distributed forms and needed to transform and customize to suit international learning standards. Procedures followed to make proprietary contents exportable to open standard were remarked on E-Learning standard website (e.g., ADL), and many experiments also proved the feasibility of learning contents transformation, such as SGML documents [24] and DICOM (Digital Imaging and Communications in Medicine) medical images [25].

There is no doubt that much information and knowledge can be exploited from WWW (World-Wide Web) under the new trends of information sharing and collaborative development. In this way, the logistic of E-Learning industry must take WWW as a single platform to access and integrate different information in global view.

By taking improvement in software development for reference, such as component model and rapid Prototyping, many researches seek to transfer the ideas and benefits of the reusable concept to the development and delivery of educational instructions. Reusable learning assets is an innovative paradigm shift in instruction generation that promises to bring to education the same improvements in productivity that it has in software development [6]. With integrating ADDIE model and rapid prototyping to meet the need of mass customization, we proposed E-Learning instruction generation approach in terms of

experience service illustrated in Figure 2 and the components listed as following.

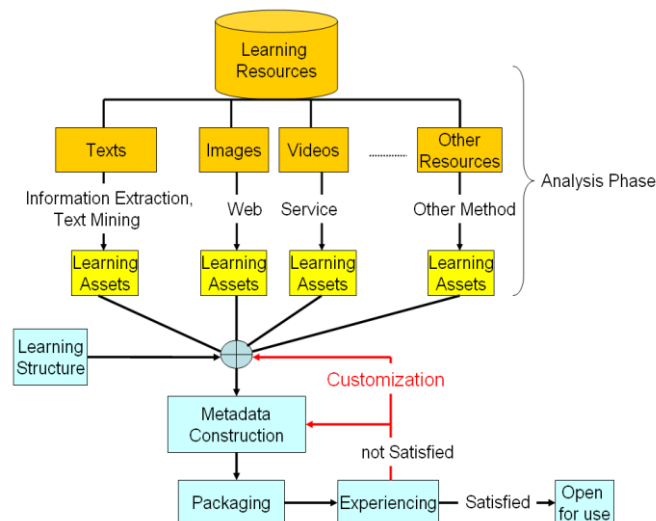


Fig. 2. E-Learning instruction generation model

The proposed approach can be separated into five procedures and introduced as follows :

- (1)From learning resources to Assets: In this phase, the learning resources are identified. Assets are learning content in its most basic form and can be text, images, videos, or other digital resources. The text can be analyzed and prepared in advance separately according to transformation, Information Extraction or Text Mining. Besides, through advanced way of data integration and information organization, images and videos can be taken as learning assets by Web services interface. By means of tagging and syndication, many websites, such as Flickr, wikipedia, open text archives, etc., can be accessed and aggregated. Then packaging into SCORM-compliant learning assets is to form other procedure’s basis.
- (2)Define Learning Structure: Learning objectives, contents, lesson planning and media selection are decided and the learning structure is defined in this procedure.
- (3)Metadata Construction: SCORM requires the inclusion of metadata for describing the course content. This procedure deals with metadata construction automatically and such arrangement facilitates users of E-Learning systems to be able to identify appropriate course materials in an efficient and effective way. SCORM 2004 example on ADL’s website was a good template to carry on, and it is easy to modify this Manifest file if the evaluation of package is not satisfied.
- (4)Packaging: During this procedure, a learning packing including the related learning resources and metadata is generated. By packing all files in RFC1951 format, the output can conform to SCORM standard.
- (5)Experiencing: We take experiencing instead of evaluation in this procedure, and importing courses into Learning Management System (LMS) in order to present the generated instruction. With trying out and reviewing online, it is easy to check if the results meet our demand. Go back to procedure of learning structure definition or metadata construction and rebuild the instruction again.

Conceptual Model of Proposed Service Framework

The proposed innovative mechanisms of learning instruction generation service can be outline as the following conceptual model illustrated in Figure 3.

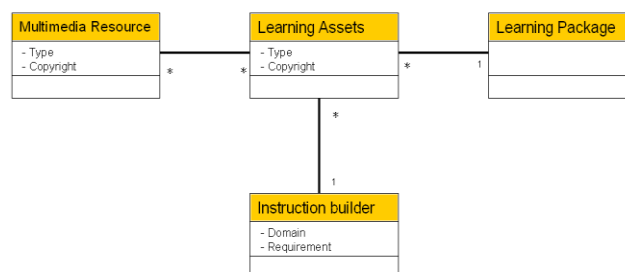


Fig. 3. E-Learning instruction generation

The growth of the Internet, service automation, globalization and the dynamic componentization of learning assets are driving the reconfiguration of instruction generation networks at a scale and pace never before seen in history. By following this innovative service, productivity can be improve with lower down the cost of courses generation and allow the instructors to concentrate on his tasks. The goal of mass customization can also have been achieved as well.

CONCLUSIONS AND RESEARCH DIRECTION

With the trend of service innovation and experience economy, this study points out issues of low material productivity and defines the modular architecture that equips an innovative service to offer mass customization. An approach of E-Learning instruction generation is proposed as well for addressing material inadequate issues. Promoting innovative services with mass customization in E-Learning service sector speeds up E-Learning services development and Experience Economy realizing.

Reusable learning assets is an emerging paradigm shift in instructional systems and course building need to start thinking in terms of learning objects. We proposed a framework of wrapping various multimedia resources as learning assets and course builders can reuse and combine them depending on different teaching strategy and objective. It not only offers more flexible but also meets the concept of share and reuse. Besides, we take advantage of prepared programs to complete the manifest file conform to SCORM specification automatically for saving time and lowering cost in course building. At last, this framework takes rapid prototyping into consideration and experience outputs on LMS instantly. In conclusion, there has been enormous increase in course production productivity through our proposed framework.

Moreover, the right combination of reusable software components in an SOA can provide each individual with a customized software experience. Researches also claim that learning assets repository could help save time and cost while avoiding the repeated rebuilding from scratch of similar instructions [16]. We can summarize and store different heterogeneous learning assets in storage to improve the value of our proposed model and make the core value of experience service to appreciate continuously.

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HOW DO VIRTUAL TEAMS WORK- A SOCIAL RELATIONSHIP MODEL BY SEM

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ABSTRACT

Virtual teams have brought the need for organizations to improve the performance of virtual teams. Among these key issues to be successful, social dimensions have been catching researchers and managers' attentions. Hence, this study derives a preliminary social relationship model from Powell et al's (2004) virtual team framework and conduct an experiment to validate it by SEM. The results reveal: (1) Communication has a positive impact on relationship building; (2) Relationship building has a positive impact on cohesion; (3) Relationship building has a positive impact on trust; (4) cohesion and trust have positive impacts on performance.

Keywords: Virtual teams, Social relationships, Model, SEM

INTRODUCTION

[3] found that past research on virtual teams paid too much attention to the development of advanced technological environments instead of the social and psychological dimensions. Although a few studies have investigated the social aspect of virtual teams, such as [9]. However, with the complexity of human activities over the Internet, there is a need for exploring the social dimensions of virtual teams in depth. From the review of past studies, it is found that social relationship is problematic within virtual teams. [1] found that cohesion among virtual team members is weak due to some members may attempt to contribute nothing and let others carry their workload. In addition, building trust within virtual teams is tough [5]. However, some scholars were aware of the importance of social relationships in virtual teams and developed theories to formulate it. Such as hyperpersonal communication theory [16] and Social Information Processing perspective [17] asserted that a virtual team, while deficient in face-to-face meetings, is able to adapt itself to this environment and achieve high levels of performance if enough time is given. Thus, the intent of this study is to build a model to explore the social relationships and their effects on performance and satisfaction in virtual teams.

FORMING THE PRELIMINARY FRAMEWORK

[11] reviewed 43 articles (1988~2002) about virtual teams and proposed a detailed framework of virtual teams. This framework has a solid theoretical base and it indicates the potential variables in both social and task dimensions which affecting the performance and satisfaction of virtual teams. However it only displays a general idea about the virtual teams and fails to further explore the variables' effects toward the performance and satisfaction, and the interactions between the variables. The, it can be an excellent starting point for this study. To abstract the social dimension of Powell et al's framework the preliminary framework is formed in Figure 1.

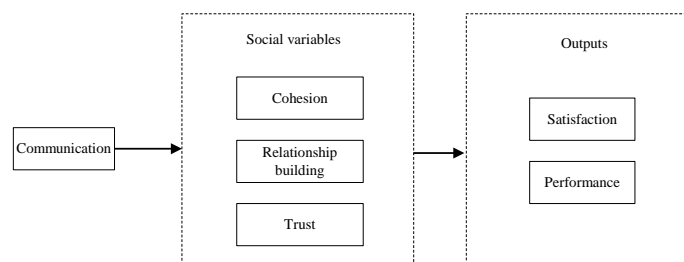


Figure 1 Preliminary framework of this study

LITERATURE REVIEW

In this section, all variables in the preliminary framework are reviewed.

Communication: Although some researchers argued that communication in electronic environment has decreased due to the lack of speech acknowledgements (e.g., “hum?” “Uh-hmm”) and social greetings [12], there is no doubt that electronic communication consumes more time and conversation contexts. Others suggest that a problem-solving task is not suitable for electronic communication, even if the task is low in complexity [15], which implies that the efficiency of electronic communication in problem-solving tasks is lower than FTF communication. **Relationship building:** According to TIP theory [8], there are three functions that are performed by group members: production, member support and group well-being. Members support and group well-being is related directly to relationship development in virtual teams, which suggests that since members spend more time on goal and task oriented activities and it is more difficult for VT to engage in developing relationships. Thus, the lack of relationship development may result in frustrating team members. **Cohesion:** [2] developed a subjective conceptual model of cohesion, which proposed that the perceptions of cohesion of group members are important for

the members' behaviour. [13] tested the model and GEQ in 740 high school varsity athletes to determine the degree of factorial invariance across gender (426 males, 314 females) and across type of sport teams. Trust: According to [22], better use of personal relationship is associated with better quality and efficiency. [4] states that strong social interaction in a team contributes to better performance and the most important factor to create excellent interaction among team members is trust. **Performance and Satisfaction:** The measurements of performance and satisfaction in virtual teams are diverse. This study analyzed the approaches of evaluating performance and satisfaction of ten empirical studies from 1994 that focused on virtual teams and found that the methods of appraising performance can be categorised into three types: grader/ranking, discussion board/videotape, questionnaires. Graders are engaged in scoring the outcome (e.g., group report). Ranking has two sources: individual/group ranking [14] and experts' ranking [14]. Individual/group ranking is done by each of members. Experts' ranking is done by selected experts (e.g., lecturers). The two mainstreams of satisfaction are "satisfaction with the process" and "satisfaction with the outcomes".

HYPOTHESIZED MODEL BUILDING

CMC has also been found to promote interpersonal relationships in a virtual environment [10]. Relationship building can strengthen feelings of inclusiveness or a sense of belonging to teams and further foster cohesion [11]. Cohesion has been considered to be the most important small group variable [7]. It has been associated with better performance and satisfaction [10]. In addition, relationship building is connected to trust [6] and trust is regarded as one of the key elements to performance [18]. These studies depict a potential path from communication to relationships, relationship building to cohesion, relationship building to trust, trust to performance, and cohesion to performance. However, the connections between relationship building and cohesion are ambiguous. To aggregate these studies, this study proposes two models shown in Figure 2:

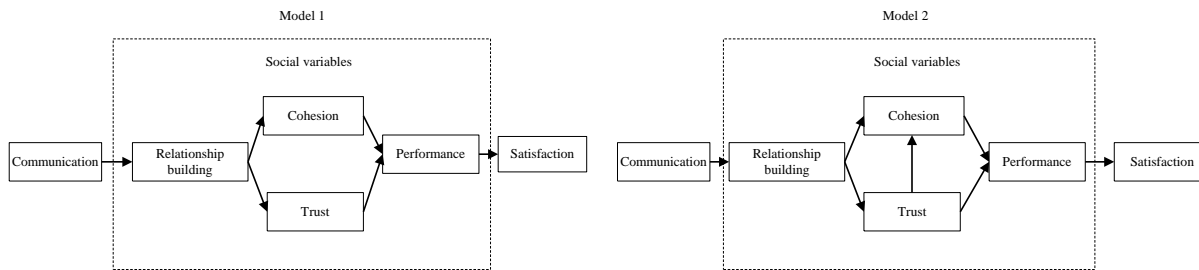


Figure 2 Proposed model 1 and 2

RESEARCH METHODOLOGY

54 groups, which comprised of 220 business students, were pre-assigned and the discussion boards, built in a Networked Learning Environment Courseware System called Blackboard, were created for each team. Students were grouped with different classes to avoid that they meet each other and they were told that the discussion boards in Blackboard is the only permitted communication approach. Students discussed and exchanged files to finish the assignments posted on the discussion board and submitted reports. The, hard copy questionnaires were distributed in the lectures and tutorials. 200 validated questionnaires were collected, giving the return rate of 90%.

MODEL TESTING

Figure 3 show the results of applying SEM by LISREL 8.72 on the proposed model 1 and 2.



Figure 3 The results of applying SEM on model 1 and 2

By comparing the criteria of the two models, it can be found that model 2 is superior to model 1. Thus, Model 2 is selected as the social model of virtual teams.

DISCUSSION

By observing model 2, it can be found: (1) Communication has a positive impact on relationship building. This finding is not so surprising and is corresponding to the hyperpersonal communication theory [16] that virtual team members are still able to build social relationships in a virtual environment. (2) Relationship building has a strong and positive impact on cohesion. This finding also makes sense. If virtual team members have good social relationships, they would feel more cohesive and work like a team. (3) Relationship building has a strong and positive impact on trust. If virtual team members have good social relationships, it promotes the development of trust. (4) Although the path (trust to cohesion) is insignificant, with this relationship, the model fitness of model 2 is far better than model 1. This implies the relationship between the two variables is meaningful for the social structure. (5) Cohesion has a strong and positive impact on performance. It implies that if virtual team members feel cohesive and work like a team, the performance would be higher. (6) Trust has a positive impact on

performance. (7) Performance has a positive impact on satisfaction. This finding implies that higher performance teams have higher degree of satisfaction. (8) By observing the paths between the three social variables (relationship building, cohesion and trust), relationship building and trust could be mediators for cohesion to affect the performance. This means that the degree of cohesion's impact on performance would be influenced by relationship building and trust.

CONCLUSIONS

This study contributes a new framework of social relationships for virtual teams, which derived from Powell et al's [11] framework with intact literature base. The framework reveals the relationships between variables and gives a new view toward the virtual team structure. Also, these findings confirm the importance of the social relationships toward the performance and satisfaction of virtual teams. This could promote the further research to improve the performance and satisfaction of virtual teams.

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AN XML-BASED CONTINUOUS AUDITING WEB SERVICES MODEL – AN IMPLEMENTATION STUDY

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ABSTRACT

The concepts of continuous auditing are now more than two decades old, many researchers have issued different continuous audit system models for applying over internet technology. A continuous audit is an assurance service where the time between the occurrence of events underlying a particular subject matter and the issuance of an auditor's opinion on the fairness of a client's representation of the subject matter is eliminated. The auditor offers restricted views provided by the continuous audit web services (CAWS) routines on a fee basis to analysts, investors, financial institutions, and other parties interested in obtaining continuous audit (CA) of business performance or other audit objects of interest. In our study proposed not only discuss with how to ensure the integrity and effectiveness of the entire data collection system but also implement the XML web services to enterprise applied for correctness and usefulness well-known the CAWS model. The CAWS design and demonstrate an implementation of continuous audit with the internal auditor data verify for compliance CA domain. The demonstrated CAWS model uses data retrieval layer, data analysis layer and data presentation layer over the internet to continuously monitor by the audit department. The article concludes with suggestion for future research and our implemented experiences.

INTRODUCTION

The concepts of continuous audit have are now than now than two decades old [9], many financial statement accounts are being managed in real-time [7]. The relentless advance of technology during past few years has changed the nature, evidence of the audit process [12]. The audit environment is changing to keep pace with the changing business environment. The information technology improvement is changing from traditionally tools of Electronic Data Interchange (EDI) to recently E-Commerce of "interconnected networks with symbiotic relationships across a unique network" [22]. The electronic business has brought significant efficiencies and cost reductions to supply chains for compressing cycle times, eliminating redundant procedures among trading partner and reducing the amounts of paper source documents [22]. Some index indicated that there have been 71.7 percent of firms implement the ERP systems among the top-1000 firms in Taiwan, in specific Financial & Accounting, Sale & Orders, Production & Manufacturing, Delivering, Purchasing, Supplier & Chain, Personnel and Warehouse & Inventory [14].

The EDI solution is a pioneer tool in the continuous audit world. The EDI required substantial hardware investment and specific intermediaries (i.e. standard formats and translation software) which transmitting data defined with trading partner. The EDI networks have lost the popular tool until the internet network generated. The E-Commerce was not only facilities business transactions through general Internet of WWW browsers, but also enabled more diverse business activities to be conducted globally. The special characteristic of the E-Commerce is open environment and easily application setting which provide small and medium-size enterprises opportunity to application. Hence the EDI solutions had been out of the current information technology with timely basis and reliable information from investor and regulators expectation.

In response to the market's demand for timely and reliable information, AICPA and CICA have just completed that the continuous auditing (CA) is to address the significant issue auditors will encounter in performing this type of services [1]. It seems certain the investor and regulators, and creators will increasingly demand the information about financial performance not only delivery on the more timely basis, but it to be prove with CA by the independent auditors. For example, Just-In-Time (JIT) inventory processes, managed by trading partners who supply chain, make online, real-time reporting of inventories on corporate balance sheets possible. Likewise, JIT cash management procedures, where suppliers of capital are given access to an organization's cash flow, make real-time monitoring and evaluation of cash, payable and receivable account balance sheet [21]. Woodroof and Searcy developed a conceptual of a continuous audit. As proof of such model by design, demonstrate an implementation of continuous audit within the debt environment for the academic community to investigate implications of real-time financial reporting [13].

Debreceeny and Gray provided the extensible business reporting language (XBRL) standard for on online reporting of financial information. XBRL solution is in the initiation of the audit report. In a continuous audit environment, audit reports should be available when demanded and produced automatically. The data generated by the client, the financial statements could be tag by using XBRL and published to the web. The creation of the XBRL-tagged financial statements is "push" by the client system on to the web [6]. Woodroof and Searcy used the digital agents and alarm triggers sent over the Internet to continuous monitor whether actual values of client's variables are in compliance with standard for CA variables in the debt covenant agreement [13].

The improvement in information technology had been changed by that the official World Wide Web Consortium (W3C) defined the Web-Services. A Web Service is a software application identified by URI [IETF RFC 2396], whose interfaces and

biding are capable of being defined, described and discovered by XML artifacts and supports direct interactions with other software application using XML based messages via internet-based protocols. Murthy and groomer defined the specification of frameworks and technologies that facilities such as a Web-services-based for continuous auditing mechanism in enhanced audit world. The Continuous Auditing Web Services (CAWS) mechanism world run as a “web services” in the audit firm’s computing environment and could be applied at a very granular level to provide assurance about the specific business process. It approached facilitates a new “pull” model of auditing [8]. They think that the web model including the browser and web server, reusable the components that encapsulate the business logical and explore the raw data from database to be programmatically accessed internet protocols [8]. Although the technology of SOAP, WSDL and UDDI had been clearly defined the application in the web services, it is still need to define simplify process information or data format for interchange with third party. The web service is unlike the traditional tightly coupled models, such as common object request broker and distributed component object model (DCOM). The web service’s client and the server are loosely coupled.

However, the aforementioned model is still being discussed in the academic and lack implemented application for the enterprise with current information technology and business environment. In our study proposal, the main objection is not only discuss with how to ensure the integrity and effectiveness of the entire ERP system but also implement the XML web services to apply enterprise for correctness and usefulness well-known the CAWS. There are three layers in the auditors for CAWS application in our study [5]. The CAWS model include of the data retrieval layer, the data analysis layer and the data presentation layer. The major proposed will use XML based character of freely definition to context for data retrieval and implemented the XML web service is our priority proposal. Follow as: (1) Implement the Web service platform to retrieval data from ERP or other system for real time data collection. (2) Subjection oriented to retrieval the data from ERP system and fit continuous audit criterions. (3) Create the major components of the emerging XML web services framework. (4) Discussion about our experience and concern issue about technology sector and future research in the continuous audit area.

The remainder of paper is organized as follow. Section 2 provides some theory background and discussion the various components of XML web service framework that following the continuous audited criteria. Section 3 implements the prototyping system in to integrated system and embedded the data retrieve component into the web service platform. Section 4 summarized the paper and discussed future direction in the line of research.

LITERATURE

The continuous audit is not only depend third party management, but also emerging IT framework such as XML and Web services. There are divide 5 sections about our topic domain in the literature. We will discuss the XML based for the web services in the Section 2.1. The section 2.2 will discuss about develop continuous auditing criteria in the system. The section 2.3 will discuss Business Process Execution Language for Web Services (BPEL4WS). The section 2.4 will discuss Continuous Auditing using Web Services Framework Components. The section 2.5 will discuss Auditing tool about ACL (Audit Commends Language).

XML based for the web services

XML web services defined in terms of its three essential elements, as follow: (1) XML Web services expose useful functionality to Web users through a standard Web protocol. In most cases, the protocol used is the simple object access protocol (SOAP). (2) XML Web services provide a way to describe their interfaces in enough detail to allow a user to build a client application to talk to them. This description is usually provided in an XML document called a web services description language (WSDL) document. (3) XML Web services are registered so that potential users can find them easily [25]. This is done with universal description, discovery, and integration (UDDI). Recently some research issue the extensible business reporting language (XBRL) tags for external report.

The web service was definition by the W3C Web Services Architecture Group state [3] as “a web service is a software system identified by a URI, whose public interface and bindings are defined and described using XML. Its definition can be discovered by other software systems. These systems may then interact with the Web service in a manner prescribed by its definition, using XML based message conveyed by internet protocols.” Three major standardization initiatives have been submitted to the W3C consortium to support interactions among Web services in the literature:

WSDL (Web Services Description Language) [24]: WSDL is an XML-based language for describing operational features of Web services. WSDL descriptions are composed of interface and implementation definitions. The interface is an abstract and reusable service definition that can be referenced by multiple implementations. The implementation describes how the interface is implemented by a given service provider.

UDDI (Universal Description, Discovery, and Integration) [24]: UDDI defines a programmatic interface for publishing (publication API) and discovering (inquiry API) Web services [24]. The core component of UDDI is the business registry, an XML repository where businesses advertise services so that other businesses can find them. Conceptually, the information provided in a UDDI business registration consists of white pages (contact information), yellow pages (industrial categorization), and green pages (technical information about services).

SOAP (Simple Object Access Protocol) [24]: SOAP is a lightweight messaging framework for exchanging XML formatted data among Web services. SOAP can be used with a variety of transport protocols such as HTTP, SMTP, and FTP. A SOAP message has a very simple structure: an XML element (called envelope) with two child elements. The first element, the header includes features such as security and transactions. The second element, the body includes the actual exchanged data. A key

difference between an XML-based SOAP message and traditional MIME-typed message is that the web browser merely displays the HTML page, whereas the web service client must interpret the data in the XML message and perform some action based on the data. Standardize HTML tags specify the formatting of data on a web page, XML tags are customized to provide a standard way of representing the contents of data on a web page and logical choice as a message format web services. The SOAP protocol mandates the use of XML to represent the message, but the actual message content depends on the purpose and corresponding design of the Web service.

Many SOAP toolkits provide support for generating WSDL file the exiting program interface for reading the file and communicating with an XML web services, such as Microsoft's Visual Studio.NET. A Web services standards or technologies stack [4] is shown in the Figure 1 to illustrate the relationships and dependencies among various web services standards. It can be use by standards organizations in guiding the standards development efforts and used by IT user organizations to assess deployment strategies for Web services technologies.

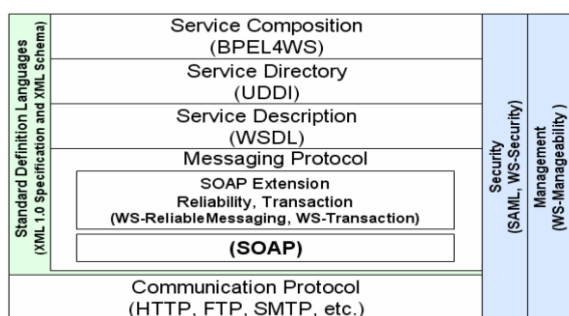


Figure 1. Web Services Standards Stack

Develop continuous auditing criteria in the system

The requirement for correct and timely financial information leads to the need for quality audit service from the auditor to support continuous verification and dissemination of accounting information. In future we will be facing real-time business reporting with real-time auditing [7]. In the financial statement audit, the auditor's responsibilities focus mainly on periodically collecting and assessing audit evidence, evaluating the strength of internal controls, and formulating an opinion on the fairness of financial statements. In the continuous audit process is similar with the traditional audit for using the rapid advances in Internet technologies and the increased demand by the public for real-time electronic access to corporate databases, many public companies (e.g. AT&T, Microsoft, IBM) have already released their financial and operating information on their Web sites.

The internet world cause the AICPA and CICA to develop how real-time auditing can be implemented to fulfill the statement-users' needs In response to the market's demand for timely and reliable information, the AICPA and CICA have just completed a research report, continuous auditing address the significant issues auditors will encounter in performing this type of service [1].(e.g. the nature, purpose, scope, and conditions for a continuous audit) and has identified significant matters auditors should consider (e.g. planning a continuous audit, collecting and evaluating evidence continuously, and reporting).

Continuous auditing has been articulated by the CICA-AICPA Joint Study Group [1]. A continuous audit is a methodology that enables independent auditors to provide written assurance on a subject matter using a series of auditor's reports issued simultaneously with, or a short period after, the occurrence of events underlying the subject matter. The conduct a continuous audit, a number of conditions must be present in the study. These conditions are the following:

- (1) The client must have highly reliable systems. These systems must be able to provide the necessary subject matter to the auditor on a timely basis.
- (2) The subject of the audit has suitable characteristics necessary to conduct the audit. For example, if the audit is focused on evaluating internal controls, then the auditor must be able to electronically interrogate these controls.
- (3) The auditor must have a high degree of proficiency in information systems, computer technology, and the audited subject matter.
- (4) Automated audit procedures will provide most of the audit evidence necessary to opine on the subject of the audit.
- (5) The auditor must have a reliable means of obtaining the necessary audit evidence so that an opinion can reached.
- (6) The auditor must have timely access to and control over any audit evidence generated as a result of the continuous auditing procedures.
- (7) It is necessary to have a "highly placed executive" in the client organization who will serve as a champion for the adoption and support of continuous auditing.

In this section as we know that the CA have to compliance 7 criteria to design the XML based CA system.

Continuous Auditing using Web Services Framework Components

The XML Web services as facilitator for continuous auditing, conventional techniques, such as EAMs and software agents, lodged within the client's computer system are no longer applicable. Murthy and Groomer [8] had design CAWS to describe how continuous auditing would operate in an XML-enabled business processing environment. In the research scenario, users requesting assurance on client business process on a continuous or frequent basis by invoking auditee-specific CAWS within the auditor's computing environment. Consider an XML-enabled e-commerce sales transaction processing application for an

auditee. One aspect of verification demanded by assurance customers is whether the revenues being report by the audit client were valid. The sample depicted how a sales transaction CAWS would work to provide CA regarding the revenue amounts being reported by the audit client. A potential extension to the model was for the auditor's CAWS to request confirmatory data from the appropriate external agents responsible for the execution of specific subprocesses within the overall sales business process for the audit client in the figure 2 [8]. In this sample, the external auditors would use CAWS to assist in the gathering of audit evidence to support an opinion on an audit client's financial statement. Hence we will inherit the sample character to implement in our case study.

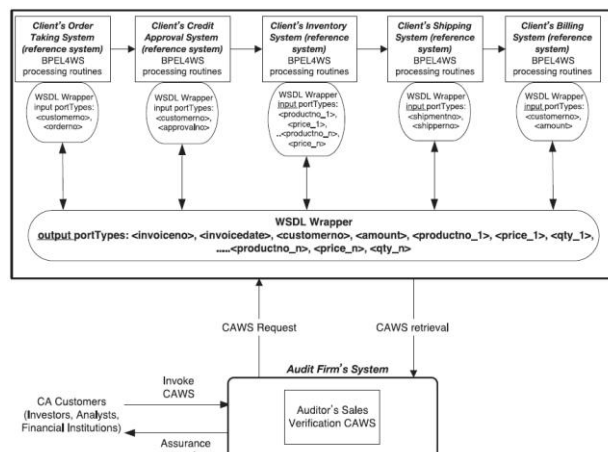


Figure 2. CAWS for sales verification (DataSource: Murthy and Groomer(2004))

Auditing tool about ACL (Audit Commends Language)

The otherwise, ACL is the preferred software tool of audit and financial professionals for data extraction, data analysis, fraud detection, and continuous monitoring. ACL expands the depth and breadth of data analysis, increases auditing findings. With ACL, organizations can achieve fast payback, reduce risk, assure compliance, minimize loss and enhance profitability. Providing a unique and powerful combination of data access, analysis and integrated reporting, ACL reads and compares enterprise data—any data, flat or relational databases, spreadsheets, report files, on PCs or servers—allowing the source data to remain intact for complete data quality and integrity. Used as a standalone PC application and/or as the client with the Server Edition software, ACL employs a single, consistent client interface and provides easy, immediate access to data. For example, analyzing server data, to information stored on mainframes, to mySAP for ERP data, or networked PCs. This ensures optimized performance and optimum flexibility in accessing new sources of data (ACL Institute,2001).

ACL Continuous Controls Monitoring (CCM) solutions provide an independent mechanism to automatically monitor internal controls effectiveness, supporting compliance efforts, and minimizing the risk of error and fraud. ACL CCM solutions are multi-platform capable and work with any source of data - enabling the visibility critical to effective management of the order-to-cash cycle. Following the COSO (Committee of Sponsoring Organizations) internal controls framework as figure 3 to identify key controls objectives, ACL CCM analytics perform complex transactional analyses and identify control failures. A sample of the control objectives covered by CCM analytics follows:

- (1). Manage Customers: Ensuring credit limits are appropriate and that users have not created fictitious customers or are selling to OFAC-listed and other restricted organizations.
- (2). Order Entry: Ensuring credit limits are not exceeded or been change without authorization; monitoring for excessive discounts.
- (3). Manage Pricing: Monitoring for pricing errors or excessive discounts.
- (4). Sales Invoicing: Ensuring shipment of sold goods only and monitoring for unbilled shipments or delays in shipments.
- (5). Receipts: Monitoring for disputed billings, delays in collections and unapplied receipts; ensuring customers do not exceed terms.
- (6). Collections: Monitoring for disputed billings, collusion or fraud, and revenue write-down

The order-to-cash cycle typically crosses several corporate functions, the resulting handoff from department to department can become a source of error, fraud, and delays resulting in reduced cash flow. In addition, large amounts of data are typically housed in multiple IT silos, and these disparate data sources make it difficult to gain insight into the critical data that underlies the entire process. As a result, the order-to-cash cycle can be prone to a high degree of risk, making it more important than ever to put in place a set of controls to identify sources of revenue leakage, suspicious activities, and inefficient processes [2].

BUSINESS PROCESSES	CONTROL OBJECTIVES				
	Authorization	Accuracy	Completeness	Validity	Efficiency & Effectiveness
Manage Customers	✓	✓	✓	✓	✓
Order Entry	✓	✓	✓	✓	✓
Manage Pricing	✓	✓	✓	✓	✓
Sales Invoicing	✓	✓	✓	✓	✓
Receipts	✓	✓	✓	✓	✓
Collections	✓	✓	✓	✓	✓
CCM Analytic Coverage	✓	✓	✓	✓	✓

Figure 3. COSO internal controls framework

RESEARCH METHODOLOGY

The literature chapter 2 discuss about information technology of XML based web service and continuous audit concept which we know the CAWS model is still a lack of discussion on how to apply modern Internet techniques to facilitate the implementation of continuous auditing. In our study combines two domain knowledge as the XML technology and continuous audit for complete the research targets. The research methodology based on the meta-research from McCarthy which the information accounting research methodology is inherit the two domains of information technology and information management. In our methodology of used system presentation and implementation which the CAWS model research topics which is classify innovative, constructive and modeling by case study.

The case study is one of key part vendor in the TFT-LCD industry, the company had deployed multi-site manufactory between the Taiwan and China which implement the ERP system about Financial & Accounting, Sale & Orders, Production & Manufacturing, Delivering, Purchasing, Supplier & Chain, Personnel and Warehouse & Inventory and implement business process management which to been linked the business process management (BPM) for system authorization approval. The company had been developed paperless in the all site and used the BPM system to replace artificial signing. In the current time, the audit department was very nervous traditional audit method and business trip to remote site for the auditing, in this way it's too late to find the internal operation risk and effect the timely audit efficiency. We are great to read the continuous audit paper for improve the timely audit by the web services. It is caused us try to implement the continuous audit model. The company has been the completely information system, such as enterprise resource planning (ERP), manufactory execution system (MES), business process management system (BPM), document control center (DCC), human resource management system (HRM) and knowledge management (KM). The more detail information technology infrastructure as figure 4.

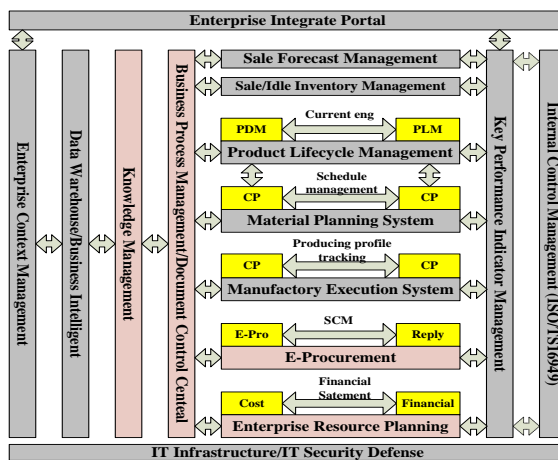


Figure 4. IT infrastructure from case study

An XML-based Web Services Auditing Model

Murthy and Groomer [8] made a continuous auditing web service model sample for continuous auditing in an XML-enhanced computing world and described the context of a hypothetical scenario. Consider an XML-enabled e-commerce sales transaction processing application for an auditee. The specification of verification demand by assurance customers is whether the revenues being report by the audit client are valid. How a sales verification continuous auditing web services would work and provide continuous auditing regarding the revenue amounts being reported by the audit client. The audit client retrieved data from the audit client's sales system on parameters defined at the time the continuous auditing web services was invoked by the continuous audit customer. The data retrieved by the continuous auditing web services from the sales system comprise fields defined as output port types in the web services definition language wrapper of the sales system. The data items from the sales system, the sales verification continuous audit web services in the auditor's system then requests confirmatory data from reference system [8].

In our study refer the Murthy and Groomer (2004) [8] CAWS for sales verification model and revise for closely our practice in the figure 4. There are two product systems to join the prototype building, the Data System ERP control 4 modules as sales system, inventory system, accounts receivable system, accounts general system. The other process management is Agent-Flowing BPM system to control ERP system flow linkage and the control notes mapping the internal control system by the electronic assign (TS2, ISO). All the system have been connected to the WSAL Wrapper and import the ERP transaction data

and Agent-Flow process data into the each XML Based Data Retrieval Component. The Continuous Audit Web Services must be created for each business process, define the audit client's business parameters and specified in the client business process WSDL wrapper. The <input> operation of each CAWS portType must be fed by the <output> portType of the client business process that is being checked by the auditor's CAWS. The audit operation uses the generalized audit software (GAS) for Web Service data detection, such as audit command language (ACL).

The Continuous Audit Process Design

Although this research report has described the continuous audit framework in various aspects Many research previously issued about the continuous audit techniques (CATs) and focused on the use variants of embedded audit model (EAM), discussed how EAM could be employed in the database environment [8]. The continuous auditing implementation in the corporate setting of main objective for who auditors must gather the enough evidence achieved audit risks acceptable. The audit process is necessary conduct test of control and analytical procedures to be like EAM or general audit for gather necessary evidence. In the example, the traditional test of transaction audit objective like existence, completeness, accuracy, classification and timing. In our study use the sale cycle to evidence system prototype available, integrate and complete by the objective audit process. Detail sale cycle audit objectives and control procedures are in the table 1 for mapping the section 2.2 Continuous Auditing Process Criterion.

Audit objectives in sale cycle	Transaction evidence and control procedure
Recorded sale transaction and indeed occur(Existence)	1. Check customer no of invoice whether in the customer data table. 2. The order number whether in the accounts general journal.
Finish recorded sale transaction(Completeness)	Tracking the shipping no, invoice no and account general journal linking.
Accuracy in the record numbers(amount of money)	Recalculating sale incomes which the same with posted it.
Recorded sale transaction in the actual date(timing)	Compare the sale transaction date and shipping date.
Recorded sale transaction in the account received table and accuracy summary(post and summary)	Summary day book amount which tracking a general ledger and accounts receivable.

Table 1. Sale cycle of audit objectives and control procedures

Moreover, on a monthly basis, auditors are used to drive these monthly cycle detection. By the way the audit objective has nothing change the underlying focus for the audit work. Only techniques and methods for gathering the evidence have changed.

The System Prototype Design

We will build an XML-based Web Services prototype and system interface for data retrieval in the session 3.2. The prototyping development need to meet the continuous auditing criterion and XML-based Web Services technology limited. We introduce our case information technology environment and prototyping development tools here.

Prototyping Development tools

Operation System: Windows Based Series Version.

Web Server: IIS

Program Tools: Java Client Application

Application Software: Oracle 9i

Data Retrieval Layer

The layer provides a bridge between the Client and Auditor which contains the data retrieval for CA data preparation. The <input> operation of each CAWS portType must be fed by the <output> portType of the client business process that is being checked by the auditor's CAWS [8]. On a continuous basis, the client generates and stores financial reports (such as the receiving report, perpetual inventory summary, and cash payment summary in our vendor invoice example) and transaction log, and cash-disbursement log in the web services of audit database. The financial report the associate transaction log files are the main

input to the CAWS, the data retrieval mechanism has to implement input the controls to make sure that: (a) the received data are from the right client; (b) the received data are not modified or illegally accessed during network transmission, and (c) the client can't repudiate the data transmitted. The data retrieval layer collects the relevant information and documents from ERP and BPM system. Following the system form is in figure 5.



Figure 5. Data Retrieval Layer

Data Analysis Layer

The data analysis layer consists of the audit database and an audit tool of ACL (Audit Commands language) for supporting verification and analysis of financial reports. The specific field of financial reports and transaction log files are identified and automatically read in the ACL project database. The data analysis layer should adopt certain control procedures to ensure that (a) the transactions comprising the financial reports and transaction logs are complete, and (b) no modification has been made to transactions that have been previously audited.

The ACL audit database and its associated knowledge base are the core in the CAWS to support all fundamental analyses, diagnoses, verification, and exception reporting for typical acquisition cycle, the ACL the associate audit database should include the all applicable GAAP and auditing rules. These rules are used to link accounting metrics to standards for measurement and evaluation. For example, measurement and recognition criteria for inventory, accounts payable, and various expenses for evaluating the system operation, and cutoff tests of accounts payable are included as predefined rules. The extracted data are analyzed and evaluated using these current GAAP and auditing standard for checking appropriateness and accuracy, some typical auditing rules may appear and detect form as below and figure 6:

Rule #1: JOIN PKEY OEA03 FIELDS OEA01 OEA03 OEA032 SKEY OCC01 UNMATCHED TO "join" OPEN PRESORT
 OEA01: Serial NO filed in the Sale Order table
 OEA03: Customer NO filed in the Sale Order table
 OEA032: Customer Name filed in the Sale Order table
 OCC01: Customer NO in the Customer Profile table

Rule #2: JOIN PKEY OGA01 FIELDS OGA01, OGA02, OGA03 SKEY OMA10 UNMATCHED TO "join1" OPEN PRESORT
 OGA01: Serial NO filed in the shipping table
 OGA02: Shipping date field in the shipping table
 OGA03: Customer NO filed in the shipping table
 OMA10: Serial NO filed in the account received table

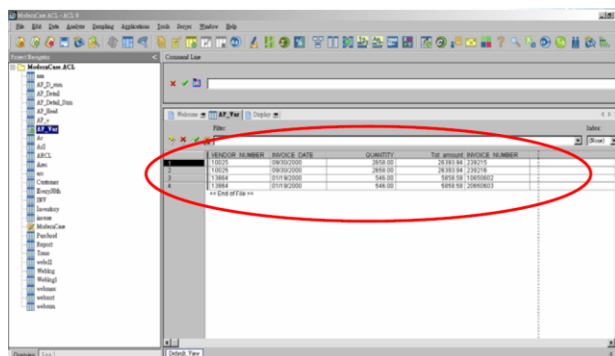


Figure 6. Data Verified

Data Presentation layer

To develop the XML web services to connected the client internal database by the web interface in a continuous environment. The web interface solution uses the JAVA client to complete. The web interface sophisticated the data flows that are specifically system specification fitness. In example of ERP system connected BPM system. The data transmissions have be worked when

the user login to the web services and click the continuous subjective tags which import the joint data into web services database for ACL verify. The data presentation layer provides operational and presentational user interface for the auditor to browse, navigation, and the review final outcome summaries and related accounting information and documents.

CONCLUSION

In our study of CAWS model derived three layers as data retrieve layer, data analysis layer and data presentation layer. First, the data retrieve layer created major components of merging XML web services framework and connected the internal database (ERP system, MES system, BPM system) to retrieve the data which was continuous subjective oriented to collect the data. Second, the data analysis layer used the continuous audit tool as ACL which is almost prefer audit tool for verify the continuous subjective data for business assurance to verify the sample model of sale cycle in the company. The CAWS model to be applied is verified that the internal control implementation within the audit client's system with functioning properly. The CAWS had the interface with the client's system to retrieve the internal database relating to periodic sale cycle data which continuous audit data preparation. The data transmission had been made the XML format documents for the auditor to data transfer by the audit tools (ACL). The auditor used the ACL to analysis the data for the sale cycle subject auditing and completed the data verify in the subtask. The CAWS configured with a series of subjective test transaction of sale cycle and designed to verify the proper operation of internal controls by the ACL within the audit client's system. Finally, the data presentation layer had been received the audit documents and upload it in the web services.

The CAWS was the automatically web-based platform and improvably the data transmission efficient from the auditor to the client. The data retrieve layer could avoid the manipulative error and promote the correctly audit quality for reduce the audit cost from traditionally audit methods to data transmission. In this manner, the control verification CAWS invoked by users whenever business assurance about the functioning of internal controls in the audit client.

Furthermore, Remin and Prather [19] was issued about the XBRL international financial reporting standard (XBRL IFRS) initiative for a common international XML tag set for financial report. The XBRL IFRS specification is intended to integrate with XBRL GL which is a creation of "data hub" that receives XML-based inputs from company's internal accounting system and provides XML-based outputs to systems within or outside the company. The data hub could be used by a company firm to simplify the process of XML information interchange with its audit partner. In our study, the data analysis layer as ACL freely data connected with XBRL format for data import/export with XML data format. The case study model with CAWS efficiently and effectively to reduce the audit cost and improve multi sites audit quality without complicated criteria that the client, the auditor and related third parties [13].

IMPLICATION AND FUTURE RESEARCH

The article proposed an architecture for accomplishing a pull model of continuous auditing which included three layer as data retrieval layer, data analysis layer and data presentation layer for completely build CAWS model. The data analysis layer was the most popular and easy-use audit tool although it worked with the general audit tool of package software. For practice, the majority of Taiwan enterprises have building the manufacture sites across Taiwan to China areas, therefore the business environment need strong continuous audit for assurance business process in this competitive era without timely the XBRL development gaps connected with audit partner. In our study, the CAWS model to been implemented based on continuous audit criterions and applied general audit system as ACL to analysis the verified data. This CAWS model could reduce the system development cost without stringent criteria that the client, the auditor and related third party must be motivated and have the expertise to participate [13]. But it is still need to simply the process data format definitions.

Continuous audit was a comprehensive electronic audit process that enables auditors to provide some degree of assurance on the continuous information simultaneously with, or shortly after, the disclosure of the information. We will continuous to research the CAWS model by this principle which reduce the audit cost in the system development and enhance the audit quantity in the future research, such as compare system implement cost with other model.

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ASSESSING eGOVERNMENT SERVICES QUALITY

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ABSTRACT

The services in the virtual environment or electronic services contain a wide spectrum of operations starting from pure sales via internet to the pure services – free or as the part of service agreement. Electronics services are relatively new kind of activities from theoretical and practical point of view. In that context arise a question what methods should be applied in estimation of public electronic services' quality and what dimensions should be treated as critical. The theoretical framework for public services assessment was developed taking into consideration such theoretical models as SERVQUAL and SERVPERF. The empirical survey was carried out evaluating 3 public services quality in Lithuania. The survey allowed determining users are more tend to give priority to clearness easiness of use, quality of information and technical quality.

Keywords: e-government, public services, services quality

INTRODUCTION

Service quality has been investigated for more than two decades, still, scientific studies in the field of electronic service quality are still in an early stage (Santos, 2003). Taylor Nelson Sofres (2001) in their study determined that approximately 8 billion pounds that could be earned from potential sales via Internet were lost due to low quality of electronic services in 2001. Also, most customers start browsing the World available with a help of Internet, and these people are not inclined to waste their time for low quality services. If customers' dissatisfaction with electronic services grows, this can negatively affect growth of virtual economy (Rust, Lemon, 2001).

Some scientists recommend allocating 70 to 75 percent of electronic business budget for the improvement and development of electronic services (Alsop, 2000; Stepanek, 2000; Waltner, 2000). The reason for such recommendations is the fact than an electronic service is more than order fulfillment, response to inquiries and e-mail communication. R. T. Rust and K. N. Lemon (2001) state that electronic services (generally) and service providers (particularly) reflect the future of electronic commerce. Studies of scientific literature show that most researchers recognize significance of electronic service quality, as a critical factor of electronic service success. J. Santos (2003) distinguished two main reasons for such recognition. First, electronic service quality has a significant impact on customer satisfaction and intentions to use electronic services in future. For example, one of reports for 2002, prepared by *Boston Consulting Group*, reveals that 41 percent of customers, who have had a failure in product or service purchasing online, have abandoned online purchasing absolutely. This report also emphasizes that dissatisfied customers purchasing online spend, on average, much less than satisfied customers. Second, electronic service quality is important for the attraction of perspective customers. Willingness/intention to purchase products or services via Internet of customers not purchasing via Internet is induced by electronic service quality, especially such aspects as transaction security, service personalization, Internet site availability.

ELECTRONIC SERVICES' QUALITY

Primarily, electronic service quality is different from the one of traditional services because electronic services differ from electronic services. Due to this fact, before speaking about electronic service quality it must be reviewed what is an electronic service and what are their characteristics.

Recognition of the electronic service (e-service) concept has been increasing among practitioners and scientists fore some time past. An e-service can be defined as a service in the virtual space (Rust, Lemon, 2001). J. Reynolds (2000) states that an electronic service, or e-service, is a service based on the help provided by an Internet site. According to K. De Ruyter, M. Wetzels, and M. Kleijnen, (2000), electronic service is an interactive, content-oriented and Internet-based customer service, driven by the customer, and which is integrated with organizational customer retention processes and technologies in order to strengthen the customer-service provider relationship. Electronic service, according to Z. Rahman (2004), is a service provided online using telecommunication and multimedia technologies. Besides, H. Surjadjaja, S. Ghosh and F. Antony (2003) argue that the electronic service concept is not just a combination of words "electronic" and "service". In the real electronic service process, all communication between the service provider and the customer, or a part of this communication proceeds via Internet, for instance, when a ticket is purchased via an Internet site.

Analyzing electronic service quality, it is important to consider the fact that these services are different from traditional services. The importance of direct customer's interaction with the service provider decreases in the electronic service provision process, because such interaction almost doesn't exist.

According to A. van Riel et al. (2001), research in the field of electronic service quality is still in an early stage. Two main attitudes to electronic service quality research are identified at this time. The first one is oriented to the technological link,

through which electronic services are provided (Dabholkar, 1996; Lociacono, Watson, Goodhue, 2000; Webb, Webb, 2004). Based on another attitude, scientists study electronic service quality from the perspective of existing traditional service quality theories (Grönroos et al., 2000; Parasuraman, Zeithaml, Malhotra, 2005; Santos, 2003).

One of the first definitions of electronic service quality was suggested by V. A. Zeithaml, A. Parasuraman, and A. Malhotra (2000). This definition states that service quality in the Internet is the scope, to which an Internet site facilitates an effective and efficient shopping, and product/service purchase and delivery. Scientist (Gummerus et al., 2004; Frassnacht, Koese, 2006) criticize this definition in recent years, stating that it encompasses a too narrow field of electronic services, i.e., only the Internet shopping. Also, only the importance of an Internet site in electronic service provision is identified in the definition. Certainly, an Internet site is important, as it is a visible link of electronic services with the customer. However, technical infrastructure and aspects of electronic service provision invisible for the customer are also important. Their importance particularly increases, when the time for service fulfillment comes.

J. Santos (2003) defined electronic service quality as a general customers' evaluation and opinions about the expertise of electronic service provision in the virtual market. One of the newest and most acceptable definitions of electronic service quality was presented in August, 2006. According to M. Frassnacht, I Koese (2006) electronic service quality is the degree, to which electronic services can meet most significant needs of the customer effectively and efficiently (this is a modification of the definition presented by V. A. Zeithaml, A. Parasuraman, and A. Malhotra (2000)).

After an analysis of scientific literature the hierarchical model of M. Frassnacht ir I. Koese (2006) was selected in this work, as the basis of conceptual model for the evaluation of quality of electronic public services. The selection was condition by the fact that earlier evaluation models encompass only a narrow part of electronic service evaluation, i.e., only customer link (service provider's Internet site) quality evaluation, whereas this model encompasses quality of the customer's link, service and its provision process, as well as quality of service purchasing.

Another advantage of this model is the fact that it is intended for an evaluation of quality of various electronic services. This model has already been tested in cases of three different business-to-customer electronic services: personal Internet site creation and support service (pure service), sport news provision service (information provision), and an electronic shop of electronic equipment (product selling).

However, though studies performed by authors supported the model's suitability for the evaluation of quality of analyzed services, its suitability for the quality evaluation in cases of business-to-business or electronic services is not known. According to authors' view, a universal adoption of the model can be also limited by the fact that the model has been tested only in one state, Germany.

This work intends to adopt the model for the evaluation of quality of electronic public services. The model's review reveals that two of nine subdimensions suggested by the M. Frassnacht ir I. Koese (2006) hierarchical model are not relevant in the evaluation of quality of electronic public services, namely, *selection attraction* (determines the level, to which to which the available selection variety attracts and appeals the customer) and *functional benefit* (the scope of service conformity with itself). As it has been stated in the first chapter, electronic public services mean provision or reception of information and documents by physical or (and) legal persons, determined in legal acts issued by state or municipal institutions. A selection variety enabling the customer to chose if he needs a particular service or not does not exist in the case of these services. The only thing he can choose is using the service online, or in traditional ways. Practically, these services don't always conform to their purpose, therefore, an evaluation of the *functional quality* subdimension loses its meaning. The conceptual model for the evaluation of quality of electronic public services is presented in Figure 1.

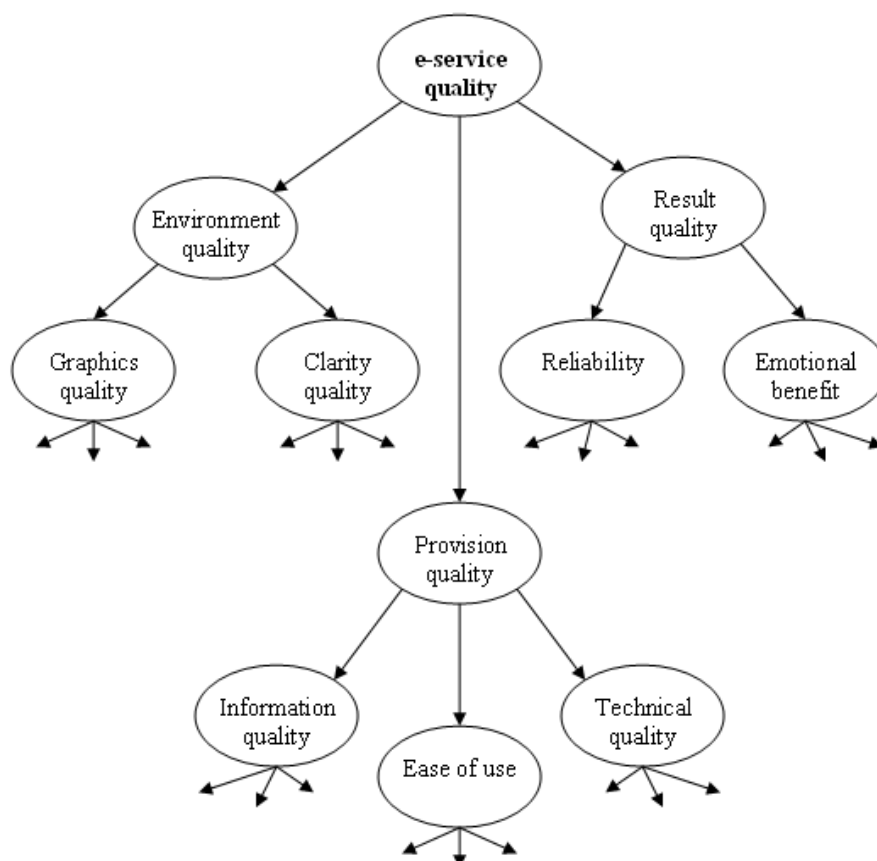


Figure 1: Conceptual model for the evaluation of quality of electronic public services

Statements (there are 33 statements, because 6 statements related to selection attractiveness and functional quality have been removed from the original model of M. Frassnacht ir I. Koese (2006)), dedicated to obtain numerical values of 7 subdimensions and a total value of the electronic public service quality evaluation. The design of the model has been based on results obtained in the analysis of scientific literature. Therefore, the model is theoretical and its suitability for practical application was investigated.

PUBLIC SERVICES IN LITHUANIA QUALITY ASSESSMENT

Research Methodology

The developed conceptual model was used to evaluate public services in Lithuania. The empirical research was oriented towards three services.

Research problem: can the designed conceptual model for the evaluation of quality of electronic public services be applied in practice?

Research purpose - to perform an empirical research of possibilities for an application of the conceptual electronic public service model in cases of public electronic services characterized by three different maturity levels.

Research object - evaluation of quality of electronic public services characterized by three different maturity levels.

Three different services provided by Lithuanian public institutions were selected for the empirical investigation:

- Issue of a passport of a citizen of the Republic of Lithuania. Customers can receive information about terms and places where they can get a passport, and about required documents, using electronic means. Customers can download standard forms of application to issue a passport of a citizen of the Republic of Lithuania in MS Word or Adobe pdf format. This is an electronic service of the first maturity level (if there was a possibility to fill the downloaded form and deliver to the Migration Service, this would be a service of the 2nd mature level). Service Internet link: <http://www.epaslaugos.lt/index.do?node=324>
- Services of public libraries. Search of issues present in archives of large Lithuanian cities can be performed in Internet at this time. Also, desired books can be ordered. You just have to arrive to the library later and receive ordered books, presenting a reader's certificate, for reading in the reading-room or at home (if selected books are allowed to take way from the library). This is an electronic service of the third maturity level. Service Internet link: <http://www.libis.lt/>
- Delivery of the annual income declaration for the State Tax Inspectorate. Declaration are accepted by the Inspectorate in electronic form, through EDS (Electronic declaration system) since 2004. With a help of this systems, customers can deliver their declarations without a need to walk away from their computers. This is an electronic service of the fourth

maturity level. Service Internet link: <http://deklaravimas.vmi.lt/PublicPages.aspx>

Research hypotheses:

H1: Respondents will give quite low scores for the graphical quality, but they will evaluate the clarity quality better, therefore, total evaluations of environment quality will not be low (public institutions creating their Internet sites pay more attention to site functionality, not attractiveness and beauty)

H2: Presentation quality in different maturity levels is evaluated differently (customers of electronic services sometimes don't understand that value of provided services is not always equal, if levels of their transfer to the electronic media are different, and they want equal ease of use and simplicity)

H3: The emotional benefit subdimension of the result quality dimension is the element of electronic public services receiving lowest scores (the use of electronic services by customers is more stimulated by necessity than by willingness. In case of electronic services, customer experiences positive feelings, knowing that he has avoided the necessity to visit a public institution, or at least has reduced the visit duration and has saved some time. However, the using a service does not cause many positive feelings on its turn).

Research method selection. A quantitative method was selected for the investigation. This method enables to select particular research aspects and motives beforehand. Besides, data of a quantitative research enable comparison of relative significance of investigated aspects, in this case - different quality aspects.

Data collection method selection. Considering the fact that customers are going to evaluate service quality, when the model is applied, as they fill their questionnaires, questionnaires with analogical structure have been chosen for the survey. Survey questionnaires were presented in the Internet site www.apklausa.lt. The decision to present questionnaires in the Internet was determined by the fact that the evaluation of quality of electronic services, i.e., services provided in the virtual environment was studied. Customers who use Internet were surveyed this way, and there was no need to waste time with answers of customers who don't use Internet.

Respondent selection. Internet addresses of questionnaires were not promoted purposefully and were not sent to any particular potential respondents, consequently, they were filled by interested visitors of the site www.apklausa.lt.

Questionnaire composition. A separate questionnaire was designed for each case of evaluation of quality of electronic public services. Questionnaire composition was based on the conceptual model for the evaluation of quality of electronic public services presented in the theoretical part of this work. The questionnaire consisted of 33 statements, which were grouped according to subdimensions:

- Graphical quality - 5 statements;
- Clarity quality - 3 statements;
- Information quality - 4 statements;
- Ease of use - 6 statements;
- Technical quality - 5 statements;
- Reliability - 4 statements;
- Emotional benefit - 3 statements;
- General quality - 3 statements.

Short descriptions of services investigated by a particular questionnaire were presented in the preamble of each questionnaire, and Internet sites to reach these electronic public services were presented. Formulation of statements in each questionnaire was adapted for particular services.

Respondents were asked to give 1 to 9 points for statements, where 1 is the lowest score, and 9 is the highest score. Respondents could just select the score, not to write it (for questionnaires were not spoiled, writing higher or not whole numbers).

MS Excel program was used for obtained data processing, which is a popular tool enabling presentation of analysis results in the form of various diagrams.

RESEARCH RESULTS

Response rate in two weeks, when questionnaires were presented in the Internet site www.apklausa.lt, was as following: 123 respondents completed the questionnaire on the service of Lithuanian citizen passport issuing, 145 - the questionnaire on e-services of public libraries, 108 - the questionnaire on annual income declaration delivery through RDS system. Totally, data from 376 questionnaires are analyzed.

Environment quality dimension. This dimension is related to the appearance of customer's link, and two dimensions have been attributed to it: graphics quality and clarity quality. *Graphics quality* determines how properly customer link components are expressed visually for example, text, icons, digital images or background). Clarity quality determines the degree to which customer link design structure helps the customer to understand what he wants.

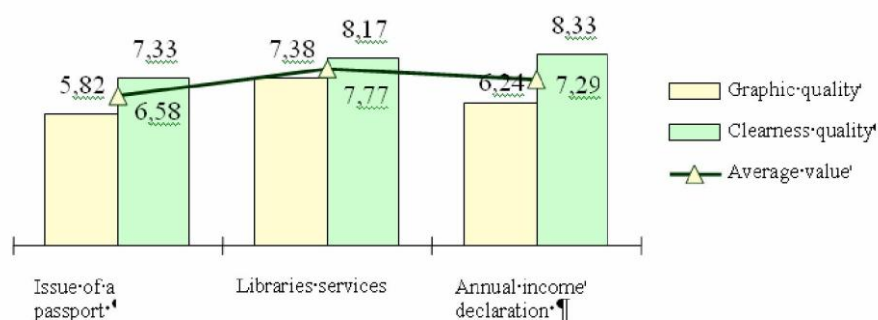


Figure 2: Values of sub dimensions of Environment quality dimension and their average (points, in the scale 1 to 9)

The 2 figure shows that respondents evaluated *graphical quality* of all services lower than clarity quality. As it is seen after the review of all sub dimensions, only emotional benefit sub dimension is scored lower. Graphical quality of the public service related to Lithuanian citizen's passport issue received the lowest score among all three services from respondents – 5,82 point. Likely, respondents, most of which are men, as it was mentioned earlier, didn't pay much attention to the appearance and attraction and they are not inclined to score these graphical quality aspects high. Respondents gave highest scores for graphical quality of electronic services provided by public services, among three evaluated electronic services – 7,38 point. Such a high score can be influenced by the fact that libraries are objects of culture and they care about visual expression of Internet sites more than public institutions, therefore, respondents score graphical quality aspects of these services higher than respondents evaluating quality of other services.

Clarity quality was scored higher than graphical quality. Among all three evaluated services, respondents who evaluated quality of electronic services related to Lithuanian citizen's service issue gave lowest scores for clarity quality, as in the case of graphical quality evaluation. However, the score is higher than the score given by respondents for general service quality. This shows that respondents score clarity quality in the case of this service higher than general quality. Declaration delivering clarity quality was scored higher (8,33 points). This shows that, though the Internet service created by the State Tax Inspectorate for the EDS system through which the mentioned service is delivered is not attractive, everything is presented clearly in it. Values obtained after calculation of average values of graphical quality and clarity quality sub dimensions show environment quality of electronic services provided by libraries has received highest scores, and quality of electronic services related to Lithuanian citizen's passport issue has received lowest scores.

Provision quality dimension is related to customer's communication with an Internet site during service usage, therefore, it includes various aspects important for customers when they search for information, select from available options and purchase services. This dimension encompasses sub dimensions information quality, ease of use and technical quality. Subdimension *information quality* encompasses the scope of comprehensiveness, accuracy and timeliness of information provided for the customer (e.g., product descriptions, payment terms or frequently asked questions). *Ease of use* characterizes the functionality level of customer's link as the customer seeks for the electronic service. The third subdimension, technical quality, reflects quality of data transmission and data processing in the process of service provision. Values of these subdimensions calculated according to respondents' scores are presented in Figure 3.

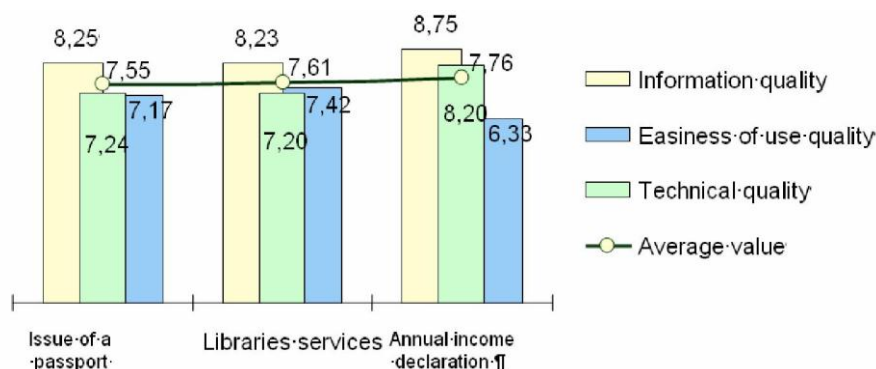


Figure 3. Values of sub dimensions of provision quality dimension and their average (points, in scale 1 to 9)

As Figure 3 shows, respondents of the survey have given highest scores for the information quality sub dimension in all cases – all average scores are higher than 8 points (of 9 possible). This shows that providers of electronic services evaluated in this work take care of novelty, clarity, comprehensiveness, and accuracy. As it was in the case of clarity quality sub dimension, respondents gave highest scores for annual declaration delivering service provision quality (8,75 points). This affirms that concern of the State Tax Inspectorate that has created the site for EDS system, through which the mentioned service is provided, about provision

comprehensive, accurate and clear provision of information for system users is valued by customers. Another sub dimension, ease of use, is scored a little lower than the general average of provision quality dimension quality. This means that service providers should find the way to make using services easier for customers. Respondents scored this sub dimension lowest in the case of annual income declaration electronic service (6,33 points). The score is very low, because respondents don't think that using this service is easy. This sub dimension was scored highest (average – 7,42) by respondents using electronic services of public libraries. It is likely that most respondents use these services often, and they are used to the system, therefore, using services seems easy to them. However, there was no question in the questionnaire about service usage frequency of respondents, therefore, it is impossible to prove this opinion.

Technical quality sub dimension was scored highest on the case of annual income declaration delivering electronic (8,20 points). This can be caused by the belief of EDS system users that data transmission is secure, because service provider is the State Tax Inspectorate. Also, customers of this service scored data transmission security much higher. They evaluated other statements almost the same, as respondents who evaluated quality of two other services.

Result quality dimension. In the conceptual model, *result quality* refers to the outcome that the customer receives with service provision. This dimension is expressed in two sub dimensions: reliability and emotional benefit. Reliability is the scope to which the service provider keeps its promises. It must be noted that this sub dimension does not include reliable infrastructure operation, because this field is encompassed by technical quality sub dimension. And *emotional benefit* means the scope of positive feelings caused by the service.

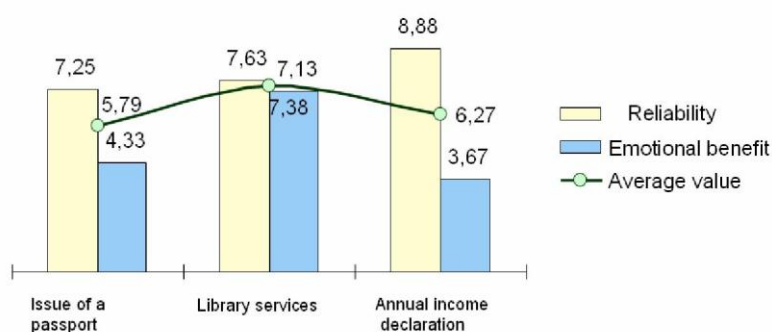


Figure 4. Values of subdimensions of result quality dimension and their average (points, in scale 1 to 9)

Data presented in Figure 4 show that, according to the respondents' opinion, reliability of Lithuanian electronic public services is high. They gave highest scores for annual income declaration delivering service reliability. This is likely more related to customers' belief that the State Tax Inspectorate has to fulfill services it provides fast and reliably than to reality. Among all three evaluated electronic services, respondents scored reliability of electronic services related to Lithuanian citizen's passport issue lowest. This result was conditioned by especially low scores of the statement "service provision is such as you want". It can be assumed that customers of this service expect more than just information; therefore, they feel disappointed when their expectations are not met.

Emotional benefit in all cases, as it was mentioned before, received lowest scores from respondents. Lowest scores were given in the case of annual income declaration delivery – 3,67 points. This shows that usage of this service does not cause many positive emotions for customers. Emotional benefit of electronic services provided by public libraries had highest cores – 7,38 points. This is understandable, because usage of library services is caused by necessity only in very rare cases, customers use these services voluntarily, and their usage on Internet causes positive feelings.

FUTURE RESEARCH DIRECTIONS

Summarizing the completed research, it can be stated that the conceptual model of quality of electronic public services is suitable for application in the evaluation of electronic public service quality. Still, presentation of statements dedicated for evaluation of total quality for respondents is questionable, because evaluations of these statements seem biased. Current research was focused in G2C area, unless the future research should take into consideration and G2G, G2B areas.

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E-BUSINESS SERVICE SEMANTIC CLASSIFICATION AND RETRIEVAL

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ABSTRACT

In this work we provide an initial analysis of e-business service classification and retrieval. We present a process of associating e-business services with ontologies and show how the process can be similarly used for e-business service retrieval. The semantic understanding of business services may provide added value through the creation of new compositions of services. We analyze two common methods for text processing, TF/IDF and context analysis. We also compare the use of service description as a means for free text retrieval of categorized WSDL description of web service. Our initial results indicate that context analysis is more useful than TF/IDF and that free textual descriptions can be used for retrieval of categorized WSDL description using similar processes.

Keywords: e-service, classification, retrieval, semantic

INTRODUCTION

Electronic businesses today are increasingly developing new systems and services based on existing components. Services based on extant software resources supply immediate value creation to an organization. An electronic business can utilize the advantages of using existing Web services to build new applications. Standards for Web services, such as WSDL, are already available. However, the problem of identifying and integrating e-Services is a challenging task. We present semantic methods to enable businesses to classify existing modules to facilitate their integration into new services: the process of associating services with ontologies. Service classification is an important pre-processing step for tasks such as service composition and rapid e-business construction.

Services are autonomous code packages, which can be utilized by businesses to provide e-Services through the Internet. These units were independently developed and hence are characterized by different platforms, programming languages, and interfaces. This lack of homogeneous structure requires a method that defines the automatic communication between services so as to enable the integration between them.

However, as communications protocols and message formats become standardized in the web community, it is increasingly possible and important to be able to describe the communications in some structured manner. For example, WSDL addresses this need for standardization by defining a grammar that describes network services as collections of communication endpoints able to exchange messages. WSDL service definitions supply documentation for distributed systems and provide guidelines for automating the process of applications communication.

Previous methods based the process of matching services on annotated textual description. Works on service integration focused on various aspects of the problem. The issue of interface heterogeneity was addressed by the use of semantic web services. Using languages such as OWL-S [1], the scope of Web services is extended with an unambiguous description by relating properties such as input and output parameters to common concepts and by defining the performance characteristics of the service. The concepts are defined in *Web ontologies* [2], which serve as the key mechanism to globally define and reference concepts. Service composition through planning (in the AI sense) was introduced [12, 3] to manage the complexity of the problem.

In [21] and [20], it is argued that the process of service composition may have an exploratory nature rather than one of planning. Therefore, it is often the case that only partial solutions to composer requirements exist, as Web services are created autonomously without any a-priori knowledge of their intended use.

Furthermore, composer requirements may not be well-defined. Rather, they may be driven by the availability of Web services. This type of usage requires iterative composition and selection of partial services, rather than the design of the complete composition. In an attempt to support exploratory composition, an

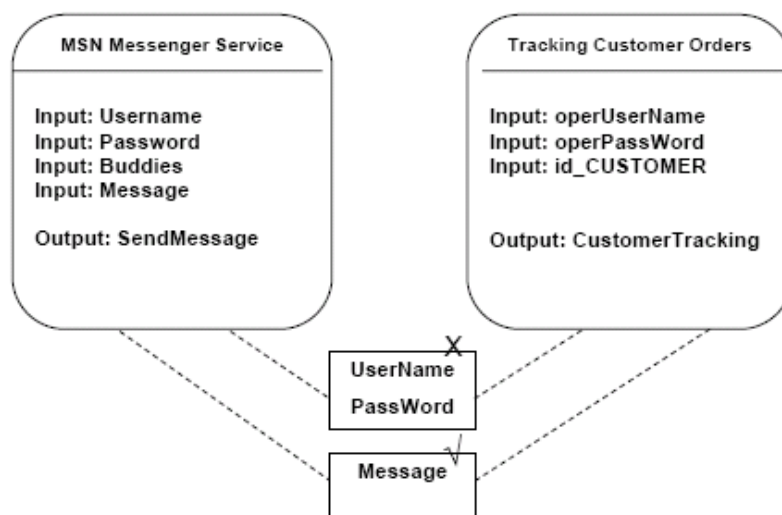


Fig. 1. Unite service example

engineering approach was taken to provide *approximate service retrieval*, in which the best effort composition is followed by “gluing” services together using some additional programming work.

Since these methods do not address semantical meaning, the matching of services (*e.g.*, for the purpose of composition) may provide semantically incorrect results, especially in the creation of new business services that seek to integrate existing modules. This problem was addressed by [6]. They presented a general method of associating semantic meaning with services in an ontology so as to facilitate better matching.

This paper focuses on the critical element of semantical meaning that promotes better matching. We present electronic businesses with a semantics-based method that allows the identification of existing services that can be integrated to create new applications for the organization’s benefit. By identifying the existing services that can be integrated, we enable the more rapid and more complete construction of new business applications.

Take, for example, two real-world Web services, illustrated in Figure 1. The two services, *MSN Messenger Service* and *Tracking Customer Orders*, share some common concepts, such as the *UserName* and the *PassWord* concepts. These two services originate from very different domains. The first is concerned with business and the second with communication. These two services might be considered for a meaningful composition: a business might be interested in tracking customer orders using the MSN messenger service. However, this example demonstrates that methods based exclusively on mapping the concepts to the service’s parameters (such as in [14]) may yield inaccurate results. In our example, the *UserName* and the *PassWord* concepts represent totally different organizational points of view. In the *Tracking Customer Orders* the username represents the system operator who is tracking the client. Conversely, in the *MSN Messenger Service* the username and password represent the calling user. We expect that the two services will share the *Message* that is transferred between them, the output from the one service acting as the input to the other. However, only one service carries this concept and thus we seek to link between the services and offer businesses the possibility of combining the two services.

Therefore, in this work we propose to implement in the field of business the use of *service classification* and *service retrieval*. Service classification defines a process that classifies a service to a set of concepts (or an ontology) that represents a domain. Service retrieval represents a similar process that can extract relevant business services based on free textual description. The classification and retrieval of services to and from their respective domains can be used to classify the validity of the service composition and to rule out compositions of unrelated services. We present methods that spotlight possible compositions of innovative business services using existing ones.

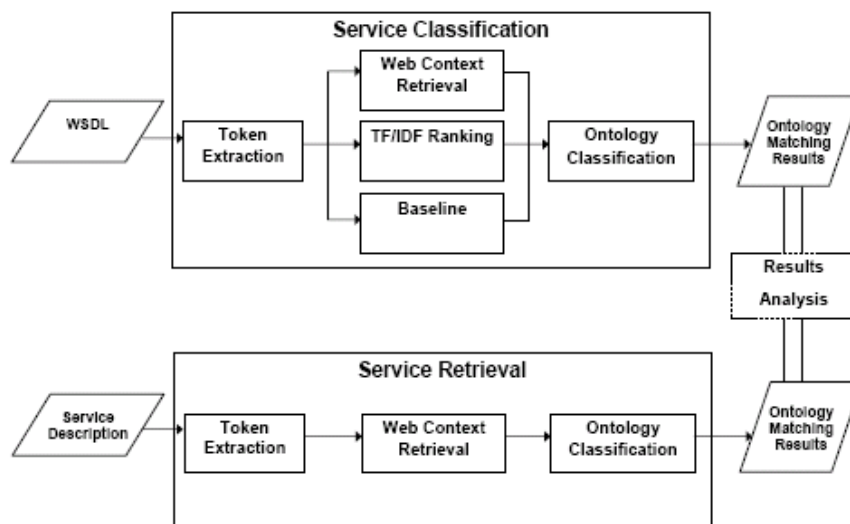


Fig. 2. The similar business service classification and business service retrieval processes

We provide a preliminary study, showing how e-business service semantic classification and retrieval can be performed based on the use of two known methods, TF/IDF [18] and context generation [19]. We propose a three dimensional classification of methods for associating a Web service with an ontology concept and provide a similar technique for the retrieval of Web services. We present partial experiments to test various combinations of these known methods for the classification and retrieval, using a real-world data set. Our analysis indicates that context analysis is more useful than TF/IDF for WSDL classification and that context analysis can be used for free textual description e-service retrieval.

The rest of the paper is organized as follows. Next we provide a simple model for service classification and service retrieval using the three dimensional classification. In following section we present the design and results of the experimental evaluation of our work. The next section describes related work. Finally, the last section concludes the research and provides directions for future work.

BUSINESS SERVICE CLASSIFICATION AND RETRIEVAL

Overview

In this section, we describe how the business process can utilize the model described in [6] to categorize new business services and to search for existing e-business services. We examine each business process from two points of view. One point of view is based on the syntactic properties of the service that will be associated with an ontology concept. The other point of view is the textual description of a service which can also be associated with an ontology concept. Figure 2 details the stages of the e-service classification on the top process flow. The bottom business process flow portrays the textual service retrieval stages. For the classification process, different evaluation methods are used. Since web services usually appear with both a WSDL document describing the syntactic properties of the service interface and a textual description, we can separate these two descriptions and treat them as distinct inputs. We can then analyze and compare the results - the ontology concepts to which each of the two processes maps.

Figure 3 depicts an example of these two descriptions. The top describes the syntactic properties of the TrackingAll e-business service. The bottom includes the textual description that accompanies this service. The spelling mistake in the original textual description emphasizes the difficulties associated with the business service classification and retrieval process.

Three methods were used for the analysis of the e-business service classification: TF/IDF, Web context extraction, and a *baseline* for evaluation purposes. The Web context extraction method was also used for the

business service retrieval. The baseline method is a simple reflection of the original bag of tokens extracted from the service descriptions. The basic data structure used by all the methods is a ranked bag of tokens, which is processed and updated in the different stages. After the different analysis methods were applied, the final classification and retrieval are obtained by matching the bag of tokens to the concept names, attributes, and documentation of each of the ontologies.



Fig. 3. Example of the tracking customer orders service

Service Classification Analysis

The service analysis is based on token extraction, representing each service, S , using sets of tokens, called *descriptors*. Each token is a textual term, extracted by simple parsing of the underlying documentation of the service. The descriptor represents the WSDL document, formally put as $D_{wsdl}^S = \{t_1, t_2, \dots\}$. WSDL tokens require special handling, since meaningful tokens (such as parameter names and operation names) are usually composed of a sequence of words, with the first letter of each word capitalized (*e.g.*, setCustomerPermission) or separated by an underscore (*e.g.*, CUSTOMER_Username). Therefore, the tokens are divided into separate tokens. The tokens are filtered using a list of *stop-words*, removing words with no substantive semantics. For instance, the tokens *get*, *response*, and *result* are common in many WSDL documents.

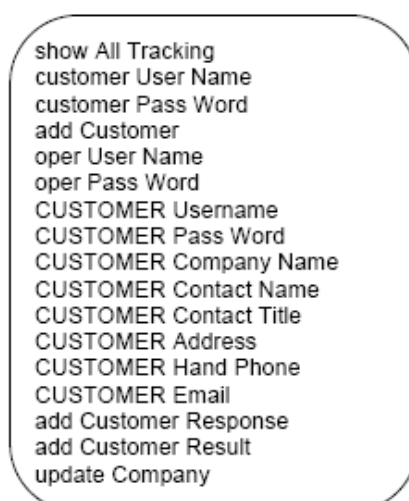
An illustration of the baseline token list is depicted in Figure 4. These tokens were extracted from the WSDL document. All elements classified as name were extracted. The sequence of words was expanded as previously mentioned using the first capital letter of each word or underscore separating the words.

Service Retrieval Analysis

We analyze the service retrieval based on the textual descriptions accompanying each of the services. These textual descriptions vary in length from a sentence to a paragraph describing the service. The textual descriptions are usually released with the e-business service. Since these free text descriptions are written by the service developing party we assume they most accurately define the service concerned.

The service retrieval analysis is based on similar token extraction, representing each service query, S , and using the *descriptors*, sets of tokens. Each token is a textual word from the query, extracted by parsing the documentation of the service according to space separators. The query service descriptor, $D_{query}^S = \{t_1, t_2, \dots\}$, represents the textual description of the service.

An example of the query descriptor tokens would be all of the words appearing in Figure 3 bottom. The original spelling of the description, including the spelling mistakes, was kept in order to represent similar query conditions.



```

show All Tracking
customer User Name
customer Pass Word
add Customer
oper User Name
oper Pass Word
CUSTOMER Username
CUSTOMER Pass Word
CUSTOMER Company Name
CUSTOMER Contact Name
CUSTOMER Contact Title
CUSTOMER Address
CUSTOMER Hand Phone
CUSTOMER Email
add Customer Response
add Customer Result
update Company

```

Fig. 4. An example of the baseline representation of the customer order service

Analysis Methods

In this section we describe the two methods used for the classification and retrieval of the e-business services, TF/IDF and context extraction, and present the motivation for choosing these two methods. Nevertheless, this choice is more or less arbitrary. Other methods for text extraction from the vast literature of Information Retrieval (IR) [16] and Machine Learning (ML) [13] can be used.

TF/IDF Analysis TF/IDF (Term Frequency / Inverse Document Frequency) is a common mechanism in IR to create a robust set of representative keywords from a corpus of documents. The method can be applied here separately to the WSDL descriptors and the textual descriptors since the linguistic characteristics of the

two document types are very different. By building an independent corpus for each document type, irrelevant terms are more distinct and can be eliminated with a higher confidence. In order to formally define TF/IDF, we start by defining $freq(t_i, D_i)$ as the number of occurrences of the token t_i within the document descriptor D_i . We define the term frequency of each term as:

$$tf(t_i) = \frac{freq(t_i, D_i)}{|D_i|}$$

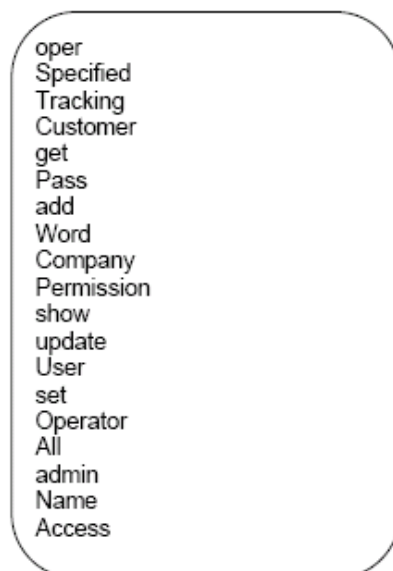
We define \mathcal{D}_{wSDL} to be the corpus of WSDL descriptors and \mathcal{D}_{query} to be the corpus of textual descriptions. The inverse document frequency is calculated as the ratio between the total number of documents and the number of documents that contain the term:

$$idf(t_i) = \log \frac{|\mathcal{D}|}{|\{D_i : t_i \in D_i\}|}$$

Here, \mathcal{D} is defined generically, and its actual instantiation is chosen according to the origin of the descriptor. Finally, the TF/IDF weight of a token, annotated as $w(t_i)$ is calculated as:

$$w(t_i) = tf(t_i) \times idf^2(t_i)$$

While the common implementation of TF/IDF gives equal weights to the term frequency and inverse document frequency (*i.e.*, $w = tf \times idf$), we have chosen to give higher weight to the *IDF* value. The reason behind this modification is to normalize the inherent bias of the *TF* measure in short documents [17]. While traditional TF/IDF applications were concerned with verbose documents (such as books, articles and human-readable Web pages), WSDL documents and the textual description of services are relatively short. Therefore, the frequency of a word within a document tends to be incidental, and the document length component of the TF generally has no impact.



oper
Specified
Tracking
Customer
get
Pass
add
Word
Company
Permission
show
update
User
set
Operator
All
admin
Name
Access

Fig. 5. An example of the TF/IDF high scored list of the customer tracking service

The token weight is used to induce ranking over the descriptor's tokens. We define the ranking using a precedence relation $\preceq_{tf/idf}$, which is a partial order over D , such that $t_l \preceq_{tf/idf} t_k$ if $w(t_l) < w(t_k)$. The ranking is used to filter the tokens according to a threshold which filters out words with a frequency count higher than the second standard deviation from the average frequency. The effectiveness of the threshold was validated by our experiments. Figure 5 presents the list of tokens which received a higher weight than the

threshold. Several tokens which appeared in the baseline list (see Figure 4) were removed due to the filtering process. For instance, words such as “Response” and “Result” received below-the-threshold TF/IDF weight, due to their high frequency.

Context Extraction The extraction process uses the World Wide Web as a knowledge base to extract multiple contexts for the tokens. Extraction is used to filter out biased tokens, to provide a more precise ranking, and to extend the service descriptors. The algorithm input is defined as a set of textual propositions representing the service description. The result of the algorithm is a set of *contexts* - terms that are related to the propositions. The context recognition algorithm was adapted from [19] and consists of the following three steps:

1. **Context retrieval:** Submitting each token to a Web-based search engine. The contexts are extracted and clustered from the results.
2. **Context ranking:** Ranking the results according to the number of references to the keyword, the number of Web sites that refer to the keyword, and the ranking of the Web sites.
3. **Context selection:** Finally, selecting the set of contexts for the textual proposition, defined as the *outer context*, \mathcal{C} .

The algorithm can formally be defined as follows: Let $\mathcal{D} = \{P_1, P_2, \dots, P_m\}$ be a set of textual propositions representing a document, where for all P_i there exists a collection of descriptor sets forming the context $\mathcal{C}_i = \{\langle c_{i1}, w_{i1} \rangle, \dots, \langle c_{in}, w_{in} \rangle\}$ so that $ist(\mathcal{C}_i, P_i)$ is satisfied. In our case the adopted algorithm uses the corpus of WSDL descriptors, \mathcal{D}_{wSDL} , as propositions P_i , and the contexts describing the WSDL as tokens c_i with their associated weight w_{i1} . McCarthy [11] defines a relation $ist(\mathcal{C}, P)$, asserting that a proposition P is true in a context \mathcal{C} . The context recognition algorithm identifies the outer context \mathcal{C} defined by:

$$ist(\mathcal{C}, \bigcap_{i=1}^m ist(\mathcal{C}_i, P_i)).$$

The input to the algorithm is a stream, in text format, of information. The context recognition algorithm output is a set of contexts that attempts to describe the current scenario most accurately. The algorithm attempts to reach results similar to those achieved by a human when determining the set of contexts that describe the current scenario (the Web service in our case). For example, Figure 6 provides the outcome of the Web context extraction.

One of the most interesting properties of the Web context extraction analysis is its ability to add new, relevant, words. For example, the algorithm removed the word “tracking,” which appeared in the baseline and the TF/IDF token lists, and introduced the words “marketing” and “shipping” which are more relevant to the business domain (for which the service actually belongs). This is an example of the advantages the Web context extraction approach has over the TF/IDF and baseline approaches.

Ontology Matching In this final step the semantically extracted token set can be treated similarly in both the service classification and the service retrieval processes. This step matches the finalized semantically extracted token set with the ontological concepts. Let O_1, O_2, \dots, O_n be a set of ontologies, each representing different domain knowledge. We provide a simplified representation of an ontology as $O \equiv \langle C, R \rangle$, where $C = \{c_1, c_2, \dots, c_n\}$ is a set of concepts with their associated relation R .

In order to evaluate the matching of the concepts with the service descriptor, we use a simple string-matching function, denoted by $match_{str}$, which returns 1 if two strings match and 0 otherwise. We define S as the service, and recall that D^S is the service descriptor. Also, we define n to be the size of D^S . The overall match between the ontology and the service is defined as a normalized sum of the concept matching values:

$$match(S, O_i) = \frac{1}{n} \sum_{c_j \in O_i} \sum_{t_i \in D^S} match_{str}(t_i, c_j)$$

To conclude our example, in the baseline and the TF/IDF analysis, the two services mentioned in Section 1, the MSN Messenger Service and the Tracking Customer Orders process, were mapped to the same ontology

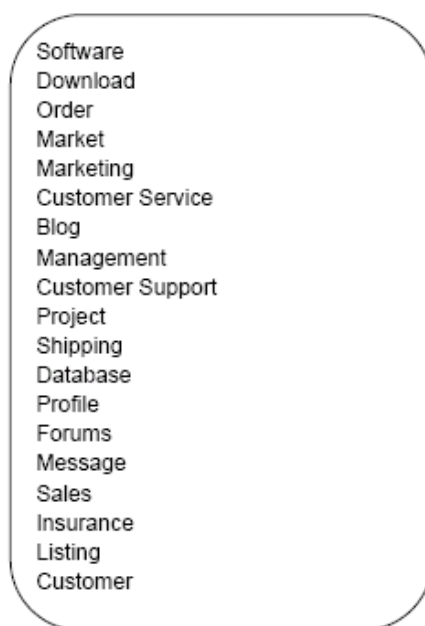


Fig. 6. An example of the web context

based on User and Pass, which are misleading descriptors in this case since one relates to the *business* ontology and the other to the *communication* ontology. Using context analysis, they were matched together not only to the same ontology but also under the same ontology concept - *Message*.

Discussion

The e-business service classification described in the service description supplied by the service developer and service provider is inefficient in specifying the classification, due to the perspective of the developer and provider and the terms they use. Another problem is that the developer is not aware of all the existing ontologies and all their concepts when providing a service. Furthermore, the provider cannot be forced to supply a detailed description. These textual descriptions usually consist of a bare minimum of information, which sometimes does not add to the understanding of the service.

The technique of e-business classification and retrieval proposed here can enable companies and applications to quickly, easily, and dynamically find and use Web services over the Internet, thus promoting the better exploitation of existing web services. This technique comprehensively addresses the problems of web service development through the re-use of existing autonomous code packages.

An important feature is that the model is not industry-specific. The model can be implemented in any field due to its ability to extract tokens based on knowledge retrieved from the Internet. Any industry, worldwide, offering products and services can benefit.

The model makes it possible for businesses to quickly identify web services which can be composed. Using the model of web service classification and retrieval new services can be created based on existing classified services. Additionally the model can suggest to the business solution developer possibilities that previously had not been thought of.

This model has a number of immediate benefits for businesses. The use of existing web services to compose new services enables the conservation of valuable organizational resources and promotes the speed of development of these new services. It allows businesses to invoke existing Web services to comprise new ones - so as to provide added value to their customers.

We conclude this section with a worst case performance analysis. The complexity analysis of the TF/IDF method yields $o(mn)$, where m is the number of WSDL documents and n is the number of tokens. The complexity of the context Web-based method is $o(an)$, where n represents the number of input cycles, such

as each line of text. The a represents a constant limiting of the number of top ranking results from each cycle of the algorithm. The context method performance execution time is higher than the TF/IDF, since it needs to access the Web search engine for every line of input extracted from the WSDL, and can reach between 3 to 4 minutes for very long WSDL documents. However, since each web service only needs to be classified once in its lifetime, performance is less crucial than accuracy. For the retrieval process, the performance is much faster and is up to 5 seconds for a query that is composed of a few sentences.

EMPIRICAL ANALYSIS

In this section we describe our experiments and provide some empirical analysis and comparison of the different business service classification and service retrieval methods.

Experimental Setup

The data for the experiments were taken from an existing benchmark repository, of several hundred Web services, provided by the researchers from University College Dublin.¹ Our preliminary experiments use a set of 29 representative Web services, divided into 4 different topics: courier services, currency conversion, communication, and business. For each Web service the repository provided a WSDL document and a short textual description. The ontologies that were used for the comparison were taken from another repository, named OWLS-TC [9], which includes over 40 different ontologies from various domains.

The experiments examined three different methods for business service classification and one method for business service retrieval, as described in Section 1. The service classification methods included:

Name Context The Context Extraction algorithm described in Section 1 was applied to the *name* labels of each Web service. Each descriptor of the Web service context was used as a token.

Name TF/IDF Each word in the document was checked for term frequency and inverse document frequency (TF/IDF). The set of highest ranking weighted value words was used.

Our experiments compared the two methods, with an addition of a **baseline**, which included the original token list extracted from the service descriptors. The actual comparison was based on mapping the output of each of the methods to the set of ontologies, using the string matching method described in Section 1.

The business service retrieval was based on the textual description of each service. The Context Extraction algorithm was applied to the textual description of the Web services forming the **Descriptor Context**. Each descriptor of the Web service context was used as a token.

Performance Measure The metrics in our experiments were recall and precision. Recall that services can be classified into several domains and therefore we show, via example, how these measures were computed. Assume that a given service is judged by a human observer to belong to ontologies A, B, and C. Now, assume that a method classifies service X with ontologies A, B, D, and E. We penalize this method for not choosing C and for choosing D and E. Therefore, the precision should be $2/4$ since only 2 out of the 4 ontologies we provide are a match. Recall should be $2/3$, since we managed to identify 2 out of the 3 ontologies to which the service belongs.

Experimental Results

In our first experiment we analyze the usefulness of going beyond the baseline bag of tokens. Figure 7 compares the precision and recall of the methods of classification and retrieval. The baseline method achieved 100% recall but only 11% precision. This result means that the baseline has sufficient tokens to match with almost all of the ontologies for each service. Clearly, this phenomenon shows poor selectivity, as shown by the low precision level. The TF/IDF improved the precision to 17% while keeping the recall at 100% due to elimination of some of the most general tokens which belong to most ontologies. The best result, dominating all others, was achieved by the Name Context method, yielding 100% recall and precision of 37%. We can therefore conclude that the use of context generation has significant impact on the success of text classification. Further improvement is needed to increase precision even more.

¹ <http://moguntia.ucd.ie/repository/ws2003.html>

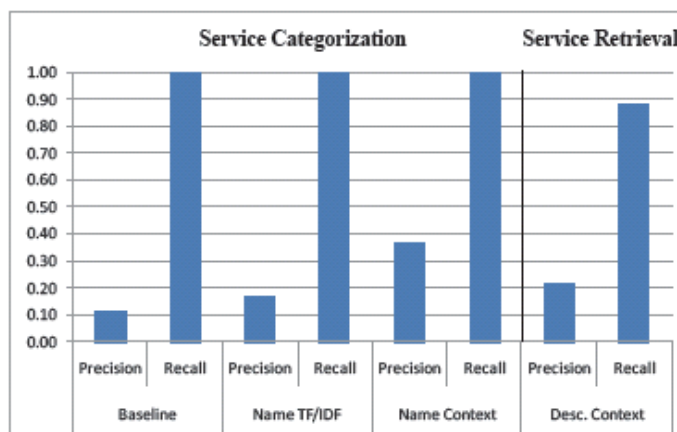


Fig. 7. Precision and recall of all methods

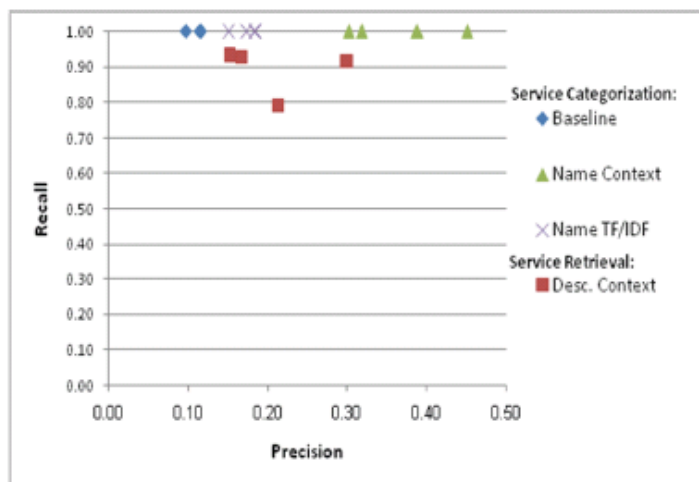


Fig. 8. Precision vs. recall of service classification and service retrieval

Data Regarding the service retrieval method, the Description Context managed to increase the precision to 22%. However, the cost was an 11% decrease in recall.

Our aim is to improve the precision while maintaining the level of recall, and thus the integration of the Name Context and the Name TF/IDF methods should be considered. Since these two methods work differently to extract tokens, the integration of the Name Context method with the Name TF/IDF method should boost the precision through the examination of the overlap between the two resultant sets of ontologies.

Precision can be improved by pre-processing the ontologies themselves. TF/IDF can be applied to filter out common concepts by using the corpus of ontologies. Thus, generic concepts, such as *market*, can be replaced with more precise concepts, such as *stock-market* and *fish-market*. Classification can be improved, by relying only on truly identifying tokens.

Figure 8 displays the precision vs. recall of the classification and retrieval, partitioned into topics. The results are presented on a precision/recall graph, where precision is given on the x-axis and recall on the y-axis. We can see that the performance of the Baseline method for all topics is dominated by the Name TF/IDF and Name Context methods. The figure shows all four baseline results, yet they overlap in pairs. The results of the TF/IDF method are also clustered together, at a slightly higher value. The Name Context

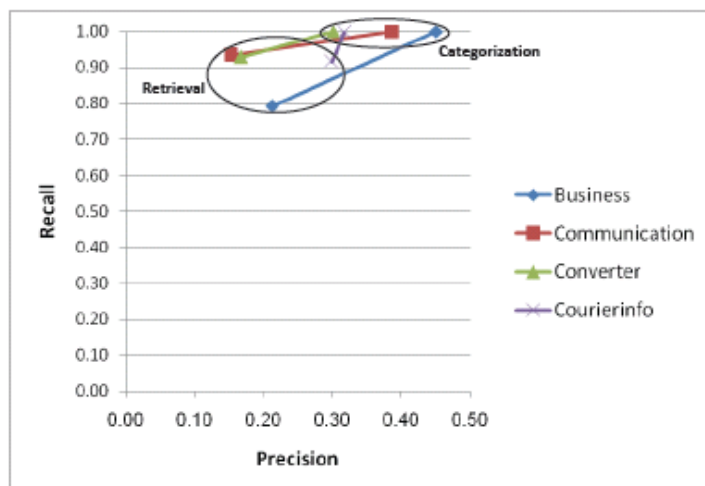


Fig. 9. Precision vs. recall of classification and retrieval according to each topic

method dominates all other methods, achieving the highest precision and recall levels for all topics. For the Business domain, the method achieved precision of 45% and recall of 100%.

The results of the service retrieval using the Description Context method are more dispersed, with a lower recall than all the other methods and a precision that overlaps both with the TF/IDF method and with the lower precision values of the Name Context method.

The results of the classification and retrieval can be combined using different metrics. For example, the classification and retrieval can be aggregated using probability multiplication, measures averaging, finding minimum and maximum, etc.

Figure 9 displays the precision and recall for the best performing classification method, Name Context, and the retrieval results, using the Description Context method, achieved according to each topic. The purpose of this figure is to examine whether there is a considerable difference between the classification and retrieval in certain topics.

Figure 9 shows that in the topic of *Business* there exists the largest difference between classification and retrieval results of recall and precision 0.32, followed by the topics of *Communication* 0.24 and *Converter* 0.15. The lowest difference between the results was achieved by the *Courier Services*.

However, in the case of *Courier Services* we assume that the small difference between the classification and retrieval methods is due to low classification success of this specific method with the topic. This can be attributed to the *Courier Services* being a smaller domain with more tokens appearing in the labels. In the topics of *Business* and *Communication*, which are broader in scope, the name labels do not necessarily specify the topic and hence only the name context method was successful in inferring the right tokens.

RELATED WORK

Dong et al. proposed a search engine for Web services, Woogle [4]. It accepts keyword queries and returns results according to information in WSDL documents, such as message parameters. Although some of the matching algorithms used by Woogle are relevant to our work, Woogle matches keywords and our work explores the matching of formal concepts. We were able to provide further empirical evidence for some of the conclusions of Dong et al.: the effectiveness of clustering tokens according to their mutual distance in the WSDL file.

ASSAM [7] is a tool for semi-automatic annotation of Web services. It uses learning techniques to narrow down possible concepts, helping a human user manually tag the service. The objective of our approach is to provide a fully automatic labeling method (which is a coarser-grain task) and to classify and retrieve the service rather than to label service parameters.

Patil et al. [15] present a combined approach towards automatic semantic annotation of services. The approach relies on several matchers (string matcher, structural matcher, and synonym finder), which are

combined using a simple aggregation function. Duo et al. [5] present a similar method, which also aggregates results from several matchers. Our research aims at a coarser-grain task and we therefore chose different methods for our preliminary evaluation. However, we intend to evaluate the methods suggested in these works in future research.

Other models, such as [10] and [8], can be adopted for text classification as well. We choose to compare a set of three classification models and a retrieval model as a proof of concept.

CONCLUSION

In today's world, businesses need to adapt their services to the frequent changes in their business environment. Semantic classification and retrieval of services can assist businesses in their continuous struggle to improve their services and keep ahead of competitors by reducing the costs of generating new web services.

The ability to compose Web services based on free text and flexible composition can simplify the implementation of organizational needs. Our approach extends the scope of Web service utilization, by providing businesses with usable methods to investigate and access large scale service repositories. Rather than asking businesses to manually annotate their services with formal concepts, our method employs the information contained in the World Wide Web to establish rich context for user queries. Thus, we present a possible solution for the inherently poor description of Web services.

Our experiments prove, to some extent, the inherent problems of analyzing WSDL documents. Their short length and limited vocabulary cause serious challenges for labeling and classifying services. The weak performance of the TF/IDF measure, which works successfully on more verbose texts, proves that relying on the service text alone will not yield sufficient results.

We have described so far a work-in-progress. We intend to extend our experiments to a larger corpus of business services. Also, we encountered some problems with the use of general-purpose ontologies. Clearly, classification will work better with smaller, focused ontologies, and we intend to seek many such ontologies for a more rigorous experimentation. We will also look at methods for identifying coherent sub-ontologies based on classification results.

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THE WORKFLOW KERNEL DEVELOPMENT AND BENEFIT ANALYSIS FOR ELECTRONIC MANUFACTURING INDUSTRY

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ABSTRACT

Since the advantage of low production cost is not existing any more for companies based in Taiwan due to the global manufacturing approach, how to reduce the production costs effectively is a critical issue for most of the manufactures. In the mean time, the communication of research and design, human resource management, customer support service, and daily operations across the international boundary also become important in order to achieve the goal of making the accurate daily support, create good quality products and providing products more quickly for customers. At the same time, companies usually grow up by merging other companies to quickly catch up the speed of innovation and production. How to integrate information & culture quickly between each other also needs to be studied. The purpose of this research is to make a suitable workflow development that can fit company culture requirement and handles daily demands and lead into manufactory & sub-company rapidly for Taiwanese electronic industry. The developed workflow fits the needs of WfMC which specify the requirements of process definition tools, workflow client applications, invoked applications, other WFMS enactment service and administration & monitoring tools. By using the workflow control, the case company efficiently reduces the inventory level, production cost up to 10% within one year testing period.

Keywords: Workflow, Competitive Strategy.

INTRODUCTION

Workflow Management System (abbreviated as WfMS [1-7]) is a complete set of process management system, which has been defined in WfMS by applying the logical definition of daily workflow to allow computer to promptly and precisely implement logical definition of workflow, as well as automatically dispatch the preset workflow route, or manually designate the workflow route to assist people in the daily workflow by taking advantage of computer's powerful automation capability. The evolution of workflow management is composed of the regulations or procedures of business process automation, while workflow is composed of document, information and work task, which would pass from one to another participant.

The key benefits of workflow can be categorized as following:

- a. Improving Efficiency - automated business workflow can eliminate many unnecessary procedures
- b. Better Flow Control - improved management in the process of business workflow to make the standardization for work methods and provide improvement for inspection and audit
- c. Enhancing Customer Service – customers' response can be projected within the consistent leading flow
- d. Flexibility – in accordance with the change in business workflow, software can also be changed flexibly according to the workflow
- e. Improving Business Workflow - focusing on the business workflow to make the process to be more streamlined and simplified

As early as 1995, "A CASE COMPANY" has already stepped into the filed of CR-ROM, and recruited the excellent R&D team from Industrial Technology Research Institute (ITRI). Currently, it has more than 330 engineers with master's degree or Ph.D. degree who are responsible for tasks of the anti-seismic design, circuit design, programming and functional adjustment that made A CASE COMPANY's CD-ROM to reach the world-class standard. In 1997, its China plant has been established, since then A CASE COMPANY has not only been started its OEM business for major global PC players, but also entered the domestic market in China; therefore, A CASE COMPANY has boosted its reputation in the CD-ROM industry, and it has also built the image and praise of being the Top 1 brand in China.

When implementing Workflow to company, Paperless is the first thought for employees, which is able to cut down the costs of regular administrative process, such as the overtime, approval of the leave, etc. For long term business planning, the Information Management department of this company should think about what is the solution of making the maximum competitiveness for this company after implementing the process automaton. By adopting the 80/20 Principle (known as Pareto Principle) to discover the 20% most important process that influenced company's process; among which, pre-electronicalized prior process will be the most effective method of creating value.

It is not difficult to sort out the most important 20% process and have them to be electronicalized, the hard part is how to smoothly promote such idea and action to related personnel in this company. In addition, it would rather be regarded it as an implementation of enterprise transformation than a promotion of process automation. The purpose of this study is to propose a solution for the issue of how promptly integrate with employees who scattered all over the world and the problem in certainly implementing the workflow and order for this company.

METHODOLOGY

As to reach the purpose, this study has adopted the onsite operation of each workflow in this company and the interview

with its employees who are currently using the workflow to discover the most optimal tool of workflow for this company by aiming at its company culture.

The methodology and content of this study has included the following:

- a. Research on the state of each workflow inside the company.
- b. Evaluate the importance to company (degree of company's competitiveness) in accordance with each workflow
- c. Discover the process of core competitiveness and make proper adjustment and rationalization, and then make it able to apply in the future automation process to achieve the purpose of enterprise transformation.
- d. Evaluate the comparison between functions for the workflow softwares that sold in the existing market, and make discussion on related types (patterns) of workflow.
- e. Evaluate the workflow software sold in the existing market that conformed to the company's demand, and the feasibility of self-R&D for the workflow software.
- f. Evaluate the overall improved efficiency after implementing the workflow software.

This study has adopted the workflow automation that implemented in A CASE COMPANY as the main research item, and researched on the improvement in company's competitiveness after the implementation.

The research process of this study is divided into the following steps:

- a. Drafting Research Plan:

Collecting related process (Workflow) data and conducting analysis and organization on the collected data and literature, and then determining the research direction and making the correlative plan.

- b. Related Literature Review of Workflow to Manufacturing Industry

Aiming the literature review of general manufacturing industry that they are R&D and taking orders in Taiwan, producing and shipping in China after implementing the workflow in their companies.

- c. Analyze the related issues on the CD-ROM manufacturers that they are R&D and taking orders in Taiwan, producing and shipping in China, through conducting the onsite inspection and interview to understand their workflow and problems.

- d. Construct or Implement Workflow System

Since the pattern that A CASE COMPANY is R&D and taking orders in Taiwan, producing and shipping in China to understand the issue and study related literature, as well as make comparison with the existing workflow to conduct the evaluation of feasibility and construct an optimal set of workflow system for A CASE COMPANY workflow system.

- e. Follow-up Performance Evaluation of Empirical Research

Implement the actual process of enterprise to the workflow system in this study, and then conduct the empirical study after implementing the follow-up performance evaluation.

- f. Conclude the Conclusion and Suggestion that Came Out from this Experiment

LITERATURE REVIEW

In 1993, as for the workflow management systems that were provided by each major manufacturer at that time, their functions were irregular and all of them were unique systems. Thus, a non-profit organization (NPO) named as Workflow Management Coalition (WfMC) has been established internationally, and it has proposed the Workflow Reference Model in 1995 which has been accepted and approved by Object Management Group (OMG) on November 1998. Therefore, it became the standard referential criteria of workflow management facility in CORBA [2]. WfMS has defined the term of "workflow" as: "Automation of Handling Process for Computerizing All or Partial Business". It is emphasized on the process automation of operation, among which, document, information and work items, etc. should be follow the programmed process and regulation to transfer among participants (including personnel, unit organization, information system) to jointly complete the work.

WfMC has defined the term of "workflow management system" as: "A system that is able to completely define, manage and execute the workflow, and it is able to deduce the executing sequence of software according to the workflow logic which represented by computer."

In recent years, due to the transformation of A CASE COMPANY from a simple company that is R&D and taking orders in Taiwan to become producing and shipping in China, such adjustment of operation strategy caused significant difference between workflow and organizations, and this is the so-called "change management," among the process of change management, the implementation of workflow management system is one of the important steps.

In the analysis of construction requirement for A CASE COMPANY's Workflow, Easy Maintenance is one of the main targets due to all employees of A CASE COMPANY are scattered in various locations, such as Hsinchu, Taipei, Guangzhou China, US, Holland, Hungary, etc., if it adopted the 2-tier framework, it may encounter the problem in different Client versions which will cause higher maintenance cost; and the most important issue is that the IT personnel is insufficient at beginning for A CASE COMPANY.

In order to solve the issue of insufficient IT manpower, and make it to operate within the existing notes 2-tier environment, the only way is to develop the Workflow Web, and the Client can be maintained by using the least manpower; in addition, current notes 2-tier environment can be applied to develop the Workflow Application to achieve the goal of money saving.

Plan out the workflow kernel that conformed to the need of A CASE COMPANY, in addition to follow the workflow pattern that possessed the internal credibility, it should be conducted the comparison with the function of well-known workflow tools; therefore, it can be then made A CASE COMPANY's workflow kernel to be more completed. Although A CASE COMPANY is seldom conducted the manpower development, it still can be reached the desired functions by using customized methods. The accessibility of developing environment is only issue that A CASE COMPANY is unable to make comparison with

international major players; however, it only used the manpower of 2-3 persons to complete all workflow that conform to A CASE COMPANY, and it is the workflow tool that is unable to be matched by some international major players' workflow tools.

The 3 following points are the characteristics of Workflow Kernel for A CASE COMPANY:

1. The minimum maintenance cost:
 1. Modulized signing and reviewing workflow which is able to use repeatedly.
 2. IT development program, signing and reviewing personnel of workflow responsible unit.
 3. Self-development, it is no need to pay maintenance cost to supplier.
2. The same workflow that used in RONIC COMPANY group:

To reach the integration with the environment of using interface in order to reduce the employee education training cost, and the integration with workflow between different systems.
3. Implementing action of each order and indication:

No more time, geographic and environmental restriction, though a series of actions, such as sign/review, discussion, response and issuance for the sign/review system of Workflow Kernel to achieve the Information Transparency and Order Consistency. In addition, adopted the most rapid and correct working commend to reach the entire process's smoothness of R&D, production and marketing in order to increase the company's competitiveness

The Workflow Kernel is the electronic sign-off for the internal system of A CASE COMPANY, which is a multifunctional system on the basis of connecting Web and Lotus Notes mails and integrated with workflow sign-off, mails, document management, authority security control into an entire system that self-developed by A CASE COMPANY. The Workflow Kernel is able to satisfy the internal basic need for OA system, such as ask for leave, overtime, etc, and the document sign-off workflow systems, such as EN, ECN, etc. that used for advanced RD in A CASE COMPANY.

Relationship between Workflow Kernel and Each Applicable Program of A CASE COMPANY

The main function module of workflow kernel for A CASE COMPANY: system logon, account management database, main workflow kernel interface, distribution database of personnel organization system, distribution database of workflow, dispatch log database, proxy database, sign on file database, urgent pending sign-on document database, common opinion database, applicable program example database, etc.

Data among these modules are mutually related to each other, which connected to form the entire Workflow Kernel of A CASE COMPANY, and it can not be lacked any one of them. In addition, there's an example database which defaulted the program of basic workflow functions, and used to customize the applicable program of any workflow for A CASE COMPANY.

The function introduction of each module: (as shown in Figure 1)

1. System Login: Portal Site of A CASE COMPANY.
2. Account Management Database: individual basic information and account password management.
3. Main Interface of Workflow Kernel: Personal portal site after logon
4. Personnel and Organizational System Distribution Database: Official department, organization and personnel of A CASE COMPANY which provided for the using of WorkFlow Kernel, and employee inquiry.
5. Workflow Distribution Database: the designed access location of each workflow, which can be used repeatedly
6. Dispatch Log Database: provided dispatch record of document control center that used to be the reference to inquire the issuers, time and versions of technology document.
7. Proxy Database: when employees asked for leave or on the business trip, they can designate the proxy. The function of proxy is that they can sign the document according their own authorization, and they also can wait the person who asked for leave and went on the business trip back to sign the document. As for the person who asked for leave and went on the business trip, they also need to designate the proxy, and they can sing-off the document via Internet.
8. Pending Sign On Database: store the pending sign-on document or match sign-on document for each applicable program, after the sign-off personnel logon, the remained pending sign-on document or file will come out automatically.
9. Urgent Pending Sign-on Document database: when it exceeded the set time of pending sign-on document for the signing personnel, this database will send a message to such personnel to urgently sign on the paper or document.
10. Common Opinion Database: when signing on the document, the sign-on personnel is able to use this database to embed the common personal opinion into the sign on document or file in case of the additional signing remarks.
11. Applicable Program Example Database: The development of workflow applicable program for A CASE COMPANY is able to use this applicable program example database to develop various types of applicable program to reduce the lead time of development.

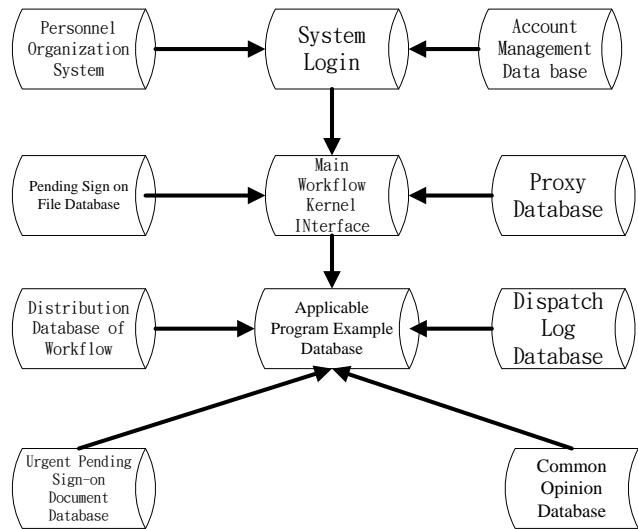


Figure 1 Function Description of Each Module

EMPERICAL FINDINGS AND DISCUSSION

Since 2005, after the Workflow Kernel of A CASE COMPANY has been completed, it then has continually completed various applicable programs; in addition, they were successfully used to the applicable programs that developed in accordance with the Workflow Kernel of A CASE COMPANY. Meanwhile, these programs were not restricted within the geographic regions, and can be transmitted to each business point of A CASE COMPANY all over the world via Internet to achieve the benefit of Workflow Kernel for A CASE COMPANY.

By using the interview with users and the advantage and disadvantage analysis of each workflow Kernel of A CASE COMPANY, we get the following findings: I. Comparison between the time consumed by inquiring the information of manual and automatic sign-off: it will be obtained from the result in Figure 2.

1. Information source of consumed time by the manual workflow inquiry is the averaged value of interviewing with company's employees, which the data is obtained by adopting the round-off method.
2. Information source of consumed time by the automatic workflow inquiry is the averaged value of interviewing with company's employees and actual onsite testing, which the data is obtained by adopting the round-off method.

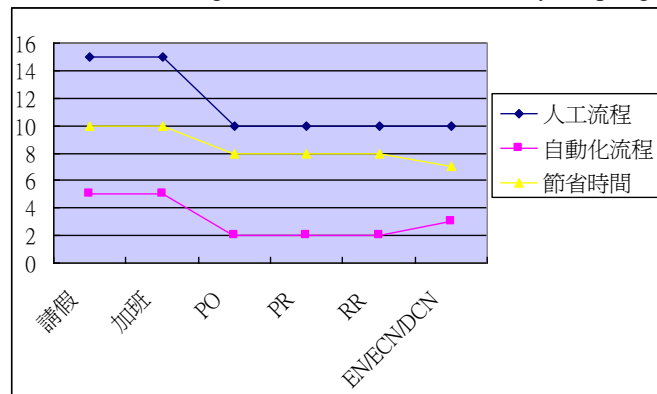


Figure 2. Comparison between the Time Consumed by Inquiring the Information of Manual and Automatic Sign-off

II. Comparison between the Time Consumed by Manual and Automatic Sign-off: it is obtained from the result that listed in the following Figure 3

1. Information source of consumed time by the manual workflow inquiry is the averaged value of interviewing with company's employees, which the data is obtained by adopting the round-off method.
2. Information source of consumed time by the automatic workflow inquiry is the averaged value that obtained from the systematic calculation of the sign-off time, which the data is obtained by round off to the second decimal point.

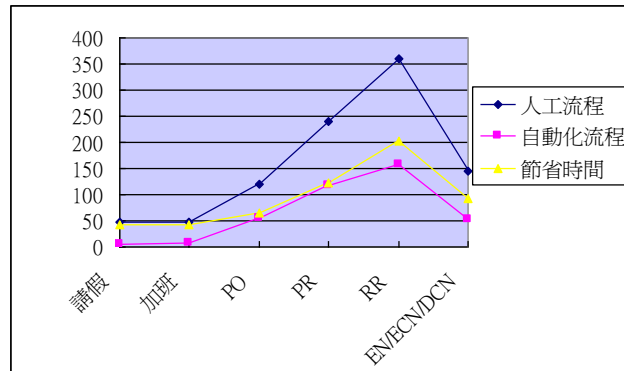


Figure 3. Comparison between the Time Consumed by Manual and Automatic Sign-off

III. Relationship of Implementing EN/ECN/ECR to the Days of Inventory (DOI) between 2005 and 2006

It has improved about $(59.1-53.8)/53.8 \approx 10\%$, which converted to the inventory turnover of NT\$1.1 billion $\times 10\% =$ NT\$1100 million. As shown in Figure 4.

The data source is the public information that released by A CASE Company.

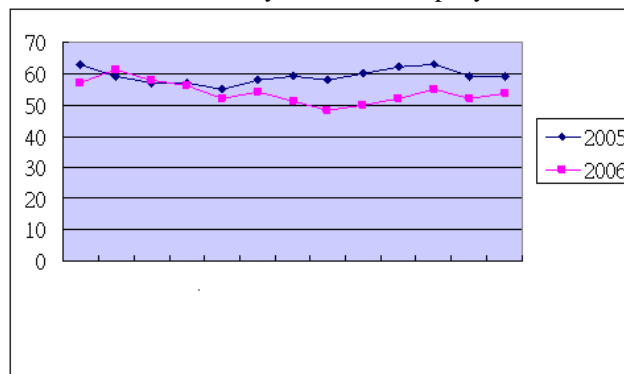


Figure 4. Relationship of Implementing EN/ECN/ECR to the Days of Inventory (DOI) between 2005 and 2006

CONCLUSION

This study has adopted the Reference Model as the basis to design a framework of Workflow Kernel System that conformed to the need of A CASE COMPANY and the standard interfaces that were proposed by WfMC [1][2].

As for the relationship between business patterns of A CASE COMPANY, it always merged the companies that possessed same characteristics as it did, thus the mergence must caused the problem in integration between systems inside A CASE COMPANY; in addition, the integration with Workflow is also a difficulty in A CASE COMPANY. On the other hand, after completing the integration of workflow between enterprises, what is the impact on benefit and culture will be brought that can be an extended discussion from this study.

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DECISION-MAKING EXPERIENCES: PERSPECTIVES ON M-COMMERCE AND E-COMMERCE

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ABSTRACT

We explore multi-channel decision-making experiences, especially in m-commerce and e-commerce. 232 e-mail messages sent by participants in two experiments are analyzed using Critical Incident Technique (CIT). Our findings suggest that decision-making in m-commerce is perceived as stressful and not necessarily a positive experience. We also find that participants in m-commerce hold their prior experiences in e-commerce as points of reference to which they compare their current or subsequent decision-making experiences. Cost Theory and Expectation-Confirmation Theory provide possible explanations for the findings. We identify and categorize factors that influence decision-making (shaping positive and/or negative decision-making experiences) and identify unique and channel-specific factors.

Keywords: M-Commerce, E-Commerce, Decision-Making, Expectation-Confirmation Theory

INTRODUCTION

It is interesting to explore consumer decision-making experiences across multiple channels (e.g., e-commerce, m-commerce, in-store). Our objectives in this paper are four-fold: 1) to explore how consumers perceive decision-making experiences across multiple channels, especially m-commerce and e-commerce; 2) to explore the kinds of responses – positive or negative – that are elicited as a result of these perceptions; 3) to group these responses into underlying themes or dimensions; and 4) to identify unique and channel-specific factors.

THE CHANNELS

All communication channels have capabilities that lead to “distinct, objective richness” [2, p. 154]. These capabilities are based on feedback capability, the communications channel utilized, language variety, and personal focus. The more a channel incorporates these elements, the richer it is. The four types of channels that are identified by McGrath and Hollongshead [4] are: *text*, *audio systems*, *video systems*, and *face-to-face* communications. Hence, face-to-face is considered the richest medium and text is considered the least rich.

In our experiments, we explore e-commerce, m-commerce and in-store setting. Each channel has certain “associated characteristics” are defined in terms of the decision-making “costs”. For the purpose of our experiments, the “costs” we consider in the different channels are defined in terms of cognitive search costs (as opposed to physical search costs). In-store setting, as we traditionally know it is also the most “rich”. Since this channel is the most “rich” among the channels of search being investigated, it means that a *low* degree of cognitive effort and, therefore, low search costs on part of the participants is required for decision-making. E-commerce is a channel where participants undertake decision-making from a computer terminal. This channel is *more* “rich” than **m-commerce** (explored in the next section), *but less* “rich” than **in-store**. Consumers can access specific information in the text format on e-commerce as well as m-commerce, but e-commerce is more “rich” than m-commerce, because of the larger interface. The foregoing indicates that the richness of the medium results in a *lower* demands on cognitive abilities are made by the search tasks compared to when the same search tasks are carried out on a mobile device. However, *higher* demands on cognitive abilities are made by the search tasks compared to when the same search tasks are carried out at a physical store. M-Commerce provides consumers with the ability of carrying out transaction through a wireless Internet-enabled device. Two major differences between e-commerce and m-commerce are the interface (small versus large screen) *and* the portability of the mobile device. The cognitive effort associated with conducting electronic searches is further magnified when processing information from a small screen. Hence, it is argued that cognitive load is *higher* on m-commerce than e-commerce.

THEORY AND HYPOTHESES

Stigler [6] argues that the consumer will continue to engage in the decision-making process only until the utility obtained from additional information is smaller than the cost involved in obtaining it. Cost theory forms the basis of the following hypotheses:

H1: Among the three channels, decision-making in e-commerce is perceived as least stressful and most positive.

H2: Among the three channels, decision-making in m-commerce is perceived as most stressful and least positive.

H3: On m-commerce, usability/device features contribute towards the perception of added stress associated with the decision-making process

We argue that consumers have certain prior expectations about outcomes associated with each channel and the confirmation (or disconfirmation) of these expectations will lead to satisfaction (or dissatisfaction) and hence positive (or negative) experiences. This argument implies that consumer decision-making experiences a consumer in a channel will influence usage intention. Expectation-Confirmation theory [5] forms the basis of the following hypotheses:

H4: When prior consumer expectations of their decision-making experiences on a channel are confirmed (disconfirmed), there is a positive (negative) response.

H5: Consumers expect their decision-making experiences on m-commerce to be the same as that on e-commerce. Confirmation (disconfirmation) of these prior expectations leads to positive (negative) response.

METHOD AND DATA COLLECTION

The Critical Incident Technique (CIT) is selected as a method for identifying underlying critical factors that lead to positive and negative consumer experiences [3] across the three channels. Two experiments (one between-group and one within-group) are conducted in a large public university in the Southern United States. The first experiment is a 3 x 3 between-group experiment and the second one is a 2x 3 within-group experiment. Participants in the between-group experiment are randomly assigned to one of the nine cells (factor one: channels: in-store, e-commerce and m-commerce; factor two: three levels of task complexity), where each participant is asked to undertake a decision-making task for either an airlines ticket for a friend (“search” service type), or a restaurant where s/he would like to take friends out for dinner (“experience” service type). 212 volunteers sign up for the study (two experiments together). Of those who sign up, 207 participate in the experiments. Usable data are obtained for 201 participants. All participants are undergraduate business majors. Participants are each awarded an extra credit for their efforts and their names are entered into a raffle drawing of 5 gift checks of \$60.00 each. All the participants are under 30 years of age (18 – 27), the mean and modal ages being 20.7 years 20 years. 53.1% are females; 35.2% have a family income of over a hundred thousand US\$ and 85.2% are Caucasian Americans. Right after making the choice, participants are asked to send emails to their friends about their experiences during the decision-making task: “Now, we want you to write an email message to your best friend about your decision-making experiences on this medium. What would you say?” The participants write an email to an alias email account especially created for the experiments. From the two experiments, 232 responses are gathered and are used in the analysis.

Data Analysis

Out of the 232 e-mail responses, nine are not usable (e.g., do not talk about the shopping experience). Therefore, 223 usable responses are used in the data analysis. Of these 223 e-mail responses, 78 are from e-commerce participants, 77 are from m-commerce participants and 68 are from in-store participants. The results of these interviews are then content analyzed, as CIT proposes (see [1]). For the purposes of our paper, critical factors are defined as those factors that contribute towards consumer experiences in each of the three channels (e-commerce, m-commerce and in-store). An analysis of the e-mail responses yields critical factors (positive or negative). These critical factors are further sorted into categories and subcategories (through a qualitative analysis). Three judges independently identify three major groupings of critical factors that account for all consumer experiences in each of the three channels: **product-related** (e.g., price, product attributes), **channel-related** (e.g., convenience, ease) and **Personal**. Inter-rater agreement is 96.7%.

Results and Discussion

Table 1 shows each of the major categories (and the subcategories) of critical factors that emerge for the three channels, along with the percentage of critical factors for each

Table 1: Critical Incident Analysis

E-Commerce Participants: (78 respondents: 110 positive critical factors; 16 negative critical factors); M-Commerce Participants: (77 respondents: 78 positive critical factors; 171 negative critical factors); In-Store Participants: (68 respondents: 104 positive critical factors; 49 negative critical factors)

Critical Factors	M-Commerce Positive	M-Commerce Negative	E-Commerce Positive	E-Commerce Negative	In-Store Positive	In-Store Negative
<u>Channel-Related</u>						
Layout	1.21%	0.80%	6.35%	1.59%		
Ease of Use	1.61%		4.76%			
Navigability	1.61%		0.79%			
Convenience	5.62%		3.97%			
Save Time	0.40%	1.61%	3.17%		1.31%	5.88%
Usability/Device Features	2.41%^a	12.05%^a				
Mobility	2.41%	0.40%				
Atmosphere					1.95%	0.65%
<u>Personal</u>						
Decision Making	10.04% ^{cde}	24.10%^{cde} 12.85%^{fg}	25.39%^{bed} 5.56% ^{fg}	7.93% ^{bcd} 3.16% ^{fg}	20.27% ^c 1.31% ^{fg}	15.69% ^c 9.15% ^{fg}
Amount of Information (Overwhelming)		3.61%				0.66%
Physical Comfort (Tedious, Exhausting)		3.21%				
Emotional Comfort (Annoying, Irritated)		10.04%				6.54%
Compare with E-Commerce						
Privacy			0.79%			
<u>Product-Related</u>						
Price	3.61%		13.5%		11.76%	
Other Product Attributes	1.61%		15.1%		15.03%	
Product Selection	0.80%		7.94%		9.80%	
Total	31.33%	68.67%	87.32%	12.68%	61.43%	38.57%

χ^2 values are calculated for these frequencies (not on the reported percentages). All values are significant at $p < 0.005$

^a: $\chi^2_{35,1} = 16$; ^b: $\chi^2_{42,1} = 12.30$; ^c: $\chi^2_{180,2} = 26.66$; ^d: $\chi^2_{126,1} = 24.87$; ^e: $\chi^2_{84,1} = 14.41$; ^f: $\chi^2_{57,2} = 25.77$; ^g: $\chi^2_{42,1} = 24.32$

subcategory. Table 2 identifies the common and unique factors for each channel. These overall factors help us better understand what channel-related characteristics contribute towards what kind of consumer experiences.

Table 2: Common and Unique Factors

Critical Factors	Common / Unique Factors
<u>Channel-Related</u>	
Layout	α
Ease of Use	α
Navigability	α
Convenience	α
Save Time	γ
Usability/Device Features	Unique (M-Com)
Mobility	Unique (M-Com)
Atmosphere	Unique (In-Store)
<u>Personal</u>	
Decision Making	γ
Amount of Information (Overwhelming)	γ
Physical Comfort (Tedious, Exhausting)	β
Emotional Comfort (Annoying, Irritated)	Unique (M-Com)
Compare with E-Commerce	β
Privacy	Unique (E-Com)
<u>Product-Related</u>	
Price	γ
Other Product Attributes	γ
Product Selection	γ

α = Factors common to M-Commerce and E-Commerce; β = Factors common to M-Commerce and In-Store; γ = Factors common across all three channels
 25.39% of the critical factors identified show that participants like making decisions in the e-commerce channel, a far greater percentage than 7.93%, who indicate that decision-making in this channel is not something that they would like to undertake. This finding is significant ($\chi^2_{42,1} = 12.30, p < 0.005$), lending support to H1 and H4. The responses for *Decision Making* are further analyzed across all three channels ($\chi^2_{180,2} = 26.66, p < 0.005$) and to compare m-commerce with e-commerce ($\chi^2_{126,1} = 24.87, p < 0.005$), thus lending support to H1 and H2.

12.85% of the critical factors point out that the amount of information in m-commerce is “overwhelming” for the participants and account for negative feeling inducing factors. However, note that, it is the same amount of information that participants are exposed to in all three channels. The responses for *Amount of Information* are further analyzed across all three channels ($\chi^2_{57,2} = 25.77, p < 0.005$) and to contrast m-commerce with e-commerce ($\chi^2_{42,1} = 24.32, p < 0.005$). Again, these results lend support to H1 and H2.

12.05% of the critical factors associate negative feelings with the features of the mobile device in m-commerce as opposed to 2.41% critical factors that associate positive feelings ($\chi^2_{35,1} = 16, p < 0.005$). Overall, it seems that device features or usability features induce negative feelings, lending support for H3. Although 10.04% of the critical factors identified show that participants like making decisions in the m-commerce channel, a far greater percentage (24.10%) indicates that decision-making in this channel is not something that many participants like to undertake. This finding is significant ($\chi^2_{84,1} = 14.41, p < 0.005$). Thus, we find support for H3, H4, and H5.

IMPLICATIONS

Theoretical and Managerial

This study offers several implications for researchers. First, we extend ECT (Expectation Confirmation Theory) to the realm of decision-making in various channels. We find evidence that participants might hold their prior experiences in e-commerce as points of reference to which they compare their current or subsequent shopping experiences, which can possibly be explained through ECT. Second, participants display greater negative feelings than positive feelings about decision-making in m-commerce, which is different from how they feel in either e-commerce or in-store environments. This finding can probably be explained with the help of Cost Theory. Third, the *same* categories of **Product-Related** factors are important to consumers across all the three channels. Our study draws a parallel between traditional retailing and e-tailing, and further compares these two channels to m-commerce.

This study offers several implications for managers. First, although users perceive similarities between the three channels of search, they do not perceive them as being exact substitutes. Rather, we find that users have specific behavioral characteristics in each of the three channels. Second, PDAs are probably not suitable for carrying out complex tasks. Small and compact features are a plus in the endless pursuit of better gadgets, but our findings point out that there is probably a threshold in terms of when a product becomes too small to handle and can be used efficiently. Our findings suggest that m-commerce is best suited for very simple tasks. Third, marketers interested in sending advertising materials over a PDA would probably have to limit the amount of information to be sent. Information disseminated via mobile devices would have to be relatively simple as consumers find “scrolling” (when using a PDA) extremely “stressful”.

LIMITATIONS AND FUTURE DIRECTIONS

There are several limitations associated with this paper. First, in the two experiments, participants are guided to visit sites and make decisions. Although efforts are made to replicate actual shopping environments, the findings might be different when consumers shop in more natural settings. Second, we do not consider after-sale experiences (e.g., delivery, post-services). Third, our sample consists of college students who are savvy with respect to Internet use. It is also interesting to compare the results of different demographic and characteristic groups (e.g., age, income, Internet experience). Researchers might be interested in exploring other channels of search. In addition, different product categories might affect decision-making in various channels. Since mobile commerce is a relatively new area, it would be interesting to study what types of information can be effectively provided to consumers on the move. Also, consumer responses to usages that are specific to the m-commerce environment might be explored in greater detail. Especially, usability/device features and their effect on consumer decision-making might be studied at a greater depth.

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SOCIAL UNDERSTANDING OF MOBILE COMMUNICATION TECHNOLOGY

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ABSTRACT

As mobile communication technology continues to penetrate the global society, it becomes imperative for the research community to understand such extraordinary phenomenon, particularly in relation to the social context that largely shapes the innovation process. Primarily derived from fads/fashions and institutional theory, this study thus sets out to contribute social understanding to the existing body of knowledge. Factor and reliability analyses from 143 questionnaires revealed three distinctive components that were subsequently labeled as social coercion, normalization, and imitation, respectively. These emerging factors were consistent with conceptual definition and could thus serve as a valuable instrument for future studies.

Keywords: Mobile communication technology, social, coercion, imitation, normalization, factor analysis

INTRODUCTION

The rapid development of mobile communication technology in recent years has gained increasing attention in the business world and in the research community [1]. One of the most notable examples is the exponential growth of mobile (cellular) phones. Such extraordinary market penetration urges the research community to carefully examine the driving forces behind this overwhelming phenomenon and reconsider previous theoretical perspectives in the existing information technology (IT) or information systems (IS) literature. More specifically, this study contends that traditionally popular perspectives such as diffusion of innovation theory [5] and technology acceptance model (TAM) [6] could hardly shed new light on the exponential phenomenon of mobile communication technology. Nevertheless, widely studied notions derived from either diffusion innovation theory such as relative advantage, compatibility, trialability [9] or TAM such as perceived ease of use and perceived usefulness [10] apparently tend to simplify or overlook the social context in which the users reside [11], with which they interact [12], and by which their innovation or adoption process is shaped and reshaped [13, 14].

In line with such social perspectives that have increasingly gained attention in the management discipline [15, 16] and in the IT literature [17, 18], this study seeks to contribute social understanding to the existing body of IT and/or innovation knowledge. More specifically, three primary objectives that will shape the investigation direction are: (1) to better understand the overwhelming phenomenon of mobile communication technology, (2) to help contribute social perspectives to the existing body of knowledge, and (3) to develop and validate an instrument for specific social perspectives. Drawing primarily from fads and fashions and institutional theory, this study inquires, "What are the underlying social forces that lead to the rapid adoption of mobile communication technology?" In comparison with some previous study in a similar context, this study is also interested in understanding "Do the effects of these social forces sustain over time?" Such inquiries are important because the results could help shed light on the first two research purposes directly and lead to the third research purpose subsequently. The accomplishment of these research objectives could in turn help better manage emerging innovation and particularly, mobile technology in its social context.

SOCIAL PERSPECTIVES

Although the existing literature tended to ignore social aspects of management practice [12], the research community in general, and the IT research discipline in particular, have recently paid increasing attention to understanding social aspects of technology adoption [13]. Departing from overwhelming dominant technology acceptance model (TAM) [6] or widely appreciated diffusion of innovation theory [5], these emerging social perspectives argue that individuals' innovation behavior is often influenced and shaped by the social context in which he/she engages [15]. By the notion of fads and fashion [8] Abrahamson further argues that in the context of adoption of innovation, actors often imitate a fashion setter or an "opinion leader" [5] because fashion setters possess certain power to inspire others to "trust their choices of technologies and to imitate them" (p.596) and thus frequently shape and disseminate collective management beliefs [18]. While the notion of fads and fashion focuses on imitation and norms, DiMaggio and Powell further articulate three pressures coming from social and institutional context that specifically drive an actor to imitate or follow other actors [20]. According to these theorists, those pressures stem from coercive, mimetic and normative forces that an actor faces in the social and institutional context in which he/she resides [21, 22]. Recently, empirical understanding of these social and institutional perspectives on management practice and technology innovation has gained increasing attention in IT management [30-32]. The following sections will further explain each of these perspectives and their connections to the research propositions.

Coercive Perspective

Coercive pressure is a strong force implying an action that actors must undertake. At the individual or group level, coercive pressure is most likely to emerge when individual actors fear to be left behind [8] or be excluded from a social group [36]. In the

use of information technology and mobile technology particularly, such fear could result from the situation when an individual falls behind in technology adoption that causes them embarrassment or rejection, either explicitly or implicitly. In other words, when an individual fails to use similar technology, they are likely to sense high degree of urgency that leads them to promptly respond to such pressure. As soon as they possess similar technology as their peers do, they could more easily identify with and relate to the group. Given the context of individual use of mobile technology where devices could often be present in social groups, it is even more likely that individual actors would sense the coercive force imposed on them if they fail to obtain similar devices [36]. As such, coercive forces are often associated with an individual's use of mobile technology. This argument leads to the first proposition.

P1: Coercive factors are positively correlated to the use of mobile technology

Mimetic Perspective

Mimetic pressure, on the other hand, is highly related to environmental and technological uncertainty [37]. In relation to management fashions, studies suggest that actors often fear to be different while facing uncertainty [8]. Therefore, they would simply follow fashion setters or group leaders when adopting an innovation [18]. In the context of mobile technology, individual actors would inevitably face technological uncertainty due to the evolving nature of technology. Mimetic pressure would thus be likely to emerge and in turn drive individuals to model themselves after those who have regularly used mobile technology. In the college settings where students often engage in social groups, it is even more likely that the student's choice of mobile technology would be influenced by opinion leaders in their social context. Particularly if the technology devices are stylish or fashionable [41], college students would be more likely to be tempted to adopt. This perspective leads to the second proposition as follows.

P2: Mimetic factors are positively correlated to the use of mobile technology

Normative Perspective

Finally, normative pressure is mostly associated with social norms [42] and often results from professionalization, the process through which actors respond to the pressures that are caused by the exchange of information in a group [20]. The professionalization helps reveal the information regarding each individual's and his/her organization's action and in turn creates an inevitable comparison among group members and organizations [24] [43]. In the context of mobile technology adoption, such normative pressures could also be easily observed [36]. It might be mostly because mobile technology, particularly cellular telephones, could be accompanied with individuals to their social group. Since its presence is more easily to be observed in a social group, the social norm could thus be more likely to emerge and consequently urges members in a group to consider similar technology either as their social contacts, significant others, or role models. Therefore, normative factors are significant in the innovation process of mobile technology. This argument leads to the third proposition.

P3: Normative factors are positively correlated to the use of mobile technology

METHODOLOGY

Since the research investigation concerns emerging issues of social perspectives and mobile technology, no existing instrument is customized for such purpose and logically self-developed questionnaire is exercised. Such self-developed instrument also seeks to connect to one of the research purposes aforementioned. This self-developed instrument is primarily derived from Chen and Wong [40] where 18 items related to social perspectives are constructed. Five major sections are incorporated in the instrument including demographics, cell phone, laptop, school satisfaction, and life satisfaction.

Procedure and Analysis

Two hundred and ninety four questionnaires were distributed to sixteen business classes, all in the disciplines of information systems, statistics, and operations management, in a university near a major metropolitan area in the U.S. The actual class size ranges from 12 to 24 with a total of 158 in the lower level (freshman and sophomore) and 136 in the upper level (junior and senior). One hundred and forty nine questionnaires were returned, which resulted in return rate of 51 percent. Six questionnaires were excluded from the subsequent analysis due to their incomplete information. As a result, one hundred and forty three useful questionnaires (49 percent of questionnaires distributed) were used for further data analysis.

While the data collection is largely dependent on survey method and questionnaire, the data analysis is derived from exploratory factor analysis and multiple regression analysis. The final result confirmed three components. Each of them consisted of five, four, and two items, respectively, and was corresponding to different social perspectives.

Table 1: Results of Factor Analysis

Variables	Factor Loadings after Varimax Rotation		
	Social Coercion	Social Normalization	Social Imitation
SC1	0.754	0.268	-0.071
SC2	0.772	0.284	0.208
SC3	0.717	0.137	0.376
SC4	0.839	0.152	0.108
SC5	0.733	0.018	0.245
SN1	0.052	0.749	0.395
SN2	0.081	0.767	0.321
SN3	0.369	0.698	0.042
SN4	0.231	0.812	0.046
SI1	0.285	0.211	0.861
SI2	0.166	0.259	0.882
Eigenvalues	5.08	1.64	1.15
% of Variance	46.18	14.92	10.48
Cumulative % of Variance	46.18	61.1	71.58
Internal Consistency	0.861	0.818	0.907

The rotated factor matrix shown in Table 1 demonstrates the factor loading, eigenvalues, percentage of variance explained, percentage of cumulative variance explained, and internal consistency (i.e. Cronbach α). These three factors are apparently related to coercive, normative and mimetic dimensions of social perspectives as subsequently categorized as social coercion, social normalization, and social imitation, respectively.

Regression analysis was further attempted to evaluate the correlations between these factors and dependent variable, the frequency of use. Unfortunately, the responses from 143 samples used resulted in a near constant value for dependent variable. More specifically, a vast majority of students used cellular phones so frequently that the scale available to them could make no practical distinction among their choices. This result suggests that further revision on the existing instrument, particularly in relation to the frequency of use, is needed and different technology chosen for investigation (other than cellular phones) might be essential.

DISCUSSION OF RESULTS

Despite the unfortunate, missing results from multiple regression analysis, the information provided could be viewed as a positive opportunity for future improvement in twofold. First, although this study could not immediately examine the correlations between three factors, extracted and validated by exploratory factor analysis, and dependent variable—the frequency of use, it provided insightful contextual information from which the next stage of study could learn. Evidently, cellular phones have become so pervasive in society and on college campuses that the frequency of using such technology among college students has practically developed into an everyday habit. The highest option of the usage frequency needs a completely different scale.

Further Revisions

One suggestion is to use ‘average monthly payment’ as the measure for the frequency. This measure could provide fair assessment of the usage frequency in countries where monthly payment is often determined by the service contract that specifies certain usage packages. For instance, many service carriers in the U.S. provide a variety of individual subscription plans ranging from USD \$29.00 to \$199.99 per month with free time limit allowed from 300 to 6000 minutes, respectively. When a user exceeds his/her monthly minute limits, substantial fees would be added to the existing monthly payment (and resulted in different monthly payment for different individuals). Since college students have widely utilized cellular phone, it is likely that their service agreement and in turn their monthly payment might correspond to their frequency of usage. Moreover, it might be possible to observe that they occasionally exceed the usage limit and result in different service charge even if they might have similar plans. The alternative for ‘average monthly payment’ could be ‘average monthly minutes used.’ This measure could provide an even more precise and direct assessment if the respondent’s recollection is accurate.

The other suggestion is to investigate different technology other than cellular phones. For instance, laptop computers might not be as popular as cellular phones considering the cost and sizes of device. The higher cost of laptop computers suggests that not every college student possess one. The size of devices further implies that the students could not carry one as easily as they do with cellular phones. These factors are likely to lead to different frequency of use. Another technology that could be considered is residential access points that provide wireless connectivity at each individual’s residential area. As the cost of access points decreased significantly over years, many individuals including college students began to implement these devices at home. However, the technology itself is not portable but provides portable, wireless access to the networks. Individuals would then be more likely to use it when they need to access the networks. Therefore, the usage frequency would be likely significantly

different from that of cellular phones that are basically attached to an individual as an accessory.

Social Factors

While these suggestions are primarily for future instrument revision and research investigation, the results from factor analysis provides constructive information separately. It clearly illustrates three distinctive factors that were extracted from and validated by factor analysis and scale reliability. These factors, i.e. social coercion, social normalization, and social imitation are in line with the research purposes motivated by inadequate understanding of social perspectives on the use of information technology in general, and mobile communications technology in particular. They could thus provide valuable foundation for future studies that are interested in social perspectives of IT adoption.

Logically, comparable validation could be performed in relation to different technologies or IT practices. Online banking, for instance, has increasingly transformed how individuals come to (or not to) interact with the banks. Many large banks in the U.S. have further encouraged their customers to adopt 'paperless' statements. Moreover, mobile phone users in Europe have progressively turned into mobile online banking, i.e. perform online banking via their mobile devices. Do individuals move toward such new IT practice simply based on their economic needs or social influences?

Another example that has gained overwhelming attention recently is social networking. MySpace, for instance, was founded in 2003 and has grown into a vast community with registered users of nearly 189 million by July 2007 (wikipedia.org). Other well-known social networking sites included classmates.com, Facebook, Hi5, and Orkut. Their users were estimated at 40, 34, 50, and 57 million, respectively (wikipedia.org). How did all these recently founded social networking websites penetrate our society so rapidly? How social coercion, social imitation, and social normalization play out in these individual subscribers' decision making process? Most interestingly, the combination of different IT practice or technology such as online banking, which mostly concerns economic and financial issues, and social networking websites, which are by nature for socializing purposes, would provide contrasting effects and in turn help better reflect on how social perspectives (i.e. coercion, imitation, and normalization) influence an individual's innovation adoption or IT practice.

Ad Hoc Comparison

Compared to a similar study conducted four years ago [36], this study also extracted similar social factors. Although they labeled these factors differently as coercive, normative, and mimetic pressures, respectively, the underlying emphasis of each factor is consistent with arguments proposed by this study. More specifically, the first factor, also the most consistent and influential one in its statistical power, concerns with a sense of urgency coming from social groups. Individuals would feel being excluded or embarrassed if the technology is not in their possession. In addition, the second factor underlines the notion of normalization, a process through which technology norm is created by social groups. In other words, individuals would develop a sense of 'equality' as other members in the group if they also have a similar technology. Such particular sense of norm is very likely to be led by individuals' significant others or role models. Lastly, the third factor reveals the need to model after or benchmark other people. Such benchmarking or modeling effects clearly resemble imitation process through which individual users tend to use similar or identical technology as others'. Although ad hoc comparison does not serve any statistical purpose or explanatory power, it helps reinforce the argument that social perspectives are worth attention in future IT/IS research.

CONCLUDING REMARKS

As an ongoing investigation, this study sets out to accomplish three purposes, i.e. to (1) better understand the overwhelming phenomenon of mobile communication technology, (2) help contribute social perspectives to the existing body of knowledge, and (3) develop and validate an instrument for specific social perspectives. Despite incomplete results of regression analysis, the insight gained from the investigation thus far has helped shed light on these objectives. In reflecting the first purpose, as mobile communications technology penetrates and transforms our society so rapidly, we now come to witness closely its diffusion effect on college campus. The existing scale of frequency measure is no longer valid because little distinction could be made to identify college students' usage frequency. Almost every student surveyed indicates highest usage rate available on the instrument. It suggests further refinement of measurement scale.

In reflecting the second and third purposes, factor analysis indeed extracted and reliability analysis sustained three major components labeled as social coercion, social normalization, and social imitation. Each of which addresses issues of technology usage in social groups and thus provides social perspectives to the existing understanding of IT practice. However, due to missing results from multiple regression analysis, further data collection and analysis are needed so that the final instrument could be confirmed and validated and these objectives be accomplished. At the moment, even without those new data and results, suggestions could still be made that social perspectives be considered and incorporated into future research studies because these perspectives could provide different ways of thinking and in turn helps build a more creative intellectual community.

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FACTORS INFLUENCING COLLABORATIVE COMMUNICATION IN VIRTUAL TEAMS

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ABSTRACT

Collaborative communication has properties different from face to face communication. For instance team can generate ideas, manage information that are beyond the skills of any single team member. In this paper we examine factors that can influence collaborative communication in virtual teams. To study this we used a survey method across various organizations in China. We collected data to get responses from managers and experts engaged in collaborative efforts for product design developments in virtual environments. We conducted factor analysis and used the mean value of factors to test our hypothesis. We found that in the Chinese context, the significant factors were: constructs of team collaboration; information technology support and training; clear descriptions of team objectives and of tasks to be accomplished. Our results show that collaborative communication in collaborative virtual team environment is guided both by the global competition as well as indigenous and institutional pressures. Managers view decision making as a business issue in a globally competitive environment.

Keywords: Collaborative communication, collaborative environment, virtual teams

INTRODUCTION

Communication dynamics are diverse in virtual team collaborative environments, and factors contributing to communication in virtual spaces are not similar to face to face conversational environments [1] [2]. By the term virtual team we refer to groups of geographically and organizationally dispersed co-workers that are assembled using a combination of telecommunications and information technologies to accomplish a common organizational task [3]. Virtual project teams can quickly be formed and disbanded and there are opportunities to select expertise and exploit organizational competencies regardless of an expert's location [4]. Participants' collaboration, learning, interaction and knowledge management are different in virtual settings compared to co-located environments, and these differences influence team decision making efficiencies [2]. In this paper we examine the factors which may influence virtual team decision making.

Research across disciplines has focused on decision making at the individual level using multiple theoretical frameworks and research settings. Collaborative decision making has properties different from individual decision making, such as the ability of a team to generate ideas that are beyond the skills of any single team member. It requires coordination between several members and stakeholders [5]. Decision making research at the collaborative virtual team level specifically in developing market contexts like China is still nascent phenomenon (see [6] [7]) and being an emerging area of research, theoretical models have yet to be established [8]. Collaboration across various departments to enable efficient and timely decision making remains a constant challenge for organizations. Efficient management of collaboration can improve organizational competitiveness [9]. Decision making is the main link between team collaboration, technology support and task description for virtual teams in any organization [10] [11]. An increasing number of organizational units are becoming collaborative and distributed, but little is known about their processes and performance structures [12]. Data collection issues further impede research in this field in developing markets like China. Recent studies (see [13] [14] [15]) show that IT and related technology adoption in organizations and in general is becoming an integral part of routine commercial and non-commercial activities. It is widely used for supporting team collaboration and decision making in product design [11] and our study is motivated by these developments.

In this paper we study collaborative team decision making with an objective to understand what factors contribute to decision making in virtual teams. To achieve this we used a survey method across various organizations engaged in collaborative efforts for product design and developments in virtual spaces. Results of our study can benefit organizations aiming to improve their designers' efficiency we identify the most relevant issues in developing a support methodology. The paper is organized as follows: in the next section we examine relevant research to identify the items to be studied. The subsequent section presents our research methods, followed by the data results and analysis. Finally, the results are analyzed and the implications for managers and for future research are discussed.

CONCEPTUALIZATION FOR STUDY MEASURES

Several models have been employed by researchers to unfold decision making processes in collaborative virtual environments (see [16] [8], [17]). De Sanctis and Poole (1994) portray decision making in groups and virtual teams as an outcome of a process in which technology structures, tasks, organizational environments and the internal structures are major influencing factors. Later studies expanded this model by studying how an inter-organizational virtual team adapted the use of collaborative technology for decision making [8], and how a group support system (GSS) may be used to support virtual teambuilding (see

[17]). Their results highlight the importance of defining goals to foster better team collaboration and decision outcomes. In this study we examine collaborative decision making using at least three categories frequently used in related studies with variations, namely: team, technology, and task description. In the following section we discuss selected relevant research to develop our study measures.

TEAM COLLABORATION

One of the core characteristics of a virtual team is the element of collaboration, where team members work together on a common task while they are separated in time and space [3] [17]. These collaborations can be at cognitive or affective levels and are essential for knowledge and task sharing amongst the team members. This impacts the competencies and subsequent decision making of virtual team members [7]. Efficient team collaboration is needed from the quality and timeliness perspectives of decision making [5] [18]. Inefficiencies in collaboration can prevent organizations from developing innovative ideas [8] [19]. Decision makers face multiple tasks during product design, but team collaboration makes these processes clearer and simpler. In virtual team arrangements, collaboration has become more challenging because asynchronous or synchronous modes of communication are required to exchange data, information, and expertise among dispersed team members [5]. Teamwork involves interaction amongst team members. The dissemination of timely and relevant information about each person's expertise and earlier work experiences can improve collaboration, cohesion and commitment, and thus influence decision making positively [10] [20]. The nature of the relationship between the knowledge source and the recipient facilitates team work [21]. For such collaboration, teams which are usually comprised of cross-functional members also need to be tightly integrated and strongly coordinated [11] [22]. Leadership becomes important in such team environments for improved coordination of collaboration [23].

Researchers such as Tobin (1998) have expressed concern that effective knowledge share and communication may not take place in virtual teams in organizations lacking flexibility in team work. This can diminish team members' motivation and impede for instance, the communication of best practices within an organization and can affect the decision making processes negatively [25]. One solution is to introduce individual level monetary reward systems (such as profit sharing or gainsharing through bonus, employee stock options etc.) and team level reward systems based on team performance [25][26]. These incentives motivate team collaboration to work effectively and cohesively toward common goal attainment.

INFORMATION TECHNOLOGY SUPPORT

Information technology permits the dispersion of teams across space and time, while remaining a key element of their processes [16] [23]. Modern organizations, including those in emerging markets like China, are deploying information technology solutions to support collaboration in virtual arrangements [6]. Several commercial decision support tools and systems are available to product designers to enhance information acquisition and dissemination. These tools thereby support team collaboration, knowledge sharing and task definition [6] [17], and are intended to help the decision maker develop an understanding of the otherwise complex decision making environment [28]. However, the value of the resulting change depends on how well the tool is matched with the needs of the intended users [29]. Further, these support systems and tools themselves are of less value if the user is unable to exploit them to meet the defined objectives [8] [29]. Appropriateness of IT tools facilitates task interdependence and synchrony of communication in virtual teams [10] [20]. Decision makers may not act optimally because of the conflicting meanings that a system support can convey [8] [29]. Simpler configuration of IT tools and systems support can mitigate these limitations but it is equally important that team members be trained to solve encounters with unexpected problems. For example, the introduction of any tool into a collaborative environment has the potential to serve as a catalyst for positive or negative change. Appropriateness and user friendliness of IT tools can resolve such negative encounters.

TASK DESCRIPTION

Technology provides an environment for team collaboration and decision making leading to the achievements of common goals and objectives. But this achievement can occur when clear definitions of objectives and task to be completed are established. The nature of the task to be carried out influences team performance and clarity of task description enables surfacing of several inputs of decision making process which guide team members for better decision making [17] [23]. These inputs include exploitation of expertise of multi-functional teams, knowledge about the defined task and the procedures to accomplish the same, project risks and uncertainties amongst others. Uncertainty about the tasks may disrupt the flow of communication and team members can experience higher cognitive loads and trade off decision accuracy [32]. While systems and IT support can limit these negative trade off effects to an extent, clarity in team and task objectives remains critical at every stage of decision making process [32].

RESEARCH DESIGN AND METHODOLOGY

We developed 13 items (see Table 1) to study their relationship with our dependent variable. We measured our dependent variable on the importance of effective decision making [34]. In this study we report the results of our survey. Our intended subjects were product designers using virtual team collaboration for their task fulfillment. We randomly selected both Chinese and international organizations using business directories, personal networks and recommendations. We conducted our survey in the Shanghai area as it is the business centre of China and therefore provides an appropriate setting for empirical investigation of e-commerce and e-business issues. We approached medium to large organizations employing more than 100 people. We collected our data through a questionnaire. The research instrument was distributed through e-mails and direct contacts. In total we approached 490 team participants through e-mails and a small number of 22 through direct contact. One hundred and one responses were received in total (63 online responses and 38 email responses), with a response rate of 19 percent. We obtained

usable data from 89 respondents representing 72 organizations with a final response rate of seventeen percent. We approached seven non-respondents through telephone and found no significant difference between the respondents and non-respondents and confirm the no non-bias in our final sample. The items and the reliability of each scale are presented in Table 1.

MEASUREMENT VALIDITY AND RELIABILITY

The questionnaire design was thus based on the literature review and the interview findings. The items were measured using seven-point Likert scale. One item was used to measure our dependent variable of the importance of effective decision making. The questionnaire was translated, pilot tested and validated. An explanatory factor analysis (EFA) was conducted to examine the discriminate validity of the measurement items. 13 measurement items representing our research framework were subject to principal component factor analysis. A five-factor structure was suggested, using the criteria of eigenvalue greater than one, and the extracted factors accounted for 59.97% of the total variance. A varimax rotation was performed to gain a clear picture of the composition of the factors. The resulting factor loadings are shown in Table 1 with all factor loadings less than 0.40 suppressed. The factor loadings for all the items were higher than 0.50. The individual factor labeling and variance are shown in Table 1. Cronbach's alphas were computed to assess the internal consistency reliability of the scales extracted. As shown in the second column of Table 1, the reliability coefficients range from 0.57 to 0.76 with overall reliability of 0.72. Other than factor five, the reliability coefficients are near 0.70 which is suggested to be the acceptable level in such studies. Our results confirm that the measurement scales are valid and reliable.

Table 1 Exploratory Factor Analysis and Reliability Results¹

Factors	Alpha	Measures	Factors Loadings				
			1	2	3	4	5
Team Collaboration	0.676	Role of leadership for virtual team collaboration	0.625				
H ₁ (+)		Usefulness of previous task experience	0.615				
		Usefulness of Information about team members" knowledge and expertise	0.584				
IT Support	0.687	Knowledge sharing is facilitated by IT		0.766			
H ₂ a(+)		Team collaboration is facilitated by IT		0.681			
		Information technology support is important		0.674			
		User-friendliness of IT tools used for decision making efficiency		0.571			
IT Training	0.757	IT training is useful			0.864		
H ₂ b(+)		System support is beneficial to team members			0.832		
Task	0.696	Clear definition of decision objectives				0.739	
H ₃ (+)		Clear definition of teamwork objectives is necessary				0.641	
Incentives	0.566	Flexible team organization is important					0.819
H ₄ (+)		Reward is useful for facilitating better team work					0.766
Eigenvalue			3.204	1.874	1.288	1.194	1.171

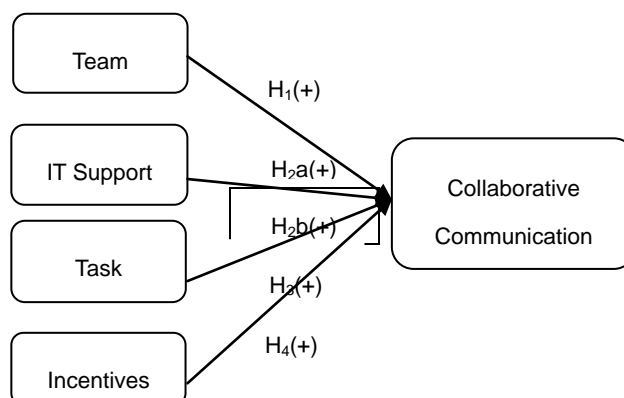
Extraction Method: Principal Component Analysis.

¹Rotation Method: Varimax with Kaiser Normalization.

The above five factors were then used as independent variables to examine their impact on the dependent variable of the importance of effective decision making using regression analysis. Since the independent variables are factors extracted from original variables within the studied construct, there is no correlation among them. Further, the results obtained from the model offer empirical evidence for hypothesis testing. We tested the following hypotheses as shown in Figure 1:

- H1: Team Collaboration is critical and positively related to decision making
- H2a: IT support is positively related to decision making
- H2b: IT training is positively related to decision making
- H3: Clear task definition is important and we hypothesize for a positive relationship with decision making
- H4: Incentives facilitate team work and this factor has a positive relationship with decision making.

Figure 1 Hypothesised Model



The regression results are shown in Table 2. As shown in Table 2, the evidence is mixed. The independent variables, labeled as Team Collaboration, IT Support, IT Training, and Task Description, are significant positively associated with the dependent variable of importance of effective decision making. Thus, H1 and H2a and H2b and H3 are supported (all $p=0.00$). However, the proposed positive relationship between Incentives (i.e. H_4) and the dependent variable of importance of effective decision making has no significant relationship and is not supported. It seems incentives have little impact on decision making.

Table 2 Results of Regression Analysis*

Model	Unstandardized Coefficients		Standardized Coefficients	t	P-value
	B	Std. Error	Beta		
(Constant)	6.283	0.73		86.074	.000
Team Collaboration	.399	0.73	.466	5.438	.000
IT Support	.284	0.73	.331	3.865	.000
IT Training	.176	0.73	.287	2.638	.000
Task	.117	0.73	.137	1.596	.000
Incentives	-.102	0.73	-.119	-1.390	.168

*Notes: a) p -value for F-test in Anova is =000 b) $r^2 = 0.37$ and Adj. $r = 0.34$

DISCUSSION AND CONCLUSION

Team collaboration (H1) was supported to be significant for project decision making. This may be attributed to the dynamic and multi layered processes where multi-task and multicultural teams need more collaboration to bridge communication and other work related gaps. This collaboration amongst the respondents is perceived to be significantly important for better decision making outcomes. Task complexities also require team collaboration and the role of leadership gains importance. Availability of information about cross-team expertise, experiences and knowledge is significant for team collaboration in multi-task and multicultural teams. These are also necessary components for collaborative decision making. Further insights and explanation can be derived from cultural and social structures in China where people work more cohesively in every aspect of life. Relationships constitute an important element of Chinese work and management style. These attitudes expand to the workplace and future research can benefit by focusing on cross-cultural issues in virtual team collaboration in the global context.

Our hypothesis that IT training (H2a) and IT support (H2b) has a positive relationship with decision making was supported. This indicates that the managers in China value and require IT tools, systems support, and related training to facilitate their project and team work. The use of IT tools and system support is not yet prevalent in China being an emerging market, therefore young managers and project team participants require continuous training. Compared to international markets China's technology adoption rate is low, and extensive IT and systems support and training will be necessary to sustain competitiveness. A large number of multi-national corporations have their regional units in China for cost and strategic benefits. IT training is considered to be important for communication on project and task fulfillment through knowledge management in these organizations. However, several IT tools are developed at headquarters located outside China, and many of these IT tools are in English language. These tools are not necessarily developed to exclusively serve the local needs. And often standardized tools are employed for cost considerations. Subsequently, team members and parent organizations invest more on training and support systems to carry out headquarters tasks as face to face communication is neither feasible nor possible at all stages of decision making processes. Global IT markets are converging rapidly and new tools are constantly being employed to respond to short project fulfillment periods. Virtual team members invest in training to mitigate the impact of advance technological development

and to remain competitive in the world market. Task complexities and tools incompatibilities can be addressed by training and support systems. Researchers and practitioners can focus on improving the compatibility of various tools to engage the project workers better. Future research can focus on the Chinese user behavior, and on how IT Tools and support can help improve their usability, and team members' decision making efficiencies. Longitudinal research methods can be applied to study the impact of IT support and training on decision making.

Our hypothesis that a clear task description improves decision making (H3) was supported. This shows that since most projects are defined in subsections and operationalised across various departments making collaboration and clear task description are necessary. Teams are responsible for developing selected segments of the projects and team objectives can not be achieved without clear task definitions. By understanding the full context of the project, team members develop cognitive as well as affective associations with the task to be completed and become more efficient. IT facilitates knowledge and expertise sharing and the user friendliness of tools contributes to this. Many projects carried out in China are from multinationals and the headquarters use English language to write and communicate the essentials. Language differences can enhance miscommunication in multi task and multilayer expert teams comprised of novices to experts, but better task description can address these problems. Further research investigating the issues, such as- how task complexities and communications can be improved by clearer task definitions and descriptions across cross-functional, cross-organization, and multi-expertise virtual teams- can contribute to our knowledge in this field.

Our hypothesis for incentives as a positive indicator was not supported (H4). One explanation may be in cultural difference because monetary incentives are not always evaluated to be positive in China and awards and honors are important. Monetary rewards like bonuses are perceived to be a component of the regular salary payments. Another possible explanation is that respondents may have understood the term "reward", as used in our survey instrument essentially in monetary terms. This indicates that semantic sensitivity would be needed in future research to capture the intended meaning better. In China's rigid hierarchical social structure power and authority are more important than monetary gains. Team members are more likely to forsake short term monetary benefits for long term job related awards like promotion and better placements in the hierarchical management structure. Furthermore, in a collective culture like China, team based rewards are more likely to be accepted than individual rewards. Further studies could benefit by adding some cultural variables to investigate how effective reward mechanisms for teams or team members may be established.

Our study suffers from several limitation and results should be interpreted and viewed accordingly. Our study is limited to more developed medium and large organizations and our model's ability to explain temporal dynamics is also limited. Despite these limitations, our findings have both theoretical and practical implications. Theoretically it shows the significance of team and non-team related factors. The study shows that decision making is largely influenced by team and technology related factors. It shows to practitioners that China's drive to integrate into the global market and follow the global management style when the team working environment is global. But findings also suggest that factors related to information technology and team collaboration are not the only perceived driving force for the effective decision making. These dynamics are influenced by the local cultural norms and future studies could benefit by examining them. International and local managers could include these aspects in their communication and strategies to create efficient and collaborative work environment.

Future research might identify points when team collaboration becomes less or more effective, and examine how information technology influences the decision making over-time. More research is needed at the organizational level in cross-cultural contexts to determine the efficiency factors of team work decision making. Empirical studies may be conducted with larger sample population and other research settings in virtual space like communities and forum. Longitudinal analysis investigating how the determinants change over time and how they interact to influence team and organizational decisions would contribute to our theoretical knowledge.

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CONSUMER TRUST IN INTERNET-BASED AIRLINE RESERVATIONS

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ABSTRACT

This paper explores consumer trust in Internet-based airline reservations using the data collected from individual consumers in Hong Kong. The empirical analysis shows that such attributes as perceived usefulness, ease of use, reputation, privacy, security and responsibility significantly influence consumer attitudes towards online airline reservation services. In addition, consumer attitudes are related to integrity, benevolence and ability, which in turn affect consumer trusting intentions to use online airline reservations. The research results in practically useful implications for improving Internet-based airline reservation services.

Keywords: Internet, airline reservations, consumers, trust and service management

EXECUTIVE SUMMARY

The primary objective of this research is to explore consumer trust in Internet-based airline reservation services. The issues in relation to trust in electronic commerce have been discussed in the literatures such as [1] [2] [3] [4] [5]. In the case of Internet-based airline reservations, consumers usually need to provide personal data such as name, telephone number, mailing address, nationality, passport number and credit card number when using an online reservation system to book air tickets. It is not uncommon that consumers may wonder whether the system can effectively make airline reservations. They may also worry about whether the system can protect personal privacy and reliably conduct electronic transactions. Moreover, they may concern about whether the system cares individual interests and benefits. If consumers had confidence in the Internet-based airline reservations, they would be willing to purchase the e-air tickets and disclose personal data to the reservation system. As far as this is concerned, the present paper examines a number of variables in relation to consumer attitudes, trustworthiness and trusting intentions.

The research methods include literature review, questionnaire design, survey and statistical data analysis. A research model and several hypotheses were developed on the basis of the established theories and the trust-related issues associated with Internet-based airline reservation services. The questionnaire was generated in the light of the proposed hypotheses. It consisted of a number of items in relation to perceived usefulness, ease of use, reputation, privacy, security, service quality, attitudes, trustworthiness and trusting intentions. A seven-point Likert scale was used ranging from not important to very important. It also collected demographic data such as age, gender, education, occupation and income. The questionnaire was distributed to individual consumers in a random manner. The respondents were requested to provide feedback in response to the questions and express opinions on Internet-based airline reservations. As a result, one hundred sixty responses were collected for data analysis. Several procedures of the Statistical Packages for Social Science (SPSS) were used to test the survey data in the light of the proposed hypotheses.

A three-level model was constructed to examine the relationships of a number of attributes in relation to consumer trust in Internet-based airline reservation services. Firstly, perceived ease of use, reputation, privacy, security, and service quality are antecedents of consumer attitudes. Secondly, consumer attitudes are supposed to be related to integrity, benevolence and ability. Thirdly, these attributes are antecedents of consumer trusting intentions to use Internet-based airline reservations.

The empirical results suggest that perceived usefulness, ease of use, reputation, privacy, security, and service quality have direct and significant effects on consumer attitudes. At the same time, consumer attitudes are highly related to integrity, benevolence and ability. Furthermore, these attributes have significant and direct effects on consumer trusting intentions to use Internet-based airline reservations. In particular, integrity, benevolence and ability, which represent trustworthiness, considerably determine the level of trusting intentions. In other words, a high level of trustworthiness in terms of integrity, benevolence and ability is essential to encourage consumers to use Internet-based reservation services.

Although different consumers have different perceptions on different trust factors, it is important to appreciate the determinants of the Internet-based airline reservation services from consumer perspective. It is not uncommon that consumers are very careful about the use of online services especially for expensive consumptions in the virtual environments. They would believe that benevolence is an important factor that affects trusting intentions. They may also consider to what extent they can benefit from online air-ticket reservations in comparison to traditional ticketing services. Therefore, the service providers should pay attention to consumer concerns in order to design a practically useful and user-friendly Internet-based platform for airline reservations. At the same time, they should try to let the customers enjoy the operations and benefit from the services.

This paper identifies the determinants of consumer attitudes and trusting intentions towards the Internet-based airline

reservation services. It has resulted in practically useful implications for managing Internet-based e-services. In conclusion, the building of trust is essential to the sustainable development of Internet-based airline reservation services, because it helps consumers reduce their concerns about risk and uncertainty when sharing their personal data in virtual environments. The service providers should devote to improve service quality and enhance the level of trust in order to encourage consumers to continuously use the Internet-based airline reservation services.

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‘BEAUTY LIES IN THE EYES OF THE BEHOLDER’: WHY AND HOW ISLAND TOURISTS LOOK AT SMTE WEBSITES

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ABSTRACT

This research examined the information needs of small and medium tourism enterprise (SMTE) customers sampled from two popular island destinations in the Indian Ocean. It also identified their motivations and inhibitions in using the Internet. A study of the website navigation behavior showed that the appeal mix and multimedia mix features were accessed more than the offering mix features. The association between the tourism products bought online and the purchase motivations was mapped using correspondence analysis. The online buyers of ‘accommodation’ and ‘attractions’ were motivated by transactional objectives while the ‘access’ and auxiliary product buyers by informational uses.

Keywords: Tourist information needs, online motivations and inhibitions, SMTE websites, website navigation

INTRODUCTION

The Internet has outpaced traditional sources of information on tourist destinations within the short period of its existence, resulting in inquisitive, searching, discerning and independent tourists. Characterized by the ease of access and wealth of information, it has contributed to the emergence of tourism and travel consumers who prefer to search for holidays themselves online, rather than through travel agents. A do-it-yourself (DIY) phenomenon has resulted in which offline trade intermediaries are being replaced by direct online interfaces of the tourism service providers [2]. This study examines the information needs, online motivations and inhibitions of the SMTE customers sampled from two popular island destinations in the Indian Ocean.

CONTEXT AND RATIONALE

According to the UNCTAD’s Information economy report [21], the number of international tourism arrivals is expected to increase by 4.1 per cent annually to reach close to 1.6 billion international arrivals by 2020. Among the destinations, islands are among the most visited [10] and tourism in these islands is dominated by SMTEs [1]. Technology provides unprecedented opportunities for the coordination of SMTEs at the local level to provide a seamless tourism product in order to enrich the total customer satisfaction. It enhances business efficiency by empowering organizations with economies of scope [7]. It also offers new opportunities to offset several competitive disadvantages of SMTEs [13]. The Internet impact has been felt not only by the supply side, but also the demand side. One of the key ongoing changes in consumer behavior has been the transition from a passive reacting subject to the so-called “postmodern” consumer, one who is creative and innovative and who interacts and initiates experiences, shaping his/her own shopping experience [16].

REVIEW OF LITERATURE

The relevant literature can be classified into three areas, namely study of online customer profile (who), intention (why) and behavior (how). While such a compartmentalization is tidy, it also reveals certain gaps which this study attempts to fill.

Online customer profile

Many studies have been conducted to profile the typical online user using the demographic characteristics. The typical Internet user of the Twentieth century is young, professional, and affluent with higher levels of income and higher education [18] [12]. They value time more than money which automatically makes the working population and dual-income or single-parent households with time constraints, better candidates for non-store retailers to target [8]. Internet usage history and intensity also affect online shopping potential. Consumers with longer histories of Internet usage are educated and equipped with better skills and perceptions of the Web environment [20] [15].

Online customer intention

Researches studying the intention of the online users in business-to-customer (B2C) e-commerce context have lead to identifying the motivations and inhibitions of the users. In the travel context many components may make up for the travel experience and therefore the combination of convenience, immediacy, lower prices and rich information is highly effective [12] [4]. The most frequently cited reasons for not purchasing travel products online are, in the order of precedence: credit card security, no assessment of product quality, privacy issues and ‘rather purchase locally’ [22].

Many consider the lack of trust to be a very significant factor affecting intention to purchase from the Web. Discussion has focused mainly on security of transactions, privacy of customers’ personal information and general trust in the vendor of whom the customer has not any prior experience [11]. Factors that limit online shopping include as difficulties in navigating the Internet and limited offerings of individual sites, lack of price competitiveness and disappointment with customer services [14].

Online consumer behavior

Despite the growing importance of the Internet as an information source for travelers, as a marketing tool and as a way of doing business, there is a general lack of behavioral studies on how these travelers use the Internet for information, booking and purchase of travel products and services. Consumers are able to gather information about products and services on the

Internet [19], but the information gathering capability of the online consumer can profoundly affect behavior through changes in market dynamics [6]. The more consequential the purchase decision, the more time and effort consumers are willing to expend to search for information that they believe will lead to a good decision [3].

The travel decision-making process is a complex multi-stage process layered along a hierarchical set of activities [9]. Here too, convenience can serve as a key driver of the travel planning process. On the Internet, consumers can self-build a combination of various complementary travel products with relatively less difficulty when compared to the traditional context. But the Internet can also add to the complexity of the process because of the plethora of sources to coordinate and piece together.

This study revisits the online tourist motivations and inhibitions by comparing the tourists from two different destinations with diverse destination positioning. While several of the behavioral studies have been based on intentions and perceptions, this study takes into account, the online tourists' actions.

RESEARCH PROBLEM

Despite the fact that online tourism and travel sales are now a substantial and growing proportion of total sales in one of the world's largest industries, there still exists a lack of comprehensive literature on the online tourist behavior and little or no analysis that looks at the SMTEs websites through the eyes of the tourists. The aim of this research is to establish the information needs of the SMTE customers. The research questions are: Who are the visitors to SMTE websites? What brings them to the SMTE websites? What do they do there? To provide answers to these questions, the research objectives are:

- To profile (in terms of demographic characteristics) the international tourists visiting the two island destinations
- To assess the tourists' level of satisfaction with online search and with online purchase
- To find out the motivations and inhibitions for online search and for online purchase
- To identify the website features/activities that are noticed by and used by the tourists
- To analyze the online purchase motivations for different tourism product categories

This research has certain limitations. First of all, it is specific to place (Andaman Islands, India and Mauritius, Indian Ocean) and time (the year 2005). In the Andaman Islands, the original data collection plan had to be rescheduled in the aftermath of the December 2004 Tsunami tragedy. Since the market is fragmented, there is a need for more focused studies on specific market segments (say, the honeymooners) with regard to their Internet usage. Future studies may investigate the preferences of Internet users for tourism and travel products, so that more personalized products can be designed to cater to different market segments. This offline study of online behavior may suffer from data error. Hence the actual online behavior may be studied from click-stream data and be corroborated with the professed behavior for greater accuracy.

RESEARCH METHODOLOGY

To study the online motivations, inhibitions and behavior of the tourists at the SMTE websites promoting Island Tourism, two prominent island destinations, namely the Andaman Islands, India and Mauritius in the Indian Ocean were chosen as the study locations. Endowed with identical natural resources and attractions, these destinations differ in terms of their tourism infrastructure development and marketing strategy. In terms of destination positioning, Mauritius follows a high-value-low-volume strategy while Andaman Islands follow a high-volume-low-value strategy.

The primary data for this study was collected from the international tourists visiting either of the two island destinations. The sample inclusion criterion was that the respondents be customers to the SMTEs in these island destinations. 40 SMTEs (representing accommodation, access, attraction and auxiliary product categories) with a web presence were identified (through a disproportionate stratified sampling) as the data collection spots. 200 international tourists were approached and 190 complete responses were collected. A detailed questionnaire was developed after an extensive review of the relevant literature on online consumer behavior, and it was used for collecting data through personal interviews. The questionnaire consisted of six sections that asked the respondents about the purpose of visit to the destination, motivation for using the Internet for information and shopping, inhibition in not using the Internet for information and shopping, navigation behavior at SMTE websites, satisfaction/dissatisfaction with the use of Internet for travel information and shopping and demographic information. A pre-test of the questionnaire was carried out with 20 respondents for clarity, practicability and reliability. The pre-test did not indicate any problems. Sufficient precautions were taken to avoid sample bias. SPSS (version 12.0) was used for data analysis.

FINDINGS AND ANALYSIS

Characteristics of Internet and non-Internet users

Table 1 describes the respondents in terms of their demography, purpose of visit and annual spending on tourism and travel. Among the 190 tourists surveyed, 160 were Internet users and 30 were non-Internet users. Pearson chi-square tests were used to examine if any significant differences existed between Internet and non-Internet users. Results showed that Internet and non-Internet users differed in terms of travel purpose. Further investigation revealed that the honeymoon travelers and adventure tourists were typically internet users. Apart from this, no significant differences existed in the demographic characteristics between internet users and non-users among the respondents. Non-internet users were likely to be older and traveled for holiday purposes compared to the Internet users. Majority of the respondents (37.5 per cent in Internet user category and 40 per cent in non-Internet user category) were in the age group 31-40 years. Nearly 83 per cent of the respondents were at least degree holders in terms of education. Compared to non-Internet users, more Internet users lived in urban areas. Among the surveyed tourists, 15.8 per cent have not accessed the Internet at all for any tourism/travel related search for reasons like 'unfamiliar technology', 'internet is too crowded', distrust for online information and comfort level with the regular offline options.

Table 1. Demographic and behavioral characteristics of Internet and non-Internet users

Characteristics	All sample (n = 190) %	Internet users (n = 160)			Non-Internet users (n = 30) %	df	p
		Surfers only (n = 74) %	Surfers & Shoppers (n = 86) %	TOTAL (n=160) %			
Age							
21-30	31.1	36.5	29.1	32.5	23.3	3	0.480
31-40	37.9	36.5	38.4	37.5	40.0		
41-50	21.1	21.6	17.4	19.4	30.0		
> 50	10.0	5.4	15.1	10.6	6.7		
Education							
< degree	16.8	17.6	16.3	16.9	16.7	2	0.699
Degree	46.3	50.0	45.3	47.5	40.0		
> degree	36.8	32.4	38.4	35.6	43.3		
Living area							
Urban	41.6	32.4	51.2	42.5	36.7	2	0.838
Semi-urban	40.0	47.3	32.6	39.4	43.3		
Rural	18.4	20.3	16.3	18.1	20.0		
Purpose							
Holiday	35.8	39.2	29.1	33.8	46.7	4	0.020
Adventure tourism	42.1	39.2	50.0	45.0	26.7		
Visiting Friends	5.8	4.1	3.5	3.8	16.7		
Honeymoon	8.4	9.5	9.3	9.4	3.3		
Others	7.9	8.1	8.1	8.1	6.7		
Spending							
< \$5000	48.4	47.3	46.5	47.3	56.7	3	0.722
\$5000-10000	24.7	25.7	25.6	25.7	20.0		
\$10000-15000	16.3	20.3	12.8	16.3	16.7		
> \$15000	10.5	6.8	15.1	11.3	6.7		

Level of and reasons for satisfaction with online search and with online purchase

The tourists' level of satisfaction was more for online search than for online purchase. It was also found out that online buyers were more satisfied with their online search. Further chi-square test revealed that online search satisfaction leads to future intention to purchase online.

The dominant reasons for satisfaction with online purchase included the confidence inspired (in terms of definite and complete information) by the transaction, the ability to buy customized tourism products, getting better prices online and the efficiency of the transaction itself. The major reasons for dissatisfaction with online purchase were the lack of online payment security information, poor after-sales service and the mismatch between the online promise and the offline delivery.

Motivations and inhibitions for online search and for online purchase

At a fundamental level, the motivation theory contends that cognitive or affective motives seek individual gratification and satisfaction [17]. In the given online context, the most important reasons for consumers to search online were the ease of information gathering, perceived availability of cheaper deals and the wealth of information. The major reasons for online purchase were found to be convenient transactions, cheaper deals and the confidence inspired by the on-site experience.

Nearly 46 per cent of the respondents searched online but have not purchased any tourism/travel products online. Several factors inhibit their online purchases. The issue of information privacy and transaction security is the biggest inhibitor for a consumer to purchase online. Interestingly, the subsequent reasons highlight the 'personal touch' desired by the consumer with the vendor and the limited interactivity in an online transaction as inhibitors to purchase online. About 7 per cent of the respondents indicated that the SMTE websites were not e-commerce enabled and hence they could not purchase online.

Online consumer behavior

The respondents came to know of the SMTE websites from online as well as offline sources. The online sources of information in the order of precedence were: search engines, hyperlinks in other websites, online ads and word of mouse. The offline sources included marketing communications, word of mouth, tourist guide books, trade intermediaries and travel fairs. The online sources informed more people than the offline sources. Word of mouth/mouse and tourist guide books were popular

sources concerning Andaman Islands whereas online ads and hyperlinks were popular concerning Mauritius. The on-site behavior of the respondents was studied by asking for the website features that were noticed by and also used by them. Among the website features noticed by the respondents, 'Places to see' or 'things to do' was the most noticed followed by price-related information and company information. Among the website features used by the respondents, the informational features dominate over the transactional features on a website. Among the website contents, the multimedia mix elements had a higher noticed-to-used ratio compared to offering mix and appeal mix elements. Among the actions taken by the tourists after completing a search on the Internet, it was interesting to note offline purchase following an online search in many of the responses. Among the tourism products purchased online, the accommodation sector ranked first, followed by the 'access' sector and the 'attractions' sector. A Pearson chi-square test indicated significant differences between the destinations and the online purchase of 'attractions' and auxiliary product categories.

Association between tourism products purchased online and the purchase motivations

Correspondence analysis depicts associations between two or more categorical variables. Table 2 represents a contingency table showing the frequencies of a two-way cross tabulation matrix comprising tourism products bought (four levels) and online purchase motivations (six levels). Figure 1 represents the correspondence map as a joint plot of tourism products bought online and the buying motivations involved. Correspondence analysis procedure from SPSS (version 12) was performed.

Table 2. Correspondence Table

Type of product bought online	Online buying motivation						
	Convenience	Efficient	Better prices	Price comparison	Detailed information	Helps me plan	Active Margin
Accommodation	17	18	11	3	2	3	54
Access/Travel	17	14	17	5	5	0	58
Attractions	14	15	12	4	2	5	52
Auxillary products	7	1	2	3	0	0	13
Active Margin	55	48	42	15	9	8	177

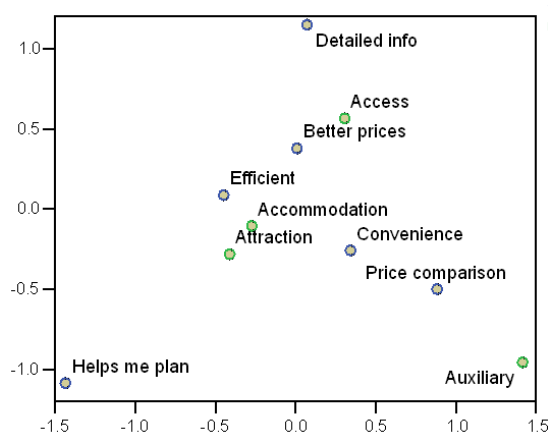


Figure 1. Correspondence map (Joint plot of tourism products bought online and the buying motivations)

It indicated that the online shopping motivations for different tourism/travel products are distinctively different. Among the buyers of 'accommodation' and 'attractions' products, the primary online purchase motivations were convenience and efficiency of the transaction. Motivations like 'better prices' and 'detailed info' dominate for 'access' products and 'price comparison' for auxiliary products. In general, the online buyers of 'accommodation' and 'attractions' were motivated by transactional objectives while the 'access' and auxiliary product buyers by informational uses.

DISCUSSION OF RESULTS AND IMPLICATIONS

Few important findings emerge from this study. There seems to be a difference between Internet and non-Internet users in terms of certain demographic and purchase characteristics. Honeymooners and adventure tourists are more likely to be Internet users. This finding can help SMTEs to target their e-marketing communications to these groups. SMTEs can cooperate at the destination level in order to increase their total competitiveness as a destination or as the total tourism product [7]. Among the online sources of information about SMTE websites, search engines ranked first, followed by links in other websites, online ads and word of mouse. As a result, it becomes imperative for a SMTE website to be search engine optimized and also be 'connected' to other related websites. In a study of SMTE's e-marketing pay-off, the search engine optimized websites provided better returns on investment [1]. In terms of the top of the mind awareness about tourism and travel related websites, the popular travel portals scored high followed by special interest sites like scubadiving.com. SMTEs would profit much by participating in the affiliate network of such special interest sites. For example, mauritiusholiday.com is a niche site offering wedding photography services to tourists visiting Mauritius for their wedding and honeymoon. A small or medium enterprise in the accommodation sector will do well to place a link in mauritiusholiday.com and be found by a honeymooner.

The study found out that online search satisfaction led to online purchase or at least a future intention. Interestingly, less number of respondents was satisfied with online purchase compared to online search. The SMTEs ought to take note of the reasons for online purchase satisfaction as well as dissatisfaction. The reasons for satisfaction range from pre-purchase through purchase to post-purchase benefits. The pre-purchase benefits like the confidence inspired (in terms of definite and complete information) lead the pack. The ability to deal directly with the service provider and obtaining a customized product (instead of having to choose from a standard menu) had delighted many respondents. The lesson for SMTEs is to load their websites with comprehensive, clear-cut and up-to-date information, offer product customization freedom and provide different approaches for tasks (for example a 'walk-me-through' approach instead of a 'do-it-yourself' approach for complicated tasks). The online purchase dissatisfaction set in due to lack of secure payment information, poor after-sales service (for example, lack of communication) and online-promise-offline-delivery gap. The SMTEs need to address these. A relationship-orientation rather than transaction-orientation helps to retain the consumers. The website must be considered as a virtual portrayal of reality at the destination in order to minimize the promise-delivery gap.

The motivations and inhibitions for online search and purchase reveal the consumers' perceptions. Apart from the easily gathered and rich information in an online search, 'looking for cheaper deals' motivates the search. An SMTE site with an easy-to-navigate layout, detailed click-through information, price information and guarantees and useful utilities like currency converter can excite the visitor. Transaction convenience and cheaper deals were the top reasons for online purchase. SMTEs should facilitate the assembly a personal holiday plan in the 24*7 convenience of one's home at the click of a mouse. SMTEs need to pay attention to why surfers do not end up as shoppers. The study identified the inhibitions of such surfers and highlighted information privacy and transaction security as the biggest concerns. SMTE websites need to have a privacy policy in place and posted on the site. A secure payment gateway can do away with lot of fears to transact online. 'Lack of personal touch' emerged as another inhibitor. Alternative contact methods (such as online chat or phone) can bring in the much needed personal touch and interactivity. A small percentage of the respondents pointed to the lack of e-commerce enabled SMTE websites for not purchasing tourism products online.

The on-site behavior of the tourists revealed that the multimedia mix elements (such as maps, pictures and video clips) enjoyed a higher noticed-to-used ratio compared to offering mix and appeal mix elements. It gives clue to SMTEs on the site content. Intriguingly, features like intra-site search and online ads received very little attention. The on-site activities reveal a goal-directed behavior since 'places to see' or 'things to do' ranked high on both noticed and used website features. Based on the post-search behavior, an SMTE site should be part of an integrated marketing communication as a visitor may follow up an online search by establishing an offline contact directly or indirectly (say, through the DMO contact office). Among the tourism products purchased online, the accommodation sector ranked first, followed by the 'access' and 'attractions' sectors. An SMTE in the accommodation sector can create cross-selling opportunities with the other sectors.

A correspondence analysis (Figure 2) identified the online purchase motivations for different tourism product categories. Transactional objectives motivated accommodation and 'attractions' buyers while informational uses motivated the 'access' and auxiliary product buyers. The correspondence map delineates travel components based on consumer perceptions of situational criteria [5]. For example, flights and car rentals are relatively more established sectors in the online travel segment. The 'access' sector has greater price transparency, which drives consumers to seek more evaluative information on that front. On the other hand, consumers attach more importance to transaction convenience and efficiency to SMTE services (such as accommodations and attractions) that are not so established. The SMTEs offering different tourism products should be aware of and be responsive to the online purchase motivations of the tourists.

In terms of destination positioning, Mauritius follows a high-value, low-volume strategy whereas Andaman Islands follow a low-value, high-volume strategy. Looking into the sources of information about SMTE websites, Andaman Islands could be said to be less represented on the Internet compared to Mauritius. The tourists to Mauritius bought more 'access' and auxiliary products and the tourists to Andaman Islands bought more accommodation and 'attractions'. The tourists to Andaman Islands were more price-sensitive, more internet-savvy and less worried about online privacy and security issues. In comparison, more tourists to Mauritius searched online and shopped offline and they liked the Internet for its convenience and efficiency. They were more worried about the privacy and security concerns, thought Internet was impersonal and wanted 'personal touch' and were less Internet savvy. The lesson for the SMTEs is to align their e-marketing strategies with the destination positioning.

CONCLUSION

This study was done to identify the information needs of the SMTE customers so that the SMTEs may meet these needs profitably through and at their websites. This study is exploratory in nature and provides only a general picture on the tourists' motivations, inhibitions and on-site behavior. With the availability of sophisticated web development tools, the SMTEs face the temptation of building websites that showcase technology. But a visitor may very well be saying, 'Don't show me how good your website is. Show me what I need'. Beauty indeed lies in the eyes of the beholder.

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COGNITIVE LEARNING THEORY: APPLICATIONS TO E-CUSTOMIZATION RESEARCH AND PRACTICE

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ABSTRACT

This paper reviews and synthesizes cognitive learning theory literature with potential applications to e-customization research and practice and highlights parallel work in online and offline marketing as well as information technology. A framework that provides a comparison of various learning theories with potential applications to e-customization is presented. Major theories suggest heterogeneity among individuals with regards to cognitive learning styles and strategies. Findings also propose a positive effect of the congruency between consumer learning styles (strategies) and online message format (content) on communication efficiency, recall, attitude, and decision making. A synthesis review with potential research and managerial applications is furnished.

Keywords: cognitive learning theory, e-customization, cognitive styles, cognitive learning research, decision making, heuristics.

INTRODUCTION

When engaged in information search and product identification online, consumers can be considered to be in a process of learning. Available theories in cognitive learning have not received adequate attention by online researchers. Online research focused on modeling and predicting online consumer and shopping behavior [1][2][3], showing that models could be useful in predicting behavior based on previous online behavior captured by visit sequence, clickstream, prior experience, as well as individual differences. On the other hand, online research in the mass customization and personalization area has so far stressed production and technology aspects of the process. Some studies, nevertheless, showed how customizing items location at emails and e-newsletters based on consumers' observed behavior or preferences considerably enhance communication efficiency and productivity [4].

Internet technology has been advancing rapidly making it possible to provide a personalized webpage and ads, in both content and format, to each customer. Consumer research showed that differences in consumers predict where and how a consumer chooses to shop and be motivated to behave in a certain way [5]. Nevertheless, many questions, such as how initial consumer's abilities and preferences in acquiring and processing information could be used as an input to customize information content and format on the Internet or if learning abilities, preferences, and strategies can be used as a base to cluster consumers online are still widely unanswered. Fortunately, available cognitive theories in the learning and education literature might provide the answer and furnish a base for future research that considers or questions the role of cognition. These theories can be examined, extended, or applied to online as well as offline marketing and IT research.

LEARNING AND EDUCATION COGNITIVE RESEARCH

Available literature in cognitive learning needs exploration and investigation by online researchers. Careful review of cognitive learning theory reveals two major themes in literature—universal and individual-based.

Universal Cognitive Learning Theory

The first theme in cognitive learning theory is universal, meaning that the theme does not take into account differences among individuals when learning and cognition occur. Thorndike's learning laws [6] can be said to give a good example of this theme and to possess various applications in online and cognitive research. Thorndike's laws provide a deep insight into learning efficiency and effectiveness. Investigating the applicability of these laws to the field of online marketing and verifying how these laws interact with each other are interesting research areas.

1. The law of readiness. Individuals learn best when they are ready to learn. Certain contents and cues alignment at a Website page would motivate individuals and improve their site experience, increasing both visit duration and the intention to revisit. Mathwick and Rigdon [7] found adequate levels of challenge at the Website to improve interactivity and drove individuals away from an apathy or boredom state.
2. The law of exercise. Things most often repeated are best remembered. There is almost a consensus in offline and online advertisement as well as learning research on the positive impact of repetition on memory. However, attitudes resulting from direct interaction or experience are stored with higher level of confidence than attitudes resulting from indirect experience with the product [8], limiting the efficacy of online product advertisement on attitude change compared to a brick and mortar shop experience. Nevertheless, number of ad exposure and number of a website pages visited were positively related to repeat purchasing [9].
3. The law of effect. Learning is strengthened when accompanied by a pleasant or satisfying feeling. Humor and positive emotions included in an ad were related to both attitude toward ad and attitude toward brand [10]. Another study showed message humour to be moderated by individual characteristics [11].
4. The law of primacy. Primacy, or the state of being first, often creates a lasting impression. Newell and Rosenbloom [12] found

individuals to acquire skills quickly at first but later skills improvements require much more efforts. Johnson, Bellman, and Lohse [13] investigated the applicability of the power law of practice online and found initial sites visited and learned to receive more future visits and acquire higher customer loyalty.

5. The law of intensity. An exciting, challenging, and vivid learning experience teaches more than a routine or boring experience. Challenge and enjoyment were also hypothesized to have a formative role on attention, learning and attitude toward site [14][15].

6. The law of recency. When controlling for other variables, the message recently learned is best remembered. One of this law's applications in online research is studying the effect of website content and format periodical update on memory and attitude determinants. Moreover, the role of this law could be investigated in the field of media convergence.

Individual-based Cognitive Learning Theory

The second theme in the learning literature is individual-based, meaning that it emphasizes the heterogeneity among individuals with regard to cognitive learning, information acquisition, and information processing. Four general categories of cognitive learning styles theories could be distinguished—learning styles as abilities, as personality characteristics, as preferences, and as flexible preferences and strategies.

Learning Styles as Abilities

Some cognitive learning research stressed the importance of studying individuals' abilities, as opposed to studying individuals' preferences. Among these, Gardner [16] and Riding's [17] theories will be discussed. Stating that an individual has a set of intelligences or abilities, Gardner's classified abilities under various categories—visual or picture abilities, linguistic or semantic ability, kinesthetic or touch and body abilities, logical or number abilities, interpersonal or people ability, intrapersonal or self ability, and musical or rhythm ability. Some associated measures were developed and some are available online. Due to its various categories, this theory cannot be easily applied to online consumer research; however, it might be applicable to certain online research questions, especially consumer behavior when using entertainment and leisure Websites and some specific customization areas. Arguably, previous categories can be regrouped under wider categories, supporting the VAK model discussed later.

Riding's cognitive style analysis (CSA), while similar to previous theory in judging individuals abilities, is different in both base theory and applications. Riding and Rayner [18, p.7] viewed a cognitive style as 'an individual's preferred and habitual approach to organizing and representing information'. Differentiating between a strategy and a style, Riding and Cheema [19, p. 195] explained that 'Strategies may vary from time to time, and may be learned and developed. Styles by contrast are static and are relatively in-built features of the individual.' The structure of Riding's model and its associated assessment tool, the CSA, is two-dimensional, one dimension reflects cognitive organization (holistic-analytic) and the other reflects mental representation (verbal-imagery). Using one of Ridings' two dichotomies, Monga and John [20] found consumers from eastern cultures to be more holistic and consequently evaluate brand extensions more favorably than Western consumers. The same research found Western natives to be more analytic. Indeed, the main concern of Riding's model is the speed of reaction and processing rather than with accuracy, which emphasize its adequacy to online research and practice.

Learning Styles as Personality characteristics

Myers-Briggs and Jackson's cognitive learning modules regard styles to be stable in accordance with personality. Following Carl Jung's psychological types theory [21], Myers-Briggs type indicator (MBTI) is a personality test designed to identify significant personal preferences. Major dichotomies (extraversion/introversion, sensing/intuition, thinking/feeling, judging/perceiving) provide insight into personal disposition to acquire and process information. This theory has its critique [22][23]; nevertheless, marketing researchers have investigated and successfully applied this theory to the field of advertising and communication.

Adopting two of the MBTI three dimensions and the notion of product information richness, Jahng et al. [24] provided a statistical examination to the interaction of information richness online, or static versus multimedia-enabled picture as in the performed experiment, with the retained dimensions on purchase behavior. In this work, picture richness had a significant effect on the intuitive and feeling consumer styles. Supporting a relationship between effectiveness of product presentation format and consumer's personality types, the authors called for researching the effect of personal characteristics and preferences on consumer interface and predicted e-business interface design to become automatically adaptive and customizable in both content and format to each single customer. Learning theory proposes gender to be a factor in cognitive styles. In a recent study, males were about three times more likely to prefer gathering information using their senses (i.e. sensing style) than females, who preferred reacting to information with personal reflection and consideration for others (i.e. feeling style)[25]. On the other hand, twice the number of females preferred gathering information through the use of unconscious (i.e. intuition style).

Jackson's learning styles profiler (LSP), on the other hand, is a cognitive learning model with roots in biology. The model considers learning styles as one subset of personality [26]. Learning styles identified in the model are the initiator, reasoner, analyst and implementer. The model seems appropriate for info content customization online (the pieces of information offered on a Webpage or in an email, i.e. product specifications, detailed pricing, customer referrals, similar or substitute products) as opposed to info format customization (the form of presenting information on a Webpage or in an email, i.e. simple text, text in a tabular form, picture, 3D image, video, interactive media and flash).

Learning Styles as Preferences

Different individuals exhibit different learning styles. Choosing a learning or communication approach that would result in higher recall level is becoming a usual practice at an increasing number of institutions [27]. Reviewing major learning styles

theories in this category, the VAK model [28] will be discussed because of its parsimony and adequacy to online research applications. Perceptual learning styles were found to distinctively relate to three psychological factors and human senses. Cognitive learning styles, the physical modality dimension in Dunn's model, is recognized and applied in youth and adult learning in different institutions and could be related to representational systems and neuro-linguistic programming [29]. Compared to other cognitive styles theories, this model has received numerous empirical investigations in the learning literature. The basic idea behind the VAK model is that while most individuals do perceive and learn, instructional environments and approaches respond more or less effectively to different individuals' learning style and affect both attitude and outcome. For example, research has pointed out statistically better results when college students' perceptual preferences were identified and used [30][31]. Similarly, in a corporate training environment, adults had significantly better achievement and attitude when perceptual preferences were matched with training session methods [32]. A recent meta-analysis research gave support to the model validity [33] and noted the improvement in attitude and achievement when learning styles were matched with teaching methods or instructional materials.

Although the VAK model is simple with potentials to e-customization and online research and applications, it has not been yet investigated or applied by researchers. On the other hand, the VAK cognitive styles can be said to affect communication efficiency and thus online purchasing decision rather than navigational and information search patterns. Calcaterra et al. [34], for example, found no support for a relation between cognitive style and information search patterns and found personal experience to play an important role in explaining navigation behavior.

The VAK's cognitive learning styles, illustrated in Table 1, are **(a) Visual**: Visuals learn best by seeing images and shapes, have vivid imagination, and are quiet by nature. They find difficulty to interpret instructions communicated verbally and prefer to acquire info using their eyes; therefore, it is easier for this segment to store and recall visual-rich messages than audio-rich messages. Audio accompanying a message would hinder visuals' comprehension. When it is the time to recall a piece of information, visuals would first recall the image they had formed in their minds [28]. Communicating info to this segment can be optimized by increasing visual cues, text images, and charts. Since this segment can be physically aroused by bright, changing colors and high definition pictures, it can hypothesize that visuals' attitude toward site can be enhanced by applying a combination of text- and visual-rich format. To help visuals form a purchase decision, more product visuals could be communicated and a text-chatting option with another customer or a salesperson could be provided; **(b) Auditory**: Auditory individuals prefer to use their ears, enjoy talking and listening, have an outgoing personality in general and find difficulty interpreting text- and visual-rich instructions. To fully understand, these individuals should hear, listen to an explanation, or at least self-read the text [28]. These individuals can be stimulated by rhythms, poem, and music. Theory indicates that this segment comprehension can be improved online by increasing auditory contents and cues, offering the option to listen, rather than to read, a product review, and listening to other customers' feedback or comments. Interactive video might not be the best alternative to approach auditory individuals because video richness in visual cues might induce distraction and reduce efficiency by filling limited memory space. Because auditory individuals are better at solving problems by discussion, forming purchase decisions is expected to be enhanced by allowing them to interact verbally (audio discussion at a Web forum, with salespeople and other consumers). Increasing interactivity to this segment can be reached by applications and games that engage consumers in forming lyrics, music, and rhythms. Similarly, background music and other auditory cues can be expected to improve comprehension and attitude; and **(c) Kinesthetic/Tactile**: these individuals favor the tactile and feeling sense to acquire information. Poor at listening skill, they learn easily by doing, practicing, and expressing emotions. Kinesthetic individuals learn best by hands-on activities, by watching someone else performing the task, and by applying a certain task themselves. Such activities improve both information processing and memory recall [35]. Managing an online presentation format that both appeal to and compensate for lack of suitable information for these consumers (i.e. touching product) is not an easy task. Theory indicates that these consumers should have the option to interact and get involved with the product online (i.e. move it around and view it from different angles, assemble or adjust a simulated product, review an interactive video of another person assembling or using the product). Detailed info about the size of the product, colors, smell, weight, and touch might as well help compensate for information loss for these individuals. On the extreme, these consumers can be given the option of a free trial of the product or can be offered a product prototype or a sample such as a piece of a sweater's cloth.

Allowing kinesthetic individuals to engage in live activities with other consumers, to interact with salespeople, and to express feelings and concerns about the product would theoretically fill a gap between these individuals' preferred leaning style and the online medium. Research should investigate if engaging in hands-on activity do improve involvement with the product for this segment and the effect of such activities on product perceived risk, attitude, and choice. Furthermore, these consumers would specifically value the option to build-up or customize the product more favorably than other segments because such activities are congruent with the kinesthetic/tactile learning style. Video-simulation, real size images and more info about the product physical characteristics can be hypothesized to improve this segment comprehension and purchasing attitude.

Table 1: The VAK's Learning Styles and Preferences

<i>Visual</i>	<i>Auditory</i>	<i>kinesthetics/tactile</i>
Reading	Listening	Hands and body use and movement
Observing	Lecture	Total involvement in task
Diagrams, complicated graphs	Discussion	Designing and adjustment
Pictures	Recording	Hands-on activities and affection

Research has showed that modifications of information format can compensate for individual differences in perceptions and abilities to process information. Peck and Childers [36] developed a measure to reflect the consumer need-for-touch of the product (NFT scale) and found consumers to be heterogeneous on this dimension. This heterogeneity affected product perceived risk and intentions to buy. Although developed separately and for a different purpose, the NFT scale should theoretically show positive correlation with the VAK tactile subscale.

Learning Styles as Flexible Preferences and Strategies

As opposed to separately study cognitive styles, a body of learning research focuses on learning as strategies that take into account contextual and previous experience influence. Among these, Kolb, Sternberg and Entwistle’s theories are widely used and will be briefly discussed. One of the most influential models of learning styles, Kolb theory of experiential learning [37] and associated measure – the learning style inventory (LSI) [38] have generated a considerable body of research in the education literature. Kolb observed some individuals to have specific preferences for some activities such as exercises but not others, such as lectures. According to Kolb model, a learning style is not a fixed trait, but ‘a differential preference for learning, which changes slightly from situation to situation; at the same time, there is some long-term stability in learning style’ [39, p.8]. Each of the four dominant learning styles in the model (diverging, assimilating, converging, and accommodating) forms a different quadrant of the learning cycle. This model is recognized and applied in education, medicine, and management training. Acknowledging different learning styles were found to help individuals reach better decisions, solve problems, and communicate effectively [40]. Kolb’s model seems applicable to online research and would be particularly suitable to study consumer decision making processes, heuristics, message framing and priming as well as the effect of information content-strategy fit on product choose and purchase online.

Using the similar concept, Sternberg theory of thinking styles identifies people as assuming different roles according to task and context. Sternberg [41] distinguished between style and ability. An ability ‘refers to how well someone can do something’, while a style ‘refers to how someone likes to do something’ and is ‘a preferred way of using the abilities one has’ [41, p. 8]. Sternberg argued that a certain individual do not have a style, but a profile of styles. Sternberg’s theory of thinking/learning styles is based on his theory of mental self-government, where he regarded governments to reflect heterogeneity among and to represent extensions of individuals. Sternberg defined four forms of government (monarchic, hierarchic, oligarchic and anarchic) for self governing with two scopes (internal, external), two levels (global, local), and two leanings (liberal, conservative).

Each aspect of government is considered necessary for self management in different contexts. Some of the emerging segments are (a) Hierarchic individuals recognize the need to set priorities and accept complexity; these individuals tend to be organized and systematic in decision making and ‘tend to fit well into organisations because they recognise the need for priorities’ [41, p. 23], (b) Oligarchic people ‘tend to be motivated by several, often competing goals of equal perceived importance’ [41, p. 23], (c) Monarchic individuals are single-minded and are driven by what they are single-minded about. These individuals do not let anything affect their judgment or decision making, (d) Judicial people ‘like activities such as writing critiques, giving opinions, judging people and their work, and evaluating programs’ [41, p. 21] and (e) Anarchic people are motivated by ‘a potpourri of needs and goals that can be difficult for them, as well as for others, to sort out’ [41, p. 23]; they score high on creativity and innovativeness and likes challenging the system.

The model suggests that a match between styles and abilities creates a synergy that leads to improved efficiency in performing a task. Styles are considered to vary according to tasks and situations; these styles are acquired and do develop according to experience, time as well as other factors. Some studies [42][43][44] offered empirical examinations for this theory. Obviously, Sternberg model seems to have potential applications to online consumer segmentation and info content customization.

On the other hand, Entwistle’s approaches and study skills inventory for students (ASSIST) theory and measure [45] focus on capturing individuals’ knowledge base, skills, attitudes, and effective learning strategies. This model has a complex structure, called the web of influence, which connects motivation, methods, and performance with effects, design, and intentions. The ASSIST Inventory is widely implemented and was constructed based on other scales, namely the ASI, RASI, and CPQ [46].

According to this model, an individual’s perception of obtaining new information becomes more complicated or sophisticated with experience and time. An individual’s typical strategies and cognitive styles, therefore, do affect this individual conception of learning or knowledge nature. Table 2 identifies the model’s four ideal types of learning strategies and each type specific characteristics [45].

Table 2: Entwistle Ideal Types of Learning Strategies

<i>Plungers</i>	<i>Hustlers</i>	<i>Non-committers</i>	<i>Reasonable Adventurer</i>
Emotional	Competitive	Cautious	Curious
Individualistic	Dynamic	Anxious	Reflective
Impulsive	Not responsive	Risk Averse	Critical

Indeed, this model can be used to customize online information contents and to initiate a heuristic model of the communication-apprehension process online. Such a model, if carefully examined and developed, would guide IT and Website developers to engage users in a process of critical reflection and insure use quality improvement and satisfaction. Recall that

online research regarded an adequate level of challenge as an important factor in improving interactivity and satisfaction [7]. Table 2 gives a summary of potential research applications of discussed theories in e-customization and online marketing fields.

Table 2: Discussed Cognitive Learning Theories and Potential Applications

<i>Theory</i>	<i>Potential Research Application to e-customization and Online Marketing</i>
Gardner’s multiple intelligence theory and scales [16]	Special info format customization applications; behavior on entertainment and leisure sites.
Riding’s cognitive style analysis and associated assessment tool (CSA) [17][18][19]	Info format customization (imagery-verbal dimension) & info content customization (holistic-analytic dimension)
Myers-Briggs type indicator (MBTI) adopting Carl Jung's psychological types theory [21].	Info format and info content customization; customization according to gender differences
Jackson’s learning styles profiler (LSP) applied neuropsychological model of learning styles [26].	Info content customization; online decision making
The VAK model (visual, auditory, Kinesthetic/tactile) and associated scales [28].	Info format customization; customer aid toolkit.
Kolb theory of experiential learning and associated measures – the Learning Style Inventory (LSI) [37] and the 4MAT [47]	Info content customization; online decision making; message framing; priming
Sternberg’s theory of thinking styles derived from the theory of mental self-government [41].	Info content customization
Entwistle model and associated Approaches and Study Skills Inventory for Students (ASSIST) [45].	Info content customization; online consumer heuristics

CONCLUSION AND IMPLICATIONS FOR E-CUSTOMIZATION RESEARCH AND PRACTICE

Presenting typologies as complex theories rather than classification systems, Doty and Glick [48] successfully argued that typologies identify ideal types, whereas classification systems specify decisions to categorize items in mutually exclusive, exhaustive sets. Researchers should consider this aspect when applying cognitive learning theory to marketing and management research. This paper shows that while online and marketing researchers successfully adopted some learning theories, many theories are still unused while possessing a potential of responding to pertinent research questions and provides a framework that serves as a reference of cognitive learning research and allows for direct comparison with some cognitive work in online and offline marketing and IT disciplines.

Close review of cognitive learning research in the education literature reveals some important findings. First, while some cognitive theories still need validation through empirical examination, some theories have received examination and have generated considerable body of empirical research in the learning literature with various degrees of consensus. For example, theories that studied cognitive styles as preferences such as the VAK model and measures ensuing from Jung’s theory of psychological type, namely the Myers-Briggs type indicator, have generated consistent line of research. Similarly, marketing research adopting the latter theory resulted in consistent findings. Second, some theories seem to complete, integrate, or add value to others. For example, the VAK model’s categories could be linked to or considered as a higher level grouping of Gardner’s multiple intelligence categories. Moreover, theories that regarded styles as flexible preferences and strategies implied that while abilities or preferences do develop and adjust according to time or context, these abilities or preferences evolve slowly and can be considered to be stable over a considerably long period of time. The latter justify studying and measuring styles or considering these styles to be fixed over a moderate period of time. The previous aspect also leads to notice the benefit of linking cognitive theories before pursuing a research or a certain application in the e-customization and online marketing fields.

Third, cognitive learning theories do interact with parallel cognitive research in online and management literature. Reviewing the literature in the field, cognitive style (strategy) and message format (content) congruency, or cognitive fit, positive effects on attitude and outcome and the heterogeneity found among individuals’ learning and information processing styles seem to be vocal shared themes.

Fourth, although some cognitive learning theory, mainly Jung’s psychological types theory and associated MBTI measure, have been directly tested and applied in online research, other theories, such as the VAK, Kolb, Entwistle, and Jackson’s theories, have received very little if no coverage by online and IT researchers. This work reviews major cognitive learning theories and suggests potential applications of these theories to e-customization and online research.

Fifth, while two different themes, universal and individual-based, exist in cognitive learning research, both themes can be considered equally important and complementary rather than contradictory. For example, Thorndike’s universal laws are useful to researchers interested in testing and developing global cognitive theory. On the other hand, individual-based cognitive theories are vital for online researchers interested in e-customization, optimization of message effectiveness, or other applications and consumer toolkits the depend on individuals’ heterogeneity.

Sixth, some cognitive learning theories are relatively new and some have not received adequate empirical testing. This, while posing a challenge to researchers trying to evaluate and test these theories in an online context, delineates a promising prospect for these theories' applications in enhancing cognitive theory online as well as in IT and other management disciplines.

Consequently, online and information technology research should be directed to investigate the applicability of available cognitive learning theory and research. For example, theories that considered styles as abilities or preferences, for instance the VAK and Riding's cognitive styles, seem more adequate to study online cognitive fit, communication efficiency, and message format customization. On the other hand, theories that analyzed styles as flexible preferences and strategies appear more suitable to study message content customization, online information interpretation and processing, as well as online consumer decision making and heuristics.

Researchers should also investigate how gender and cultural differences affect cognitive styles. Sternberg [41] indicated that surrounding environment shapes and predicts individuals learning styles. Monga and John [20], for example, found holistic versus analytic thinking to differ by culture and leads to different evaluations of brand extensions. Similarly, a study found Asian adults to be significantly more auditory and visual and found Caucasians and Puerto Rican adults to be high on kinesthetic, but lower on the auditory and visual dimensions [49]. The role of gender should also be considered when assessing and examining cognitive learning styles in an online context [25].

Theory implies online and IT practitioners be aware of consumers' cognitive styles heterogeneity and account for such heterogeneity when communicating or priming messages to consumers and when designing and developing consumers' interface and applications. Researchers and practitioners in other fields, such as communication and advertising, can use the framework presented and test for potential applications. Online practitioners should consider customization of message format (content) communicated based on cognitive learning styles (strategies) as indicated. They can, for example, empower consumers by giving the option to choose from multiple or hybrid presentation formats such as audio, video, and interactive product representation and by developing suitable consumer toolkits. Online researchers can use the framework provided to evaluate and adapt relevant theory from cognitive learning, test for suggested and other potential managerial applications, and consolidate cognitive research findings.

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INTERNET-BASED E-MEDIA AND CONSUMER ATTITUDES: AN EMPIRICAL RESEARCH

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ABSTRACT

This paper empirically explores the attributes associated with Internet-based e-media using the survey data collected from the consumers in Hong Kong. It has been found that perceived convenience, user-friendly interface, contents, efficiency and image significantly influence perceived usefulness of Internet-based e-media. In addition, self-efficacy and design characteristics are positively associated with perceived ease of use of Internet-based e-media. Moreover, these attributes together with subjective norms considerably explain consumer attitudes and intentions to use Internet-based e-media. The findings have practically useful implications for managing Internet-based e-media and developing new media in different contexts.

Keywords: Internet, e-media, attributes, consumer attitudes and empirical research

EXECUTIVE SUMMARY

The adoption of Internet-based e-media is an important research area, because Internet-based e-media plays an influential role in mass communications in the world. This paper aims to identify the major variables that might significantly influence the acceptance and adoption of e-media. Firstly, it constructs a research model based on the theory of reasoned action (TRA) [2], the technology acceptance model (TAM) [1], and the theoretical extension of the technology acceptance model (TAM2) [4]. Secondly, it illustrates several research hypotheses, followed by research methods. Furthermore, it presents empirical results and discusses the findings. Lastly, it is concluded by highlighting the direction for future research.

The TRA, the TAM and the TAM2 have been extensively used to examine user behaviors in relation to computer-based information systems. They especially highlight the importance of perceived usefulness, perceived ease of use, and the relevant attributes of computer-based information systems [3]. Therefore, this paper applies these theories to construct a conceptual model to evaluate consumer acceptance and adoption of Internet-based e-media. The present research model inherits the main concepts of the TRA, the TAM and the TAM2. In particular, it examines consumer perceptions of several variables such as system features, design characteristics, self-efficacy, ease of learning, efficiency and convenience.

The research methods associated with the present research include literature review, design of questionnaire, distribution of questionnaire and statistical data analysis. The questionnaire consisted of a number of questions in relation to efficiency, convenience, system features, design characteristics, self-efficacy, ease of learn, and perceived image. It also consisted of several items in relation to subjective norms, attitudes and intentions to use. Moreover, it included the enquiry of demographic data. The questionnaire was circulated to individual consumers. As a result, two hundred and twenty useful responses were collected for data analysis. The respondents were Internet users with experience in e-media. Several procedures associated with the Statistical Packages for Social Science (SPSS) were used to test the survey data.

The data analysis results in meaningful findings. Firstly, several features associated with perceived ease of use are found important. For instance, design characteristics, self-efficacy and ease of learn positively affect perceived ease of use of Internet-based e-media, although some other factors may be related to perceived ease of use. Some respondents suggest that it would be desirable if e-media could possess special effects. Special effects mainly include the use of multimedia technology, which may not be available in some e-media at this stage. Although users may not look for special effects due to the constraints of bandwidth, e-media service providers should consider these features when designing an e-media website. Secondly, information contents, efficiency, convenience and perceived ease of use are factors significantly influencing perceived usefulness of e-media. In particular, the provision of the latest e-news is important, because many want to know the news through e-media. Moreover, perceived usefulness, perceived ease of use and subjective norms positively affect individual attitudes towards e-media, which in turn influence individual intentions to use. Consumers may tend to use e-media, though it may not be perceived a privilege of status.

This project examines a number of variables in relation to Internet-based e-media and identifies the major concerns about the use of e-media from consumer perspective. The empirical results suggest that perceived usefulness, perceived ease of use and subjective norms significantly affect consumer intentions to use e-media. The findings should have practical implications for managing Internet-based e-media. The e-media service providers are suggested to improve these aspects in order to attract more people to use the services. Future research can be carried out to explore consumer perceptions of various types of e-media in different contexts. It would be meaningful to identify specific variables associated with e-media in different cultural environments, because the information will be useful for the improvement of existing e-media and the development of new

media services.

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THE EFFECTS OF PRODUCT KNOWLEDGE AND INTERNET EXPERIENCE ON ONLINE SHOPPING BEHAVIOR

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ABSTRACT

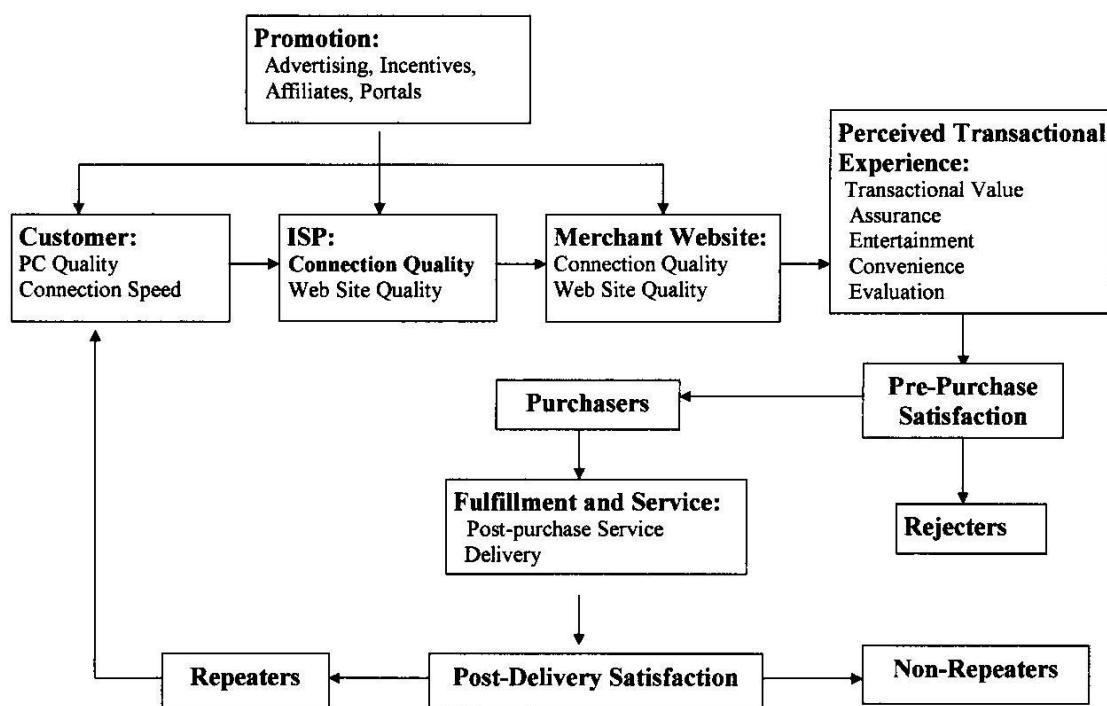
Thanks to tremendous growth of e-commerce and the advancement of Internet infrastructure, the online shopping medium has become a staple in many world economies. The present study examines how the consumer's product knowledge and Internet experience affect the level of uncertainty and perceived risk. Potential dimensions of product knowledge and Internet experience are developed and examined. Their effects on uncertainty and risk perception are proposed. An add-on model linking product knowledge, Internet experience, uncertainty, risk, trust, and purchase intention is developed. The add-on model is incorporated into an existing model of online shopping process (NetShop). The revised overall model suggests how online shopping intention can be affected by the level of product knowledge and Internet experience, via their effects on uncertainty and perceived risk, as well as the three original factors, interactivity, transaction, and fulfillment.

Keywords: Online Shopping, Product Knowledge, Perceived Risk, Trust

INTRODUCTION

Thanks to tremendous growth of e-commerce and the advancement of Internet infrastructure, the online shopping medium has become a staple in many world economies. In order to be successful in the Internet niche, new and established firms engage in business model reengineering to keep up with changes in how customers acquire goods and services. The quick expansion of e-commerce in the 1990s and its ever-presence since mid 2000s and on have changed the retail landscape dramatically in the world economy. In the B2B sector, Internet technology facilitates numerous changes in corporate infrastructure in information exchange and procurement and distribution process. In the retail sector, the Internet has become a staple shopping medium. The importance of online medium prompts intensive research interest and various models of shopping behavior. Among competing models, the NetShop model (Figure 1) developed by Chen and Chang [1] [2] captures the essence of the online shopping process.

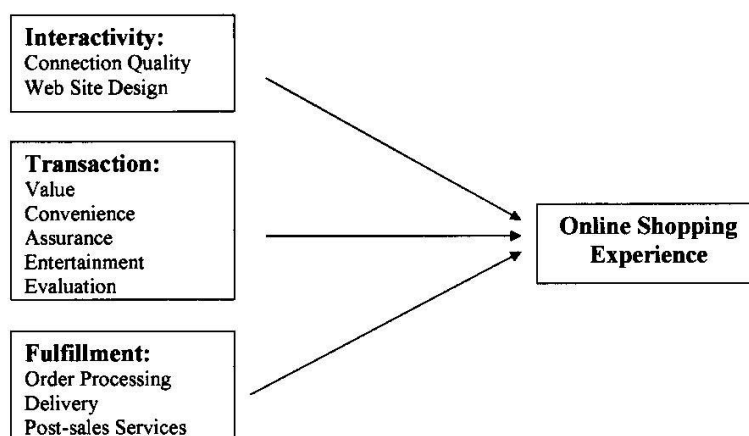
Figure 1: The Descriptive Model of Online Shopping Process



Source: Chang and Chen [2]

Based on the model, the consumer's online shopping satisfaction is determined by three factors, interactivity, transaction, and fulfillment (see Figure 2). *Interactivity* encompasses those human-computer interface factors that link a shopper with the online shopping site, e.g., Internet connection, website design and appearance, and system capacity. It is analogous to the physical shopping environment in a traditional retail store. *Transaction* includes factors that directly affect one's purchase decision, e.g., price, convenience, and security. *Fulfillment* contains factors such as delivery, exchange and return policies, and post-purchase services.

Figure 2: Determinants of Online Shopping Experience



Source: Chang and Chen [2]

As the Internet shopping medium becomes mature, the sector has gone through significant makeover. The Internet bust since early 2000 has helped consolidate the Internet retail sector as many Internet startups went under while many others consolidated with one another. Many Internet marketers have reduced the importance of price factor and turned their attention to value components, such as convenience and efficiency. As the online sector becomes more mature with healthy Internet infrastructure, less emphasis was placed on factors such as privacy and security, which have been of great concern for Internet shoppers for many years [5] [6] [7] [10]. In the fourth quarter of 2002, online retail sales reached \$17.44 billions, an increase of 40% from the same period a year ago [3]. By the end of 2006, online sales had exceeded \$200 billions, according a study conducted by Forrester Research Inc. for Shop.org, the online arm of the National Retail Federation and CNet News (October 2006).

One issue has clouded online shopping sector is uncertainty. Uncertainty in buying behavior refers to the degree to which the outcome of a transaction cannot be accurately predicted due to information asymmetric, that buyers are often at a disadvantage in information. Uncertainty includes seller quality uncertainty, (incomplete information, shirking, or even defrauding, and product quality uncertainty, not as expected, not as promised, and being compromised [9]. The level of uncertainty has a direct impact on the formation of risk perceptions associated with a purchase [4]. Some unique online shopping characteristics contribute to the heightened degree of uncertainty and often make online purchases seem to be riskier than what they really are.

Based on the NetShop model, the present study examines how the consumer's product knowledge and Internet experience [8] affect the level of uncertainty and perceived risk and how such effects can be incorporated into the overall online shopping model. Potential dimensions of product knowledge and Internet experience are developed and examined. Their effects on uncertainty and risk perception are proposed. Finally, a model linking product knowledge, Internet experience, uncertainty, risk, trust, and purchase intention is developed. The add-on model suggests how online shopping intention can be affected by the level of product knowledge and Internet experience, via their effects on uncertainty and perceived risk.

The following specific relationships are proposed and examined:

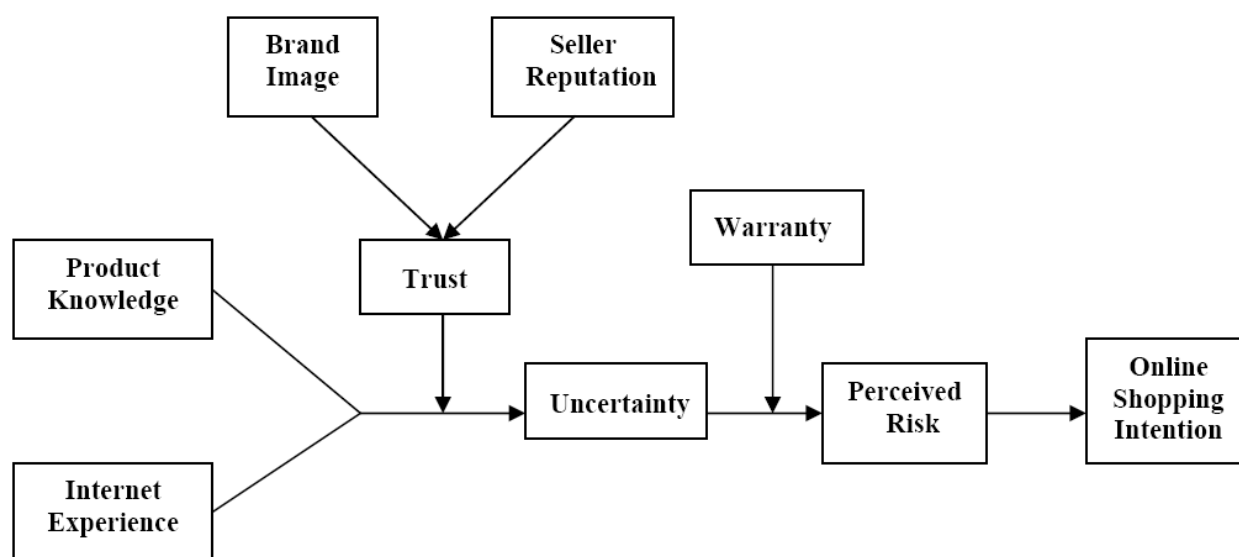
- Product knowledge has a negative relationship with uncertainty. Knowledgeable online shoppers are more certain with their online purchase decisions.
- Internet experience has a negative relationship with uncertainty. Internet-savvy online shoppers are more certain with their

online purchase decisions.

- Internet-savvy online shoppers who are knowledgeable about the product have the lowest level of uncertainty.
- Risk is a direct, positive function of uncertainty. Online shoppers who are uncertain will perceive an online purchase as risky.
- Online shopping intention is negatively related to the level of perceived risk. Online shoppers will avoid making risky purchases.
- Trust is an effective factor that can moderate the effects of product knowledge and Internet experience. Trust can be built by various means, such as brand image and seller reputation.
- Perceived risk can be reduced by means such as warranty.

The added model is shown in Figure 3.

Figure 3: The Add-on Model on the Effect of Perceived Risk on Online Shopping Process

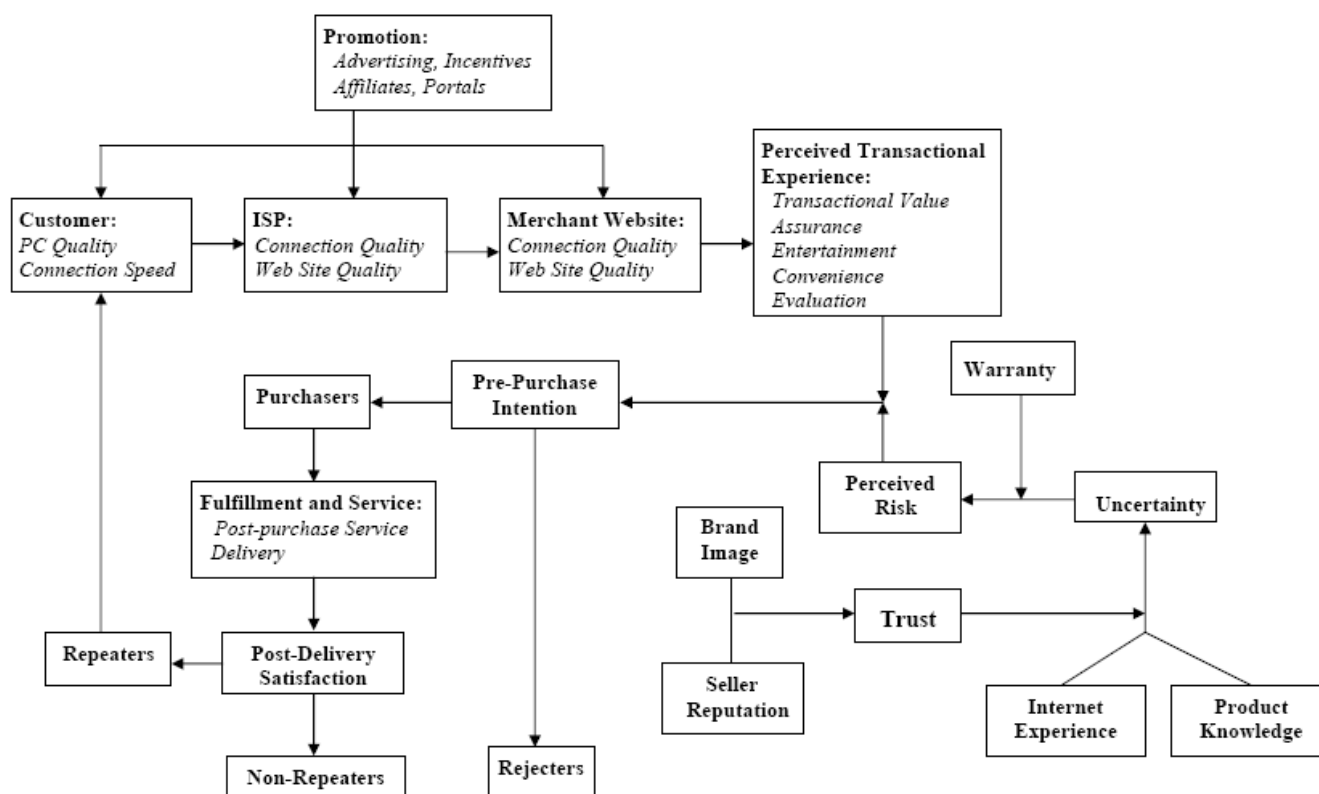


Combining the add-on model to the Chen and Chang's [1] [2] NetShop model, a revised NetShop model is depicted in Figure 4. The model suggests that consumers' product knowledge and Internet experience can be used to segment potential customers. It is more effective to market to online shoppers who are Internet savvy and knowledgeable. On the other hand, it can be futile to target at consumers who lack product knowledge and are not comfortable with the Internet in general. For consumers who are somewhere in between, managerial factors, such as brand image, seller reputation, and warranty can be incorporated into the purchase decision process to lessen the degree of uncertainty and perceived risk and increase purchase intention.

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Based on the revised NetShop model, overall online shopping experience is affected by four components: interactivity, transaction, fulfillment, and perceived risk associated with the online purchase. The model offer a broader view of the overall shopping process and suggest a more comprehensive approach in evaluating online shopping experience. The model can be of diagnostic value to the managers and researchers. The managers may examine various component of the shopping process in diagnosing the weak links in the overall online shopping process. Academic research may test and revise various relationships as suggested in the overall NetShop model. As further empirical evidences accumulate, the model can be refined and revised based on research findings.

Figure 4: The NetShop Model of Online Shopping Process



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THE INFLUENCE OF ADVERTISING TO THE PURCHASE INTENTION OF MOBILE PHONE IN TAIWAN

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ABSTRACT

Consumer purchase intention is one of the key factors affecting companies advertising strategy. Advertising is a pervasive influence in our daily lives. It is urged that, to enhance communication and persuasion, marketers should seek a cognitive, affective, brand attitude or behavioral response through the exposure of advertisement. This paper is to study how ways of advertising influence on the purchase intention of Taiwan University students. Each person could have different reasons and motifs (preference) in choosing brand of mobile phones. Therefore, it is interesting to explore the influence of advertising to the purchase intention of Taiwan university students. Three questions are asked; How Taiwan university students react to the advertising? What factors influence the purchase intention of Taiwan university students? And what are the students' reactions to brand attitude?

Keywords: Advertising, Consumer Behavior, Marketing, Brand, Mobile Phone.

INTRODUCTION

How does advertising affect consumer attitudes and purchase intention? This study will explore this question by conducting a survey on mobile phone advertising in Taiwan. Seven "real" brands (from low involvement to high involvement brand) of mobile manufacturers were used as study stimuli. Advertising is very important since it learns how to create and spread messages used to promote and sell products and services. Firms always use advertising to communicate messages and to persuade consumers to buy their products. Advertising also can build brand image of one product too. Consumers will be influenced to buy something because of the advertising that they have ever seen. If the cognitive thoughts/beliefs are prominent in the consumer's memory, the impact will be greater on the consumer's attitudes and thus his/her behavior [1]. Thus for those consumers drawn to particular sport events, marketers can use sponsorship to increase the frequency of exposure for their marketing messages and have greater impact on consumer attitudes [2]. Advertising and promotion are undertaken through cooperation between the service providers and the mobile phone manufacturers which are represented in the country by their franchise holders. Service providers use brand names in their advertising copy by showing a line of mobile phone models coming from different franchise companies and the range of functional mechanism [3].

Consumer behavior will be influenced by the advertising input given to them. Advertising can give some effects to consumer's affect, cognition and experience [3]. It can motivate consumers to consume and have loyalty to the products offered. They can make a choice to select products they need and want from many kinds of products based on their affection and feeling to the products based on the advertising which is offered or they see from some advertisement, such as television, radio, newspaper, pamphlet, leaflet (advertising copy), or board advertisement.

The distinction between cognition and affect has been reviewed by plenty of scholars [4-6], but the results were not determined. According to the earlier studies [7][8], cognition is one of the most important factors that determine affect and consequently result in purchasing intention and behaviors. Another stream of studies [5] claimed that thinking and feeling are two independent systems. They suggested that the slower, more detailed cognitive system might be predominated by the faster, cruder affective system. More recent studies recognized that affect is a critical role in the consumption experience [9][10]. Attitude toward the ad (A_{ad}) has been defined as a "predisposition to respond in a favorable or unfavorable manner to a particular advertising stimulus during a particular exposure situation" [5]. A_{ad} may contain both affective reactions, e.g., advertising created feelings of happiness, and evaluations, e.g., of an advertising's credibility or informativeness [11].

This research is done in order to get the data about the ways of advertising that influence the purchase intention of university students in Taiwan since they use many kinds of mobile phones with different brand. According to Biehal, Stephens and Curlo, [4], brands vary in the amount of power and value they have in the market place. They also mentioned that a consumer will behave towards a particular brand. A powerful brand has high brand equity. Brands have higher brand equity to the extent that they have higher brand loyalty, name awareness, perceived quality, strong brand associations, and other assets such as patents, trademarks, and channel relationships.

Upgrading mobile phones to newer models is a common practice among teenagers. Purchase is undertaken either immediately, upon introduction of the newest model with higher prices, or at a later date when the prices are reduced [5]. Besides, mobile phone companies use advertising to influence the purchase intention of customers. Service providers also use brand names in

their advertising copy by showing a line of mobile phone models coming from different franchise companies and the range of functional mechanism.

Researcher and practitioners have the same opinion that the most explosive growth in telecommunications has occurred in internet and mobile telephone services [6]. These two technologies are combined into the internet-enabled mobile device. It has become one of the most promising advertising media around [7]. For example, SMS (short message service) direct marketing is becoming a popular advertising method in worldwide. Consumers are spending 58 million messages per day in 2004 within the United Kingdom [8]. The trend has migrated to the United States as well. An SMS-TV direct marketing campaign was conducted by McDonald in conjunction with a popular song contest program, offering concert tickets and backstage passes. Coca-Cola executed a text message campaign for college students in which a number printed on a Diet Coke can could be used as an entry in the Coca-Cola Grand Sweepstakes Competition [9]. According to Mullman [10], as many as 81 percent of 18- to 21-year-olds have mobile phones, and most of them are likely to participate in TV or radio polls, purchase ring tones, play games, and send text messages.

Mobile phones are popular with teenagers, known as the “text generation”, in the Philippines. Many students, even those in the lower middle class, have been caught up with the inevitable plague of texting within the last five years. The process of texting is that a mobile phone user sends a message from one cellular phone to another in the form of words or texts instead of speaking directly over the phone. The number of global mobile phone subscribers hit 2.3 billion in 2006, which is expected to climb to 3.3 billion by 2011. It is expected that Asia-Pacific will account for 47.9% of global subscribers by 2011. Aside from the strong growth in basic cellular services, there is a strong demand for mobile Internet services across the Asia-Pacific region [11]

It has been proven that each person has different reasons and motifs (preference) in choosing brand of mobile phones. For this reason it is interesting to explore the influence of advertising to the purchase intention of Taiwan university students; how students of Taiwan university students react to advertising?; is it positive or not to them?; what factors influence the purchase intention of Taiwan university students; How does the advertisement influence the brand attitude?, is it influenced directly or indirectly?; and how does the advertisement influence the purchasing intention?.

CONCEPTUAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

Cognitions' influence on Ad-evoked Feelings, Attitude Toward the Advertising (A_{ad}) and Attitude Toward Brand (A_b)

Much research on advertising in consumer behavior, for the most has focused much on cognition. But this study is interested in the feelings generated by an individual in response to an advertising and ultimately if that will influence purchase intention. Though Mackenzie, Lutz and Belch [12] used a cognitive response method and did not examine feelings specifically, their results support the hypothesis that feelings toward and advertising can influence the nature of subsequent processing of the advertising, observed in this study as cognition. Cognitive responses can classifications categorize as positively or negatively valenced brand-related cognitions, ad-related cognitions, or idiosyncratic thoughts [13].

According to Edell and Burke [14] that the characteristic the advertising as having cognitive elements. The cognitive element is made up of different subjects' judgments of the advertising's characteristics (i.e. descriptions of the advertising itself, such as “humorous, informative) which in case the affect of feeling element is based on feelings subjects experience during the advertising exposure (e.g., amused moved, fed up). However, Hoch and Loewenstein [15] propose that feelings of desire that consumers often experience in shopping situations may “occur with the minimum conscious deliberation characteristic of automatic or mindless behavior” and with little or no cognition” [15]. Base on Edell and Bruke's study, we propose that the congnitions will have a direct influence on ad-evoked feelings.

H1: The congnitions will have a direct influence on ad-evoked feelings

Cognitive responses are simply the thoughts that consumers produce when they are exposed to advertising. The cognitive response model hypothesizes that when individuals receive a message, they exert mental effort by attempting to relate the message to their existing attitudes, knowledge, and feelings [16]. Consequently, the responses generated in this way would affect consumers' attitudes [17]. The intensity of cognitive responses (i.e., the number of thoughts) is proposed to directly affect consumers' memory performance. This is because an increased depth of ad-processing results in more thoughts about the ad; this allows consumers to be more aware of and better consciously recollect in later retrieval what they saw or heard [18]. The valence of cognitive responses is suggested to influence consumers' attitudes on advertising; accordingly we proposed that the congnitions will have a direct influence on attitude toward the advertisings.

H2: The congnitions will have a direct influence on attitude toward the advertisings

Many studies have been extensively studied the cognitive respnses in brand attitude formation under a variety of conceptual frameworks, such as the Dual Mediation Model [19], the resource-matching hypothesis [20], and the accessibility/diagnosticity framework [21]. A common theme among cognitive-response models of attitude formation is that the net favorability of cognitive responses elicited by a persuasive message determines attitude strength [22]. While precedent studies theoretically conceptualized that cognitions influences on consumer's brand attitude, we propose that the congnitions will have a direct influence on attitude toward the brand.

H3: The cognitions will have a direct influence on attitude toward the brand

Effects of Ad-evoked Feelings on Attitude Toward the Advertising (A_{ad})

Several researchers have demonstrated that, next to cognitions, feelings could also play an important role in the formation of judgments on advertising [23]. Individuals in positive-mood states have shown to evaluate stimuli more positively than individuals in neutral- or negative-mood states. It means that mood may influence persuasion relatively to direct affect transfer [24]. The primary implication of direct affect transfer is that when an unconditioned stimulus spontaneously provokes an affective response then the transfer of affect exists [25]. In addition, based on the Feelings-as-Information Model, Schwarz [26] suggested that individuals might assume that their mood states are affective reactions to the object being evaluated and thus base their evaluations on their affective states. Thus it is predicted that the ad-evoked feelings could frame A_{ad} .

The underlined theoretical argument from Elaboration Likelihood Model [27] suggests that there are two different ways in which ad-evoked feelings might influence A_{ad} . While the direct impacts of ad-evoked feelings on A_{ad} in our research model are just as what ELM called “peripherally process the message”, we propose that the ad-evoked feelings will have a direct influence on A_{ad} .

H4: The ad-evoked feelings will have a direct influence on A_{ad}

Effects of Ad-evoked Feelings on Brand Attitude (A_b)

Studies of ad-evoked feelings typically have included A_{ad} and A_b as dependent variables. Earlier analyses of the impact of affective responses to advertisements suggest that ad-evoked feelings elicited by advertising will have an impact on brand attitude (A_b). Holbrook and Batra [28] suggest that A_{ad} and emotional response to advertisements mediate the effect of advertising content on change in A_b . Furthermore, different emotional responses have different effects on A_{ad} and work through A_{ad} to explain changes in A_b . According to Edell and Burke [14] and Stephen and Russo [29], direct and indirect effects of ad-evoked feelings on A_b are found for both familiar and unfamiliar brands.

Each consumer would have his/her own unique brand mental map (or consumer brand representation). In addition to this, the consumer brand knowledge may be derived from several sources: objective reality (consumer personal experience); constructed reality (message from advertising and media); and experiences of others (such as word-of-mouth) [30]. The influence of feelings has been theoretical and empirical supported. Holbrook and Batra [28] demonstrated that A_{ad} and ad-evoked feelings mediate the effect of advertising content on A_b and that different emotional responses have varying effects on A_{ad} , in turn, influence A_b . Because of the extent of theoretical and empirical support for the causal linkages in Burke and Edell’s framework, we propose that the ad-evoked feelings will have a direct influence on A_b .

H5: The ad-evoked feelings will have a direct influence on A_b .

Effect of Attitude towards the Advertising (A_{ad}) on Brand Attitude (A_b)

Mitchell and Olson [31] highlighted the major influence of the attitude towards the advertising (A_{ad}) by demonstrating that the effect of visual and emotional elements on the brand attitude (A_b) is mediated by A_{ad} . They further argued that this A_{ad} is a distinct concept from formed product beliefs and that they both influence A_b independently. Studies on A_{ad} had been conducted in a number of methodological contexts, although a number of researchers have found that the dual-mediation model of the effects of A_{ad} best fits the data in individual studies, more specific findings concerning path within the model have been mixed. Since then emotional responses in advertising have received increasing attention. Shimp [32], just mentioned assumes a direct link between A_{ad} and A_b and implies that a positive attitude towards the advertising is directly carried over to a positive attitude towards the brand. Support for this theory has been found in previous studies, in which it was concluded that advertising evaluations were debilitated by negative affect and stimulated by positive affect [33][34]. The findings of Biel and Bridgwater [35], for instance, state that “people who liked a commercial ‘a lot’ were twice more likely to be persuaded by it than people who simply felt neutral towards the advertisement.” Consumer’s affective responses to ads have been of increasing interest academics. In particular, one research stream has investigated the influence of attitude toward the advertising (A_{ad}) on brand attitude (A_b). In the 1970’s, scholars suggested the importance of understanding viewer’s global evaluations of advertising [36]. Okazaki, Katsukura, and Nishiyama [9], also refer that attitude toward advertising directly and positively affects attitude toward brand. Based on the prior studies, we propose that the effect of A_{ad} will have positive influence on A_b .

H6: The effect of A_{ad} will have positive influence on A_b .

The Effects of Attitude toward advertising (A_{ad}) and Brand Attitude (A_b) on Purchase Intention (PI)

Brand attitude has been proposed to be preceding purchase intentions. Shimp [32] proposed that attitude towards the advertising is a mediating influence on purchase intention. According to Kotler and Keller [37], an attitude is a person’s enduring favorable or unfavorable evaluations, emotional feelings, and action tendencies toward some objects or ideas. Attitudes put the consumer into a frame of mind of liking or disliking an object, and lead consumers to behave in a fairly consistent way toward similar objects. Thus, favorable attitude will lead to behaviors.

According to the balance theory [38], a consumer will generate favorable attitudes toward an advertising message or a brand; he/she will maintain cognitive consistency among various ideas and concepts about which he/she think. In order to be consistent among ideas, the consumer may create behavior intentions toward buying the brand if he/she has already generated favorable

attitudes toward the products. Mowen [39] argued that consumer’s intention to buy some product might result from positive affects or feelings toward the product. In the low involvement situation, the impact of beliefs on behavior is minimal, while in high involvement situation, the beliefs of the product play more critical role on purchase intention.

Many researches has been done on Brand Attitude (A_b) and its effects or relations to Purchase Intention (PI) such as researches by Brown and Stayman [40] and MacKenzie, Lutz and Belch [12][19]. This research found strong support for A_{ad} - A_b -PI relationships. MacKenzie, Lutz and Belch [12] proposed and tested four causal models of the mediating role of A_{ad} on A_b and PI. They found support for the dual mediation model. Also, Mowen [39] argued that consumer’s intention to buy a product might result from positive affects or feelings toward the product. As result of this evidence, we have developed the following hypothesis (as mentioned above):

H7: The effects of A_{ad} will have positive influence on consumer’s purchase intention

H8: The effects of A_b will have positive influence on consumer’s purchase intention

CONCEPTUAL FRAMEWORK

Based on the literature review and research hypotheses as illustrated in the previous sections, this study develops the conceptual framework of this research as shown in figure 1. Although many studies have focused on investigating the interrelationship between Cognition, Attitude toward Advertising, Feeling, Brand Attitude and PI a comprehensive research framework as illustrated in this study was not formulated from previous literature. It is argued that the results of the study may provide a more holistic perspective for the academicians and the practitioners to evaluate the effects of cognition on attitude toward advertising, feeling and PI.

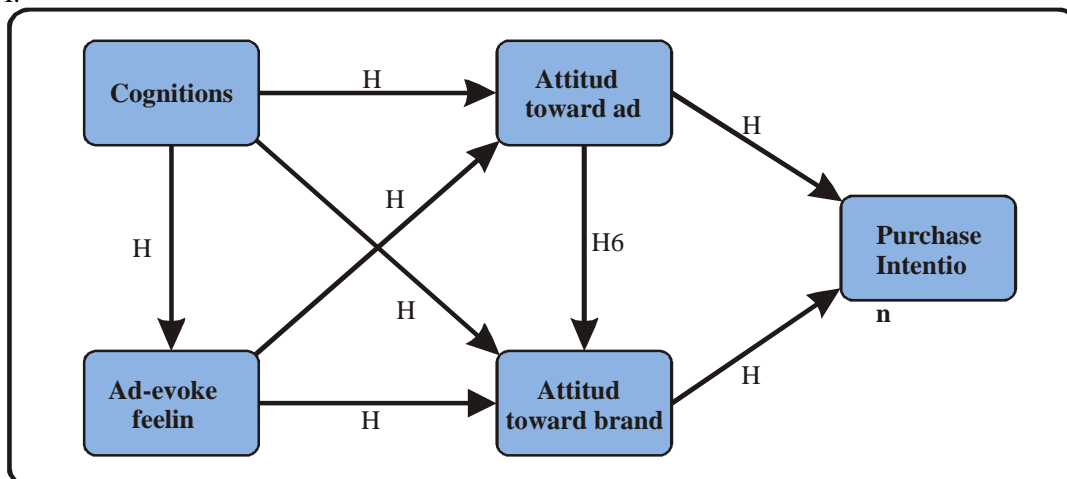


Figure 1 The conceptual framework of this study

PRODUCT STIMULI SELECTION

Zaichkowsky’s [41] involvement scale will use for the manipulation check of the level of involvement of the product brand. The selection of the product is based on four categories for three reasons. First, they are different in many aspects, such as price range, purchase frequency, and consumption situation (place and interaction among others). Second, these products are suitable for the studies of Attitude toward advertising and Brand attitude due to the consumers can evaluate differently on each individual products. Third, the respondents that are familiar with the brands and products will provide reliable responses to the questionnaire. The product brands selected for this study are shown in Table 1.

Table 1 Product Brands in Formal Test

Products of the Brand	Brand Involvement index Based on Zaichkowsky
Sony Ericsson	High ↑↓ Medium ↑↓ Low
Motorola	
Nokia	
Ben-q	
Pantech	
Innostram	
DB Tel	

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INTERNET BANKING ADOPTION: THE SECURITY INFORMATION PERSPECTIVE

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ABSTRACT

The objective of this paper is to examine the issue of Internet banking adoption from the perspective of the security information provided by banks on their Web-sites. Security policies provided on the Internet by eight Australian banks were examined and analyzed. Results show that apart from preventive measures, banks hardly disclose any information regarding other aspects of security such as detection. Apart from stating the security measures adopted by banks, most Web-sites have an extensive discussion of banks' expectation of users' roles in security maintenance. It is also interesting to note that while all eight banks expect users to use anti-virus software and firewalls, only two banks indicate they use virus scanning tools.

Keywords: Internet banking, online banking, Internet security.

INTRODUCTION

Internet adoption rate in Australia in 2005 was more than seventy percent but only about thirty percent of the population uses Internet banking. Because of the relatively low adoption rate of Internet banking, studies have been done in Australia and other regions, such as Singapore, Hong Kong, New Zealand, and Scandinavia countries, to examine the antecedents of Internet banking adoption. For example, in a recent study in Australia, 32 Internet users interviewed individually and in focus groups [1]. Their results suggest that factors such as convenience, accessibility, security, privacy, and cost influence participants' Internet banking decision. Moreover, participants would have faith in banks if banks had strong security measures.

RESEARCH QUESTION AND METHODOLOGY

The objective of this paper is to examine the issue of Internet banking adoption from the perspective of the security information provided by banks on their Web-sites. It examines the following research question: What kind of security information is provided by Australian banks on their Web-sites? Security policies provided on the Internet by eight Australian banks were examined and analyzed. They include the four major banks, namely, Commonwealth Bank of Australia (CBA), Australia and New Zealand Banking Group (ANZ), National Australia Bank (NAB), and Westpac Bank, and four other banks as follows: St. George Bank, Suncorp-Metway (Suncorp), Citibank, and HSBC. Results of this study will help banks understand where they stand in comparison to their counterparts in terms of security information provision and might shed light on why Internet users prefer certain banks rather than the others.

RESULTS

Security information provided on banks' Web-sites were analyzed based on three aspects: prevention, detection, and response. Results show that the majority of the information provided by banks is about prevention. All banks implement preventive security measures regarding information storage and transmission. Nevertheless, in terms of detection, results show that only one bank (CBA) indicates it adopts intrusion detection systems. Suncorp is the only bank which indicates it has a backup system in place as an incident response measure.

Information Storage & Transmission

Regarding information storage, more than half of the banks have a clear policy regarding destroy of information, premises security, information access restriction, and computer access control. All but one bank indicate they adopt firewalls. On the other hand, only two banks indicate they de-identify customers' information where appropriate. Moreover, only two banks mention they adopt virus scanning tools or have measures in place against eavesdropping. Also only two banks provide employee training on privacy and confidentiality.

All banks adopt encryption in information transmission and refer their customers to look for a padlock on the browser. Moreover, all but one bank mention their usage of SSL (secure sockets layer) and digital certificates. Yet only three banks tell their customers which certification authority (CA) issues their digital certificates. Half of the banks specify they use 128 bit encryption standard.

Expectation of Users

Apart from stating the security measures adopted by banks, most Web-sites have an extensive discussion of banks' expectation of users' roles in security maintenance. All eight banks expect users to install the latest anti-virus software and firewalls on their computers. All but one bank expect users to install anti-spyware programs. Six banks expect their customers to apply the latest software update and security patches. To facilitate their customers, six banks provide customers with hyperlinks to Web-sites that sell firewalls, anti-virus software, and anti-spyware software. More than half of the banks remind their customers to log off after Internet banking sessions and not to use shared computers to access their Internet bank accounts. Half of the banks expect customers to check last login time and previous transactions to identify any potential problem. Only three remind customers not

to include sensitive personal information in their e-mails.

Additional Security Measures

Some banks provide additional security measures such as secure token or secure SMS (short message services) messages. Citibank provides an on-screen keyboard which is a measure against keyloggers. CBA allows customers to set up an additional login ID which has only restricted access. This facilitates customers who want to check their bank accounts while they travel. Similarly, NAB provides an additional security measure to customers who want to access their Internet bank account while traveling by allowing them to lock their passwords after completion of Internet banking sessions.

CONCLUSION

In summary, all eight Australian banks provide different degrees of detail of security information to their customers. Apart from preventive measures, banks hardly disclose any information regarding other aspects of security such as detection and incident response. It is interesting to note that while all eight banks expect users to use anti-virus software and firewalls, only two banks indicate they use virus scanning tools. While all banks indicate they adopt different security measures such as encryption and digital certificates, most do not explain the terminologies to their customers. Results suggest that banks place a big onus of security on their customers. It is questionable whether such a high level of expectation is realistic because prior research has shown that the e-literacy level of Australian Internet users is not that high. Some banks began to provide two-factor security measures to their customers but the development in this area in Australia is relatively slower than that in other regions such as Europe. The next step of this study is to examine the perceptions of Internet users on such security information and whether their decision to use Internet banking is affected by the security information provided by banks.

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CONCEPTUALIZING A KNOWLEDGE SOCIETY IN CHINA: A UBIQUITOUS PERSPECTIVE

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ABSTRACT

Developing Ubiquitous Network Societies (UNS) has been a subject of investigation in last decade. Several policy and technological projects have been proposed and implemented at global level to promote ubiquitous network. This paper focuses on China's preparation towards UNS by analyzing and evaluating the prerequisite technological developments that enable the construction of UNS. The objective of this paper is to identify the notable features of UNS in context to China. Being the nascent area of study our research approach is from technological perspective.

Keywords: Ubiquitous Computing, Ubiquitous Network Society, UNS, China.

INTRODUCTION

Developing Ubiquitous Network Societies (UNS) has been a subject of investigation in the last decade. Several policy and technological projects have been proposed and implemented at global level to promote ubiquitous network. Japan and Korea are considered as pioneers in UNS but most countries including Singapore, Italy and India have incorporated the concept of UNS into their development strategies. Globally many policy and technological projects have been proposed and implemented to introduce the advent of Ubiquitous Network. This paper conceptualizes construction of UNS in context to China by analyzing and evaluating its prerequisite technological and network developments. The objective of this paper is to identify the notable features of UNS from technological network perspective. China has yet to formally embrace the UNS concept as a strategic choice although the National Information Center held a national seminar in 2006 focusing on Ubiquitous Network and IT Development Strategies [1]. Since then the government has begun to realize and recognize the importance of Ubiquitous Network for information oriented development. Broadband adoption is slower than internet adoption but with a target of 200 million internet users by the year 2010, migration to broadband can be expected to grow facilitating the advent of UNS [2]. In this context our research is timely and relevant and provides insights to academics, policy makers and practitioners. Given this is a nascent area of study; our research approach is applied and explanatory to understand the technological context of UNS development. We draw on policy papers, studies in the related fields to identify the characteristics of UNS.

TOWARD A UBIQUITOUS NETWORK SOCIETY

The "Ubiquitous" concept was first articulated by Weiser when he envisioned that interconnected computing devices could be accessed everywhere and used effortlessly and unobtrusively just as the electricity or telephones of today [3]. The notion of Ubiquitous Network was initially brought forward by Murakami in Nomura Research Institute in Japan in 2001. Later he presented his ideas to OECD meeting describing how users can surf the network by suitable terminal equipment anywhere and easily [4]. This prospect was accepted and adopted widely in several countries. For instance, U-Japan (2005) and U-Korea (2004) strategies aimed at developing a ubiquitous society in Japan and South Korea were conceptualized.

The term Ubiquitous Network Societies captures the convergence and connectedness between a number of technological fields as well as their implications for the socio-economic, political and legal aspects of a society [4] [5]. There is no consensus on the term UNS definition. U-Korea document identifies UNS as "a technological society armed with intelligent network, most advanced computing technology and other advanced digital technology infrastructures. In a ubiquitous society, everybody and everything can enjoy the convenience brought by modern information technology". For the purpose of this paper we understand UNS where techniques of wireless communication networks, sensor networks and ubiquitous computing are connected to constructs a society in which everyone can utilize modern information services in a most efficient manner [6]. UNS may be identified by many characteristics and in the next section we examine literature to identify some of the main embryonic features of the UNS.

IDENTIFICATION OF CHARACTERISTIC AND BENEFITS OF UNS

The main characteristic of UNS self-evidently is its ubiquitous nature relating to the ability to communicate for all. It serves users and non-users of telecommunications and the internet services. The latter segment includes senior citizens, children, or even pets [7]. In this sense UNS offers smart and digital homes, provides better solutions to health and nursing problems particularly for the old. Ubiquitous technology will be embodied in the machines so that they can communicate and exchange information [8]. The real physical things are called U-things if they are attached, embedded or blended with computers, networks, and/or some other devices such as sensors, actors, e-tags and so on. Smart u-things are ones that can sense, compute, communicate and take some responsive or automatic actions/reactions/proactions according to their goals, situated contexts, users' needs, etc. For

instance, in digital homes and smart cities, home electric appliance and public facilities are able to communicate collaboratively and process the information invisibly. The National Institute of Information and Communications Technology of Japan have completed a real-life ubiquitous home testbed for home context-aware service experiments in 2004 [9]. Therefore the concept of UNS aims to not only satisfy the need of industrial and economic development but also bring about revolutionary progress for everyday life.

Another major characteristic of UNS is that computers, machinery and networks are invisible and least intrusive or obstructive to the user and the society. More specifically, computers will not appear as computing facilities, but as information facilities in the forms of embedded processors, memorizers, communications modules and sensors put together [7]. These information facilities can compute, communicate and function as sensors, and can be conveniently combined with traditional facilities. They can easily connect with each other or to the Internet. Most of them are embedded facilities as small as the dust floating in the air, namely the smart dust [10]. These are wearable devices and context-aware technologies which make the networks and computing exist everywhere, but people do not sense their existence and need not look for, perceive or control those [11]. In this intelligent network, user experiences the calm convenience brought by networks and embedded mixed reality of activities in the virtual and physical worlds.

Next, UNS is essentially for the service for users. In this sense it qualifies the electronic age where primary focus is on commercial models [12]. This principle is represented by technological humanism and service humanism [1]. It concern with users daily needs and machine, interactions, information dissemination and processing is calm and this is the most profound delineation form our current environments [13] [14]. This service-like access can also be provided by the system without user participation. Thus ubiquitous network will be dealing in information considered private and public [15]. UNS saves people from handling the complicated machines and machine-to-machine based (M2M) daily activities. This influences work efficiencies and other commercial patterns, harmonizing people and their surroundings, promoting the quality of their life and happiness index [5]. They will eventually cause the transformation of the whole society.

The UNS focus is on serving the user and the humankind and its value derives from various benefits it extends to the society. At business level Ubiquitous communication creates new revenue streams. This is relevant for networks and M2M communications especially from data and voice services, on both fixed and mobile networks. Many other industries the retail, logistics, automotive, aerospace and pharmaceuticals stand to derive commercial benefits from UNS. These include a reduction in process costs, inventory, errors, and cycle times; the improved coordination of the supply chain; and monitoring of critical process parameters [16]. This efficiencies and benefits may affect the social systems comprising legal frameworks, usage practices and value judgments. These benefits can be identified as creating an energetic, worry free, convenient and exciting society [17].

Based on the above discussion we identify three main characteristics and benefits of UNS namely universal, calm and user centered. With the perspective of benefits and values extended by UNS, user readiness to adopt ubiquity warrants further investigation.

ENABLERS OF UNS: A TECHNOLOGICAL PERSPECTIVE

Realization of UNS is mainly dependent on the technological development of the wireless communication network, perception technology and ubiquitous computing. The first step toward UNS is to construct an omnipresent wireless communication system on the basis of broadband communication network. The technology of wireless network can be classified into four types: Wireless Personal Area Network (WPAN), Wireless Local Area Network (WLAN), Wireless Metropolitan Area Network (WMAN) and Wireless Wide Area Network (WWAN).

Wireless Personal Area Network (WPAN)

To improve on current data volume and speed related transmission, WPAN is used to replace entities transmission line to make data synchronization and alliance possible between different systems [18]. Such main wireless communication technology as Bluetooth, Ultra Wide Band (UWB), ZigBee and radio frequency identification (RFID) have their own conditions of development, advantages and disadvantages, and existing problems. For instance, currently Bluetooth is the most commonly used WPAN technology for its ability to enhance short distance communication through faster transmission. It is being widely used in mobile telephones, head earphones, cars, computers, family automation and industrial supervision. Bluetooth faces competition from ZigBee in the field of low rate transmitting, and from UWB in high rate data transmitting field and the cost of Bluetooth is comparatively higher.

Ultra Wide Band (UWB) refers to any radio technology with bandwidth larger than 500 MHz or 25% of the center frequency 3.1GHz~10.6GHz. UWB uses nanosecond narrow pulse to launch wireless signal. It has a very wide transmission bandwidth, very low transmission power and a powerful transmitting rate from dozens to hundreds of Mbps. It is suitable for high rate, short distance wireless personal communication and its spectrum can be shared with many other businesses. Although currently, its frequency resource is rather limited, UWB raises a new way of spectrum management and distribution, creating efficiencies in the spectrum [19]. UWB is a type of carrier free communication technology, and it omits the large energy for the launch of carrier. The power consumption of UWB wireless link is only one percent of the general wireless link. This allows the device to work without battery. UWB has a strong ability of anti multi path interference, and is particularly suitable for high speed transmission

in the indoor complex environment. Its current business usage is in printers, digital cameras and other production needing to exchange data with PC. It is considered as a technique for future home-based wireless broadband network [20].

ZigBee is a unified wireless standard mainly used in short distance wireless connection as a simpler and more practical wireless network protocol. It can send and receive electric waves at rate as low as 9.6 kbps. The main technical characteristics of *ZigBee* are short distance, low complexity, low power, low data rate, low-cost two-way wireless communication technologies. It is primarily suited to auto control, sensing, monitoring and remote control, and so on. It can be embedded in equipment to support Geographic Information System (GIS) even be implanted into the human body to assist medical doctors in monitoring their patients' conditions. (Harsanyi 2000). The systematic complexity of *ZigBee* is much less than Bluetooth therefore overall cost of the network is relatively low [21]. From this point, *ZigBee* is very suitable for the network with a large number of terminal equipments, such as sensor networks, smart home. Low power consumption is one of the most important features of *ZigBee* and experts believe that *ZigBee* technology will provide the first technology platform from theory to reality of UNS. It formulates the way for the fourth wave of computing technology and *ZigBee* standards set an application framework for different manufacturers to share network resources for vast commercial prospects.

Radio Frequency Identification (RFID) is a key enabler of the ubiquitous network society [22]. RFID refers to those technologies that use radio waves to automatically identify and track individual items. The unique function of RFID technology is that it can mark anything or anyone in a virtual world from the real world with the function of "marking", "address number" and "sensing". However a typical RFID system generally consists of RFID label (divided into passive and active tag), antenna, reader and the computer system. The price of passive tag has been as low as RMB 1-2 Yuan.

China has opened up the 950 – 956 MHz band for RFID trials. The Standardization Administration of China (SAC) announced in 2004 that it has set up an RFID Tag Standards Working Group to develop China's national standards. The size of RFID market already has exceeded 1.5 billion RMB in 2005, and will grow to 30 billion RMB by the year 2009 by IDC (2006). It is obvious that demand of market and range of application are very large in China. Various personal access and sensor technologies are also under development. China enterprises like Haier Ltd. are also reacting to the trend and design for U-home by intelligent domestic electrical appliances such as refrigerator, air-condition and so on.

Individual consumers are constantly exposed to RFID in action: on toll roads, in offices, and in libraries [23]. Over the next few years, these small tags are expected to be increasingly used at various value adding applications. With wireless systems and intelligent software, RFID has the potential to provide more efficient medical care, increase convenience at points of sale, improve fraud prevention, and streamline business processes by improved visibility and control of supply chain [24]. Near-term growth in RFID use will continue to be driven by business applications with consumer applications growing in the mid to long-term. RFID can bring drastic transformations to a large manufacturing country like China.

Wireless Local and Metropolitan Area Network (WLAN, WMAN)

Compared to personal network (WPAN), local network (WLAN) can provide the more powerful wireless network link capacity, and it could cover a distance of about 100 meters. Recently, the data transmission rate has been increased to higher than 100 Mbps. Similarly Metropolitan Area Network (WMAN) can cover large geographical areas, such as the city or the suburb. Under ideal conditions and without impediment, its highest speed in data transmission and range can reach 70 Mbps and 50 kilometers. Wireless is limited in its frequency range and wire is limitless in its bandwidth. But WiMax as wireless metropolitan area network technology addresses some of these problems and is now considered the pioneer in the wireless section of Broad Band [25]. The biggest advantage of WiMax is its high rate of transmission and low cost in building the network. The disadvantage is its low mobility and incompatibility with 2G network, which make it unable to compare with the telecommunication service. Therefore, it can only work as a supplement of 3G. With the development of this technology, its future remains to be observed. In China, China Mobile Ltd has been authorised to construct a WiMAX network for the 2008 Olympics, while China Netcom has announced plans to deploy a rival technology, the Multicarrier Wireless internet Local Loop (McWiLL). McWiLL is based on the SCDMA technology in the 400-MHz band and has been developed by Beijing Xinwei Telecom Technology [26].

Wireless Wide Area Network (WWAN) is the digital mobile communication network used by mobile phones and digital devices and run by the telecommunication operators. It can cover a large area but up to now it has a low transmission rate. Two technologies adopted in WWAN all around the world—GSM and CDMA are predicted to develop widely. Recently, GSM and the relevant wireless digital technologies—GPRS and the new generation of EDGE (Enhanced Data GSM Evolution)—have occupied two thirds of the market in Europe, Asia and North America. The new generation of EDGE can be 3 or 4 times faster than GPRS in transmission. In addition, an extended technology called HSDPA (High-Speed Downlink Packet Access) will be constructed with a transmission rate higher than 3.6 Mbps. The recently proposed "beyond 3G/4G" can provide a data transmission rate as high as 100 Mbps or even higher. It can provide voice to multimedia services including real-time streaming media service. Wireless network and the wired network form the basic network of UNS.

PERCEPTION TECHNOLOGY

Perception technologies are the nerve of the wireless communication network, through which valuable data can be collected. This field relates to wireless sensor network, multi-functional perception, context-aware technology and virtual reality

technologies toward building UNS.

Sensor network is a novel technology about acquiring and processing information. The addition of wireless communication capabilities to sensors traditional functions significantly extends their potential, giving them more autonomy and collaborative potential. The variety of sensors embedded in the network node can measure heat, infrared, sonar, radar and seismic signals in surrounding environments. These networks can detect many physical phenomena including temperature, humidity, noise, light intensity, pressure, soil composition, the size and direction of mobile objects, and so on. For the mode of communication, though there are several choices, like cable, wireless, infrared light and light, it is generally believed that short distance wireless low-power communication technologies are most suitable for sensor networks [27]. China has achieved major progresses in a range of key sensing technologies, including wireless intelligent sensor network telecommunication, micro sensors, sensor nodes, point clusters, and associated applications.

Contexts like gestures, emotions, and situations are very useful when a person interacts with other persons or nearby situation in UNS. *Multifunction awareness* means that computers can interact with humans through using not only keyboard and mouse, but also gestures, facial expressions, voice and other methods. It includes images perception, speech perception, natural language comprehension, body language comprehension and is suitable to the human-centered feature of UNS [28].

Context awareness technology means to automatically provide users with appropriate services (including tasks, location, time, the identity of the user, etc.) in current scenes by using the context information. This relates to the calm characteristic of UNS and improves ease of use. Context awareness technology is the key technology to create intelligent environment. Human-computer interaction or M2M requires that the equipment perceive the context associated with the interaction in the current circumstances, and make a judgment accordingly, then make decisions and automatically provide corresponding services [29].

Virtual reality is an area where perception technology and computer technology are used to generate a simulated three dimensional visual, auditory, olfactory, or tactile world. Users can then do some browsing and interactive inspection to the virtual world from their perspectives. Its main characteristics can be attributed to immersion, interaction and imagination. Application area driving this technology include the computer games industry, e-commerce (desire for talking heads type presenters), virtual environment researchers seeking dynamics, and artificial intelligence researchers seeking good testbeds. An agent must have emotion to be believable because humans have emotions. Currently, virtual reality technology is being used in scientific research, product design and manufacturing, military training, incident simulation and other fields. Japanese DoCoMo is already able to do the scene show when combined with the communication technology [30]. It is believed to enter human's daily life in future.

UBIQUITOUS COMPUTING

Ubiquitous computing is the origin of UNS. It embodies the basic conception of "U" as the core technique for UNS implementation. It changes the traditional way of computer operation but adopts the mode of "computer at people's service" [3]. In terms of construction of UNS, on one hand, there are countless terminals; on the other hand, each terminal has limited calculating performance for its small capacity. Therefore distributed computing, such as grid computing and Peer-to-Peer computing needs to be involved. In addition, the mobility of these terminals makes motion computing available such as agent, adaptation strategy and so on.

Distributed computing is a method of computer processing in which different parts of a program run simultaneously on two or more computers that are communicating with each other over a network. However, the technique emphasizes the integration capability that mainly targets Client and Server computing and focuses on the terminal uses. Grid computing and Peer-to-Peer computing are also major distributed computing styles. Grid Computing pays more attention to the large-scaled information share, creativity use and high performance computing. It is a cooperative information share and problem solving between mobile multi-frameworks, numerous organizations. Peer-to-Peer computing utilizes the brink sources of Internet such as memorizer, CPU, and human and computes on the Internet [31]. Each computer is taken as one peer: terminal, server or router and all the peers can share the information on the internet, information processor, and information storage and so on. Peer-to-Peer is a dispersive and ad hoc network system which weakens the central server but emphasizes the function of the individuals in UNS.

To conclude, due to their compatibility certain degree of competition exists in these technologies, but UN technologies will continue to co-exist and complement for the benefit of the whole structure. Constructions on network base and technology base are well under way in China and some key technologies such as Micro-Electro-Mechanical Systems (MEMS) are at par with international levels.

UBIQUITOUS NETWORK IN CHINA

Although China did not formally extended the concept of UNS until the National Information Center held a seminar called "Ubiquitous Network and IT Development Strategies of China" in 2006. The government then recognized that the importance of Ubiquitous Network for information-oriented development. The construction of Ubiquitous Network base has been in the pipe line and some key technologies such as MEMS are advance as international level. Over the past two decades, China has built a national transmission backbone network consisting of eight "vertical" and eight "horizontal" transmission backbones

sub-networks that cover the whole country. Following Next Generation Networks (NGNs) and Internet Protocol (IP) based networks, the ChinaNet Next Carrying Network (CN2) began initial services in 2004. This is the largest commercial network in China and aims to become the largest IPv6 network for commercial use in the world. Further, acceleration of competition in China's telecom industry through 3G licensing is aimed to propel building UNS. China has announced its own national standard for RFID, in the 900 MHz band. In December 2006, Automatic Identification Technology Association (AIM China) formally released nine Association standards, such as labels and readers. This should facilitate the adoption of UNS but a variance in standards may also be a challenge to its development.

There are more than 880 million telephone users in China, including 372 million fixed-line phone users and 508 million mobile phone users [32]. The large numbers of telephone subscribers are the potential strength for broadband adoption which activates the coming ubiquitous network application. The demand from users is evident especially in megapolises.

Technological, market and user's demand perspective indicates that construction of UNS in China is feasible and inevitable. China government is now actively making out the long-term U strategy. We recommend the following to accelerate UNS construction:

1. Support UNS by making information development strategies and relevant polices; propose U plans for metropolises and industries according to China's conditions; propose information strategies such as U-China which will accelerate the progress of China's UNS.
2. Intensify the research on Ubiquitous technology, program the application of wireless frequencies, actively participate in the discussion and establishment of the relevant technology standard and obtain China's own knowledge property rights by learning from the current international standards.
3. Quicken the construction of the seamless ubiquitous network and provide a fine industrial environment for the providers of ubiquitous technology.
4. Promotion of advanced use of UN in business and daily living in a creative way. The government could use ubiquitous network to resolve social problems. On the other hand, it is necessary to study the changes in social life which will be brought about by UN; Focus on putting forward solutions to the problems such as network safety, privacy and vicious information, both technologically and legally.

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KNOWING WHO TO KNOW IN KNOWLEDGE SHARING COMMUNITIES: A SOCIAL NETWORK ANALYSIS APPROACH

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ABSTRACT

Information stored in online communities consist not only knowledge contents, but also the information of knowledge providers and searchers' connective relationships, and network structures. Online Communities provide effective platforms for interaction and play pivotal roles in making provision for the basis of analysis as all the ask-response paired relationships are automatically recorded. This paper demonstrates how to apply social network analysis to analyze the interaction data for generating the "role information" of the knowledge searchers and providers. Integrating concepts of uncertainty in knowledge searching and sociometric used in social network analysis, we develop a mechanism for role matching in knowledge search for each questions posed. Roles identified in this approach including central, network entrepreneur (e.g. spanning structural holes), neighboring mediate (e.g. knowledge gate keeper), and resource competitor (e.g. structural equivalent players). The result is demonstrated and visualized in a web-based community platform and tested in a real-world programmer forum-based community.

Keywords: Social network analysis, role analysis, knowledge network, knowledge community.

INTRODUCTION

Studies of knowledge management show that the success of knowledge transfer lies in neither communication systems nor documents, but in social relationships [1][3][6][7][16]. Different social relations tend to result in different consultations. All these point to the fact that knowledge can be better captured by shifting focus from the face value of the content itself to the social network where knowledge is embedded.

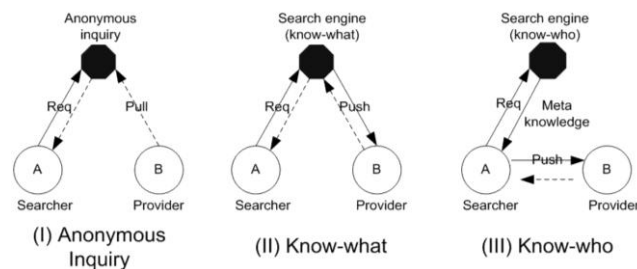


Figure 1. Knowledge Inquiry Models with computer-mediated Interaction

In a knowledge intensive online virtual community, such as a technical discussion forum, knowledge sharing usually starts with knowledge inquiry took place in an online platform, which can take three models as depicted in Figure 1. The first one illustrates anonymous inquiry where inquirers, or searchers, post questions in a forum waiting for answers from volunteers. This mode simply works in a post-and-wait manner. The second one, known as "Know-what" mode, describes most situations where huge volumes of documents or knowledge repositories are stored in a database ready to be retrieved by keyword matching or other more sophisticated yet similar techniques. An inquirer can only obtain what is stored in the database, and one may have difficulty in evaluating the quality of the information acquired.

The third approach is to make provision of linking knowledge contents to those experts who are also community members. This is the "know-who" mode, illustrated in the right most panel of the Figure 1. In this mode, the connections between searchers and knowledge providers can be established. The main task in this model is to have the knowledge of who knows about the answer, and make it available to the searchers. Meanwhile, searchers in this model will have to provide something more than keywords of their questions. They also need to reveal their level of knowledge, so the system can learn to recommend someone suitable for conducting dialogues. As a result, communities will become a platform for knowledge sharing and bring not only knowledge but also the information of provider and searcher's relative network positions, connective relationships, and network structure. For example, knowledge search engines in this model can show that people in what position are inclined to help, or whose knowledge source are more close to searchers' background.

Communities based on the "know-who" model will be more effective than the "know-what" model by facilitating knowledge transfer and enhancing experiences and value exchange, and thus help accomplish knowledge sharing through social interaction. At the end, knowledge is in the head of people [19]. From the point of avoiding "free-riders", this type of interaction via social embeddedness will help reduce improper responses [2][14] and boost sense of community and is favorable for the formation of social norm [9].

The purpose of this study is to realize the concept of implementing a “know-who” knowledge sharing platform by analyzing role information and evaluating relationships among community members from community interaction data. By utilizing the role information, we build a community platform for automatically identify the proper individuals for a query. In finding the proper person to answer a question, we consider issues from such different aspects as knowledge content, social context, and personal knowledge.

LITERATURE REVIEW

Knowledge Sharing

Knowledge generation includes not only objective processes of transferring information into knowledge through comparison, cause and effect analysis, interlink and communication but also subjective process of generating personal interpretation, through experience, reality, judgment, law, institution, etc. [8]. As knowledge is highly personalized, it has to be expressed through personal experience, impression, practiced skill, culture, or shabit [15][18]. Knowledge sharing usually starts with some kind of inquiry and search. However, answers can be provided in three different forms, as shown in Table 1. In this classification schemes, these search engine may either be focused on knowledge contents, social context, and personal preferences and profiles. Several packages or tools available for the different types of searching and browsing are listed in Table 2.

Table 1. Classifications of Search Engine

Search Mode	Cues for Search	Relevant Techniques
Knowledge content focus	Domain-specific Knowledge, Ontology, Knowledge-base, Thesaurus	Natural language, Semantic web, key-graph
Social-context focus	Feedback, Conformity, Citation relationship, Recommendation, Social network	PageRank, Citation Analysis, Social network analysis
Personal preferences focus	Personal searching history, Preference	Agent, personal KM system

Table 2. Tools for Knowledge Browsing

Research	Objective	Contribution
Sack (2000) [21]	Conversation map for Newsgroup	Visualize very-large-scale conversation map of USENET by integrate social network and semantic network
Merali et al. (2001) [12]	Knowledge capture and utilization in Virtual Communities	Jasper II (a knowledge sharing environment) use information agent for sharing knowledge from a number of internal and external sources.
Smith et al. (2001) [23]	Persistent Conversation on newsgroup	A set of tools for visualization of the structure of discussion threads and the pattern of participation within the discussions
Lin et al. (2003) [11]	Knowledge map creation and maintenance in Virtual Communities	Generate Knowledge map by text-mining on documents collected from teachers' cyber community

When viewing knowledge seekers and providers as knowledge buyers and sellers, knowledge market is like the usual market in the sense that certain uncertainties involved. Just as a purchase decision will consider reputation of stores besides goods and prices to control the risk of purchase, knowledge search could reduce uncertainty in knowledge seeking by taking account of not only knowledge content but also knowledge owner and relationship between each other [8]. According to Podolny [17], there exist two types of uncertainty in seeking knowledge in a knowledge market; one is high ego-centric uncertainty and the other high alter-centric uncertainty. The former uncertainty is the risk in searching for transaction chances; the latter is the doubt about the quality of the acquired knowledge.

To avoid the uncertainty existing in knowledge markets, social network can play the role of pipe and prism [17]. Pipe effect refers to the fact that social networks can extend human relations and connects ways to acquire resources. As the tacit feature of knowledge paralyzes the fluidity [15], one can rely on social networks for identifying the chances to acquire knowledge. The phenomenon of birds of a feather helps reveal that social networks have the capacity to agglomerate the same resources and save search cost. It is evident that social relationship is a significant element of knowledge transfer [5][8][9][20]. The Prism effect refers to the social network functions to filter lower quality while too many choices. This is made possible by exploiting the extension of the trust relationship or observation of other social network structures.

Social networks make provision for successful knowledge transfer between strong ties and weak ties. Communities tend to agglomerate people who have the same interest and construct strong ties for trust-based knowledge exchange. From outside communities, weak ties would bring resources and avoids partition of social network. Knowledge management will rely on both types of ties for transferring useful knowledge. Levin (2002) suggests the combination of weak and strong ties could help highly tacit knowledge transfer through two kinds of trust, affection and competence trust [10]. The existence of trust would be a critical basis for establishing non-money based markets for knowledge transfer. The accumulation of social capital in turn depends on the smooth operations these types of markets.

Role Analysis

To make a community platform suitable for knowledge transfer, role analysis is an important function. Role analysis in socio-metric is used to analyze actors who have similar structures or patterns [24]. The possible attributes for role analysis is listed in Table 3. These methods are derived from mathematic and multiple study fields. Similar positions in SNA reflect the relative status of individuals who are embedded in network having similar relations. Roles could reveal the same pattern

between members or positions. SNA adopts pattern match for role discrimination, which needs network index to find the same pattern role. Therefore, community platform has to provide related index for computing and comparing.

Table 3. Role Analysis

Role Attribute Type	Description	Example
Peripheral attributes	The peripheral attributes of a role are those expectations which members of the society have about a particular role that are insignificant in meeting the obligations implied by the role.	Sex/gender of a physician is peripheral to his/her functioning as a physician.
sufficiently relevant attributes	The sufficiently relevant attributes of a role are those expectations which members of the society have about a particular role that if they are missing, sanctions will be invoked.	If my physician refuses to provide a medical examination when requested to do so, sanctions may be imposed to require the examination to take place.
Pivotal attributes	Pivotal attributes are those which if they are absent, the role is said not to exist.	For instance, someone who purports to be a physician but who has not passed the appropriate medical examinations is not a physician but rather a charlatan.

Keyword Expansion

Two different relations between any pair of tags can be defined by aggregating tagging data. First, two tags are in a “Co-Resource” relation if they are adopted for the same resource. This relation is stronger between tags with more shared resources. Second, two tags used by the same user are in a “Co-User” relation. While the “Co-Resource” relation is most appropriate for establishing a public concept hierarchy, the “Co-User” Relation is most suitable for establishing a private concept hierarchy

As a result, the concept hierarchy can be used to expand keyword. The link of the target keyword and other keywords in the concept hierarchy indicates the relation of two keywords.

SYSTEM ANALYSIS AND DESIGN

The “Role” information

The search for a proper target for knowledge exchange may be subject to a variety of uncertainty. As we mentioned above in the context of Knowledge Exchange Market, this uncertainty includes High Ego-centric Uncertainty and High Alter-centric Uncertainty [17]. The former refers to the uncertainty in discovering the opportunity for exchange, and the latter, the uncertainty about the quality of the knowledge obtained via the exchange.

The “Role Information” is designed to be used in conjunction with other search cues in reducing the uncertainty of knowledge search and increase the success rate of knowledge exchange. One person’s expertise level varies as the topic in question changes, or when questioners differ. The “role information” of an individual has to be dynamic and cannot be treated like a static label. It should be determined upon who queries and what is queried. In light of this, we identify ten functional requirements shown in Table 4.

Table 4. Functional Requirements and possible solutions

No	Description of Functional Requirements	Possible Solutions
1	Provision of a list of topics available for search	Use social network analysis for Keywords, and identify the main topics and their keywords
2	Provision of Keywords analysis of the usable topics	Use social network analysis for Keywords, and identify the main topics and their keywords
3	Capable of making references to one’s closely interacting sub-groups	Revealing the user’s position in the social network
4	The number of search results can be adjusted as needed	Targets will be sorted in terms of their relevance to the query
5	Provision of information about the familiarity between the user and members	Use “neighborhood” in network structure to represent their relationships
6	Provision of information about the depth of members’ expertise	Use “significance” in network structure position to represent the expert’s status
7	Provision of information about the breadth of member’s expertise	Use “structure hole” in network position to show its variety
8	Evaluation of equivalence in expertise level	Use “structural equivalence” to find status equivalence between users and experts
9	Evaluation of bottleneck in knowledge exchange	Use intermediary analysis techniques to identify knowledge intermediary
10	Allowing users modifying their own experiences information	Availability of users modifying role information

Performing Role Analysis

We conclude from the functional requirements that there are four types of role analyses will contribute to reducing the uncertainty of searchers. These types of role analyses and the corresponding uncertainty they can help reduce is shown in Figure 2. The meaning of each type of analysis is described as follows.

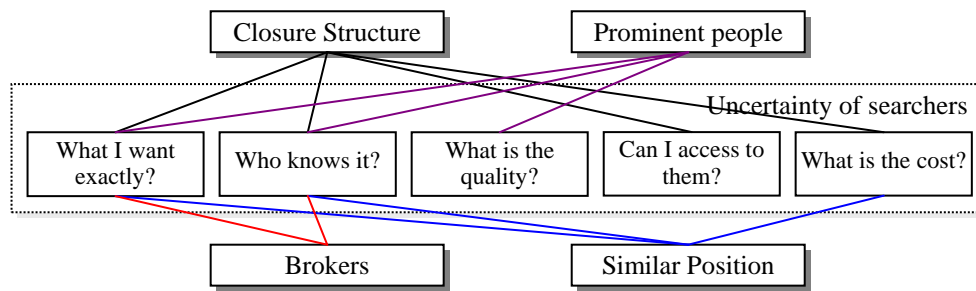


Figure 2. Use of four types of Role Analyses to reduce the corresponding uncertainty

1. **Closure Structure:** Actors with shared preferences for information sources tend to cluster together and form strong ties, leading to a closure structure. This analysis can be used to measure the closeness in terms of relationships and preferences similarity.
 2. **Similar Position:** This is used to search targets that link to similar actors and are of similar network structures. These targets enjoy common features and are highly substitutable. They tend to be peers in their capabilities and may compete for similar resources.
 3. **Brokers:** This is defined with respect to the position of searchers. Brokers play a critical role in controlling or facilitating the delivery of information. Possible roles may include gatekeepers, inter-mediators, and representatives.
 4. **Prominent people:** Two types of actors are in prominent positions of network structures. One type of the prominent roles carries high centrality and is of high level of influences, e.g. opinion leaders. The other type spans multiple network structure holes, and usually can access various sources of information. This is sometimes called network entrepreneurs.
- The four types of analyses are produced by utilizing some of the procedures for calculating indexes that are available in network analysis procedures, such as Distance, Structure Equivalence, Centrality, and Broker.

The Role Analysis Process

Our proposed role analysis is performed on top of the usual keyword-based search. That is, we take as input the resultant lists from keyword-based search and feed them into the role analysis process. There are five steps in this process. We first conduct an Absolute Role Analysis (step 1~3), where roles of prominent status and of spanning structure holes are identified. The next is to do Relative Role Analysis (step 4~5), in which the role information obtained from step 3 will be interpreted from the perspective of the searcher. This process is depicted in Figure 3.

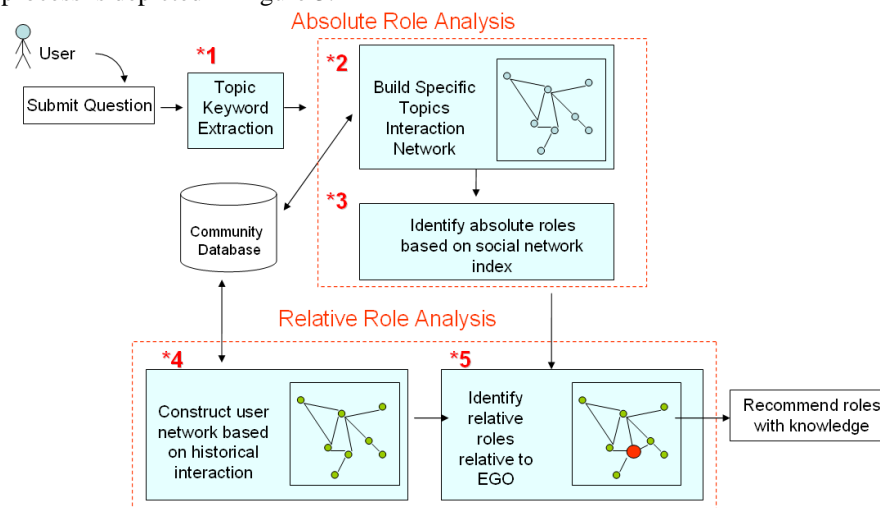


Figure 3. The Role Analysis Process

Based on keyword database and its associated keyword concept space, the system extracts keyword sets from user's question in the first step. On receiving user's queries, system automatically extracts several terms or nouns as the first level keywords. Next, system extends second level keyword associated with first level keywords by referring to the keyword concept space. For example, 'JAVA' is the first level keyword when user submits a JAVA-related question, and 'J2EE' and 'J2SE' are the extended keywords (or second level keywords). The extending action is carried out iteratively by system until the default threshold level reached. The keyword sets, including first level keywords and other level keywords extended by system, were the basis to construct Topics Interaction Network in the second step.

In second step, system looks for actors who had participated in the discussion with keyword sets derived in first step in order to construct Topics Interaction Network. If two users interact in the same topic/keyword, we build edge between them. Thus, system constructs Topics Interaction Network by searching actors who had participated in the discussion of every keyword from the community database.

The system also looks for brokers and prominent people in the Topics Interaction Network in the third step. We draw on the Structural Hole algorithm proposed by Burt to calculate the effectiveness and efficiency for each actor in the Topics Interaction Network, and list N actors (assuming N is the system default number of candidates) with the highest efficiency. An actor with high efficiency is more likely in the position of acting as broker for other actors. Further, system looks for prominent people by calculating degree centrality of each actor in the Topics Interaction Network. An actor with high degree centrality maintains contacts with various other actors and is a people of influence in the network. Thus, system will select n actors (n is the system default candidate) with the highest centrality as the candidate of prominent people.

The main task of the fourth step is extending the Topics Interaction Network into a User Interaction Network. Topics Interaction Network includes experts who are familiar with keyword sets and yet excludes questioner. We want to add actors who ever interact with questioner from community database to form a Topics Interaction Network. The edge in the User Interaction Network indicates the degree of two person's interaction. This network demonstrates those actors who ever interact with questioner and domain experts who ever joined the topic with keyword sets.

Finally, the system looks for the shortest distance between domain experts and questioner. In this final step, the system would search targets that are of similar network structures. We calculate the distance of any two adjacent nodes in the User Interaction Network and identify the shortest path between actors and questioner. The nearer the distance from questioner (or closure structure) indicates that the questioner is either more likely to find experts or the questioner and experts share the same sub-group. The system will select N actors (N being the system default number of candidates) with the lowest distance as the candidate actors of domain experts. Finally, the system will draw on structure equivalence algorithm to calculate the structure equivalence (that is, similar position) between the questioner and other actors. We utilize Euclidean Distance and CONCOR (convergence of iterated correlation analysis) to list the top N actors (N being the system default number of candidates) with the closest structure equivalence. These candidate actors enjoy common features and are highly substitutable. They tend to be peers in their capabilities and may compete for similar resources.

SYSTEM DEVELOPMENT AND AN EXAMPLE

The platform

We develop the system on top of a virtual community support platform. Conceptually, this system follows the IPO structure. At the bottom is the Community Data, which is fed into the middle layer for Role Analysis. Data are parsed and tagged, full-text contents analyzed for terms and keywords, which in turn is used to build a keywords network. Keywords will form clusters for those more likely to appear simultaneously, using the RNM algorithm [13]. This algorithm uses Peer Influence Model for calculation and classification, it is considered both easier and faster than general Partition techniques in Graph theory.

System Testing

One aspect that makes this system distinct from general virtual community platform is the capability of visualization of the recommended experts. Social Network Analysis originates from Graph Theory and shares the basic components of nodes and links. However, in order to make the nuts and bolts of network graph meaningful in presentation, we design the screen to consist of several units to reveal meanings of network pictures. These units include: Information Tagging, Scene Generator, Analysis unit, Operation unit, and Viewpoint unit.

We test our system by analyzing a forum-based community mainly for interactions between programmers. Topics are classified and threaded, and people appear on this community includes some of the well-known figures. The total registered member is more than five thousand people. The forum consists of 48 discussion boards, with topics more than twenty thousand.

After entering a keyword, a searcher can expect the system to return a network graph representing all the people, or experts, who have engaged in discussions of related topics. These "knowers" possess one particular network position that could be close or further away from the searcher. Searchers can traverse on the network graph to find one with desired status. All can be accomplished under the assistance of the system.

The search results shown in Figure 4 show the information presented in the system. The red rectangle at the left hand side represents the position of the searcher. All other actors are drawn with respect to the searcher's knowledge status (novice or experts), so the relative role information can be examined. Clicking on any node in the Tree Layout, the searcher can learn more of the selected actor's information. This information, shown in the right hand side, describes one actor in terms of five types of search uncertainty. The current picture adopts a Tree Layout, the system also provides a Spring Embedding Layout, and is capable of enlarging views.

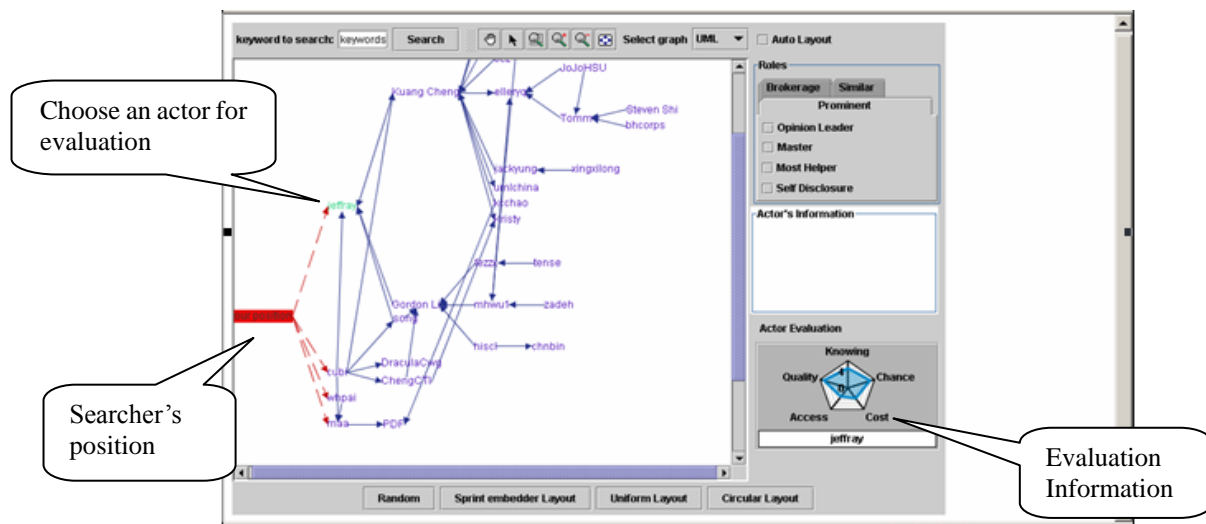


Figure 4. Search Results: Representing in Tree Layout

DISCUSSIONS AND CONCLUSIONS

Discussions

The purposes of this research include are twofold:

1. Model establishment: The system has been successfully finding out the role type which influences knowledge exchange procedure, identifying method for analysis, evaluating the value of a role, and establishing effective role search model.
2. System development: Deploying search techniques based on a community platform, developing the search system which employs the role search model to make possible the personalized knowledge filtering mechanism.

When new media emerges, it usually brings the transformation of related application. Essentially, knowledge search should not only concentrate on knowledge content itself but also has to include social interaction. Prusak has claimed that the value of knowledge depends on the exchangers' social relationships. The emergence of virtual community brings the social interaction to a new level and can be operationalized.

There are some limitations in this study. Member's background in virtual community is far more complex than that in real world. The fluidity and anonymity of membership makes it difficult to distinguish participants' identity [25]. The same individual with multiple identities also makes analysis troublesome.

The other problem is on the possible invasion of privacy or moral issues when it comes to data collection [4]. When apply this system in a real world environment, issues need to be resolved on whose permission do one need before proceeding to use community information? community constructor? administrator? or the person who posts? It is largely an open question and depends on the nature of the information and the situation of use.

Smith (1997) has also pointed to the limitations of online anthropology [22]. There are four types: the lack of generality, the lack of correlation, the lack of historical information, and the lack of scope. Among all these, this research does not escape easily.

Suggestions and Future Study

The development of this type of search system which employs social network analysis techniques is still emerging. This system provides modularized system models and friendly user interface; however, it has yet to be tested in a larger scale site. Further testing of the system can be conducted in a pseudo knowledge market, where knowledge needs to be priced, evaluated, and traded. One strong point of this system is that it can be used for different purposes of knowledge search. The fitness of knowledge search is investigated quite often, and it reveals that content is only one aspect of knowledge. Information techniques can be applied to help expose the various aspects of value.

The focus on role information leading to challenges against the popular approaches of measuring member performance based on the frequencies of posting. Many experts in a field only respond to the most critical questions, while leaving the general problem answered by lower status experts. The recognition of role information can be beneficial to the development of community if used effectively and reduce the adversary bottleneck effects.

Communities can not be easily classified as a hierarchy structure or a market. Rather, it is like an epitome of society. Our experiences in employing Social Network knowledge for the study of knowledge sharing in virtual community stand on a convenient yet solid theoretical ground. We think that it will be a fruitful research direction.

ACKNOWLEDGEMENT

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KNOWLEDGE SHARING AND BUSINESS MATCHING IN ADVERTISING AND PUBLIC RELATIONS SERVICES USING SEMANTIC PEER TECHNOLOGY

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ABSTRACT

We develop semantic peer network aiming at knowledge sharing and business matching for the domain of advertisement and public relations. We top up a knowledge-based layer upon the peer to peer network to make it knowledge base peer. The knowledge base consists of ontology for the application domain and domain instances. We develop user services for resource sharing and business matching based on the knowledge-based layer. A trust management mechanism is built into the knowledge-based layer for making trustable resource sharing and business match making. Also we develop an RDF-based streaming mechanism for automatically pushing newly matched information to appropriate nodes. We made experiment to test the performance of search for the prototype system. The result shows that the addition of knowledge-based layer upon the peer-to-peer network would not result in the decrease of performance. We also investigate future work after the prototype research

Keywords: Semantic Web, peer-to-peer network, knowledge management, RDF, JXTA

INTRODUCTION

Firms in the advertising and public relations services industry prepare advertisements for other companies and organizations and design campaigns to promote the interests and image of their clients¹. This industry includes media representatives selling advertising spaces, display advertisers designing public display ads, and direct mail advertisers. In Taiwan, the international firms and large domestic firms play the upstream role in the industry. They contract large cases from large companies, do the essential plan and design and, then subcontract the lower tasks of the cases to the domestic medium-small sizes firms. It seems that the industry in Taiwan forms an up-down layered chain of labor division. However there are problems in this chain summarized as follows.

To survive in the industry, the small-medium sized firms are eager to accept cases without considering whether they have the abilities to come up with solution for the cases they take. This would result in the decrease of service level and redundant investments among them in pursuing extra cases. Facing the price competition in the industry, professional firms either lower their service quality or withdraw from the domain. Due to the disorder in the industry, it would be difficult for customers to find out appropriate firms for certain services. An approach to solving the above problems is to create a collaborative environment providing better sharing of information and knowledge and effective business match-making in the industry. The environment must support effective ways of knowledge management for users in the domain. From requesting point of view, this includes obtaining the desired contents and finding out appropriate business partners. As for the provision part, holders should be able to keep their contents within their system while expose what they want to share with by posting the metadata to the public. In brief, to support the environment, we need technology that is able to manage metadata and operate in a distributed way without a centralized site. In this paper, we attempt to employ the semantic peer technology to fulfill the above requirements.

The semantic peer technology is a combination of the Semantic Web [1] and peer-to-peer [2] technology that provides autonomous and intelligent management of knowledge contents created by individuals. The semantic peer system architecture employs an open peer technology as the foundation and above it is a knowledge-based layer created by using the Semantic Web technology. This layer consists of a knowledge base which is constructed based on RDF [3] using OWL [4] as the ontology language and a number of management functions for the knowledge base, including addition, deletion, modification and query. The knowledge sharing and business match-making services for the advertisement and public relation industry are therefore developed upon the knowledge-based layer.

From technical architecture aspect, a peer node, representing a firm or an individual in the domain, can be equipped with a system described above to perform the management functions of the node itself. Otherwise, a peer can be set up to play the specific role of match-maker. The latter accepts the request or profile information in RDF from other peers. It can then create or update the contents to be shared, including the objects and their metadata, at its site and leave them in the site without uploading to web server. Suppose a firm A is preparing a project plan and wants to get references from others who have done the similar topic before. User of firm A can find out the desired content using the conceptual search interface by specifying the category and

¹ Refer to the descriptions of the Department of Labor, U.S., at <http://www.bls.gov/oco/cg/cgs030.htm>

constraints it wants. On the other hand, s/he can either post the request or leave A's profile information in RDF at a match-making peer and waits for the response of the satisfied result. The matching-making peer takes the request and profile in RDF as the constraints to be satisfied. On the other hand, it keeps on crawling RDF files from the peers in the domain. The crawled RDF files are fetched to the filter built according to the request or profile constraints from users and it disseminates the filtered results to their destination peers. The latter way is a kind of pushing RDF to the appropriate peers. In another use case when a firm B wants to find someone as the collaborative partner to carrying out a project or wants to let others know its abilities for potential business opportunities, B can perform the above match-making procedure by replacing the appropriate request and profile in RDF.

DESIGN OF SEMANTIC PEER NETWORK

By investigating the problems of the domain from three aspects, knowledge sharing and reuse, demand-supply chain management, and industry-academic inter-relationship, we conclude that it needs a collaborative platform that supports effective reuse and sharing of domain knowledge, management of supply-demand chain, and e-learning functions. For the first goal, we need some way to manage the content of the documents in finer grain rather than as a whole bunch. According to the state of the arts, the Semantic Web technology is appropriate to serve the purpose of building the metadata layer for efficiently managing the resources. In this paper, we do not use the client-server architecture to build up the metadata layer. Instead we use the P2P network as the infrastructure of the metadata layer. Compared with the client-server architecture, the P2P network is promising in that it has advantages over resource sharing of various types, instant messaging, content distribution and delivery, collaboration, search, and sharing of CPU and storage. Based on the metadata layer, we can therefore develop advanced services for user to meet the supply-demand chain and e-learning functions as described previously.

In this paper, we employ JXTA[5], a hybrid type of P2P network based on XML, to design the architecture of the semantic peer network. There are two kinds of peer nodes in the network: one is simple peer (S-node) and the other is rendezvous peer (R-node). User of simple peer node can use the access services, such as conceptual search, semantic navigation, information aggregation, to collect resources on semantic peer network. An R-node provides the following services for other peer nodes.

- Peer discovery and brokering: User of S-node uses this service to look for appropriate counterparts. A new peer node first of all has to contact an R-node through this service in order to join the semantic peer network.
- Profile registration: An S-node can register itself to an R-node, either automatically or manually, by sending its profile information to the R-node.
- Information filtering and dissemination: An R-node has is equipped with an information filtering engine which is used to filter out and then disseminate information for appropriate destinations. User first of all registers its favorite items to an R-node.

From the aspect of system architecture, at the bottom is the peer network layer supporting the P2P connections between peer nodes. In the middle is the knowledge-based layer built based on the Semantic Web technology. At the top, the service layer provides user application services which are built using the application interfaces supported by the knowledge-based layer. The system architecture is summarized as shown in Fig. 1.

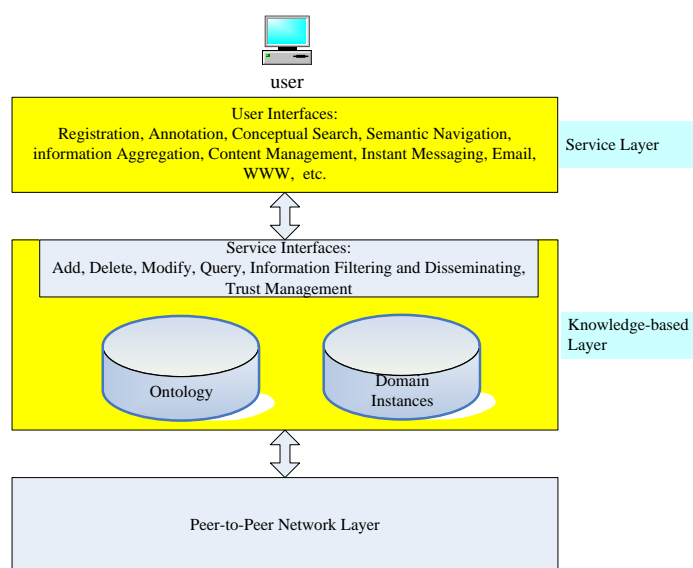


Figure 1: System architecture of semantic peer node

ONTOLOGY FOR THE DOMAIN OF ADVERTISING AND PUBLIC RELATIONS SERVICES

In the system architecture, the knowledge-based layer consists of knowledge base and service interfaces facilitating the sharing of knowledge on the domain. It is thus essential to construct the ontology suitable for the application of the domain in order that user can manage the domain instances. Due to the standard specification of ontology on the Semantic Web, we can acquire and reuse ontology from public Semantic Web portals, like Schemaweb² and Swoogle³. We can follow knowledge-engineering approach to build up ontology for new application domain. The Protégé project, for example, proposes a simple knowledge-engineering methodology to build up ontology your own purpose [6]. It starts from identifying the domain and scope in the initial step. After realizing the domain purpose competency of the ontology, it strongly recommends to choose existing industrial ontology to satisfy the goal. Otherwise, if no appropriate one exists, we create one for ourselves. The next step is to collect a list of important terms in the domain, which are potentially the concepts and relationships in the domain schema. Part of the list of terms is taken as the classes. We identify the parent-child class relationships in them as well. This forms a class hierarchy. The remaining part of the list of terms is considered as the relationships in the domain and is entered as properties of classes. After the class hierarchy and slots in classes are created, we can enter instances for respect classes. Following the above steps and consulting domain experts, we categorize the terms as six categories and each of them is further classified as sub-categories as summarized in Table 1.

Table 1: Terms of the domain of advertising and public relations services

Category	Sub-category
Design of originality (need to describe the design objects and concepts)	<ul style="list-style-type: none"> ● CF drafts, video, or audio files ● Illustrating figures ● 2D or 3D product design diagrams ● CI or VI design chars ● Commercial cartoons ● 2D or 3D design diagrams for display, activity, or performance,
Project proposals	<ul style="list-style-type: none"> ● Brief, abstracts, project ● Proposals ● Activity PR and SR proposal Marketing proposals ● Operation or management proposal
Reports and research papers	<ul style="list-style-type: none"> ● Market surveys ● Various kinds of data analysis ● Theories about marketing, advertisement, public relationship, brand ● Social survey of marketing, advertisement, public relationships ● Glossary
Relevant Support	<ul style="list-style-type: none"> ● Training, potential education ● Group activities ● Speech and presentation techniques
Forms	<ul style="list-style-type: none"> ● Various templates of project proposals ● Various kinds of diagrams ● Government or Large-scale company project proposal formats ● International advertisement company process specification formats
News announcements	<ul style="list-style-type: none"> ● Exhibition information: including Taiwan, Great China, and international areas ● Activity, competition information: including Taiwan, Great China, and international areas ● High quality web sites for advertisement, marketing, and public relationships.

According to the categorization, we create class hierarchy for the domain of advertising and public relations. In the hierarchy, there are six level-one classes and under each of them we list the sub-classes for convenience of presentation. Having

² <http://www.schemaweb.info/default.aspx/>

³ <http://swoogle.umbc.edu/>

created class hierarchy, we further employ the vocabulary of Dublin Core Metadata Initiative⁴ to add feature descriptions for each class. The Dublin Core Element Set defines fifteen elements used to describe digital resources on the Internet. In this paper, we choose eleven elements from the set and give additional descriptions specific for the purpose of the application domain.

TRUST MANAGEMENT AND SELECTIVE DATA DISEMINATION

In this paper, the determination of trust is based on the combination of trust of nodes and rank of resources. For the first part, we employ the trust record which is used in [8] for each node about the trust rating of the peer nodes having done transactions with it. A trust record consists of trust vectors each of which enumerate the ratings of transactions having been made. For the second part of the determination of trust, that is, the rank of sharing resources, we maintain in each peer node a list of resource ratings. In the list, each resource, identified by combining the JXTA uuid and directory path as described previously, is associated with a rank from 1 to 10. The rank that is lower than 6 is referred to an unsatisfied sharing, while above that is a positive rating. When user of a peer node, P, would like to know the trust rating of a resource, R, for example, it sends off a query to other peer nodes asking for the ranks they gave to R. After receiving responses from peer nodes, P computes the trust rating of

R by using the following formula, $\frac{\sum_{i=1}^k t_i f_i}{\sum_{i=1}^k t_i}$ where k is the number of responding nodes, t_i is the trust rating of node i and f_i is the rank of the resource given by node i .

The flow of the trust management protocol is summarized in Fig. 6. First of all, user of a peer node sends off query and receives query hits. It then issues another query for the ratings of the received hits. After receiving the ratings, the peer node then retrieves the node trust from the local storage and computes the trust rating of the resource using the above formula. Finally the result is presented for the user to decide whether carry on or not.

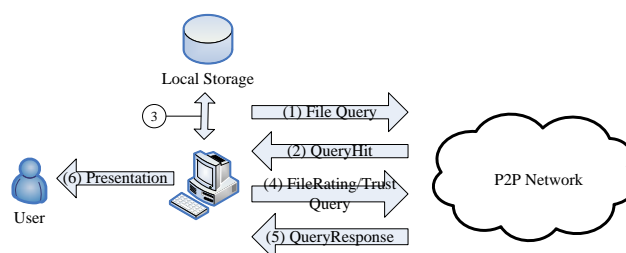


Figure 6: Flow of trust management protocol

In this paper, we design an RDF streaming machine which accepts favorite profile in SPARQL [7] from user, and disseminates matched information to appropriate destinations from the RDF metadata it crawls from various S-nodes. Research and applications on XML streaming have been widely investigated, for example, [9]. For efficiency, finite state automata are commonly used to build their filtering engine. User's profiles are represented in simplified XML paths and are processed to form a finite state machine. The filter engine then accepts the input XML documents, performs filtering, and disseminates the filtered result to appropriate destinations. In this paper, we employ this approach, while RDF and its query language SPARQL are used to replace XML and the path language. The filter engine in Fig. 7 is kernel of the RDF streaming machine. The favorite profiles in SPARQL from S-nodes are entered the favorite profile processor which then produces a finite-state automata. The filtering engine control mechanism then is triggered by the RDF events emitting from the event-driven RDF processor to operate on the finite-state machine. The filtered result is then sent to the appropriate user.

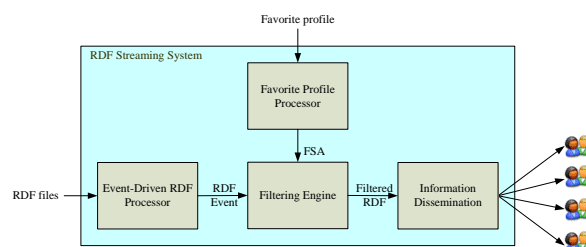


Figure 7: RDF streaming machine for information dissemination

IMPLEMENTATION

We implement a number of services for user of S-node to access the semantic peer network described in order.

⁴ <http://dublincore.org/>

Official Web Site: In this paper, we aim at developing a knowledge sharing and business matching for the advertisement and public relations based on the semantic peer network. We therefore build an official web site as the information center for the application domain to post news announcements, and software update.

Search: The search is based on the ontology we developed for the domain of advertising and public relations in Section 4. To search for certain kinds of resources, user enters suitable values in the fields of GUI, as shown in Fig. 8, and these conditions are used to form SPARQL query which are sent off to other peer nodes. User can choose one of the classes in ontology as the type of resource. User chooses in the subject field one of the industry categories as specified in 104 Job Bank⁵. After processing the query, a peer node wraps the satisfied result in XML as shown below and returns to the source node. After receiving a result, the list in the GUI is updated and a query about the rank of the result is sent off as well. After receiving the ranks from other peer nodes, it then computes the trust rating according to the formula in Section 4 and presents to user.

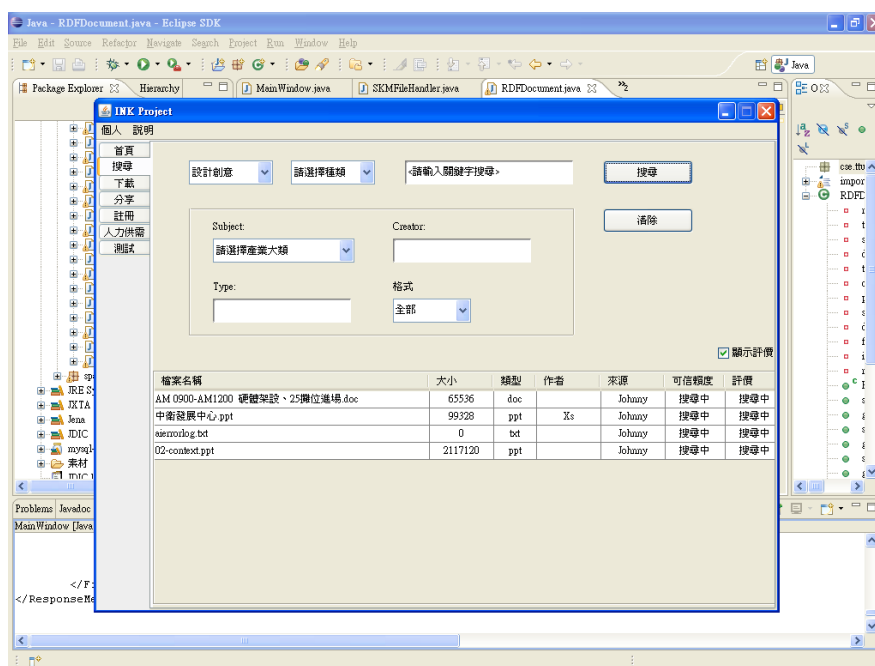


Figure 8: Snapshot of search service

Download : Downloading a file occurs either in the GUI of search result or the notification from the R-node as described later on in the registration service. We use the function of pipe advertisement in JXTA to establish the connection between the providing and receiving peer nodes. The request of downloading a file is then performed through this connection unless the receiving node does have the access right of the file. The access right is determined by consulting the node trust record in the providing node. As described in Section 5, the receiving node has higher rating if it has ever shared more files to other nodes. The node trust rating mechanism thus encourages nodes to share their resources.

Resource sharing and registration: The sharing service consist of three functions for the sharing of resources: new modify, and cancel. Compared with the folder-based sharing used in most P2P sharing applications, we provide file-based sharing because of two reasons. First, each file is associated with an RDF metadata for providing more precise search. Second, when choosing a file to share, user has to enter the associated metadata and this greatly reduces the chance of unwanted sharing in the same directory.

The registration service is used to access the RDF-based selective data dissemination described in Section 6. Through the registration service, user can subscribe her favorite to an R-node which implements the selective data dissemination. User can new, modify and delete a subscription through the service GUI as shown in Fig. 10. User enters the favorite conditions which in turn are used to form profile in SPARQL. The profile is processed to be as a part of filter in the streaming machine of R-node. The streaming machine continuously acquires RDF metadata about new resources to be shared from peer nodes, and disseminates the filtered information to the destination nodes.

⁵ www.104.com.tw

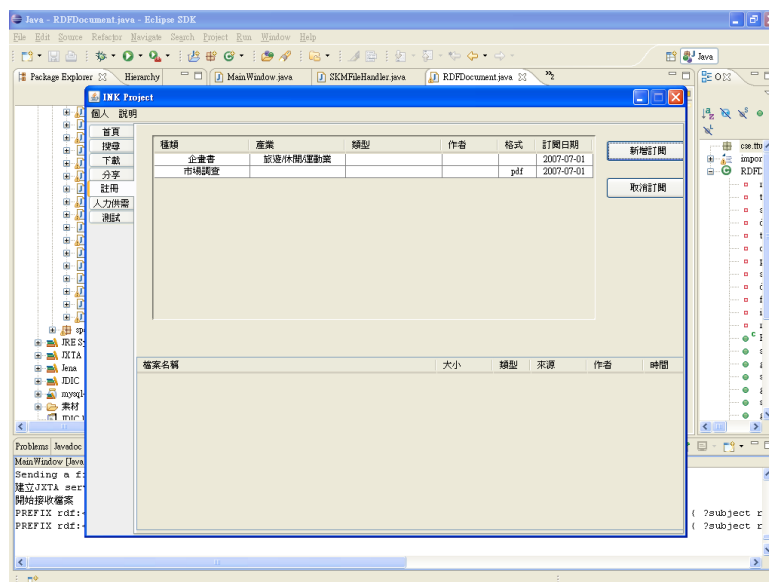


Figure 10: Snapshot of registration service

Manpower Demand-And-Supply And Personal Management: Manpower demand-and-supply service consists of two functions: looking for job and looking for talented person. Job seeker can look for employment opportunity either by using the search or registration service described previously. Similarly, company looking for talented person can achieve its goal by using the search and registration service as well.

Personal profile can be used in network community to introduce oneself. Using the personal management service, user can create or modify her personal profile. We consult FOAF [10] and trust ontology [11] to design the attributes in the profile, including basic information like name, sex, birthday, email, working and school information, and friends. Based on the profile, we can build social network which will be used in further study. An example of profile is shown as below.

CONCLUSIONS

In this paper we design and implement a knowledge management platform by combining the Semantic Web technology and peer-to-peer network. We take advertising and public relation as the target domain and build knowledge-based layer for the application domain. Based on the layer, we develop management services for user to access the domain knowledge in the semantic peer network. JXTA, an XML-based peer-to-peer network, is used to develop the connection for the knowledge-based layer in each peer node. We develop a trust management mechanism for the trust reference of peer nodes and resources to be downloaded. We also develop an RDF-based streaming system that automatically push newly matched item to the target node according to user profiles. We have collected documents of classes in domain ontology to test the performance of pull and push information. The initial result is promising but we need to scale up the test environment to see how it performs in practice.

In brief, we have successfully stepped towards the development of semantic peer network for distributed knowledge management. In the future, we need to carry out further investigations about the work we have done in this paper to improve the performance and capability of the semantic peer network, including efficient search, trust social network, maintenance of knowledge scheme, mobile peers, learning content management, and business models.

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USING IT APPLICATIONS TO PROMOTE KNOWLEDGE SEEKING AND KNOWLEDGE CONTRIBUTION IN VIRTUAL COMMUNITIES

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ABSTRACT

The Internet has facilitated the emergence of online interactions among geographically distributed groups of people with similar interests or goals. These online groups, known as virtual communities, are defined as “the cyberspace supported by computer-based information technology, centered upon communication and interaction of participants to generate member-driven contents, resulting in a relationship being built up” [9]. Surfing the Web, one can easily discover the great diversity of virtual communities serving various purposes, from interest groups focusing on the discussion of specific topics like Google Groups, to online marketplaces that facilitate transactions and delivery such as Amazon.

Virtual communities have changed the way we communicate, and thus, our knowledge sharing processes and outcomes [11]. Online knowledge communities are a form of virtual community where people share their knowledge for mutual learning or problem solving. They have significant source of value for knowledge building and exchange. For example, online knowledge communities shrink the world by gluing worldwide individuals interested in particular knowledge domain [6] [8] [12] [14]. Also, they are found to support organizational knowledge flows between dispersed research and development efforts [1].

Most virtual communities for knowledge exchange are online-originated, that is, people interact predominantly and exchange knowledge with those whom they have little or no prior interaction. In these communities, individuals’ participation is voluntary and they have high autonomy over their knowledge sharing acts [2]. While virtual communities offer a source of value for knowledge sharing and creation, such value can not be realized unless community participants are willing to exchange knowledge themselves. As knowledge inherently resides within individuals [10], the movement of knowledge across them greatly depends on their knowledge exchange behaviors – their seeking and contributing of knowledge within the virtual community.

With the proliferation of virtual communities, many studies have been conducted to examine the drivers that facilitate knowledge exchange among individuals. Some salient factors identified as motivating knowledge exchange include the social capital embedded in the relationships among individuals, their anticipated extrinsic benefits (e.g. reputation), and intrinsic benefits (e.g. enjoyment derived from learning or helping others) [3] [4] [5] [7] [13].

Despite the insights that social capital and individual motivations are crucial in facilitating knowledge exchange, existing literatures have not addressed the way of fostering them in a computer-mediated environment. This leaves a gap in understanding how technologies can enhance knowledge exchange in virtual communities. Regarding this issue, this research attempts to create a framework for building effective online knowledge communities by examining the role of technology in these communities. We aim to understand what steps can be taken to foster social capital and individual motivation so as to encourage knowledge seeking and knowledge contribution in virtual communities.

Keywords: Virtual community, online community, knowledge sharing, knowledge exchange, knowledge seeking, knowledge contribution, social capital, IT artifacts.

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A TAXONOMY OF CONSUMER RESALE BEHAVIOR IN CONSUMER-TO-CONSUMER (C2C) E-COMMERCE: AN EXPLORATORY STUDY IN TAIWAN

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ABSTRACT

This article draws on a phenomenological study of consumer resale behavior in consumer-to-consumer (C2C) e-commerce. We developed a taxonomy to describe consumer online resale behavior using the dimensions of “planned” or “unplanned resell” and “used” or “unused products” in order to examine the relationship between consumers’ reselling and purchasing behavior. We named the four consumer resale types as 1) resale of extra purchase, 2) resale after temporary ownership, 3) unintentional resale, and 4) disposition. Further, we implemented consumer interviews to empirically examine our taxonomy. Three major implications are derived. Firstly, consumer resale behavior influences consumers’ purchasing decisions. Secondly, consumer unsatisfied resale experience would damage brand image and decrease consumers’ willingness to repurchase. Finally, the motivations and behavior of consumer resale behavior are multidimensional.

INTRODUCTION

Information technology has reduced the search and transaction costs for buyers and sellers to locate and trade products, and can thereby facilitate the creation of technology-mediated electronic exchanges [8]. Today, online buyers are portrayed as having unprecedented power to avoid goods and services they do not want, to shape those they desire in a way that suits their individual tastes, and to shop around for the best price-quality combination [24]. Now the Internet allows sellers to easily reach a worldwide market and buyers to easily locate items that would be unavailable in traditional physical stores. Similarly, the sale of used products has been around for a long time in physical markets. However, electronic exchanges alter the scale and scope of what is possible with regard to the sale of used products [8]. Consumer-to-consumer (C2C) e-commerce is a revolutionary and popular model of e-commerce, where consumers form a market to sell and buy products online. For example, eBay, the largest and most popular C2C company running an online auction site, has 203 million registered users worldwide, with 90 million users in the U.S. and 113 million users in eBay’s international markets [27]. If eBay were a country, it would be the fifth most populous country in the world, and prior reports indicated that online auctions would account for US\$48.5 billion of the expected US\$195 billion of online retailing revenues by 2006 [7]. Approximately 1.3 million sellers utilize eBay as a primary or secondary source of income, according to A.C. Nielsen’s 2006 International Research.

The Internet not only changes business models but also dramatically changes consumer purchase and consumption behavior. Durable goods are no longer considered unrecoverable costs, but rather can be considered liquid assets or acceptable accounts for consumers who have mastered reselling on C2C online auction sites. The product’s value or benefits may be perceived differently when consumers contemplate reselling their propriety. With intention to resell, consumers will compare the value brought by continuously using the products, the value of holding cash earned by reselling the product, and the value of new products the cash can buy. Once the latter two values are higher than the former, consumers will conduct online resale. We can infer from the large number of online sellers and the sales amount that a great deal of consumer behavior is no longer the same as the traditional consumer behavior of purchasing and consuming only. In online auctions, consumers may play dual roles as both consumers and resellers simultaneously, or in turn. The role of a consumer as reseller is a relatively new concept; studies of consumer behavior with regard to selling, motivations, goals, knowledge, and skills differ tremendously from that of the traditional consumer buying and consuming behavior. Unfortunately, the behavior of consumer resale online has not been studied in depth. Most research mainly focuses on online buying behavior or issues related to a unique auction mechanism, such as bidding strategy in a flexible pricing e-commerce.

In addition, most previous studies about online behavior have not considered the relationship between online and offline behavior. It goes without saying that consumers consider online shopping as one of their channels to purchase goods, dispose of unwanted goods, and search for information about goods. However, it is important not to neglect the influences of offline channels when studying online issues. Cheung et al. [3] found the focus of prior studies was on investigating the factors which affect the buyer’s intention and participation levels for online purchases. However, in many countries, although e-commerce transactions have grown rapidly, the amount of total online sales is still relatively small when compared to total national retailing sales. In the United States, e-commerce sales makes up only 2.3 % of total retail sales [26], though the U.S. Internet usage rate is one of the highest in the world at 68% [14]. The low conversion rate from Internet usage to e-commerce sales indicates that consumers use the Internet

mainly for non-purchase purposes or that they use the Internet to gather product information, but make the purchases offline. According to Nunes and Cespedes [18], as many as half of customers now shop for information in one channel, then switch from that channel to another when it comes time for money to change hands. In another study, Brown and Goolsbee [2] investigated the impact of Internet comparison shopping on the offline life insurance market and reported that the growth of online comparison sites reduces life insurance prices by 8% to 15%. The results of this study demonstrate the Internet's potential to cause a shift in welfare from a whole industry to private households. In a real case in Taiwan, five imported cosmetic brands were forced to decrease their prices 30 percent in response to a request from consumers because they could purchase the same products at a much cheaper price from parallel importers selling goods on the Web [6]. Thus, better price offers and easier price comparisons encourage consumers to make purchases online from sources other than official marketers, such as auctions and small retailers. This type of online buying can in turn attract more individuals to take a part in online trading and selling and give rise to consumer online resale activities. It is necessary, therefore, to look further into the effects of such a conjunction of online and offline consumer purchase behavior.

To study consumer behavior in the Internet environment more thoroughly, it is necessary to examine these issues from a broader perspective. In this study, we focus on consumers online resale behavior instead of the bidding behavior of buyers and look at the interaction between online and offline behavior rather than treating them separately as different boundaries. Further, we examine consumer disposition behavior and the linkage between the disposition and acquisition phases, rather than focusing only on one part. We first review literature and identify the background of consumer resale situations in order to elucidate our research questions for the nature and representation of consumer resale behavior in C2C e-commerce market and the possible implications for researchers and marketers. Next, we discuss issues related to consumer resale by conceptually defining and specifying types of consumer online resale behavior in a taxonomy. Then we conduct consumer interviews to examine the plausibility of these deductions. Finally, we present the conclusions and implications of the research.

LITERATURE REVIEW

Consumer Disposition

As much of the research in consumer behavior has focused on the acquisition phase, the disposition process has received relatively less attention [16] [17] [23]. Jacoby et al. [15], in the first research about consumer disposition, developed a conceptual taxonomy for describing consumer disposition behavior and classified resale as one of the disposition choices. Following Jacoby's research, Hanson [9] developed an explanatory model of several salient factors involved in the disposition decision process. Harrell and McConocha [10] explored further and conducted a field study to discover how consumer characteristics are related to the selection of several important disposition options. Besides giving or throwing away unwanted goods, consumers can resell them in such venues as a flea market, garage sale or consignment store. Jacoby et al. [15] suggested for future research in their article that consumer disposition patterns would vary over time. With the availability of C2C e-commerce in the Internet era, the resale pattern of consumer disposition is now not only more significant, the behavior is also more sophisticated. Consumers now have more options to dispose of unwanted possessions [20].

Consumer Resale Outlets

Mowen [17] noted that the "disposition phase" refers to what consumers do with a product once they "have completed using it." But today, consumers may resell unused or not completely used goods to recover partial payment. The most important emerging disposition channel is doubtlessly the Internet via online auctions. Besides C2C websites, traditionally, consumers resell their unwanted goods through consignment stores, flea markets, garage sales and pawn shops. Consignment stores are designated to sell goods for consigners who have the willingness to sell unwanted goods at service fee. Consignment stores only receive the service fee after the sale is done. EBay "drop-off stores" often use the consignment model of selling to assist consumers in reselling products. These online drop-off store owners use eBay as a platform to sell goods for consigners who have no time or expertise to sell on eBay. A flea market or swap meet is a place where vendors come to sell or trade their goods. The vast majority of flea markets in rural areas sell goods that are second-hand. The semi-spontaneous nature and vendor-oriented open-market layout of flea markets sometimes offer concerts and carnival-type events to attract shoppers. Several studies have focused on the social embeddedness of consumption, marketplace ambience, and comparison of a flea market to traditional retail stores [1] [25].

"A garage sale is usually a community-based special sale that can be found in virtually all American communities, and which is the temporary public sale of used goods, primarily household items and clothing from in and around a private residence"[12,p.182]. Sellers in garage sales have a wide range of styles and motivations, from periodical housecleaning and socializing to making profit and generating cash [13] Differing from retailers' profit-making motivation, several studies of consumer sellers at garage sales reported that the social relations of the garage sale experience may in fact be a major reason for sellers' and buyers' participation. Herrmann [12] argues that the U.S. garage sale is a complex site that provides the potential for specific exchanges to be constructed as gifts or commodities, or both. She explains that the participants of different races and classes can transmit something of themselves with their possessions, transform their own lives in the process, and contribute to a broader spirit of community through

these reciprocal transactions. On the other hand, a pawnbroker offers monetary loans in exchange for an item of value to be held by the pawn broker. These stores sometimes carry a negative impression due to the fact that they often offer a low price for used goods. People who pawn goods usually need money urgently and value the privacy of the transaction. We find that the resale channels above share the same feature of a lack of efficiency because they do not include enough buyers and sellers in the markets and often do not see goods being sold timely at reasonable prices.

A TAXONOMY OF CONSUMER ONLINE RESALE BEHAVIOR

In order to understand consumer resale better, we have developed a taxonomy to help us get a more complete picture. After excluding professional full-time sellers or retailers on auction sites, we classify the resale behavior of consumers into four categories based on the first dimension of “planned resale” or “unplanned resale” and the second dimension of “reselling unused products” or “reselling used products” in order to study the essence of the each resale behavior. Here the dimension of unused product refers to the condition of the item that is kept intact after being acquired by consumers till it is sold whereas the products themselves may be new or second-hand before. Used product is defined as the condition when product has been used by consumers before it is sold, yet the product itself may already be used or new in the first place when consumers purchased. Table 1 presents the four types of consumer online resale behavior.

Planned Resell upon Purchase

We define the first dimension “planned resale” as the condition when consumers, before purchase, consider that they can and have the intention to resell the target product after possessing it for a period of time. Consumers will receive compensation in the future if the product is successfully resold on an online auction site. Once consumers have the thought to resell the products, how the products can be resold for a profit becomes a major concern which predetermines consumer evaluation and willingness to buy. Thus, we propose “intention to resell” as the first dimension of classification. While the intention to resell can occur anytime—after purchase, during purchase, or even before purchase—only if the intention to resell occurs before the purchase is the condition termed a “planned resale” behavior; otherwise, if the resale intention occurs after purchase, it is called “unplanned resale.”

“Intention to resell” is an important concept that we use to analyze consumer resale behavior. If consumers do not intend to sell, their passive disposal behavior is more like traditional disposition as described in prior literatures [9][10][15]. On the other hand, selling is traditionally the job of the retailer, and the main purpose for retailers to purchase products is to resell. The “consumer reseller” described here is situated between traditional consumers and retailers, and consumer resale behavior is an amalgam of traditional consumer and retailer behavior. Consumers play a role closer to that of a retailer if they plan to resell. In this case, product buying blends the purposes of personal use and future business. If consumers uncover the resell intention after they have purchased and used the product for a while without a prior plan of resale, they are more like traditional consumers and that product buying is mainly considered for personal consumption at the time of purchase. Another reason we use the dimension of “planned” or “unplanned resale” is that the nature of consumer resale is strongly linked to purchasing. Since the major purpose of consumer purchase is for personal use, consumers are not consumers if their purchase is solely for resale. Thus, to analyze consumer resale behavior, we have to start from examining the motivation for purchasing.

Unused or Used Products

The second dimension we propose is whether or not the products that consumers sell are used. The behavior of reselling goods that have or have not been used by sellers is quite different. Reselling unused products means the sellers sell products without using them, while the products may be new or second-hand. Reselling used products describes the condition where the sellers have used products before reselling them, with the products being either already used or new when the sellers first purchased the products. The original buyer and reseller of resold goods may not necessarily be the same person. For example, the original buyer may be the father of a family while his son may list the products online to resell. Likewise, someone may help her friend to resell products on eBay. Consumers who are involved in the resale process are all sellers, but they may also be the buyers, users, or person responsible for listing on an auction site. Their behavior influences the resale. Reselling unused products is similar to the behavior of retailers, while reselling used goods is more like traditional consumer disposition behavior. The motivation to dispose of used and unwanted goods is clear; the reasons for consumers to resell unused products, however, have not been examined in previous study. Using the resale plan and product usage conditions as our classification scheme, we identify four different types of resale behavior, each with its unique meaning.

Table 1. Taxonomy of Consumer Online Resale Behavior

	UNUSED PRODUCTS	USED PRODUCTS
PLANNED RESALE	RESALE OF EXTRA PURCHASE	RESALE AFTER TEMPORARY OWNERSHIP
UNPLANNED RESALE	UNINTENTIONAL RESALE	DISPOSITION

CONSUMER INTERVIEWS

We conducted consumer interviews to collect possible consumer purchasing decisions and online resale behavior, evaluating correspondence to the proposed taxonomy. By a snowball process, a purposeful sample of nine participants who had successful experience in selling a number of products online took part in this study. Three of the nine participants are males and six of them are females. Intensive interviews were conducted using a conversational, unstructured, exploratory interview style guided by participants' stories of their shopping and online resale experiences. Each consumer interview lasted about an hour. Participants ranged in age from 19 to 32, with an average age of 25. They were current or past university students from different disciplines with 4 to 15 years of computer usage experience. Regarding online transaction experience, they had 2 to 8 years of online purchase experience and 1 to 5 years of online resale experience. Almost 95% of their resale transactions were through global online C2C auction websites affiliated in Taiwan, such as Yahoo Auction or eBay Auction. To help participants recall their experiences, a conversational-styled personal interview was conducted to gain in-depth information from each participant. The interviews focused on the participants' perceptions of themselves, of their environment and of their experiences. No questions were pre-determined or standardized. Information gathering came from a free-flowing conversation, relying on the interaction between the interviewer and the participants [21]. Burns [3] stressed that there are many advantages for in-depth or open-ended interviews; one of the advantages is the greater degree of informality involved, leading to stronger rapport.

INTERVIEW FINDINGS

The results support our four-cell taxonomy. The taxonomy as a tool to analyze consumer online resale behavior is meaningful and useful, providing plenty of insights. In this session, we discuss findings from our interview regarding the typology and important subjects discovered in the process.

Four Types of Online Resale Behavior

Type 1 Resale of Extra Purchase

In the "resale of extra purchase" situation, consumers sell unused goods with a planned behavior to resell. This occurs when consumers buy extra units of the same product over and above those purchased for self use with the intention of reselling the extra for profit or for personal enjoyment. Travelers may go abroad and buy products at a lower price than that found in their domestic market, and may buy one for self use and buy extra to list on online auction sites to make a profit.

"When traveling in Italy, I found that a Prada bag is much cheaper there. I purchased one for myself and one for my sister as a gift. But after returning home, my sister told me that she didn't like the style. I ended up listing the bag on Yahoo and made a surprising windfall of NT\$5,000 (approximately US\$150). After that experience, I pay special attention to products with large price gaps around the world."

Type 2 Resale after Temporary Ownership

"Resale after temporary ownership" type of consumer sellers are usually sophisticated consumers and heavy auction site users who savvy and have plentiful experience in reselling used goods on online auction sites. Products are conceived of as liquid assets which can be easily traded in exchange for cash at a low transaction cost. Having expertise to resell, they are knowledgeable of the possible resale price as well as the risk if they cannot successfully resell the goods online. For instance, consumers may replace their mobile phones more frequently because they know they can sell a particular cell phone for 70% of the price they paid after six months of use. Of course, market uncertainty may also cause consumers to lose money if they sell the cell phone at a lower price than expected. With the development of purchasing and resale skills similar to retailers, consumers' purchase considerations and behaviors are significantly different than traditional decision-making. We will discuss the effects further later in the article.

"I sold a pair of shoes at a price just 5% below the price I bought them at. I am thrilled. From that day, I learned I could wear a new pair for a while and sell them when I don't like them. The best part is I can even have most of my money back when I sell them."

Type 3 Unintentional Resale

"Unintentional resale" is a behavior by which consumers resell a new product that they have no intention to resell upon purchase of the product. C2C e-commerce buyers sometimes realize it a very good deal because they can purchase good quality, totally new products at a much lower price when these consumer resellers conduct unintentional resale. There are three sub-categories in "unintentional resale" type resale:

Impulse Buying: Consumers sometimes purchase unnecessary products out of impulse. When realizing the purchased goods are unneeded, they list them on webs to recoup losses.

“When shopping, I cannot help purchase lots of clothes by impulse. After arriving home, I come back to rationality and find a handful of clothes that just doesn’t fit my style, then I will resell them if I can’t return these clothes.”

Mis-Purchased Items: Consumers may mistakenly purchase inappropriate items, and find returning them not worth the effort. Likewise, consumers may purchase too many items and find that they cannot use them all. In this case, consumer sellers are unable to return goods and may thus sell those mis-purchased items, such as clothing in the wrong size or the wrong computer components, via online auction sites. Having difficulties in returning these products for refund, the online resale becomes a risk reducer for consumers.

“I sold an unfitted component of my personal computer because I can’t return it due to losing the receipt.”

Unwanted Gifts: Since gift giving involves two individuals, there is a much higher possibility that the receiver may not like the gift. Gifts are ideal goods to be listed on eBay, because they are usually valuable, new, and have complete packaging, and can therefore be sold at an attractive price.

“I am happier to receive gifts after learning how to resell unwanted online. If receiving a dislike gift, I list it online for resale. An unwanted gift actually means cash to me now.”

Type 4 Disposition

“Disposition” type behavior is a phenomenon better described in the existing literature. Consumers dispose of their used products to secondary markets. Prior research about consumers disposing second-hand goods falls in this category. Jacoby et al. [15], in his research about disposition, developed a conceptual taxonomy to describe consumer disposition behavior. Although “sell it” has been a disposition category in Jacoby’s study, the ease and intensity of online resale in our study indicates a revolutionary difference from what was proposed by Jacoby and his colleagues. Using the Internet, consumers can currently resell unwanted goods at a much lower cost and on a higher scale than before. Comparing the popularity of traditional and IT-based secondary markets, we can see that the disposing scale is much larger than before the Internet era. In the United States, each year the US\$9 million of traditional garage sales are dwarfed by the \$19 billion worth of C2C online auctions [5] [11]. This category can be divided into two subcategories: “Complete Use” and “Incomplete Use”.

Complete Use: It is difficult to give a universal definition of “complete use” for each consumer because individual consumers have varying principles to manage their commodities. In this study, we define “complete use” as the situation where a product is no longer used when consumers think that the product’s value is already exploited. For instance, for many consumers, the value of a movie on DVD format is exploited once they have watched it once. Likewise, a pair of shoes has been worth its full value if worn for two years. Consumers will resell complete use products because of these reasons:

- (1) **Waste Avoidance:** Though product value is already exploited, consumers are aware of the salvage value of these used goods. To avoid the feeling of wasting, consumers feel more comfortable reselling unwanted items rather than throwing them away or storing them. Traditionally, consumers are more likely to throw away, donate, give away or store unwanted items, but after learning of the feasibility of trading unwanted items for cash, they may feel guilty if they simply discard the items.

“I realized that the huge amount of unwanted goods in the storeroom is no longer trash. It’s another bank account for me-- if I sell them I can get cash for lots of new stuff I desire. It’s a waste to throw these them away.”

- (2) **Clearing Out Space:** To create space in a house is a motivation to resell unwanted items [13] [4] [15]. Consumers may still want to keep some goods which may be used in the future, but space considerations push them to get rid of these unwanted items.

“It costs me more to keep these children’s clothes because space is valuable to me. Since I don’t need these clothes, it’s acceptable if resale price is low.”

- (3) **Environmental Protection:** Some eco-aware consumers may resell products to who may utilize the products to prevent resource shortage on earth. This type of sellers prefers doing products justice than making money.

“I believe resale is good to our earth. I would rather resell in a low price than throw usable goods away.”

Incomplete Use: Here we define the “incomplete use” situation as one where consumers cease using a product despite the fact that the product is still in good condition and working order. The reasons to resell usable products are as follows:

(1)**Dissatisfaction with Products:** It is impossible for some consumers to become familiar with a product until after using it for a period of time. It may take digital camera owners weeks to learn that the camera is too complicated in operation, and they would prefer to buy a simpler model which is easier to operate. When it is too troublesome to return the used camera, reselling it online and getting back a portion of the original money spent seems a good choice for consumers.

“I sold my newly purchased bag on eBay because I disliked the shape and it’s too small to pack my notebook.”

(2)**Writing off an Old Product’s Book Value:** Consumers may face financial guilt after making purchases of new items that are not justifiable. Holding a usable old product makes purchasing a new one “unnecessary.” Therefore, some consumers are happy to resell the old goods in order to justify the purchase of a new one [19] [22].

“I am a lover of electronic products and always use the newest models of digital cameras, TV games, PDAs and computers. Because electronic products are quickly replaced by new models and I can’t afford all these items, I deal with the problem by reselling them online.”

(2) **Life-Passage:** There are many changes for people facing a life passage, such as children growing up, relatives passing away, or moving to another country and that require some shift in possessions. Consumers may have no choice but to dispose of these belongings under these circumstances. Although the online resale will make significant revenue, the central motive of the seller is putting a distinct phase of life behind him or herself [13].

“I sold my motorbike on Yahoo auction because I have gone to U.S. to study for four years.”

Online Resale and Online/Offline Purchase

The purpose of our interview questions was to examine our proposition that online resale will influence purchase behavior. Our interview findings show that resale does have a positive effect on consumers in that they are more willing to buy from retailers and other suppliers. This is because consumer sellers feel the security of the online resale channel as a convenient disposition outlet, so they perceive less risk even if they have purchased something less desirable. Among the nine participants, three replied that there is no significant influence on their purchasing, while six replied positively, including answers such as “becoming more sensitive to online and offline prices,” “more willingly to buy from the Web,” “trying to sell more to get cash for a new purchase,” and “feeling frustrated when reselling products at a low price.” The results support a plausible strong relation between purchasing and reselling. More importantly, resale also affected repurchasing in a cyclical manner. Thus, online resale behavior and resale result play important roles in determining the first purchase and subsequent repurchase.

“I like comparing price before buying things online or offline. I feel excited to purchase products at low price and sometimes buy extra to resell for a profit.”

“I have experience in reselling my used mobile phone, shoes and PC monitors on the Internet in order to cover a shortage of NT\$10,000 (approximately US\$300) needed for a new laptop computer.”

“When I purchase a high-priced product, I consider buying one with a better resale price. For example, limited edition models usually have better resale price.”

“After selling a cell phone on the Internet at a very low price, I wondered about the reason and considered not to buy the same brand next time.”

DISCUSSION AND CONCLUSIONS

Online Resale Taxonomy

By in-depth interview, we discovered that the motivations for consumer online resale are multidimensional. Consumers under the four types of resale situations in our taxonomy may resell for different reasons. Unlike retailers who have profit as the only goal of selling, consumers resell for different purposes. These purposes include practical concerns of monetary return and reduction of purchase risk, or emotional dimensions of pleasure and avoidance of felt guilt. Just as consumers select and purchase to fulfill different needs, online consumer resale serves to meet individuals’ financial, utilitarian, and hedonic goals. However, it is well illustrated in our consumer interviews that consumer online resale behavior is idiosyncratic and multifaceted which differs fundamentally from consumer buying behavior. For further research, we suggest more detailed examination of each type online resale behavior. In addition, the consumer resale behavior should be studied across countries, since our study is conducted in Taiwan. Resale behavior should be different among cultures and retail background.

Influences of Online Resale Intention to Purchase Decision Making Process

Online resale intentions may influence the purchasing decisions of consumers in many aspects. In the pre-purchase phase, consumers with the intention to resell online may more easily arouse a need because they may perceive a lower product price; therefore, more brands and products become affordable. Furthermore, they may search for different information and have different evaluations of market preferences, such as brands providing a longer guarantee period. They also perceive lower risk toward purchase than those only with the intention to buy and are more willing to purchase goods they hesitated to buy because they can resell goods they find unsatisfactory. Moreover, consumers’ online resale price knowledge of the secondary market can also directly affect their attitudes toward and their perceived value of a brand, regardless of any intention to resell. In the post-purchase phase, consumer satisfaction with a brand may be heavily altered by the resale result, as noted earlier. Consumers may also be less likely to purchase a new product if on the one hand they cannot make “complete use” of it and on the other hand cannot resell it. Under this circumstance, consumer online resale can help to decrease the psychological dissonance that arises from a mis-purchase or incomplete use [19]. We summarize the influences of online resale intention on each phase of consumer decision process in a typical buying decision-making model in Table 2.

Table 2 Influences of Online Resale Intention to Purchase Decision Making Process

Decision Making Process	Influences of Online Resale Intention
Recognition of Need	More easily to arouse a need
Information Search	1. Less product information searching 2. More information needed related to online resale
Alternative Evaluation	1. Preferring products with higher second-hand price 2. Preferring products that are easier to resell
Purchase	1. Higher intention to “try” new goods 2. Keeping original package and certificate of authenticity 3. More carefully preserve products
After-Purchase Evaluation	1. Comparing value of a resale and continuously possessing a product 2. Activating a resale once the resale value is higher 3. Negative attitude if dissatisfied with the resale product

Market Cannibalization Effect

While the speculated cannibalization effect [8] predicts C2C online auction markets may steal some sales from retailers, online auction sites that resell consumers’ unwanted goods may actually carry over and lead to more new product sales from retailers [20], in particular with the resale of extra purchases. The other three types of consumer resale also can bring consumers cash to recover part of the original purchase payment, which could in turn encourage them to buy more new products from retailers [20] and actually increase retail sales. Consumers may even spend more with this resale money because they perceive the resale income as a windfall earning. Online resale also drives consumers to spend less time in searching product information and, therefore, to purchase what they are hesitant to buy before. The possible positive or negative impact of the online secondary market on consumers and retailers deserves further examination in future research.

Implications for Marketers

To marketers, our study has several important implications. Firstly, marketers cannot stop the growth of online secondary market but should be aware of the changes it brings. There is a loop connecting new-product markets and the secondary market [22]. When more and more consumers sell used goods, consumers may find it easier to purchase used goods by using the Internet. Therefore, a new segment of those who prefer to purchase cheaper used goods may be created by this constant secondary-product supply. Marketers must examine if the new segment is a separate segment from those who always purchase new products. If the new segment of secondary goods purchase is sufficiently large and independent, marketers need to adjust targeting and positioning strategies by addressing the resale value of goods. Secondly, millions of consumer resellers may be potential sales representatives for companies. Direct-selling companies may take advantage of these resellers to sell products or conduct customer service on C2C websites. To build an online direct-selling structure may save significant costs and allow for cross-national sales. Thirdly, gray market issues have diluted international brand values for a long time. With the boom of C2C auction sites, consumers not only can find price disparities more easily between countries but can purchase directly from small importers online. This will grow new challenges in international channel management and global pricing strategy for global brands. Therefore, international brands should rethink their global pricing policy.

With the continuous growth in the Internet user population and the development of the Internet infrastructure, there is little doubt that the phenomenon of consumers as online resellers will proliferate. Given its potential impact on changing consumer purchase and consumption patterns, online consumer resale behavior should be extensively researched and addressed. Even though a large

portion of consumers have not sold or purchased via the Internet, the impact of C2C e-commerce is intensifying with more selling agents and online resale consignment stores emerging daily [20]. In sum, the more efficient the information flow on the Internet and the lower the cost to resell products online, the faster consumer behavior will transpire. Therefore we should pay more attention to these evolving consumers.

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IS ALIGNMENT DISCUSSION: A CLASSIFICATION FRAMEWORK

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ABSTRACT

Information system (IS) alignment has been one of the most important topics recognized by management since the last decade. However, it is a complex concept. Although some classification frameworks and guidelines have been suggested, they are only useful to understand the nature of alignment constructs and the types of relationships between them. None of them classifies the ways of discussing alignment results which are the final outcomes of an alignment assessment that describe the extent and appropriateness of various constructs to one another. This paper suggests a framework to help understand how alignment results can be discussed, which includes four perspectives. It is expected that the framework can help not only readers understand IS alignment research, but also IS researchers initiate appropriate alignment research projects. Several future research projects based on this framework are also revealed.

Keywords: strategic alignment, classification framework, IS strategy, alignment dimensions

INTRODUCTION

Information system (IS) alignment has been one of the most important topics recognized by management since the last decade. This has called a large number of researchers dedicating to academic publications on this topic. Yet, as Papp [35] commented, it is a complex concept. Various kinds of definitions of alignment have been found in the IS literature. For example, Weill and Broadbent [58] defined the alignment of organizational and information strategies as the extent to which the organizational strategies were enabled, supported, and simulated by information strategies; Chorn [11] defined alignment in a broader context as the “appropriateness” of the various elements to one another. In addition to various definitions, various terms are used interchangeably to describe alignment, such as “fit” [11] [14] [33], “link” [20] [22] [37] [47], “congruence” [23] or “match” [41].

Since researchers have various viewpoints on the meaning of alignment, it is not surprising that the research on IS alignment are carried out from different perspectives. The universal agreement on a most orthodox way of conducting alignment research is hardly to be found. Although a number of classification frameworks and guidelines have been suggested to help understand how IS alignment can be discussed (e.g. [38] [48] [55]), they are mainly useful for explaining the nature of alignment constructs and the relationships between them. They seldom show us what alternatives are available for discussing alignment results. This paper defines alignment results as the final outcomes of an alignment assessment, which describe the extent and appropriateness of various constructs to one another.

For discussing alignment results, this paper proposes a classification framework to demonstrate what perspectives are available. This framework is based on the discussion of two questions: whether the discussion is a qualitative or quantitative approach and whether the discussion is the dimension or overall level. Apart from helping readers understand what perspectives are available for discussing alignment results, it is expected that this framework is useful for IS researchers to develop appropriate alignment research projects.

PREVIOUS LITERATURE

Three issues are found in the alignment literature as fundamental considerations when designing an IS alignment research: the number of constructs (constructs are the elements to be aligned), relationship between the constructs, and alignment dimensions. They are explained in the following sections.

Issue 1 – Number of Constructs

The first issue is how many constructs are involved in the IS alignment discussion. The study of alignment must have the elements to be aligned, which are called “constructs”. The numbers of constructs are various in the IS alignment studies. For example, Henderson and Venkatraman [16] proposed an alignment model termed “strategic alignment model” which explains the interrelationships between four constructs: business strategies, IS strategies, business structures, and IS structures. Some studies are based on three constructs, such as organization structures, organization process, and organization strategy [12]. Burdett [7] studied the alignment among three constructs which were customers, organization, and team.

Studying two constructs is most frequently seen in the IS alignment. For example, Sun and Hong [45] focused on the alignment between manufacturing and organizational strategies. Teo and King [51] researched the alignment between business planning (BP)

and information systems planning (ISP). Beal and Yasai-Ardekani [4] were interested in aligning CEO functional experiences with organizational strategy. It is suggested that IS researchers should clearly define how many constructs are included and what constructs are the focus in their alignment research.

Issue 2 – Relationship between Constructs

The second issue is the relationship between constructs. As Van de Ven [53] suggested, the alignment can be induced with or without causation between the constructs. This implies that the alignment of any two constructs can be with or without causation.

Relationship without Causation

The relationship without causation between two constructs means that no causation is found between two constructs or the causation is disregarded. This type of relationship can be illustrated by Figure 1.

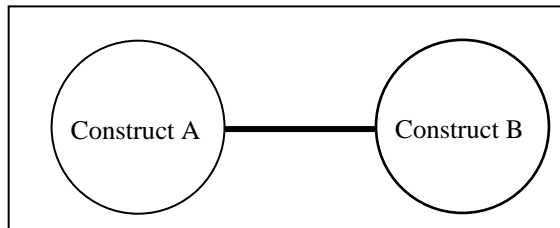


Figure 1 No causation between two constructs

Van de Ven [53] reviewed the studies (e.g. [11] [15]) concerning the theory of population ecology that was being applied to the relationship between organization and environment. The findings showed that it was possible that there was no causation implied between environment and organization structure. The reasons for no causation existing between the constructs are that the two constructs (organizations and the environment) are part of a social system. Thus, the alignment is an interaction effect of organizational environment and structure on organizational survival.

Another meaning, as suggested by Van de Ven [53], tends to disregard the causation existing between organizations and the environment. This meaning is that the alignment between organizational environment and structure may simply be a spurious result of a third set of factors that explain the observed covariations among environment and structure. For example, Broadbent and Weill [6] identified six indicators which were important in aligning organizational and information strategy in the banks. For this group of studies, the relationship between the constructs is not the focus, and can be disregarded.

Relationship with Causation

The relationship between two constructs can be considered with causation. As Van de Ven [53] suggested, an organization must adapt to the characteristics of its environment if it is to survive or to be effective. This perspective shows a clear deterministic theme derived from the environment causes of the organization's structure which must be in place if the organization is to survive [53]. For this reason, the causation does exist between the two constructs.

The causation which exists between two constructs has been widely recognized by the IS researchers [16] [25] [46] [57]. [16] revealed that each of the four constructs in their strategic alignment model can be the driver and has the driving force to influence to the other constructs. This can be termed "one-way alignment". This type of relationship is illustrated by Figure 2.

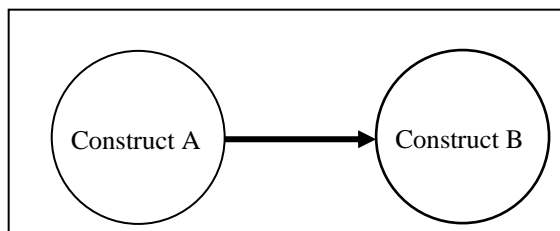


Figure 2 One-way alignment

One-way alignment means that the construct B should be aligned with the construct A. The construct A has the driving force, and is the driver in the alignment model. As construct A has the driving force, construct B should support construct A.

A number of IS alignment studies are based on this relationship. For example, Pyburn [37] tried to link the MIS plan with

organizational strategy. Tavakolian [50] focused on linking the information technology structure with organizational competitive strategy. Venkatraman and Camillus [55] studied aligning those external issues of the organization (e.g. environmental factors, competitive responses) and internal issues (e.g. internal structures, management processes) with organizational strategy.

However, many IS researchers have called for investigating two way relationships between the constructs. For example, Tallon and Kraemer [46] define strategic alignment as the extent to which the IS strategy supports, and is supported by, the organizational strategy. Baets [1] suggested not only attempting to align IS strategy into organizational strategy, but defining them in parallel.] Lederer and Mendelow [27] also argued that aligning an IS plan (ISP) with a business plan (BP) is different from aligning a business plan (BP) with an IS plan. These two types of alignment provide benefits to businesses in different aspects. Luftman [28] insisted that alignment addresses both how IT is in harmony with the organization, and how the organization should, or could, be in harmony with IT.

The “two way relationship between the constructs” means both of the constructs are the drivers. This can be termed “two-way alignment”. The causation between the two constructs is illustrated in Figure 3. In regard to the issue of causation, researchers need to consider whether a clear deterministic theme of the causation is existing in the relationship between any two constructs.

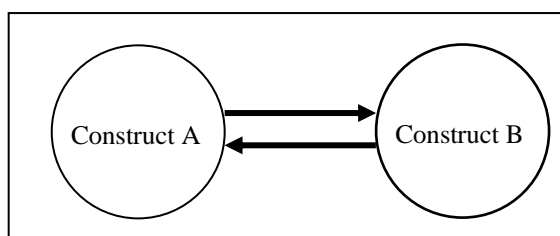


Figure 3 Two-way alignment

Issue 3 – Alignment Dimensions

The third issue is the alignment dimensions utilized to clarify the concept of alignment. Various classification frameworks have been proposed to discuss the alignment dimensions [21] [34] [38] [43] [48] [52]. The following sections will discuss the cause and effect, the social and intellectual, the behavioral and cognitive, and the current and future dimensions.

Cause and Effect

Reich and Benbasat [38] suggested two dimensions for measuring alignment: cause and effect. The effect dimension is the result or outcome produced from the alignment [43] [54]. It has various meanings to the organization, such as coordinated functional documents with the strategic plans [55], shared understandings between different levels of management, aligned behavior of the management or aligned management thinking [38] [48] [55]. However, the evaluation on the effect dimension is of little help in understanding “how” [43].

In contrast, the cause dimension focuses on understanding and measuring the means to achieve the outcome [43] [54]. This can be the explanations of the alignment [52], the process to achieve the alignment [48] [55] or the factors which cause the alignment [30].

Social and Intellectual

In addition to cause and effect dimensions, Reich and Benbasat [38] also suggested social and intellectual dimensions for measuring alignment. The social dimension emphasizes the people’s profile and ability, degree of involvement and social factors in determination of alignment [18] [38]. It is the “personnel linkage” described in Lederer and Mendelow’s [27] study, the “organizational linkage” described in Shank, Niblock, and Sandalls’ [44] study and the “subjective alignment” mentioned in Ball, Adams, and Xia’s [2] study. The social dimension focuses on measuring the units that are responsible for developing the constructs. For example, whether the agreements between the IS executive and general executives on the IS are coordinated [2]. Thus, social alignment means that the units, personnel, and social factors which are responsible and involved in the development of the constructs are aligned.

The intellectual dimension is the methodologies and tools which can be aligned or which can help a decisionmaker utilize the best way to formulate the alignment [18] [38]. This is the “content linkage” described in Shank et als’ [44] study, and “objective alignment” mentioned in Ball et als’ [2] study, which deals with the correspondence between the content of two constructs. For example, the data presented in the plan document and that presented in the budget are aligned [44]; and the IS strategy and organizational strategy are aligned. Thus, the intellectual alignment means that these methodologies and tools are aligned or these methodologies and tools utilized by decisionmakers are aligned.

Behavioral, Cognitive, Current, and Future

There are four other dimensions which have not been paid much attention in comparison with previous four dimensions (case, effect, social, and intellectual dimensions). Tan [49] distinguished alignment research into behavioral and cognitive dimensions. These two dimensions focus on how organizations “behave” (behavioral dimension) and how organizations “think” (cognitive dimension). In addition, Tan [49] argued that these two dimensions are considered as inseparable because managers behave what they think. In comparison, the behavioral dimension has been adopted frequently in the alignment literature. He suggested that more focus should be added to cognitive dimension to enrich the assessment of alignment.

The other two dimensions are current and future dimensions. They are embodied in the studies of Itami and Numagami [21] and Nakayama [34]. They recommend that alignment researchers focus more on the “current” constructs and the “future” construct. For example, Nakayama [34] suggested a consideration of the alignment between what businesses are currently doing and what they can be doing. Itami and Numagami [21] studied current strategy and technology and future strategy and technology. They identified three kinds of dynamic interaction that are conceivable between strategy and technology:

1. Between current strategy and current technology,
2. Between current strategy and future technology,
3. Between future strategy and current technology.

As organizations become more complex, alignment is more dynamic than static and incorporates more than just the readily available structures [9]. Thus, businesses should consider more about aligning the present construct with the future construct. Bergeron, Raymond, and Rivard [5] also called for adopting longitudinal perspective rather than cross-sectional operationalizations of alignment.

THE PROPOSED FRAMEWORK

The three issues discussed previously focus on the discussion of the nature of alignment constructs and the relationships between them. After we determine how many constructs are involved in our research, any causation between them, and the alignment dimensions which we are going to choose, the next is to decide how the alignment results will be discussed. Should the results be a qualitative or quantitative format? Should the results be a yes or no answer or a degree level?

This paper provides a framework, which includes four perspectives, to classify the discussion of the alignment in the IS alignment literature. This framework is based on two considerations – whether the discussion of alignment is based on qualitative or quantitative approach, and whether the discussion of alignment is at the dimension or overall level. Different from previous three issues, these two considerations specifically deal with how alignment results can be discussed and presented.

Qualitative or Quantitative

The first consideration is whether the discussion of alignment is based on a qualitative or quantitative approach. In general, the discussion of alignment results can be dichotomized into qualitative and quantitative approaches. When the qualitative approach is adopted, alignment results can be a form of qualitative descriptions [42], qualitative terms [10] [31], or alignment perspectives [1] [16] [17] [29] [56]. When the quantitative approach is adopted, alignment results refer to the “appropriateness” of the various elements to one another [11]. The alignment results are represented as a degree rather than a set of descriptions. Frequently, a quantitative approach employs the survey technique to collect data (e.g. [24] [42]).

As Schneider et al [42] contended, the richness and detail of information necessary to fully understand and apply the concept of alignment is missing in the statistical test of synergies existing among the practices. Thus, the qualitative discussion of alignment is advantageous when studying the alignment system involving a new notion. This approach can provide an intimate assessment of the extent to which the alignment construct is enacted in ways that the management actually experience it. In other words, it not only discusses what practices the informants “say”, but also how they “experience” them.

Dimension or Overall level

The second consideration is whether the discussion of alignment is on the dimension or overall level. In the studies of Cragg, King, and Hussin [13] and Hussin, King, and Cragg [19], they proposed nine items which can be used to measure alignment between the constructs of business and IT strategies. They argued that the alignment is discussed by what the results in each end and how different the results of two ends are from an overall perspective rather than splitting alignment into various parts of the nine items. In other words, the discussion of alignment can be an overall level or on the dimension level (e.g. on the nine items).

In regard to the two considerations, the framework proposed by this paper comprises four perspectives. Figure 4 shows this framework and the four perspectives.

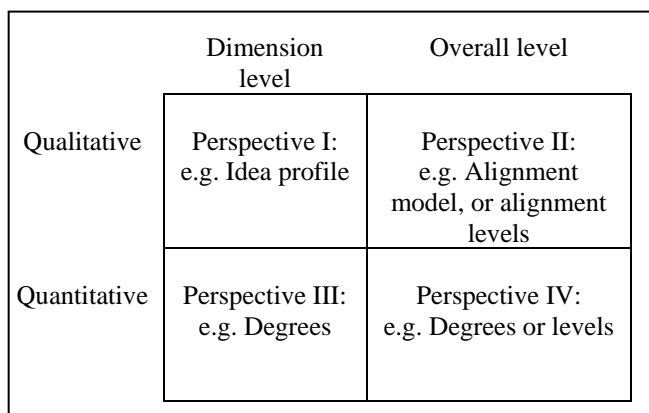


Figure 4 The proposed framework

Perspective I

When perspective I is adopted, the focus is on the qualitative discussion of alignment at the dimension level. The most common method to discuss the alignment of constructs is to create an “ideal profile”. That is, to develop a profile to match the dimension of one construct with the dimension of the other [39]. A large number of IS alignment researchers have adopted this perspective to discuss the alignment between two constructs (e.g. [3] [32] [33] [39] [40]).

Take the work proposed by Miles and Snow [33] as an example. They identified the ideal profile for matching the organizational characteristics with three typologies – Defenders, Prospectors, and Analyzers. These characteristics are summarized in Table 1.

Table 1 Ideal profile for matching organizational characteristics with business typologies (Adapted from Miles and Snow [33])

Organizational Characteristic	Defenders	Prospectors	Analyzers
Product-market strategy	Limited, stable product line, market presentation	Broad, changing product line, first in to new markets	Stable and changing product line, second in with an improved product
Research and development	Process skills, product improvement	Product design, market research	Process and product adaptation
Production	High-volume, low cost specialized processes	Flexible, adaptive equipment and processes	Project development shifting to low-cost production
Organizational structure	Functional	Divisional	Mixed project and functional matrix
Planning process	Plan, Act, Evaluate	Act, Evaluate, Plan	Evaluate, Act, Plan

As shown in Table 1, the typology and organizational characteristics represents two constructs. Those descriptions in the triangulated quadrants are the ideal profile which is used to match the specific organizational characteristics to each of the business typologies. When a company adopts one typology and has all characteristics included in the typology’s idea profile as shown in table 1, it means that the company’s characteristics are well aligned with its typology. When some company characteristics are not matched with the idea profile, it infers that some characteristics of the company are poorly aligned while the rest are well aligned.

Perspective II

When perspective II is adopted, the focus is on the qualitative discussion of alignment results at the overall level. It is to generate the alignment discussion between the two constructs overall rather than on the dimensions of the two constructs. Two methods are utilized frequently in this perspective – the discussion on the alignment levels and alignment models.

In regard to the discussion on the alignment levels, alignment researchers developed levels for discussing the alignment between two constructs. For example, Woolfe [59] proposed four stages of alignment to describe the alignment between IT plans and organizational plans: functional automation, cross-functional integration, process automation, and process transformation. Luftman [28] developed five levels to discuss the alignment maturity: initial/ad-hoc process, committed process, established focused process, improved/managed process, and optimized process. Burn and Szeto [8] also discussed the alignment between the organization and IT strategies based on five levels: failure, few benefits, better than not doing it, successful but can improve, and highly successful.

In regard to the discussion on the alignment models, the qualitative discussion on the strategic alignment model is dominant in the IS alignment literature [1] [16] [17] [29] [36] [56]. They discussed the implications of the alignment of any three of the four constructs in the model. Kerr and Jackofsky [26] also developed a contingency model which can be used to discuss the alignment between managers and organizational strategy. This was based on the assumption that organizational effectiveness is enhanced by aligning managerial talent with strategic demand.

Perspective III

When perspective III is adopted, the focus is to discuss the alignment results in the dimension level quantitatively. In other words, it is to quantify the degree of the alignment on each dimension. Pyburn [37] argued that it was important to identify whether the IS plan addressed the critical needs of the organization and in what degree. As Ball et al [2] revealed, the degree of similarity of response on the dimensions determines the degree of alignment. The degree can also be seen as a unique continuum from low to high, rather than as polarities on a single scale [53].

Perspective IV

When perspective IV is adopted, the focus is to discuss the alignment on the overall level on a quantitative basis. The researchers from this perspective quantitatively analyzed the alignment of the dimensions in the construct(s) first, and then discussed what level or type of overall alignment the results should be fit into. For example, Miles and Snow [33] first defined the degree of alignment as depending on how the alignment creates success to organizations. Then, they categorized the overall alignment into four levels:

1. Misfit: failure
2. Minimal fit: survival
3. Tight fit: excellence
4. Early, tight fit: hall of fame

Tan [47] also analyzed the degree to which IT was explicitly considered in organizations' strategy formulation first. Then, he categorized the overall alignment of IT and organizational strategy into three types: independent, supportive, and integrated. The results derived from the degree to which IT was explicitly considered in organizations' strategy formulation as being used to justify what type of IT-strategy alignment the case belongs to.

CONCLUSION

This paper has discussed three issues from the literature, which are fundamental considerations when designing an IS alignment research: the number of constructs, relationship between constructs, and alignment dimensions. However, these issues only focus on discussing the nature of alignment constructs and the relationships between them. They are not helpful for discussing the alignment results. To fill this gap, this paper proposed a framework to help those who are initiating or planning to develop IS alignment research select appropriate perspective to discuss their alignment results. This framework poses two considerations to researchers: whether the discussion of alignment is based on a qualitative or quantitative approach and whether the discussion of alignment is on the dimension or overall level. In line with these two considerations, four perspectives are identified in this framework, which are qualitative discussion on dimension, qualitative discussion on overall, quantitative discussion on dimension, and quantitative discussion on overall levels. How alignment results should be discussed when each perspective is adopted has been explained.

Several questions are posed here based on this framework, which offers plenty opportunities to conduct a series of future research projects. Firstly, is there any interrelationship between the four perspectives? As discussed earlier, the qualitative discussion of alignment is advantageous when studying the alignment constructs which involves a new notion. Therefore, should one who is exploring a new notion firstly adopt the Perspective I (Qualitative Dimension level) or Perspective II (Qualitative Overall level) to discuss alignment results? And what perspective should be adopted in the next? Secondly, what are the strengths, weaknesses, and

limitations of each perspective? Answers to these questions help IS researchers select proper perspective in order to develop more appropriate alignment research projects. Lastly, can different definitions and views on the meaning of alignment fit into this framework? And can this framework explain the reasons which cause different views on the meaning of alignment? A research project based on an extensive survey on the IS alignment literature is currently being conducted to find answers for these questions.

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EXPLORING CAREGIVERS' DESIRES FOR THEIR OLDER COUNTERPARTS TOWARD THE INFORMATION AND COMMUNICATIONS TECHNOLOGY WITH MARKET ORIENTED APPROACH

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ABSTRACT

There are many countries which suffer from high increase rate of old people population over the world. The steep increase in elderly has caused many changes and challenges, and one of the most serious and biggest challenges is caring issues. It became hard for the aged care receivers to receive caring from human caregivers, and also difficult for caregivers to take care of the aged well due to many reasons. Thus, it is time to find alternatives which can support or help caregivers' caring activities. The research focuses on exploring caregivers' intention which want to use ICT as supporter or helper of their caring. Moreover, it reveals more specific needs under different circumstances, and common values which caregivers want to receive from ICT caring services. The findings shows there are enough needs for ICT as helper or supporter for caring in the market and exploration of more specific needs and common values provides useful guideline for the ICT service providers.

INTRODUCTION

One of the hottest current issues is obviously the rapid growth of the aging population over the world. The steep increase in elderly has caused a number of challenges in our highly aged society. Among the challenges, a supporting and caring issue becomes a huge problem [2].

Traditional supports, such as caring for the health and safety of the elderly, or helping their daily life, become difficult to be received by families, like children or relatives. As society became nuclear family, there tend to be only one child of very small number of children. Decrease in number of children compared to increase in old people makes the elderly hard to receive caring from the families [4]. Moreover, even if there is enough number of families who can take care of the elderly, the families generally do not want to live with older counterparts anymore, or they can not live with them due to many reasons, such as economical problem. Thus, the elderly who can not be cared by family caregivers want to rely on paid home aide, but as the labor cost is increasing, it is also hard to receive caring services from the paid helper. Thus, it is necessary to find adequate substitutes for human care [1], [2]. The paper starts from the earlier studies which suggest Information and Communication Technology (ICT) as a useful tool to help or support human caring labor in taking care of the aged. However, the paper employs different approach from approaches of the previous researches. The previous studies were likely to develop the ICT caring technology or services by Research and Development approach without market perspectives. It can cause high possibilities that the developed technology or services are failed, because there could be not enough needs in the market or the developed technology or service do not satisfy the users' needs. Thus, market research should be done first in order to understand users' needs and values [3], [5]. Through understanding users' needs and values, ICT services as supporter or helper for caring the aged care receiver will bring high success rate of services and high customer satisfaction.

The major research questions posed by the research are: 1) To verify the existence of intentions for additional caring services which can support or help current caring activities. 2) To explore caregivers' needs for ICT as helper or supporter of current caring activities. 3) To reveal what kinds of value caregivers want to receive from using ICT for caring.

Caring Activities of Caregivers For The Aged

Caring is an activity including care health, safety or monetary aid, between care giver and care receiver. The term 'caregiver' or 'carer' is defined as someone who looks after a person who is very young, old or ill. In contrast, a 'care receiver' is described as someone who receives caring from a caregiver. In this research, care receivers are confined to the elderly, and caregivers are defined as everyone who is taking care of the elderly, including families, relatives, or paid helper.

Caregivers generally care for aging people by helping and supporting activities that the elderly cannot do well on their own. As the aged care receivers are through aging processes and confront biophysical and psychological changes, caregivers usually perform the following roles to take care of the aged care receivers: Helping daily activities, such as eating, cleaning, laundry, etc., Protecting from accidents, Checking health, Providing emotional support, for example, making a call or visiting the aged care receivers.

Thus, in the research, caring does not mean that caregivers take care of only health of the aged care receiver. It also includes other supporting or helping activities.

Following sections, study 1 and 2, are to explore and prove needs for using ICT for caring for the aged.

STUDY 1

Focus Group Interview

In this research, FGIs were performed to reveal caregivers' needs, motives, perceptions, and attitudes on using ICT as helper or supporter for caring the aged care receivers. As there are no previous researches about needs of caregivers regarding to ICT usages and ICT is not generally considered as caring helpers or supporters, qualitative research, FGI, is a good tool to reveal users' intention and needs for ICT as caring supporter or helper and to find out values or benefits which users expect to receive. The whole contents from the interviews were transcribed and videotaped. The transcriptions and videotapes were read and watched through many times by the researchers to become more familiar and have deeper understanding of contents. Seven groups of caregivers were recruited. Six participants in each group are caring for either their parents or grand parents, so they share somewhat similar caring experiences. The group age range is between twenties and forties.

Findings and Discussion

From FGI processes and results, the intentions or needs for alternatives of current caring activities and the needs for ICT as helper or supporter when caregivers take care of the aged care receivers are explored. Moreover, six hypotheses based on the specific needs are derived.

The intention for alternatives of current caring activities

FGI findings show caregivers are not satisfied with their current caring activities when they take care of the aged care receivers, and they have intentions and needs to take care of the aged care receiver more than they are doing currently. Caregivers can not take care of the aged care receiver as much as they want due to many reasons, for example, they live in very long distance, or they do not have enough time or money to take care of the aged care receivers. Thus, caregivers want to receive help or support when caring the aged in order to remove the obstacles of caring activities. However, it becomes difficult to receive help or support from human caregivers due to small number of caregivers or high labor cost. The findings derive caregivers' intentions which want to receive help or support from ICT when they are taking care of the aged care receivers.

P1: Caregivers want to take care of the aged care receivers but they can not do as much as they would like to.

P2: Caregivers want alternative which can help or support for their caring activities, and ICT is considered as the alternatives.

The needs for ICT help or support

More specific needs for ICT help or support are explored in FGI. It is found out caregivers want ICT help or support in various circumstances. Each needs is very specified, but the research reveals there are common values which caregivers demand to receive from ICT help or support.

Safety and security monitoring

Caregivers want to monitor the safety and security of the aged at home, especially the very aged or mentally impaired patient who is living alone. For example, caregivers worried the aged care receivers might cause fire due to poor operation of electronic appliances, like range or iron, or confront a thief owing to unlocked door. Caregivers want to make sure whether electronic appliances turn off or doors and windows are locked, and also wish to control them remotely for safety and security of the aged care receivers. They wish ICT help them do those jobs ubiquitously.

The value caregivers want to receive is relief by not only monitoring the safety and security of the aged care receivers but also controlling and preventing accidents in dangerous situation.

P3: Caregivers want to monitor the safety of the aged at home ubiquitously.

P3-1: Caregivers demand that ICT help them confirm the safety of the aged at home at anytime and anywhere.

Location tracking

Caregivers want to track location of the aged care receivers, especially when the aged care receivers go out alone. They wish ICT, such as Location Based Service, help them track location of the aged care receivers and prevent missing them.

The value caregivers want to receive is relief by identifying the aged care receivers' location and preventing missing them.

P4: Caregivers demand the ability to track the location of the aged, when the aged are going out alone.

P4-1: Caregivers want that ICT support them to check the location of the aged care receivers.

Health monitoring

Caregivers want to check the aged care receivers' health conditions and make sure if the care receivers are healthy or not. However, physical move to hospital with the care receivers spend not only money but also time, and it gives burden to caregivers. Caregivers demand ICT helps them examine and confirm the care receivers' health without going to a hospital. It will help them examine the aged care receivers' health more often and conveniently, and they also can prevent serious diseases.

The values caregivers want to receive are convenience by no physical move to hospital, and relief by examining and confirming the aged care receivers' health condition more often.

P5: Caregivers want to examine the care receiver's health conditions without going to a hospital.

P5-1: Caregivers demand that ICT help them check the care receiver's health without physical moving.

Emotional supporting

Caregivers want to take care of the aged care receivers emotionally by connecting with them. As caregivers communicate and connect with the aged care receivers more often, they can provide emotional supports and build and retain closer relationship

with the aged care receivers. Moreover, caregivers can update the aged care receivers' latest news through more frequent communication. Caregivers wish ICT is as connecting and communication tools.

The values caregivers want to receive are connecting by having close relationships and emotional supports, and relief by confirming no accidents to care receivers.

P6: The care giver wants to be more connected with the aged care receiver.

P6-1: Caregivers demand that ICT help them connect and have closer relationship with care receivers.

STUDY 2

Empirical Studying

Currently, surveys are conducting with 300 samples. The questionnaires are designed based on FGI findings to prove six hypotheses. As FGI findings provide the guideline for questionnaires of survey, the result will be more reliable and reflect current market situation.

Expected Findings

The six hypotheses are proved and it shows there are high positive responses which users demand to use ICT as a helper or supporter for caring the aged care receiver.

Each needs, health monitoring, location tracking, safety and security monitoring, and emotional supporting, is proved to be exist. The needs are appeared under the different circumstances, but it shows there are common values, relief, convenience, and connecting, for the different needs.

Discussion

In the study, it is proved caregivers currently can not take care of the aged care receivers as much as they want due to many reasons, so they need alternatives which can help or support their caring activities. Caregivers show positive response to use ICT as alternatives for their caring. Thus, it reveals there are enough needs for ICT as helper or supporter when caregivers take care of the aged. As the research shows caregivers' needs for ICT caring services, communication service providers are able to confirm there is enough market potential in ICT caring market.

Moreover, the paper explores more specific needs and it is found ICT can be helpful, especially when caregivers want to monitor the aged care receivers' health, confirm their safety and security, track their location, and provide emotional supporting. The needs might be satisfied with current ICT, but there are not many services or products which target to caregivers and satisfy their needs. Thus, the results provide market oriented guideline which will be helpful to develop and launch new ICT caring services or products.

Furthermore, the research also concentrates on revealing the values which caregivers want to receive ultimately. The values are found out, and these are relief, convenience, and connecting. Even if there are many needs related to ICT caring help or support, and the needs are appeared under the different circumstance, caregivers finally want to receive those three values. ICT service providers might expand and develop the services or products as long as provide those three values.

Unfortunately, there is unexpected delay in the survey, so the findings of study 2 are not proved empirically. However the survey will be completed very soon and it will support the findings of study 1.

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ERP Implementation and Cultural Issues: A case study

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ABSTRACT

Business Process Reengineering (BPR) is defined as the fundamental rethinking and radical redesign of business processes. Implementing an Enterprise Resource Planning (ERP) system involves reengineering the existing business processes to accommodate the best practices adopted by these software packages. It is also suggested that an awareness of cultural differences, both at organizational and national levels, is critical to ERP success. This paper reports on a study of BPR through ERP implementation in two Chinese medium sized manufacturing organizations. The selected organizations are the same size and have implemented the same type of ERP systems to reengineer their business processes. One of the companies is a state-owned company and the other is a private organization. The findings suggest that business processes can only reflect technical aspect from socio-technical view. Other two subsystems, human system (eg, culture, motivation, communication, willingness to change) and management system are equally important to contribute to overall organizational performance.

Keywords: Culture, ERP, BPR

INTRODUCTION

ERP systems – the Software packages

The key to the successful implementation of any ERP software package in an organization is a fit between the ERP system and the organizational processes it is there to support [1], [2]. It is important to remember that ERP systems, although promise to integrate all processes in an organization are still packaged software solutions rather than customized systems. As such, they come with built-in assumptions and procedures about organizations' business processes. The ERP assumptions and procedures, under the title of 'best practices' seldom match exactly with those of the implementing organization's existing processes [3].

ERP – The implementation

Business organizations traditionally designed their own computer systems to fit their specific organizational processes and requirements. ERP systems, although offering the option of customization, are very difficult to change to completely match existing business requirements. Basic customization means to provide the basic parameters for the system to enable the system to respond to the present organizational structure. Any change beyond the basic customization has proved to be very costly and usually result in the loss of technical support by the vendor. In fact, many researchers and practitioners have suggested that it is easier and less costly to change the business processes to match ERP systems rather than *vice versa* [4], [1]. Thus, any ERP implementation not only is a large scale software deployment exercise but it is usually accompanied by large scale organizational change [1], [2]. Consequently, a key issue in ERP implementation is how to find a match between the ERP system and an organization's business processes by appropriately customizing both the system and the organization. There have been different frameworks suggested in the past to find the best match between the ERP systems and the organizations [5],[3], [6]. A significant number of ERP implementation projects undertaken in the 1990s overran time and cost budgets. In most of these cases the reasons for overrun were often related to integrating the package with other application environments. This was not usually a technical issue but related to different applications that were never intended to collaborate. Most of these packages were and are with few exceptions designed with an inward focus. Yet many organizations deliberately chose what they referred to as 'best of breed' meaning they were choosing the modules with the most relevant functionality, little realizing that to make the modules actually work together was likely to be a major effort which in itself might compromise the functionality of each module because of a lowest common denominator effect [7]. As it was suggested by some authors eg, [3] ERP systems work on the basis of some assumptions regarding the business processes and the market in which the organization operates. Some authors suggest that ERP modules should simply be thoroughly and correctly translated into the other language such as Chinese, including user interfaces, reports, and user help files [8] for the system to be successful. Others suggest that ERP systems are designed for rule-based, mature economies rather than relation-based governance like China [9]. The adoption of ERP systems in India for example has resulted in a very painful transition and adaptation period, while the benefits have not been immediate or tangible [10], and [11]. In fact in some cases the benefits have been perceived to be much less when compared to the massive cost [12].

What most of the authors believe to play a key role in a successful implementation of an ERP systems in an Asian country is the need for business process change during the implementation of these systems eg, [13], [14].

BPR - Business process is composed of business process chain (BPC) and its associated aspects, such as resource, economic, organization, information and decision aspects. Reengineering BPC involves eliminating non-value-adding activities, making activities concurrently executed as much as possible; rethinking and redesigning supply chains [15], [16], and [17]. A key premise of ERP systems is the underlying "best practice" which reflects preferred data and process models as well as organizational structures [18]. Usually organizations redesign their business processes to cater for these reference models to take full advantages of ERP systems through BPR. Table 1 displays changes in an organization when it embarks on BPR.

These changes occur in terms of organizational structure, people’s responsibility, management systems and organizational culture.

Changes in	Traditional organization	Re-engineered organization	Organizational Elements
Organizational structure	Hierarchical	Flat	Organizational Structure; Management
Work units	Functional departments	Process teams	
Nature of work	Simple task	Multi-dimensional work	Skill
Employee roles	Controlled	Empowered	Management; Leadership; Responsibility
Managerial roles	Supervisors	Coaches	
Executive roles	Scorekeeper	Leaders	
Value system	Protective	Productive	Culture
Job preparation	Training	Education	Skill
Promotion criteria	Performance	Ability	Management
Performance Measurement	Activity (inputs)	Results (outputs)	

Table 1: Characteristics of redesigned organization (a modified version of work by 19 and 15)

Enterprise systems like any packaged information system, universally valued, it is not used in a culture vacuum. The cultural differences is suggested to contribute to a high failure rate of ERP implementation [20]. ERP systems function, as suggested by some authors such as Brehm *et al.* [3], on the basis of some assumptions regarding the business processes and the market in which the organization operates. Cultural “fit” with ERP systems might be a problem in Asia, because the reference processes model underlying most ERP systems is influenced by European or U.S. industry/business practices, which are different from those of Asian countries [21]. As organizations are encouraged to reengineer their business processes to match “best practice” in packages, there can be significant problems associated with the reengineering of local practices and processes [22]. So, an examination of the cultural differences between China and western countries is an important issue in the study of BPR and ERP. There seems to be a misfit between Chinese culture and the embodied assumptions in packaged information systems (23; and 24). For the purpose of this article, the definition of Chinese Culture refers to a society influenced by Confucius [25]. Some of the Confucian traditions include: an orthodoxy conscious tradition, a culture-conscious tradition, a morally conscious tradition, a socially conscious tradition, and a ‘this-worldly’ conscious tradition [26]. Table 2 summarizes some features of Chinese culture which conflict with the philosophy of applying IS.

Strategy Making	Using informal information and personal knowledge
Employee Empowerment	Poor employee empowerment
Information Release and Share	Selective; encourage stability and suppress message of radical; Information is personal asset of managers
Pattern of Communication	Socially-oriented and situation-centred; personal and information
Management System	Centralized
Leadership	Autocratic tendency; higher power distance
Organizational Behaviour	Individualism; Person trust

Table 2: Characteristics of Chinese Culture which is misfit with Adoption of IS [23]

In addition, Chinese culture values family connections and protecting relationships (saving face) which is one of major barriers to change in China [27]. When ERP and BPR phenomenon are examined in China, all these factors should be taken into consideration.

THEORETICAL FRAMEWORK

The adopted framework is based on contingency theory, activity theory and socio-technical theory. “Contingency theory is guided by the general orienting hypothesis that organizations whose internal features best match the demands of their environments will achieve the best adaptation” [28]. It can be used to examine interrelationships among environmental variables, organizational structure, technology and organizational performance [29]. “Fit” is an important assumption underlying contingency theory, which means that the better the “fit” among contingency variables, the better will be the performance of the organization [30]. The aim of this theory is to identify as many relevant internal and external influencing factors as possible, in order to achieve the “best fit” between the organization and the environment as long as all these elements are aligned or congruent [31]. In this study, the contingency model was used to examine the interactions and “fits” between factors of the environment, organization, ERP adoption and BPR. In the contingency model, the activity theory is to view the adoption of the ERP system as a tool to undertake BPR. Activity theory evolved from the cultural-history school of psychology [32]. The key principle is that human activity is object-oriented and is mediated by cultural means, tools and signs, and can be understood only within the context of the historically evolving society [33]. As an artefact, ERP software provides an integrated IS platform for an organization. According to Sujana *et al.*[33], artefact mediation represents “a historical

accumulation and transmission of social knowledge”. When organizations embrace ERP systems, they have to consider the difference between the embedded “social knowledge” and the assumptions of the users’ contexts.

RESEARCH METHODOLOGY

The main types of enterprises in China are state owned, private and joint venture. State owned enterprises (SoEs) are more traditional, while private and joint ventures are more modern but share some common features. The two selected companies both belong to manufacturing sector. Characteristics of research questions determine which research method should be used [34]. Case study approach is used in this research. BPR efforts are strongly related to many contextual factors and influenced by culture, so this method is appropriate to examine phenomena under its real environment [35]. According to Benbasat *et al.* [36], case study is suitable to study information systems in a natural setting. Case study could take on some types in terms of epistemology: interpretivist, positivist and combination of the two [37]. This research adopts interpretivist epistemology, which assumed that “our knowledge of reality is gained only through social constructions such as a language, consciousness, shared meanings, documents, tools and other artifacts” [38]. In this research, case study information came from documents, interviews and direct observation. Documents in the cases include ERP implementation memo, recorded transcripts of interviews on ERP and descriptions of several business processes.

The research involved collection of background information on these companies followed by interviews with the supervisors and the heads of the relevant departments in these companies. The interviews used open ended questions to collect information regarding the steps in the selected business process in each of these organizations. Then semi-structured interviews were used to collect data. The interview protocol consists of three parts: basic information about the company, ERP application in the company and BPR’s efforts.

CASE STUDY

Table 3, summarizes some general information on the two case organizations.

	MachinCO	TelCo
Industry Sector	Manufacturing (Machinery)	Manufacturing (Telecom Systems)
Ownership	SoEs	Joint
Employee	1200	4000
Turnover (2004)	US\$ 90 million	US\$ 2 billion
Employees Educational Background	Medium level (300 employees received diploma degree or above)	High level (73 % employees got bachelor degree and above)
Structure	Traditional Hierarchy	Matrix Structure or Mix of vertical and flat structure. Vertical feature is dominating.
IS adopted	PDM, ERP, KBS, MES	PDM, ERP, Purchasing systems

Table 3: Basic Information about Case Companies. PDM means product data management; KBS is knowledge base system and MES refers to manufacturing execute system.

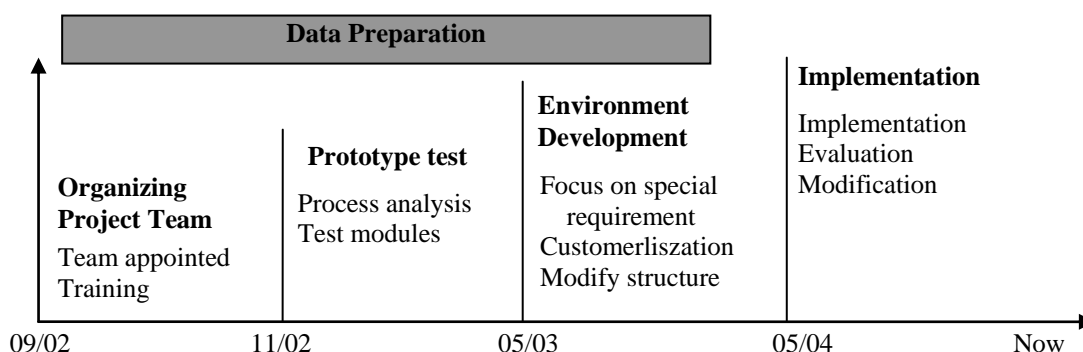


Figure 2: ERP Adoption Process in MachinCo

MachinCo through bid and case investigations of other corporations, Forth Shift ERP system was employed. Forth Shift is a brand of ERP system specialized in medium and small manufacturing enterprises in China. The enterprise applications are designed to help small to midsize manufacturing plants streamline their business processes and improve efficiency. The end result is increased profitability through reductions in overall inventory levels, higher inventory turns, faster cash collection, and improved on-time delivery performance. The adopted modules are production, storage management, purchasing, planning and order processing units. An ordinary department: information central department is charge of implementation of the system. ERP project is shown in figure 2. TelCo adopted well-known software package SAP R/3 systems. In the first stage, it

introduced MM (Material Management), SD (Sales and Distribution), PP (Production Planning), PM (Plant Maintenance), FI (Financial), CO (Controlling) and AM (Asset Management). The system integrated the four main business elements: sales, production, supply and financial. Figure 3 displays the adoption process.

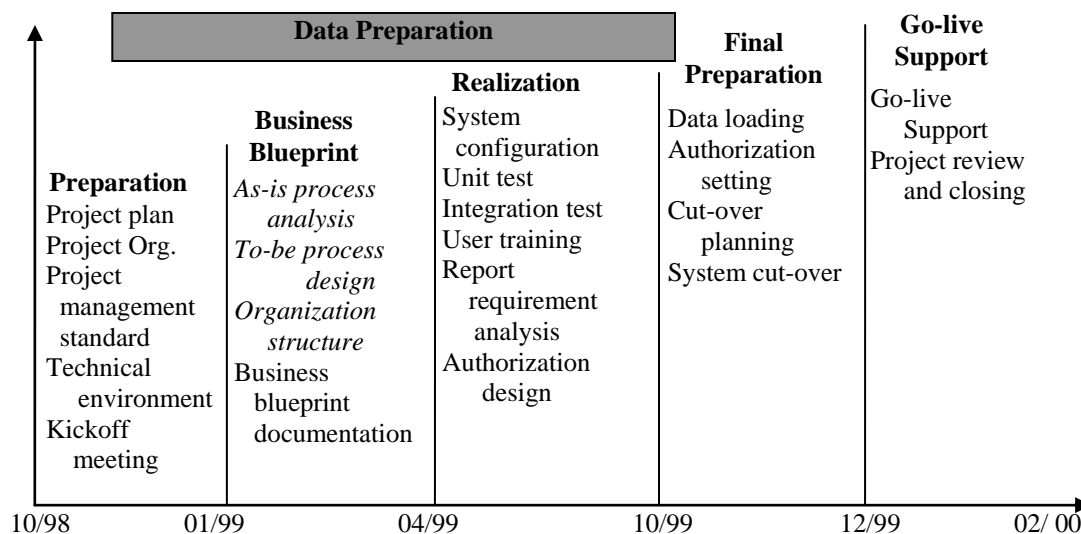


Figure 3: ERP Adoption Process in TelCo.

The business processes can only reflect technical aspect from socio-technical view. Other two subsystems, human system (culture, motivation, communication, willingness to change ect.) and management system are equally important to contribute to overall organizational performance [39].

Purchasing Process In MachinCo - The activities involved in the Purchasing process at MachineCo are displayed in Figure 4 (Appendix). The analysis focuses on steps 1 to 6 which become easier after the adoption of the ERP system because information about the required material for orders, current stocked materials and detailed data about suppliers are integrated. In step 1, the market plan is generated by the planning module of the ERP system according to the currently received orders and product stock levels. This procedure is a complex process based on scientific calculation and prediction. Every product consists of a corresponding BOM, which provides detailed data about its consisting parts and prices. However, because it is difficult to accurately predict market demand, in step 2 the plan produced by the ERP system is modified by users on the basis of their experience in the business environment. In most cases, the inaccurate prediction of market demand requires a manual change in the plan. In China, especially for SoEs, the decision-making process is highly influenced by irrational factors such as politics and “guanxi”. Consequently, most SoEs do not have accurate purchasing plans, which make it difficult for their suppliers to predict market demand. MachineCo usually relies on the personal experience of employees and informal information to predict prospective orders. For example, some managers in MachineCo have close personal relationships with the managers of its customers, from whom they can obtain some purchasing plans in advance. Other factors can also influence the change of purchasing plan. For example, if some signs indicate that the prices of raw material such as steel will increase in coming months, which could in turn cause an increase in the price of the parts, MachineCo increases its purchasing level. So step 2 mainly deals with the environmental influence on the purchasing plan. The result of step 2 is the revised market plan.

Step 3 to step 5 involve complex business rules and calculations, which are automatically conducted by the ERP system. After the revised market plan of required material is input into the ERP system in step 3, purchasing orders for different suppliers are produced automatically and immediately. Step 4 compares the revised market plan with existing stock to determine the purchasing plan. Step 5 is responsible for generating the final purchasing order to be sent to relevant suppliers. In practice, these two activities occur simultaneously in the system. When staff in the purchasing department place orders generated by the ERP system in step 5, they have to take non-technical factors into consideration to change the quantities ordered from different suppliers to some extent. For example, if a supplier’s prices are higher than others, accordingly the automatic allocation of the ordered quantity to that particular supplier by ERP system is smaller than others. However, if the supplier has a good personal relationship with MachineCo, the managers in MachineCo change the purchasing process to guarantee the desired share for the supplier. This phenomenon is common in the Chinese business environment, especially for SoEs.

The information update in step 6 occurs when the current information about material and suppliers has changed. For example, if MachineCo identifies a new supplier for a specific part or obtains a lower price for a part, then the new information has to be entered into the system to update the database. The new data has an impact on the cost calculation for relevant products which is based on the cost BOM. All these activities occur simultaneously except when some manual changes are made by users.

The ERP system relieves employees in the purchasing department of trivial and tedious tasks. As a result, employees can focus on value-adding activities such as negotiating with suppliers to reduce prices and monitoring the quality of supplied materials. In this process, the integrated database plays a crucial role in streamlining and simplifying the activities involved. The information on finance, material management, production planning and sales orders is integrated through a shared database in

the ERP system. Employees in purchasing departments have access to the shared database provided by the ERP system to place purchasing orders and make decisions.

Sales Order process in TelCo - Sales order processing in TelCo is depicted in Figure 5 (Appendix). Step 1 to step 9 occur in the marketing department between sales representatives and customers. Sales representatives need information about customers' financial status and the possible delivery schedule of ordered products. Such information is usually provided by the finance and manufacturing departments. After the sales representatives receive inquiries from customers, they check the database for information on customers. For a new customer, they create a new record in the customer database. For existing customers, they skip this step and directly check their current credit level. If a customer's financial status meets the requirements of TelCo, the representatives provide a quotation for the customer. Otherwise, the deal ends. If the two sides reach an agreement on the prices, then the next step is to consider the required product configuration. Then they confirm the delivery schedule and sign a contract. The signs "database" in the above figure refers to the shared database of the ERP system. In ERP systems, business modules such as material management (MM), production planning (PP), financial accounting (FI), and sales and distribution (SD) are integrated. Sales staff needs information about customers' financial status, current available products and possible delivery schedules. Sales staff can access all the information from the shared database in the ERP system as, shown in Figure 5 (Appendix). The "shared Database" displayed in Figure 5 (Appendix) refers to the SAP R/3 ERP system. Sales representatives are authorized to access all the relevant information involved in the order processing. After the signed contract information is confirmed in the ERP system, all the relevant data about the order such as cost and profit, are automatically and immediately generated.

In special cases, however, employees do not follow the above process. For example, if one valuable customer's current financial status does not meet the requirements of TelCo, the sales representatives should report the case to the case manager to make the final decision. Most of the customers of TelCo are its long-term business partners. In most cases, they have reached an agreement about prices and delivery schedules before they place the order. In a few cases, the customers may require non-standard products, which need the validation of feasibility in the engineering department. The above process does not reflect these variances. When TelCo determines the delivery schedule for a specific order in step 8, the purchasing process is involved, as shown in Figure 5 (Appendix). If there is no stocked material for the orders, TelCo has to purchase the essential material in which case the purchasing cycle time has an impact on the delivery schedule.

DISCUSSION

Although MachinCo and TelCo both implemented ERP systems, they achieved different outcomes. The benefits from ERP in MachinCo are not tangible. ERP just streamlines the data flow and all departments can share the real time information. TelCo's new system obviously improves decision making level, reduces the product cost and response time. For example, the cycle time of stock was reduced from 240 days to 70 days. However, the difference in organizational structure and culture, changes in business processes, motivation of adoption, management system and people contribute to this result. The following are a summary of findings of this study:

The study did not find any ERP customization problem in case organizations. ERP vendor customized the software for MachineCo to provide two quality inspection points and TelCo developed an in-house software interface to provide users in the purchasing department with authorized access to the shared database. To sum up, in most cases from the technical perspective, ERP systems are capable of supporting BPR. However, socio-cultural issues such as culture, people and management systems can enable or constrain the extent to which business processes change as suggested in the research framework. The impact of ERP adoption in business process reengineering was significantly obvious in both cases. In the purchasing process of MachineCo, the information on stock level, material, suppliers and sales orders was integrated through the ERP system with which no information exchanging and validating activities occur. Similarly, in the sales order process at TelCo, data on customers, their financial status and possible delivery schedule of ordered products were shared through SAP system. Customer inquiries can be supported with all the essential information using the unified interface. One benefit of the ERP system is to streamline the data flow for a business process.

Fundamental, radical, dramatic changes in business process are widely accepted features of BPR. However, our two case organizations who adopted ERP, did not seek to change their business processes fundamentally or radically. In MachineCo, only limited benefits were achieved. However, it was hard to describe the improvement achieved by adopting the ERP system in TelCo as "dramatic". The main focus in ERP adoption usually is on the change in organizational structure by moving from a function-oriented organization to a process-oriented organization. If the view of BPR is extended to broader aspects: values and beliefs, management, reward systems, job and structure, the changes in TelCo compared to MachineCo were more comprehensive. The obvious reason is the constraints imposed on SoEs in comparison to joint venture or private companies to undertake changes when they adopt ERP systems.

In all influencing factors, "soft elements" and their interaction play a more important role in BPR. However, the interactions could be very complex and it is impossible to state their relationship without sufficient samples. For the two cases, it seems that the ownership and motivation systems have a causal relationship with BPR. It is more difficult in SoEs to undertake BPR than in joint ventures or private companies. Observations suggest that multi-dimensional motivation systems have a more positive impact on business process reengineering than do the traditional single department-based assessment and reward systems. Seeking the causal relationships between these factors through quantitative study could be the direction of future research. When restructuring the business process, the content of jobs and of organisational structures changes for all employees. Changing jobs and structures require changes in management principles and performance measurement systems. These new management principles and performance measurement systems induce change in values and beliefs, which in turn

enable the new business processes. Consequently, as it has been suggested by different authors (e.g. 40) reengineering is not complete until all elements of the business system diamond have been changed and aligned.

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APPENDIX

Figure 4: The Purchasing Process in MachineCo.

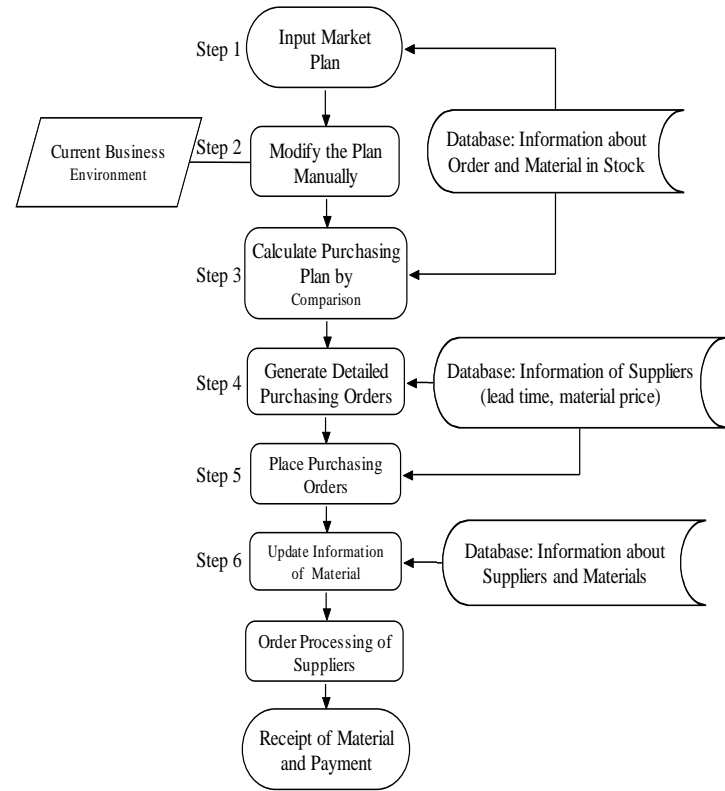
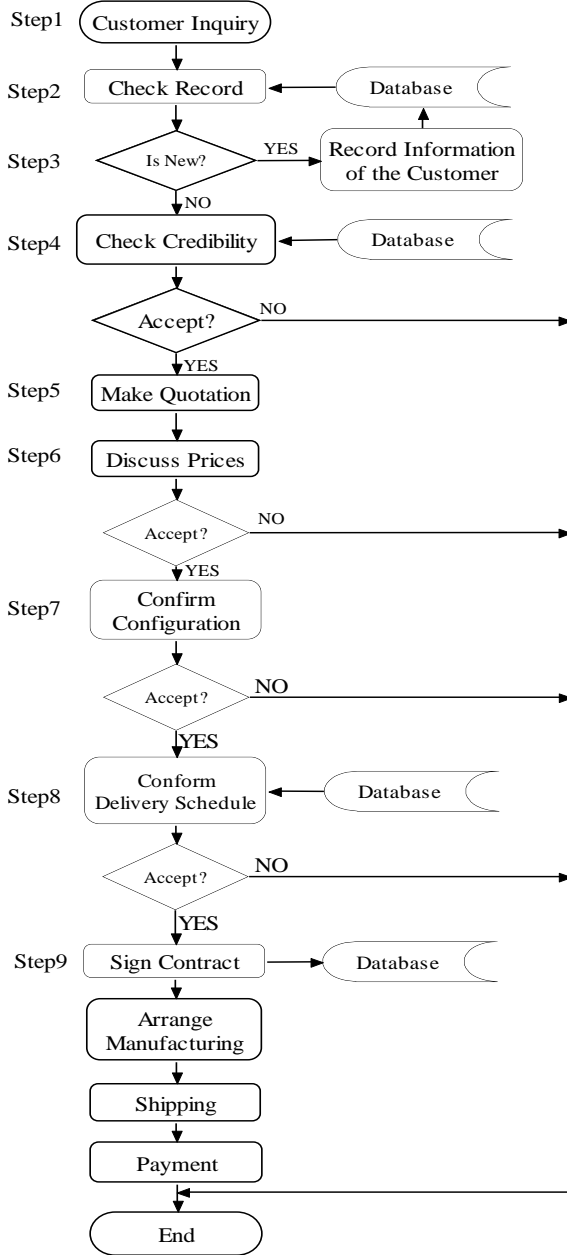


Figure 5: The Shared Information at TelCo.

SUMMARY OF A TOPICAL FORUM FAQ BASED ON THE CHINESE COMPOSITION STRUCTURE

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ABSTRACT

An automatic multiple-document summarization system for producing frequently asked questions (FAQ) of a topical forum can save forum Webmasters a great deal of time in theory. This work will address summary composition issue of a previous work by proposing a structured presentation based on a four-part pattern of traditional Chinese articles. The result of the experiment shows that the enhanced system with both domain-terminology corpus methods produced a significantly better summary presentation than the original system. Recall rate and precision rate performance indices and user evaluations are also presented and discussed to show their practical implications.

Keywords: Chinese composition structure, FAQ, presentation, summarization, topical forum.

INTRODUCTION

From the perspective of knowledge management, the long existing Frequently Asked Questions (FAQ) has been a common knowledge sharing format used in Internet newsgroups, bulletin boards, forums, and virtual communities. An FAQ is usually maintained by a Webmaster who manually summarizes the frequently asked topics from related articles into static question-and-answer format for easy access by its members. To take the advantage of the text summarization technologies for implementing useful application, Tao et al. [9] proposed a conceptual model for automatically transforming topical forum articles into FAQ summary, and empirically demonstrated the acceptability of this model via a prototype system. Their experiment implied the time and manpower savings in producing FAQ and illustrated the technical feasibility of such a model.

而這樣的過程就稱為正規化動作	(第11篇文章, 第3句) (過程, 稱為, 動作)
正規化不僅限於關聯式檔案	(第13篇文章, 第4句) (限於, 關聯, 檔案)
也是索引檔常見的設計方式	(第13篇文章, 第5句) (索引, 常見, 設計, 方式)
正規化就是捨棄重複群組	(第13篇文章, 第9句) (捨棄, 重複)
消除部分相依的複合索引鍵	(第13篇文章, 第11句) (消除, 部分, 相依, 索引)
定義	(第14篇文章, 第8句) (定義)
一方面節省儲存空間	(第14篇文章, 第9句) (節省, 儲存, 空間)
藉由程序方式解決以上可能發生的問題	(第14篇文章, 第10句) (程序, 方式, 解決, 以上, 發生, 問題)
刪除	(第14篇文章, 第18句) (刪除)
在這分配的過程中	(第15篇文章, 第5句) (分配, 過程)
且降低儲存空間的使用量	(第15篇文章, 第12句) (降低, 儲存, 空間, 使用)
以決定關聯表應該擁有哪些屬性	(第16篇文章, 第1句) (決定, 關聯, 擁有, 屬性)
其目的是建立良好結構關聯表Well	(第16篇文章, 第2句) (建立, 良好, 結構, 關聯, 其目的)
去除重複性Eliminating Redundancy	(第16篇文章, 第13句) (去除, 重複, 性Eliminating)
這是因為將不應該放在同一個關聯表的屬性拆放或硬置於同一個關聯表	(第16篇文章, 第26句) (屬性, 拆放, 關聯)
稱為非正規化型式Unnormalized Form關聯表	(第16篇文章, 第29句) (稱為, 型式, 關聯)
以期達到提高查詢的速度	(第18篇文章, 第5句) (達到, 提高, 查詢, 速度)
因為存放重複的訊息	(第19篇文章, 第7句) (存放, 重複, 訊息)
利用功能相依性以及主鍵來達到減少儲存空間	(第21篇文章, 第1句) (利用, 功能, 相依, 達到, 減少, 儲存, 空間)
不合正規化的關聯無法通過正規化檢查	(第21篇文章, 第3句) (關聯, 通過, 檢查)
必須設法拆解成更小的關聯	(第21篇文章, 第4句) (設法, 拆解, 關聯)

Figure 1. Summary ordered by article and sentence sequences

Unlike news or technical papers, Internet forum articles often suffer from short, unstructured, and even incomplete article content; incomplete format of sentences or paragraphs; and divergent concepts across multiple response articles of a specific original posting. Therefore, Tao et al.'s [9] model and prototype system adopted the simple extraction approach to produce a generic summary. Two issues are worth of concern. The first is that the summary was not presented as a typical article structure familiar to its readers. Specifically, the sentences were redundant and presented based only on the posting order of their corresponding articles without any further treatment for better readability. Another issue is that domain terminologies were not extracted appropriately. This is due to the prototype system which extracted important sentences from multiple articles by

comparing the Chinese character combinations to the Chinese Electronic Dictionary (CED) developed by the Computational Linguistics Society of R.O.C. Although CED contains 80 thousand Chinese word combinations, special domain jargons or terminologies are not covered. This issue has been addressed in the work of Tao et al. [10] and must be integrated into the FAQ summarization model and prototype system.

In order to improve the readability of FAQ summary presentation, this study intends to enhance the summary presentation module which currently arranges the extracted sentences in the posting order of articles and then their corresponding sentence as shown in Figure 1. Extracted sentences are in the first column, while the second column lists the article and the sentence numbers with the keywords. Notice that the sentences are grouped by article and are separated by blank spaces. Ideally speaking, the summary should have a fixed structure like an ordinary article in addition to the hyperlinks of keywords and their source articles as seen in commercial software [2]. As shown in Figure 2, the summary would be more readable with a conventional article structure, which will in turn efficiently save the reader's time in understanding the summary and linking it to the original article if needed. Although the article will not be like a human written article, in particular, the sentences look more like phrases which according to Ueda et al. [11] were effective, Figure 2 did reduce the redundant sentences by clustering sentences and mimicking a human writing as much as possible. As compared to Figure 1, Figure 2 does have a potential to achieve what this study is aiming for.

主題討論區FAQ摘要	
討論主題	為何要正規化，其目的、重要性為何？
關鍵字	正規化、目的、重要性
摘要句子內容 (多文件摘要)	
	forum topic
	「起」關鍵字
既稱為正規化 (Normalization)	(正規化, 稱為)
正規化的定義	(定義, 正規化)
正規化是必經過程	(經過, 正規化)
正規化的重要性	(重要性, 正規化)
正規化的目的	(目的, 正規化)
因為沒有使用正規化	(正規化, 使用)
透過正規化	(正規化, 透過)
不要因為過度正規化	(正規化)
重要性	(重要性)
目的	(目的)
	body and sub-theme
	「承轉」關鍵字
	概念 1
正規化原因與目的	(目的, 原因, 正規化, 何在)
正規化的目的何在	(目的)
而正規化的目的就是要去避免這些問題	(問題, 這些, 避免, 目的, 正規化)
	概念 2
	概念 3
重要性資料正規化可以看成關聯網要的分析的過程	(過程, 分析, 網要, 關聯網要, 看成, 正規化, 資料, 重要性)
	概念 4
資料透過正規化後	(正規化, 透過, 資料)
	keywords

Figure 2. Summary ordered by intended article structure

To address the problem described above, this research aims to enhance Tao et al.'s [9] FAQ presentation model together with the domain terminology extraction module addressed in the work of Tao et al. [10]. With the domain terminology extraction module, those keywords not covered by the CED will be retained. Most importantly, the final FAQ summary generation will be structured more toward human-writing logic. Ideally, the informative level and readability of the FAQ summary will be significantly improved, which can be judged by subjective and objective indices in a comparative experiment. Due to limitation in page length, the background information is not included, and the suggested FAQ presentation module is instead presented next.

FAQ PRESENTATION MODULE

Basic Principle

News and academic papers have specific structures. For instance, the typical academic paper has an introduction, literature review, research methods, data analysis, and conclusions [5]. When generating the summary, the heading can be used to differentiate the segment to which a sentence belongs, which makes the summary presentation apt with the format of the original article's structure. However, forum articles may not have a formal structure due to their chatting nature. Therefore, this study attempts to introduce a formal article structure for the FAQ summary to match.

Unlike the linear development of English writing, traditional Chinese writing presents a spiral pattern [4]. In parallel to the typical five-paragraph organization in English articles, the most common Chinese article organization is a four-part pattern of introduction-body-related or contrasting sub theme-conclusion, where contrasting is often treated as irrelevant to the subject [7]. Simply put, the introduction (I) breaks the topic into first sentences to attract the readers' interest, the body (B) supports and elaborates the theme, the related or contrasting sub theme (S) makes a logical turn using positive or negative examples, and conclusion (C) closes the article. Accordingly, this study intends to match this traditional IBSC structure to represent the

summary using the extracted sentences. As shown in Figure 3, the left-hand side is the desirable article structure which links those article sentences on its right.

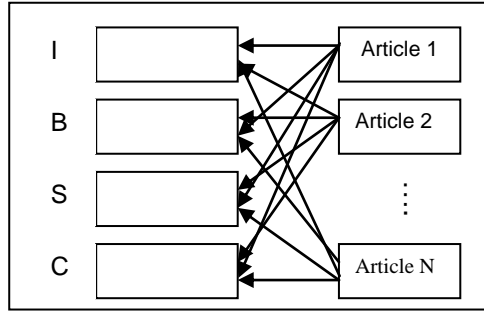


Figure 3. Summary structure with matched sentences

Observations of Forum Articles

To realize the article sentences matching the proposed Chinese four-part article structure, this study randomly selected three forums from representative forums on the Internet. These are the Blue ship, Java technology, and Smart creative teacher forums. Two situations were found from observing the articles on these three forums. First, majority of the articles have three categories of content, including topical content, extended topics from the topical content, and new topical content with no correlations to the topical content. We only considered the first two categories since the extended topical contents provide the depth of the summary related to the topical content. Second, 100 articles from three forums were selected for matching the pattern of IBSC. Not every forum article has the complete structure as we expected based on statistics: 12.66% have IBSC, 30.66% have IBS, 51% have BS, and 5.66% have C.

Summary Structure

Based on the observed types of article structure from representative forums, we know that over 50% have the B&S-part, which are difficult to distinguish and simultaneously coexist at the ratio of 94.34%. Meanwhile, as compared to the technical article structure [5] of previous knowledge, content, method and results, I-part is equivalent to content, B&S-part is equivalent to method, and C-part is equivalent to the results. Forum articles have a unique characteristic of divergence in which the replied articles of a topic may extend to new topic that usually occur while explaining the main subject. This happens in the B&S-part, and all the sentences in a new topic express the same concept [1]. Therefore, we need to group sentences into homogeneous topics for obtaining the B&S-part in the summary. Meanwhile, the sentences within each group need to be ranked based on their similarities to their common topic. In relation to this, Song et al. [8] indicated two summary generation approaches using either a set of main sentences from each cluster or using a representative cluster. In this study, the summary generation for fitting to I, BS, and C parts is taking one sentence from each concept first, and then repeating the process until the limit of compression rate restriction is reached. The C-part can select one sentence from the B&S-part as its conclusion. These C-part sentences are ordered according to their pre-determined topics. As for the I-part, it should contain sentences that are closely related to the topical sentences in the posting articles for matching the idea of breaking the article.

Process Design

To formalize the process of matching the sentences to the proposed summary structure, this study intuitively adopts sentence similarity as the basis to describe the representation algorithm as see. According to Zhang et al. [12], issues such as anti-redundancy and cohesion and coherence become critical in MDS, and current MDS systems often apply a two-phase process, namely, topic identification and summary generation. Therefore, we need to first cluster the sentences with similar concepts for the purpose of sentence grouping. At the same time, there is a need to eliminate sentences with similar semantics in the same group:

Calculate similarity between sentences

If the similarity value is larger than α_1 , merge two sentences into the same group. The calculation is as expressed in Formula 1, where the α_1 value ranges between 0 and 1 and is given by its users.

$$\text{Sim}(S_i, S_j) = \frac{S_i \cap S_j}{S_i \cup S_j} \quad i \neq j \quad (1)$$

In Formula 1, S_i is the i th sentence among all sentences, and $i=1, \dots, N$; S_j is similar to S_i ; N is the number of total sentences; $S_i \cap S_j$ contains the number of the same keywords in S_i and S_j ; $S_i \cup S_j$ contains the number of all keywords within S_i and S_j .

Delete similar sentences within the same group

When the similarity value between two sentences is larger than α_2 , delete the shorter sentence. α_2 is a value between 0 and 1 and is given by its users.

After clustering the selected sentences into groups, induced rules are applied to each group for classifying the sentences into the

three-part pattern as follows:

I-part

Since it is highly correlated to the topic article, the rule considers the similarity between the sentences and the topic sentence of the posting forum article. The similarity formula is as shown in Formula 2. When a sentence has a similarity value greater than β , classify it into the I-part set and order them by similarity value. The β value is given by the users and is a real number between 0 and 1.

$$\text{Sim}(\text{Topic}, C_{kj}) = \frac{\text{Topic} \cap C_{kj}}{\text{Topic} \cup C_{kj}} \quad (2)$$

In Formula 2, C_{kj} is the j th sentence in the k th topical forum article, k and j are positive integers; $\text{Topic} \cap C_{kj}$ is the number of identical keywords within the *Topical sentence* and C_{kj} ; $\text{Topic} \cup C_{kj}$ is the number of all keywords within the *Topical sentence* and C_{kj} .

B&S-part

Calculate the similarity level between all sentences in one group and the sentences in the posting article. When the similarity level between a group and the topical article is larger than γ , retain this group. Only the retained groups are used for composing the B&S-part. Again, these groups appear in the summary according to their similarity levels from high to low [1], and so are the sentences within each group. The group similarity is calculated according to Formula 3.

$$\sum_{i=1}^n \sum_{j=1}^m \text{Sim}(O_i, C_{kj}) = \sum_{i=1}^n \sum_{j=1}^m \frac{O_i \cap C_{kj}}{O_i \cup C_{kj}} \quad (3)$$

In Formula 3, O_i is the i th sentence in the original posting article; C_{kj} is the j th sentence in group k ; $O_i \cap C_{kj}$ is the number of identical keywords in O_i , and C_{kj} ; $O_i \cap C_{kj}$ is the number of keywords in O_i and C_k .

The similarity within a group is calculated as seen in Formula 4.

$$\frac{\sum_{b=1}^r \text{Sim}(C_{ka}, C_{kb})}{r}, \quad a \neq b \quad (4)$$

In Formula 4, k is the number of topics; r is the number of sentences in group k ; C_{ka} is the a th sentence in the k th group; C_{kb} is the b th sentence in the k th group; $\text{Sim}(C_{ka}, C_{kb})$ is the similarity value of sentences C_{ka} and C_{kb} .

C-part

One sentence from each group is selected as a conclusion drawn from the B&S-part in the C-part. That is, the keywords must coexist within both the B&S-part and the C-part. Therefore, the sentence with the highest similarity value is usually selected to be included in the conclusion. However, to avoid high similarity due to a long sentence with more keywords than shorter ones, the reciprocal of the sentence length is also used together with the similarity value to select the sentence to be included in the C-part, as seen in Formula 5. As in the previous one, the order is the same as that which appeared in the B&S-part for consistency.

$$\text{Score}(C_{ka}) = W_1 \times \frac{1}{\text{Length}(C_{ka})} + W_2 \times \frac{\sum_{b=1}^r \text{Sim}(C_{ka}, C_{kb})}{r} \quad (5)$$

In Formula 5, $a \neq b$; W_1 is the weight of the sentence length; W_2 is the weight of the similarity value; $\text{Score}(C_{ka})$ is between 0 and 1 when $W_1=0.5$ and $W_2=0.5$; $\text{Length}(C_{ja})$ is the length of C_{ja} ; K is the number of topics; r is the number of total sentences in group k ; C_{ka} is the a th sentence in group k ; C_{kb} is the b th sentence in group k ; $\text{Sim}(C_{ka}, C_{kb})$ is the similarity between sentences C_{ka} and C_{kb} .

RESEARCH DESIGN

Sample Source

The forum articles were collected from the Internet forums related to ‘‘Database.’’ Among the 390 articles, 300 articles were randomly taken as the training corpus base, and 90 articles were used in the experiment. The 90 articles were divided into three topics, each with 30 articles. The topics are ‘‘The purpose and importance of normalization’’, ‘‘How to map the ER model to the relational model’’, and ‘‘How to build the ER model and its requirements.’’

Summary Presentation

From an application-oriented perspective, the goal is to evaluate and compare the summary presentations between the raw method used in the work of Tao et al. [9] and the proposed method of the four-part pattern approach without comparing them with different advanced summarization presentation methods. This study also applies the domain-terminology module that

includes two approaches based on statistics and genetic algorithm (GA), respectively [10]. To avoid mistakes and increase effectiveness, a pretest was conducted before the formal experiment. The pretest was conducted by three student evaluators. They manually clustered the sentences of 10 articles from the forum topic of “How to update databases in two IP addresses.” There were two sets of hurdle values for deleting sentences. The first parameter value was 1 that indicated only deleting a similarity level of 1, while the second value was 0.65 for deleting sentences with a similarity level greater than 0.65. However, only when at least two out of the three evaluators agreed on the assigned similarity level were the sentences deleted. Three evaluators unanimously agreed that the summary was better when the 0.65 value was used as the hurdle value for deleting sentences.

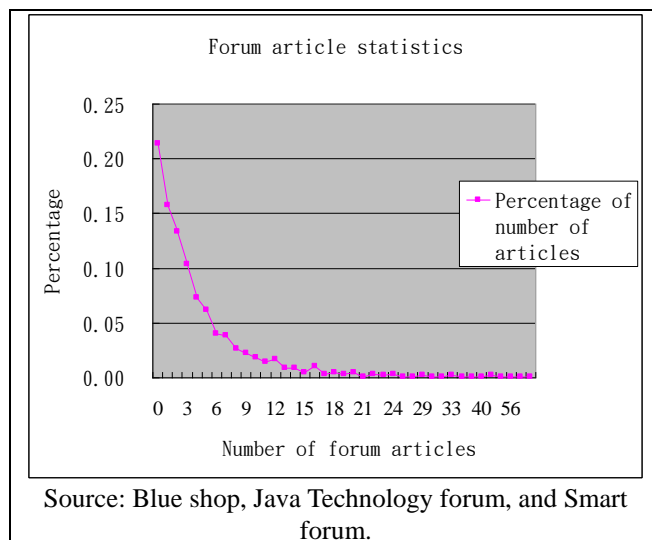


Figure 4. Percentages of number of forum articles

The experiment was divided into three groups, one control group and two experimental groups. The control group (CG) adopted Tao et al.’s [9] FAQ automatic summary system, while the experimental group 1 (EG1) adopted the proposed presentation method with the GA domain-terminology module. The experimental group 2 (EG2) was the same but with the statistical-base domain-terminology module.

Topical articles were randomly selected from the representative forums which again are Blue shop, Java Technology forum, and Smart forum. Based on the articles available on the Internet, some statistics were calculated as shown in Figure 4. Generally speaking, the number of articles can be roughly grouped into low (10), medium (20), and high (over 30). These three levels of article number were adopted in this experiment. Based on three forum topics and three groups of article size, 27 student evaluators were selected from the Graduate Institute in Information Management at a National University of Science and Technology in Taiwan. Like in the pretest, three evaluators worked as a group for one combination of the topic and article size (3 x 3 = 9 groups). The process is briefly described as follows: every evaluator reads through the assigned articles printed on paper, and selects sentences highly related to the topical article. After this paper-based selection step, each evaluator reads the summary automatically generated by the prototype system developed by this study. The evaluators were requested to evaluate the summary, the logical connection of the sentences, length of the summary, its effectiveness, and summary structure. The data collected from these 27 evaluators were used in the analyses.

RESULTS

The objective experimental analysis was conducted based on the criteria of compression rate, recall rate, and precision rate, while the subjective experimental analysis was based on user acceptance.

Objective Experimental Results

This part of the experiment was to compare the recall rate (RR) and precision rate (PR) under different compression rates for three different article sizes. The results are summarized in Table 1. A few observations are discussed as follows:

From the compression-rate perspective, the recall and precision rates of the two experimental groups are very close under the compression rates of 10%, 20%, and 30%. As can be seen in Table 1(a), experiment groups have stable precision rates at different compression rates. For example, EG2 has a precision rate of 32% and a recall rate of 40% under the 10% compression rate, 34% and 40% under the 20% compression rate, and 34% and 30% under the 30% compression rate. On the other hand, the recall and precision rates of the control group vary at different compression rates. As the compression rate increases, the recall rate also increases, and vice versa. On the second topical forum of the control group, the precision and recall rates are 10% and 12% at 10% compression. Similarly, they are 6% and 16% under the 20% compression, and 6% and 24% under the 30% compression. Therefore, these experimental groups demonstrated stable recall and precision rates despite the compression rate. Generally speaking, the recall and precision rates of the two experimental groups were higher than those of the control groups. Based on the data, EG 2 performed the best, then EG1 the second, and CG the last. One exception did occur at topical forum 3. An in-depth

examination of the data revealed that the forum articles presented sentences in either paragraphs or listings. While the first two topics have sentences in paragraph format, the third topic also has sentences in listing format.

Table 1. Comparison of the objective performance

(a) Low volume								(b) Medium volume								(c) High volume							
Topic	Comp	CG		EG1		EG2		Topic	Com.	CR		EG1		EG2		Topic	Com.	CR		EG1		EG2	
		RR	PR	RR	PR	RR	PR			RR	PR	RR	PR	RR	PR			RR	PR	RR	PR		
1	10	23	16	23	30	23	36	1	10	11	10	16	21	16	21	1	10	10	9	31	38	31	30
	20	41	14	23	30	23	30		20	16	7	16	21	16	20		20	18	8	31	38	31	30
	30	52	12	23	30	23	30		30	24	8	16	21	16	20		30	22	6	31	38	31	30
2	10	12	10	40	34	40	32	2	10	5	8	13	22	13	22	2	10	16	12	24	19	22	22
	20	16	6	61	27	44	34		20	8	6	23	22	14	23		20	24	9	29	15	29	26
	30	24	6	61	28	44	34		30	14	7	25	24	16	24		30	32	7	29	15	29	25
3	10	27	16	13	36	17	41	3	10	18	16	8	33	8	33	3	10	24	12	17	29	17	27
	20	31	6	13	36	17	41		20	26	15	8	33	8	33		20	29	7	17	28	17	27
	30	34	6	13	36	17	41		30	33	11	8	33	8	33		30	33	5	17	28	17	27

Note: 1. CG=Control Group, EG1=Experiment Group 1, EG2=Experiment Group 2
 2. Unit is % for CR, CG, EG1, and EG2.

The evaluators selected partial sentences from the paragraphs, and the whole sentences in the listing. Therefore, the number of sentences in the first two topics had a larger number of sentences. These large numbers also served as the numerator of the recall rate, which therefore made the recall rate a smaller number in the first two topics. Different types of forum articles should have different summary structures. This study suggests that when the articles are in normal paragraph format, the proposed four-part article structure should be used. The listing format of articles may be better with the original summary structure used in the work of Tao et al. [9], which is by the article order and then the sentence order of the original postings.

The recall and precision rates do not change according to the number of articles and sentences. In our data, the numbers of sentences ranged from 15-18 to more than 25 per article in different forum topics. Also, Table 1 shows that the recall and precision rates did not change with the changes in the numbers of articles in either the control group or the experimental groups. Take the control group for example; the recall rates have the highest values at the high volume of articles, while they were the lowest at the medium volume of articles. The precision rate was worst when at the medium volume of all compression rates, while it was best under a high volume at 10% compression, and under a low volume at 20% and 30% compression cases. Therefore, the performance of recall and precision rates will not be affected with the number of articles and sentences. The recall and precision rates are between 10% and 30% for all the cases in this experiment, which are relatively lower compared with the 40% to 50% in the literature. The main reason for such below average performance could be due to the article structure of the Internet forum which is simply not structural and consistent as the Internet news that has a formal recognizable structure shared by writers and readers.

Subjective Experimental Results

The criteria for subjective evaluation were based on the users’ acceptance on the summary result as well as the interface support. Therefore, the analyses are divided into the summary results and system interface.

Summary results

The evaluation was done based on users’ opinion on the indication, readability, appropriate number of sentences, and structure of the summary. The results are shown on Table 2 for the comparison between the control group and two experimental groups by the number of articles and compression rate. The general observation from the data is that the performance of the experimental groups was better than that of the control group in all the criteria. Among the two experimental groups, EG2 performed better than EG1. For example, under the 30% compression rate, the average scores of indication, readability, appropriate number of sentences, and structure of the summary are 3.11, 2.33, 2.11, and 2.88 for CG, while they are 3.55, 3.33, 4, and 4 for EG1, and 4.22, 3.88, 4.33, and 4.33 for EG2. Under the 10% compression, the averages are again 2.78, 2, 2.11, and 2.78 for CG, while the averages are 3.11, 3.22, 3.11, and 3.11 for the EG1, and 3.11, 3.44, 3.66, and 3.66 for EG2. These two cases confirmed what is concluded earlier that EG2 is better than EG1, which in turn is better than CG. In other words, adding the domain-terminology module and enhanced summary presentation module did prove to be positively perceived by the users. This means that the method of the four-part structure proposed by this study was more acceptable than presenting the summary in the original order of the articles and sentences as in the work of Tao et al. [9]. Furthermore, this experiment also confirmed that statistical-based domain terminology extraction performed better than GA-based terminology extraction in terms of users’ perception.

Table 2. Comparison of system interface

(a) Low volume					(b) Medium volume					(c) High volume				
Item	CR	CG	EG1	EG2	Item	CR	CG	EG1	EG2	Item	CR	CG	EG1	EG2
Indication	10	2.78	3.11	3.11	Indication	10	2.77	3.00	3.00	Indication	10	2.00	3.11	3.33
	20	3.10	3.44	3.44		20	2.77	3.33	3.33		20	2.66	3.33	3.55
	30	3.11	3.55	3.22		30	2.55	3.44	3.11		30	3.00	3.55	3.77
Readability	10	2.10	3.22	3.44	Readability	10	2.66	3.00	2.88	Readability	10	2.22	2.88	3.00
	20	1.40	3.66	3.44		20	2.88	3.55	3.44		20	2.88	3.55	3.55
	30	2.33	3.33	3.88		30	3.11	3.33	3.55		30	3.00	3.55	3.55
Appropriate number of articles	10	2.11	3.11	3.66	Appropriate number of articles	10	2.44	3.11	3.22	Appropriate number of articles	10	2.22	3.00	3.11
	20	1.60	3.6	3.88		20	2.88	3.22	3.22		20	2.33	3.11	3.11
	30	2.11	4.00	4.33		30	3.11	3.44	3.33		30	2.77	3.44	3.33
Structure	10	2.78	3.11	3.66	Structure	10	3.00	2.66	3.00	Structure	10	2.22	2.88	3.11
	20	2.40	3.66	3.8		20	3.00	3.22	3.55		20	2.33	3.00	3.11
	30	2.88	4.00	4.33		30	3.00	3.33	3.22		30	2.55	3.22	3.44

Note: 1. CG=Control Group, EG1=Experiment Group 1, EG2=Experiment Group 2
 2. Unit is % for CR, CG, CG1, and EG2.

System interface evaluation

This part mainly assessed whether the users perceived better while browsing the FAQ summary via the interface functions such as keywords and hyperlinks to original articles, or whether the users understood the FAQ better as shown in Table 3. The detailed results of the system interface are summarized in Table 4. Within CG in (a), 59.3% of them agree and extremely agree on the “Hyperlink” function, 44.5% of them agree and extremely agree on the “Keyword indication”, 55.6% of them agree and extremely agree on “Keywords highlighted in summary”, and 55.5% of them show medium agreement on “Summary format.” Similarly, within EG1 in (b), 63% of them agree and extremely agree on the “Hyperlink” function, 70.4% of them agree and extremely agree on the “Keyword indication”, 59.3% of them agree and extremely agree on “Keywords highlighted in summary”, and 63% of them agree and extremely agree on “Summary format.” Finally, within CG2 in (c), 70.4% of them agree and extremely agree on the “Hyperlink” function, 77.8% of them agree and extremely agree on the “Keyword indication”, 63% of them agree and extremely agree on “Keywords highlighted in summary”, and 63% of them agree and extremely agree on “Summary format.” Overall, the two experimental groups had higher satisfaction levels than the control group on the four criteria. Again, EG2 had higher levels than EG1.

Table 3. System interface

Item	Question	CG	EG1	EG2
Usability of the Interface	Hyperlinks can effectively assist a user understand the content of the forum topic	3.44*	3.74	3.74
	Keyword indication can effectively assist a user understand the content of the forum topic	3.22	3.7	3.74
	Keywords in the summary can effectively assist a user understand the content of the forum topic	3.44	3.63	3.59
	The format of summary can clearly present the content of the summary	3.33	3.67	3.67

Note: 1. CG=Control Group, EG1=Experiment Group 1, EG2=Experiment Group 2
 *. Average scores based on 5-point Likert-scale ranging from 0(very disagree) to 5 (Very agree)

In addition to the above analyses, we compared the experimental groups to the control group using the articles in a forum topic of “The purpose and importance of normalization.” Under 20% compression, the differences are summarized as follows. The number of sentences in EG2 is 39, much less than the 112 in CG. This naturally lowered the readers’ load. The structure of the summary under control group 2 was based on the I-B&S-C order as shown in Figures 3, in which the right-hand side labels these four parts in order for readers to clearly recognize these different concepts in a normal Chinese composition. The summary structure of CG, as seen in Figure 1, was based on the posting order of the articles and their sentences. The user benefit can be illustrated using a simple example: the control group had to locate the sentences with the same concept in different parts of the

summary, such as in Figure 1, that “減少儲存空間 (reducing the storage space)” was separated in the 22nd sentences in the 3rd article and the 9th sentence in the 14th article. On its counterpart in experimental group 2, as seen in Figure 2, “減少儲存空間 (reducing the storage)” was grouped together for users’ convenience. Based on the above comparison, it is clear that the concept-based four-part structure did present a concise and clear summary structure for its readers.

Table 4. Comparison of subjective performance

Acceptance	(a) CG				(b) EG1				(c) EG 2			
	Hyperlink	Keyword indication	Summary keywords	Summary format	Hyperlink	Keyword indication	Summary keywords	Summary format	Hyperlink	Keyword indication	Summary keywords	Summary format
Extremely disagree and disagree	14.8	25.9	11.1	7.4	3.7	0	3.7	0	0	3.7	3.7	0
Average	25.9	29.6	33.3	55.5	33.3	29.6	37.0	37.0	29.6	18.5	33.3	37.0
Extremely agree and agree	59.3	44.5	55.6	37.1	63.0	70.4	59.3	63.0	70.4	77.8	63.0	63.0
Total	100	100	100	100	100	100	100	100	100	100	100	100

Note: 1. CG=Control Group, EG1=Experiment Group 1, EG2=Experiment Group 2
2. Unit is % for CR, CG, CG1, and EG2.

CONCLUSIONS

This study proposed using the Chinese composition structure for improving the summary presentation of an automatic Internet forum FAQ system by Tao et al. [9]. Based on the objective evaluations, the comparative experiment results demonstrated that the recall and precision rates increased under different article volumes and compression rates. Moreover, they become stabilized without being affected by the compression rate due to redundant reduction via the clustering of similar concepts of sentences. Also, the statistical-based method for extracting domain terminology seemed to work better than the GA-based method with our sample data. On the counterpart of the subjective evaluation, the users perceived better on the criteria of indication, readability, appropriate number of sentences, and structure in the FAQ system. Based on our experiment, this study suggests the use of the proposed summary presentation module for the topic forum with paragraph-based articles in order to reduce the repeats of the summary content, and the original summary presentation module [9] for listing the style of articles in order to maintain the summary integrity at the cost of higher repeats. To further improve the usability of the FAQ summary presentation, one immediate future work should delve on the use of a complete sentence from the original article instead of partial sentences for better readability. Another one would be to apply this Chinese composition structure to non-Chinese text summarization cases for possible generalized applications. Also, despite the necessary analysis being too immature or computationally intensive [3], other techniques and methods in extraction or abstraction approaches [1] can be used to further enhance the coherence of the multiple-article FAQ summary.

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THE ROLE OF PROCESS KNOWLEDGE IN A BUSINESS PROCESS IMPROVEMENT METHODOLOGY

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ABSTRACT

The newly established holistic approach to BPM (Business Process Management) has led to increased recognition of the knowledge and experience people develop, use and share while modelling, executing and improving their business processes. However, this knowledge perspective is often neglected by the current BP improvement methodologies. Our empirical research confirms that business process improvement is, in fact, a complex, knowledge-intensive, collaborative process that consists of a set of coordinated, contextualised knowledge management processes. This paper describes the results of our on-going research project that, among other things, aims to investigate the role of individual and collective process knowledge developed and used in a business process improvement methodology deployed in a real-life, complex organization.

Keywords: Process knowledge, Process Improvement, Methodology

INTRODUCTION

Increasing competition, changes in stakeholder requirements and new technologies are driving business organizations for rapid and significant changes. In order to respond to such changes and survive in the complex business environment, business organizations are constantly striving to improve and manage their business processes. While the wide-spread understanding of BPM as the process automation technology will remain for quite some time, business leaders are now taking a new holistic approach to BPM that incorporates people, processes, systems and strategy [1]. This holistic approach to BPM has led to increased recognition of the knowledge and experience people develop, use and share while modeling, executing and improving their business processes. In fact, knowledge is considered as an integral part of the business process and not something to be managed separately. This process related knowledge is created not only by individuals, but also by groups of people sharing and using their knowledge and experience throughout the business process eco system.

The experiential knowledge owned by individual domain experts as well as the collective “know-how,” however, are often neglected during BP improvement projects as they continue to focus on the explicit knowledge that is normally captured by BP models. The problem of BP improvement has often been reduced to a modeling problem, typically performed by a process analyst whose experience is limited to the explicit knowledge expressed by process models. With their grounding in the software development methodologies, many BP improvement methodologies often include phases that closely resemble those of a software development lifecycle. For example, they typically start with analysis and design and finish with BP implementation and post-implementation (phases) that are executed in a sequential order.

In this paper, we argue that business process improvement is a complex, knowledge-intensive, collaborative process that consists of a set of coordinated, contextualized knowledge management processes. The main objective of this paper is to report the results of our on-going research project that, among other things, aims to investigate the role of individual and collective process knowledge developed and used in a business process improvement methodology deployed in a BP improvement initiative. In this research project we aim to identify and document the issues/strategies/practices related to externalization, creation, application and reuse of process knowledge in a specific e-procurement process improvement initiative currently undertaken by the BPM team in a large multi-unit organization. This paper includes an exploratory case study used in this research to identify and describe important research and practical issues created at the crossroads of BP improvement methodology and process-related Knowledge Management.

LITERATURE REVIEW

The need to improve customer service, to bring new products and services rapidly to market, and to reduce cost inefficiencies have been pushing business processes to the top of business organizations' priority list ([1], [2]). Business processes are an effective way to manage an organization at any level and eventually support its overall goals. Consequently, they are now considered the most valuable corporate asset [1] and their continuous improvement has become an imperative for many business organizations.

Business Process Improvement Concepts and Methodologies

In spite of the increased attention, BP improvement is not a new concept. Rapid advances in information and communication technologies, end-user computing and increasing globalization and competition have all intensified this need for improving business performance. While continuous improvement philosophy and methods have helped in achieving significant improvement in the quality of manufactured products and processes, their effect on business processes has been limited. Even though information technologies were deployed to improve these business processes, results are often disappointing.

The earlier disciplines of ‘Organization & Methods’ and ‘Operational Research’ have resulted in many business process improvement methodologies used to this day. Currently, business process improvement covers a continuum from incremental continuous improvement to radical reengineering of the business and its processes. Process reengineering is now considered obsolete and impractical considering its radical view of redesign, the top-down approach, strong focus on BP automation and past history of failures and problems [1]. Other approaches such as process design, process redesign, process improvement etc. are still alive and widely used by various consultants and practitioners, often under different names.

While improving business processes is well recognized as an imperative need for many organizations, the first and the foremost question asked by the practitioners for initiating such business process improvement is ‘how?’ In other words, they are interested to know what methodologies to follow and which tools to use. In fact, many consultants and software vendors differentiate themselves by the methodology they apply. Improvement methodologies are primarily the field of consulting firms who have developed proprietary business process improvement methods [3]. Even though there are many models, techniques and tools available for improving the business processes, many authors such as Davenport [2] argue that process innovation remains more an “art than science” [4].

In essence, a methodology is a theory that is put in practice with the objective of dealing with real world situations [5]. It is expected to provide a means of describing the knowledge and experience and to offer certain level of generic structure to the approach for practitioners to employ in their specific business situations. In addition to offering certain level of organization and structure to the approach, methodology is also expected to facilitate understanding of the roles and tasks and identification of the skills required to implement the approach [6].

In the revised version of his ‘what-to-do’ book called ‘Business Process Improvement,’ Harrington [7] addressed this ‘how’ question and provided technical procedures for implementing business process improvement in business organizations. This particular approach consists of a six phases – *organization, documentation, analysis, design, implementation and management*, and is expected to lead to the implementation of the best-value future-state solution [7]. Reviewing various methodologies and tools on process improvement, Povey [8] observed that the past methodologies were incomplete and generally did not address the implementation issues adequately. While most of the methodologies address the analysis and redesign with some degree of thoroughness, the actual implementation of changes were addressed either superficially or not addressed at all [8]. The next section will discuss the issues and challenges with the current BP improvement methodologies.

Challenges and Issues with the Current BP Improvement Methodologies

A methodology is expected to provide a means of generalizing and describing the knowledge and experience and, place that in a structured way to make it easy to implement by explaining the roles, tasks and required skills. Given that each business situation and each business process have unique characteristics, it is difficult to develop and adapt a common universal methodology that is applicable to all types of business situations and contexts and delivers the outcomes in all types of business scenarios and contexts. While there is always an opportunity to learn from the existing successful approaches and practical experiences in case study situations, their adaptation and reuse in a different situation cannot guarantee any degree of success. Each methodology has its advantages and disadvantages and no single model is the best one for all business situations and contexts.

Requirement to consistently follow a particular approach to process improvement prescribed by a particular methodology that worked well in a different context, may stifle the creativity of people involved in the improvement and actually restrict the opportunities for achieving optimum results. Conforming to the rigid requirements prescribed in a given methodology may be contrary to the improvement philosophy a firm would like to embed in their organizational culture.

Clouded by the undue focus on project management and organizational change aspects, the challenge to develop an improved process is relegated to the bottom in the quest to develop the ‘best’ process improvement ‘methodology’ [9]. In order to deal with this challenge, many firms tend to adopt best practices. A ‘best practice’ is a successful way of resolving a particular problem that may need to be adopted in a skillful way to the prevailing conditions. Best practices are collected and applied in various fields such as business planning, healthcare, manufacturing, software development, product design and software implementation ([10], [11]). In business process reengineering literature also, about 30 best practices are described by [9].

Increasingly this challenge has forced organizations to discover the ‘best practice business processes’ and adopt them to their local business situations rather than deploying a methodology for achieving process improvements. To make things easier for business organizations, some of the software vendors claim that the so called ‘best practice’ business processes are already embedded in their software solutions. For example, enterprise systems software vendors such as SAP, Oracle etc. claim that the

business processes embedded in their software solutions are typically best practices. These large ERP software vendors reportedly investigated business processes across a wide variety of organizations and industries and then modeled the best of them into their software solutions ([12], [13] and [14]). With many firms preferring to leave a well-tested configuration of the enterprise system unchanged [15], the underlying assumption that the best practice business processes embedded in the software remain 'best practice' forever is contrary to the continuous improvement philosophy. This brings the focus back to the improvement methodology that is sustainable and deliver continuous improvements rather than finding an 'off-the-shelf' and one-off process improvements enabled by software solutions.

None of the business process improvement methodologies documented in the literature were individually capable of providing a complete methodology. An analysis of various business process improvement methodologies that were currently in use revealed that none of them were robust enough to be able to deliver sustained improvement [8]. He has developed a 'best of the breed soft BPI' model by taking best parts of the existing models into a new model by incorporating a socio-technical approach that balances the technical needs of the process with the cultural needs of the people who execute the process.

Sustainability of business process improvement and the currency of the methodologies/models is another challenge. While business process improvement methodologies and tools have helped achieve significant improvement in operational areas, many organizations have found it difficult to sustain over the long term. Lack of sustained commitment by the senior management, lack of continued training and further development, culture clashes, 'tick box' approach by senior management in incorporating enablers of process improvement, and lack of structures to stop backsliding are some of the problems affecting the sustainability [16].

Focus on easily quantifiable and harder elements in the process improvement methodology is another issue. Even though some of these methodologies include 'soft' elements such as human relationships, resistance to change and organizational culture, their focus is on harder and more quantifiable elements of the organization ([6], [17]). Even though many best practices and research papers recognize the importance of human elements and the organizational aspects, they are not included in most of the existing methodologies. Difficulties in modeling these factors into the methodology and inability to generalize the issues across various business situations are some of the reasons for this.

Even though understanding the evaluation and continuous improvement notion and incorporation of human and organizational issues into the business process improvement methodologies are critical success factors, most of the methodologies stop at implementation stage. This seems to be inconsistent with the increasing pressures of an ever-changing world in a highly competitive business environment [18]. Moreover, this is an antithesis to the continuous process improvement philosophy adopted by many business organizations. Application of many of these approaches and methodologies is not feasible due to associated application cost, time required for its implementation and lack of knowledge about their potential benefits [18]. In an business improvement context, it is necessary to evaluate both the process itself as well as the methodology in order to ensure that it is effective when used by practitioners. Thus, several methodologies and tools developed by various experts, academicians and practitioners to help businesses improve their processes, do not seem to adequately support the practitioners through all stages in the business process improvement [6].

Another issue is whether the business process improvement methodology does indeed work or not? Many methodologies and tools have been developed both by consultants/experts and researchers without rigorously assessing their usefulness to the practitioners. It is also not clear whether these methodologies and tools, when applied, really contributed to the improvement objectives, were useful to the end users and, most importantly, whether they were tested elsewhere. Revising the frameworks and methodologies of [2], [3], [7], [19], a new business process improvement methodology that incorporates theory, tools and practices was developed by [6]. Even though this methodology was tested by the authors at the time of development in a particular business context, no further work is done. It is not clear how much better this methodology is than the previous methods. As noted by authors [6], further testing of the MIPI methodology with more case studies and a framework that incorporates users' skills into the methodology is essential.

In summary, some methodologies and tools are developed by consultants and are used exclusively by them in their consulting assignments while some other methodologies developed by the researchers are published in the academic journals. What is good for one business process and organizational context may not be acceptable and adoptable to another as many issues including the management style, organizational culture, skill levels of participants and the process characteristics such as complexity, scope, significance etc. may impact on the adopted business process improvement methodology. More over, all of these methodologies are not rigorously tested for their validity across different business situations and therefore are limited in their applicability. In addition, cost effectiveness of the methodology and the ability to adapt a generic methodology to a particular business/industry sector are also not evaluated thoroughly in spite of their significance.

However, in spite of their significant differences, most of the existing BP improvement methodologies in the literature typically consists of some or all of the following stages - development of objectives, problem definition and scoping, process analysis and modeling, redesign, identify change levers/implementation, benchmarking, evaluation and continuous improvement ([6], [16]).

All these stages of BP improvement generally are linear and sequential with varying emphasis on a particular stage of the process of improvement in each of those methodologies. In practice, it is however, difficult to visualize a strictly linear and sequential process of achieving business process improvement, especially with the methodologies increasingly incorporating 'softer' aspects such as change management and human relationships.

Knowledge Aspects of BP Improvement

As already stated, knowledge is considered an integral part of the business process and not something to be managed separately. It is deeply embedded not only in documents, models or formal repositories but also in organizational routines, processes and practices [20]. Organizational knowledge includes both explicit knowledge that can be externalised, documented, codified, shared within the same context and managed by technology as well as tacit (implicit) knowledge that is deeply embedded in the experience people develop over time. While some aspects of tacit knowledge cannot ever be externalised, some aspects of it can be described and shared usually via collaborative problem solving, sharing of the same experiences etc. This particular aspect of tacit knowledge is commonly termed "experiential knowledge".

Research in the area of knowledge management (KM) also confirms that people develop new practices even when engaged in highly repetitive, routine business processes. Knowledge and especially the process knowledge, is inseparable from individuals and their actions [2]. It is a combination of experience, context, interpretation and reflection, and involves more human participation than information [4]. Reflection upon concepts and the distinctions among them is the essence of the process of 'knowing' [21] and hence makes it inseparable from individuals. This also means that knowledge, and especially its tacit aspect, is not something that can be "bottled", stored and pushed around by technology in order to be delivered to the right people at the right point of time, as promoted by the so called "Technology-Push Model of KM" [22].

We argue that any BP design process is, in fact, a knowledge intensive process as all decisions about activities and tasks to be performed implicitly and explicitly deal with process-related knowledge. The structure of a process represents only one aspect of this knowledge derived from the organizational procedures and rules used to specify sequencing of activities, the way activities exchange information and the way processes join and branch out [23]. The need therefore to understand and appreciate the role of knowledge management within the context of process redesign and/or improvement initiatives and the way knowledge is to be integrated with the business process is imperative [24].

The process orientation implicit in the process knowledge that is possessed by the owners and users will facilitate process improvement [25]. Therefore, involvement of individuals in process improvement initiatives will allow them to exploit their core talents, skills, process knowledge and experience and leverage them into process improvements [26]. This involvement, will in the long run increase the coordination of each individual's efforts with the company's business operations in their day-to-day execution. In fact, the embedded practices and norms at the operational level characterized by the process knowledge will help sustain beneficial outcomes of the process improvement [26].

Furthermore, inadequate importance attributed to the business process knowledge among the individuals especially in administration and services sector that heavily involve knowledge-based activities is one of the major reasons for the failure of business process improvement projects [24]. In addition to this, inability of the organizations in developing predictive dynamic models for evaluating the effects of designed process improvements before implementation have also contributed to these failures. While simulation models are successfully used in manufacturing process contexts to analyse the scenarios and arrive at informed recommendations for improvement [27], not much experience and knowledge is available about the business processes in services and administrative sector.

In summary, experiential knowledge owned by individual domain experts, is often neglected during BP improvement projects as companies often adopt the model-based approach that focuses on control-flow models, coordination mechanisms, rules & policies - in essence, the explicit knowledge. With emphasis decisively shifting towards the evaluation of the improvements (outcomes) as well as the process or methodology of achieving improvements, the inseparable link between the individual/collective knowledge of the stakeholders in the project and the business process under investigation, is expected to have significant influence on both the process as well as the outcomes.

RESEARCH METHODOLOGY AND CASE STUDY ORGANIZATION

The main objective of this research is to investigate the role of individual and collective process knowledge in the development, deployment and evolution of a business process improvement methodology. More precisely, in a specific e-procurement process improvement initiative currently undertaken by the BPM team in a large university, we aim to identify and document the issues/strategies/practices related to influence of process knowledge possessed by individual participants. The main research question this study investigates is:

What is the influence of individual/collective process knowledge in the development and evolution of business process improvement methodology in this business context?

In line with the exploratory nature of this research, a case study method that involved an interpretive approach was adopted to capture

its corresponding contextual richness and complexity [28]. Interpretive research offers an opportunity to understand the phenomena through the meanings that people assign to them [29]. This project used an exploratory, structured-case study research method to investigate the business process improvement methodology developed and evolved as the BPM project progressed from its inception to completion.

In order to capture accurate reflection of the issues under investigation and the evolution of business improvement methodology in this context, semi-structured interviews with the stakeholders and facilitators of the project were conducted. In addition, the research team participated in the process improvement workshop as non-participant observer, and observed the evolving methodology and the interacting and facilitating factors in the final outcome. In addition, information that relate to the origin and history of this project, its plan of action, minutes of the previous meetings and workshops, and other policy related documents were collected and content analysed. Like all interpretive studies, this study sought a subjective understanding of the conditions, practices and consequences of social action as expressed by the stakeholders and facilitators in their particular social context and are expected to reveal complexities and details that are commonly omitted in quantitative studies [30]. The data thus collected from different sources was compared and triangulated in order to identify the development and evolution of the business process improvement methodology in this context.

The case study organization, chosen for this research, is a large university that employs about 6000 staff. The e-procurement business process improvement project, investigated in this study, is being implemented in a large faculty that employs about 200 people. The faculty consists of a number of organizational units including academic departments, research centres and other commercial units. The specific process improvements emerging from this project along with the evolving BP improvement methodology are expected to be rolled over to other faculties in time. The study was conducted during the 2006 to 2007 and is currently in the final stage. This particular organization was selected because of the access given to the researchers, its potential as a rich organizational context in which to study the influence of process knowledge and the evolving nature of the process improvement methodology in a BPM implementation context.

The e-procurement BP (also known as “purchase-to-pay”) is one of the core operational processes in any organization. In essence, it is a very simple repetitive, standard BP designed to coordinate the main activities related to procurement of goods and services from a supplier, their receipt and storage and subsequent payment. Thus, it typically includes the following high-level tasks: “order goods and services”, “Receive goods and services” and “Make payment”. An organization procures many different types of goods and services however, some of them need to be registered and subsequently managed as company assets for insurance and depreciation purposes (e.g. equipment costing more than \$5000). In this particular organization, asset management has been a very complex problem and this mainly due to a very diverse nature of assets procured by different organizational units. For example, while some of the asset types were virtually the same across all units (e.g. computers), in many instances different units had to acquire and manage very diverse types of assets. Some of them would require special storage and safety procedures in place (e.g. radioactive substances). Some would even require the specialist knowledge to check the working order of a received asset (e.g. a very sophisticated piece of equipment).

Even though the e-procurement BP remained the same (in terms of its main tasks and control flows) across different units within the same faculty, over time, the underlying organizational practices and policies have evolved and changed. This was followed by development and acquisition of different applications used to manage different aspects of e-procurement process. In particular, very diverse asset types led to development and implementation of different asset management applications designed to meet the diverse needs of different units. The e-procurement BP improvement initiative started as a part of a much larger initiative to standardize operational processes that, in turn, will enable implementation of a concept of shared business services. From the business value perspective, this will enable different units to share assets, improve bargaining power with suppliers, streamline the processes and most importantly better utilize knowledge, expertise and experience of people involved in this BP as well as other organizational processes.

Over time, the BPM team aims to start similar initiatives in other faculties, again, first with the e-procurement process and then with the other core BPs. Consequently, transfer of knowledge and experience acquired in this particular project and its transfer to the subsequent BPM projects is critical, in order to make the subsequent projects even more effective. Obviously, this is a very challenging task not only because of the underlying infrastructure, but also because of different organizational contexts including different organizational culture, information management and change management practices as well as organizational policies and practices.

As is typical in any case study research, this study had limitations, including lack of generalizability and subjective bias ([28], [30]). The findings of this study were specific to the situation observed and provide anecdotal evidence. Since the business process improvement methodology and process knowledge of individuals in the project is continuously evolving and changing, it was possible that the influence of process knowledge on certain aspects could not be seen immediately, and may become apparent only after a long period of time [31]. The limitations discussed above could thus have influenced the process as well as the outcomes of this study. However, these limitations are unlikely to have affected the validity and reliability of the outcomes significantly because the objective of the study was not to generalize, but to provide anecdotal evidence and illustrate the role of

process knowledge in this particular project.

DISCUSSION AND LESSONS LEARNT

Rather than a sequence of commonly used phases that are primarily focused on BP models and model improvement technique, this research has confirmed our initial view that a business process improvement methodology is a set of coordinated knowledge-management processes. These processes deal with acquisition (externalization), creation, co-creation, transfer and application of both explicit and most importantly experiential knowledge (i.e. externalized tacit knowledge). They need to be carefully designed and coordinated in order to best leverage individual and collective knowledge, experience and creativity.

As already pointed out, a typical BP improvement methodology would normally start with the analysis and modeling phase(s) that result in a design of an “AS-IS” model. In this case, BP modeling typically involves acquisition and transfer of the explicit knowledge from the domain experts (i.e. people actually executing these processes) to the process analyst. The analyst then proceeds to represent this knowledge by a process model. Obviously, some aspects of this explicit knowledge get lost, first during knowledge transfer and then during process modeling. In the case organization, the e-procurement process also started from the analysis phase. However, in this particular case, the analysis phase involved two sub-phases that we named preliminary analysis and collaborative analysis.

Preliminary analysis confirmed that the high-level standard model of this BP was the same across different units. Consequently, the main objective for the BPM team was to understand the level of complexity and differences between different “versions” of the same process at the lower level. However, rather than trying to identify and document all different versions of the “as-is” process and the associated policies, it was important to identify the key participants (the so called “touch points”) – people who have the explicit as well experiential knowledge about the key aspects of each version of this BP. Furthermore, the BPM team also used the preliminary analysis phase to gain better understanding of the possible sources of, and reasons for, different versions of the process. Our project has confirmed that the key participants were people in charge of various semi-structured decision making tasks in each process and the main differences occurred because of the different policies and procedures that have evolved over time around these decision making tasks. For example, the main differences could be attributed to an important decision: “Is the received good an asset?” and the associated rules used to make this decision in each unit.

Therefore, the main objectives of the preliminary analysis phase in this particular project were to locate the key domain expertise and to understand the reasons for, and sources of different versions of the same process that have evolved over time. From the knowledge management perspective, these objectives are very different from those of “traditional” BP analysis and modeling phase that typically focus on knowledge transfer from domain experts, in order to create very comprehensive “as-is” BP models. In typical BP improvement methodologies, modeling of the current (“as-is”) BPs is normally followed by design of improved (“to-be”) processes. This is often done by process analysts with a varying degree of end-user participation.

In this particular case organization, the preliminary analysis phase (as described above) was followed by a collaborative (full-day) workshop that, in essence combined the collaborative analysis sub-phase and with collaborative design. Workshop participants included the “touch points” from each unit as well as the members of senior management. The workshop was prepared and guided by the workshop facilitator who was also one of the leaders of the BPM team and therefore included in the preliminary analysis. As it is typically the case with collaborative workshops, some preliminary rules were established and discussed at the very beginning to create an environment that encourages, supports and values equal participation.

From the knowledge management perspective, the workshop included all key knowledge management processes: acquisition, co-creation, transfer and application of both explicit and experiential knowledge. Rather than in a particular sequence, these knowledge management processes were highly intertwined. Furthermore, even though the high-level model was used at the very beginning of the workshop, the main emphasis was not on process modeling. After confirming that the high-level model was indeed the same for all functional units, participants focused on process tasks. Therefore, instead of looking at control-flows between tasks and trying to identify possible problems with for example, process structure, the group focused on each individual task. As expected, the special emphasis was placed on decision tasks. The main objective was to gain shared understanding of different rules, policies that people used to make a particular decision and how they would normally proceed to implement this decision.

Again, rather than creating the fine-grained models of different versions of decision making tasks, shared understanding was achieved through collaborative exploration of different common and less common scenarios. As already stated in the previous sections of this paper, the KM field confirms that some aspects of tacit knowledge can be only externalized through collaborative problem solving. This was exactly the case with collaborative exploration of different scenarios that were proposed by the workshop facilitator as well as emerged during workshop.

This collaborative analysis (sub-phase) of the workshop focused on the key question that the workshop facilitator used to engage all workshop members: “*How does this work in your world?*”, where “this” referred to different scenarios. This question would normally lead to discussion of different policies, underlying systems and even different aspects of organizational culture that have shaped the way a particular version of the process is currently implemented. Again, rather than focusing on process aspects

(such as process structure) the main emphasis was placed on the knowledge, experience and skills, participants currently bring to each task no matter how complex or simple it was. For example, the actual task of sending an order for goods and services to a chosen supplier is, in essence a very simple, routine task. However, it was acknowledged that the real value of this task was created by the team of purchasing officers who have established and continue to expand a network of trusted, high-quality suppliers.

Looking from the KM perspective, the main objective of collaborative analysis was not on collaborative modeling but on building of shared understanding of current practices. Knowledge management processes included both knowledge acquisition from the key participants as well as knowledge transfer between different functional units via various knowledge management techniques including discussion, clarification and story telling related to different exceptions and management of complex cases. The key role was played by workshop facilitator who was in charge of coordination of these knowledge management processes.

The next phase, also performed during the workshop included knowledge co-creation that in essence, included collaborative design of new version of the key decision tasks as well as discussion of the associated policies (including both the existing and possible new policies). Compared to the typical BP improvement methodologies where the main emphasis is on design of a new "to-be" process, in this particular project the group focused on individual tasks first with the view that the overall process model will also emerge during the same process. The new knowledge was created through open discussion of new ideas and their possible implementation in different units. The key question used to facilitate this knowledge management process was "How would this work in your world?" Even though participants decided not focus on the technology, they commented on possible support for different scenarios that could or could not be provided by the existing systems.

The collaborative workshop resulted in a preliminary design of new decision tasks and the associated policies that were also combined in a new version of a e-procurement process. It is interesting to point out that, again the high level model of to-be process remained the same. This is not surprising having in mind that this is the core business process that has to include a standard set of high-level tasks, because goods and services still need to be ordered and received and payments need to be made.

After the to-be processes are designed, typical BP improvement methodologies normally proceed with the implementation phase. In this particular project, the implementation phase again included a number of knowledge management processes. After the workshop was completed and the agreed outcomes documented, this, now explicit knowledge, was then communicated back to all organizational units for further analysis and discussion. This phase is still currently in progress. The BPM team anticipates that after the reviews are completed by each unit and feedback collated, they will be ready to design an implementation plan for new process. In the meantime they have started a related information management project with the main objective to map the existing data sources and come up with the integrated view first at the conceptual and then at the implementation (technical) level.

CONCLUSIONS AND FUTURE WORK

The main conclusion of our empirical research is that business process improvement is, in fact, a complex, knowledge intensive, collaborative process. It consists of a set of coordinated, contextualized often emergent knowledge processes that cannot be captured and prescribed by a process model. Therefore, any process improvement methodology should focus on knowledge management strategies and processes rather than place the main emphasis on BP models as it has always been the case in this area. This project will continue with BP improvement of e-procurement processes in other faculties. From the KM perspective, it is expected that this would include a two-way transfer of knowledge, from completed to new projects in order to continue to improve the underlying methodology and knowledge processes as well as from the newly completed projects back to previous projects to ensure continuous improvement and sharing of new ideas.

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SUGGESTING A GUIDELINE TO INFORMATION AND COMMUNICATION TECHNOLOGY SERVICE DEVELOPMENT IN ACCORDANCE WITH USER VALUE DRIVEN PERSPECTIVE

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ABSTRACT

Information and Communication Technology (ICT) service industry, especially the mobile service market, has been one of the core growth engines for Korean economy during the last decades. However, ICT service market is currently experiencing severe stagnation mainly due to the saturation in customer expenditure.

Until recently, a technology intensive approach has been playing a critical role in terms of ICT service development in Korea. However, limitations in this technology based method have been exposed with respect to locating and addressing dynamic and in-depth user needs and demands. Various ICT services have been introduced into the market in accordance with the technology intensive approach; however, there is only the mere presence of success in fulfilling user satisfaction. Thus, nowadays, a user value-driven approach is widely gaining attention as a substitute or/and complement to conventional methods. In fact, user value-driven approach is not a brand new idea; it has been broadly practiced in many none-ICT relevant fields, however, as for ICT industry, user-driven approach is still in early stage of the adoption. Therefore, the major research question of this study is to explore user's hidden needs and demands and consider appropriate methods to apply them into ICT service developments.

Keywords: Information and Communication Technology service, user-value driven approach.

INTRODUCTION

The digital revolution triggered a combination of innovations in areas such as computing, communication technologies, and the Internet. And these innovations have brought significant changes to the Korean market such as increased competitive power and new competitors, new distribution and communication channels, and most importantly, more sophisticated and discerning customers [1].

Ever since Information Technology (IT) merged with Communications Technology (CT) and became Information and Communications Technology (ICT), ICT has been core growth engine for a more digitalized economy [2]. In fact, the importance of ICT is so strong that it now covers 15% of Korea's overall GDP, and 45~50% of the GDPs of major Korean cities [3].

However, Korean ICT industry has been experiencing some major failures recently, such failures as third generation wireless communication or WIBRO (advanced wireless Internet). They have not live up to their names as many expected, not because of the technology itself but because they do not match many customers' needs [4]. Up until now, ICT services have been successful by just providing technology-driven devices for any kind of new technology was appealing to or used by the majority of the Korean population. Yet, these fast and growing concerns suggest that the ICT industry seriously needs to reconsider its strategy for further growth.

Korean customers have spent astronomical money on the ICT services [4, 5] thus they have become immensely cautious and selective in choosing new ICT services, consequently, the Korean mobile communication industry has recently been experiencing severe stagnation, mainly because of market saturation [4, 6]. In short, the market situation is repositioning, and becoming unfavorable for service providers.

Mainly due to the rapid development of mobile communication technologies and the convergence of these technologies with other services, there's no doubt that Korean customers are facing obstacle to identify individual technologies. As a result, it is the value of services that has a major role in the choice of a mobile communication service rather than technology itself. Further, as the convergence mobile communication service market advances, users demand more sophisticated and diverse services [7, 8]. To revitalize the mobile communication market, it is critical to understand the unique values of mobile communication and to attract customers by proposing and marketing such values—the Mobile value propositions. Mobile value propositions include ubiquity, mobility, localization, and personalization [9].

In this sense, mobile service providers should differentiate themselves and obtain a competitive advantage by offering a unique value proposition and understanding customers' values and needs. Traditional Research and Development (R&D), or a technology intensive development approach, might have limits from a user value orientation as it has intently focused on the actual technology rather than user value, thus having difficulty in attracting customers in a market where expenditure is saturated. In fact, technology centric services have exposed their weakness in capturing users' initiative. For instance, various service concepts were introduced in the market in accordance with the rapid development of technology. However, there is only a mere chance of success due to the lack of understanding of users' needs and demands [7, 10]. Such a position is supported by Cho [6] who states that the current technology centric service development focuses on improving the performance and quality of the

service itself, rather than locating users' hidden needs. In this sense, the approach is limited when it addresses complex and ambiguous user demands.

Currently the user value-driven approach has been widely gaining attention as a solution to emerge from the current period of stagnation [7, 10]. Through an in-depth understanding of users' demands and needs, we could rationally expect to locate services, which could offer higher customer satisfaction and value compared to that of the traditional R&D approach. Selden [10] mentioned that through user oriented R&D, a company can increase profits, concurrently with providing higher values to its users.

This study consists of two studies. In study I, a Focus Group Interview (FGI) was conducted to explore users' needs for mobile communication services. As a result of FGI, we could extract seven primary needs. And in the following section, the study II, we designed quantitative survey based on the result of the FGI and then employed this survey upon chosen respondents to obtain sufficient enough evidence to verify the effectiveness of the extracted needs. Finally we suggested a guideline for the application of the extracted primary seven needs in the real business level.

STUDY I

METHOD

In general, FGI is believed to be a strong implement to explore active and spontaneous opinions. Therefore, we conducted a FGI instead of other quantitative methodologies in order to explore the in-depth human nature of both current and potential users [11]. A total of seven groups were formed from the 33 interviewees. The following figure (table 1) shows a brief demographic breakdown of each group.

Group number	Gender	Age	Occupation
G #1	Female	30's	Housewife & Office worker
G #2	Male	30's	Office worker
G #3	Female	40's	Housewife
G #4	Male	20's	Office worker
G #5	F, M	20's	Undergraduate student
G #6	Female	20's	Office worker
G #7	Male	40's	Office worker

Table 1: Focus group recruiting information

In each FGI, a moderator tried to extract the variety of needs each group of respondents have when they are using communication services. Additionally, respondents were asked about the more advanced mobile communications services they are demanding or expecting to use in the future. Finally, the needs for mobile communication services were derived from the responses of the respondents.

The entire FGI was videotaped and then transcribed. The transcriptions were then analyzed and interpreted in order to reveal the needs of the respondents.

Derived Needs for Mobile Communications Services

In general, based on the participants' responses in the FGI sessions above, there are seven needs, and these could be the bases for the development of mobile communications services.

Communication

Ever since, Information Technology (IT) was introduced, people have been talking to each other through a variety of channels such as e-mails, mobile phones, and Internet messengers. Because of its ease and wide accessibility, IT can support people's need to communicate with each other frequently and conveniently [12]. There is no doubt that in the future, there will be even more ways to communicate, and as the FGI respondents have expressed, people will not only want to communicate more actively than ever, they will also want to choose their method of communication depending on the person and the situation they are dealing with.

Proposition 1: Users want to communicate with each other more than ever.

In accordance with the respondent's statement, we could rationally assume that current mobile communication services are satisfying communication needs. However, they did raise their concern for the price of these mobile services, for they feel that they are quite expensive. Ultimately, these concerns show that mobile communication services need to provide more reasonably priced services so that the majority of the people can use them.

Proposition 1-1: Users demand that mobile communication services provide communication services at a more reasonable price.

Connection

Apparently, the respondents want to have close relationships with their friends and family members, many of them cannot meet each other physically frequently, leaving them to sometimes feel left out, or estranged. Seemingly, the need to connect and feel close to people is especially strong when those closest to them are celebrating a birthday or an anniversary. The respondents want methods to be part of the celebration in a special way, even when they cannot be there in person.

Proposition 2: Users seek to recover relationships through communication services.

The respondents believe that they can build a more sincere relationship and have in-depth conversations with their family members and peers through highly sophisticated communication tools, such as exchanging visual images via their mobile devices. Therefore mobile communication service provider should focus on fulfilling user's need of connection.

Proposition 2-1: Users demand that mobile communication service should help them to maintain relationships with others.

Convenience

There appear to be quite strong needs in which respondents want their lives to be more convenient. For instance, respondents do not want to invest a lot of their time to physically visit particular places in order to use specific services. They believe telecommunication service would help them to be more convenient and less time consuming.

Proposition 3: Respondents seek more convenience through communication services.

Recent developments in the mobile communication industry are expected to help respondents to have a more convenient life. M-banking can be a good example, instead of visiting a bank to use financial services respondents can receive similar quality of service via mobile device at any time and at any place. As they do not need to physically visit certain places, they can rationally expect to save their precious time. In this sense, we could rationally assume that mobile communication service can help user to entertain more convenient lifestyle.

Proposition 3-1: Users demand that mobile communication services provide more convenient services via mobile device ubiquitously.

Relief

Apparently, respondents are always worried about their surrounding contexts. First, respondents expressed concern about the security and safety of their home when they are not there. Some worried about the security of their home in cases such as burglaries and while others considered accidents such as fires, gas leaks or other such unforeseen circumstances as causes of concern.

Second, respondents are worried about the health of their family, especially when some of family members are very old. They want to check the condition of their health regularly and conveniently in order to prevent serious disease.

Third, respondents want to know the whereabouts of family members, especially young children and aged or mentally impaired parents. Young children are sometimes kidnapped or aged or mentally impaired parents occasionally can not remember where they live. To prevent losing them, when the young children or aged parents go out, respondents want to keep track of their location thereby reducing concern and being able to feel more relieved.

Proposition 4: Respondents want to be less concerned and feel more relieved through communication services.

Mobile communication services can help to reduce concern about daily life. For example, user can confirm whether the power supply to home appliances is on or off via their mobile device. If the power supply is on, action can be taken remotely like turning the power off to prevent accidents, like fires.

Moreover, mobile communication services need to examine family's health. Users feel burdened to regularly visit hospitals to check their health condition, because it can take a lot of time and cost a respectable amount of money. This situation can be exacerbated, especially when the family live separately, when it is even more difficult to check their health condition. If users could check their family's health condition via a mobile device, it would be easier to check their health more regularly, conveniently and cost effectively; moreover, such measures may even help them to prevent serious disease.

Proposition 4-1: Users demand that mobile communication service help them feel more relieved.

An Exciting life

Apparently, respondents want to have fun in their life. They stated they usually enjoy some kind of entertainment content, such as movies or television programs for their personal recreation and enjoyment. However, they also added that feel annoyed when

they must fit into conventional entertainment schedules and feel irritated when they can not enjoy the kinds of entertainment they want. Consequently, respondents show a desire to enjoy various entertainment contents ubiquitously. Respondents also enjoy recreational time with family and friends. However, sometimes they do not know what facilities, like restaurants or theaters, are conveniently located especially when they are in an unfamiliar town. Some of those surveyed expressed the desire to obtain information about places for recreation.

Proposition 5: Users need more fun through communication services.

Mobile communication services can help users enjoy exciting entertainment contents. For instance, Video On Demand (VOD), currently available service, can provide personalized entertainment content at any time that the user demands. In fact some of the respondents expressed the desire for the VOD service to be provided via a mobile device, like Digital Multimedia Broadcasting. Respondents could then enjoy a variety of entertainment content regardless of time and location.

Proposition 5-1: Users demand that mobile communication service help them enjoy their lives.

Self-improvement

During the FGI, the respondents express desire to improve themselves both from a personal standpoint, and also from professional reasons. Some of those surveyed Stated that they fill necessity to undertake education programs, such as languages or specialized skills in order to improve themselves. Others stated that they wanted professional improvement, which they suggested could be achieved by being able to manage their work more efficiently and effectively in order to become more successful in their careers.

Proposition 6: Respondents seek more educational opportunities to improve themselves in competitive environments through communication services.

According to FGI, users demand mobile communication services to provide the opportunity for self improvement. They believe that if they were able to receive education programs via mobile devices without physically visiting educational institutes, it would allow them to improve themselves ubiquitously and at a relatively lower price. Moreover, mobile communication services could assist users to communicate within an organization more efficiently, by allowing them to send and receive e-mails, and to transfer some files via mobile devices, even if they are not physically present in the office. Thus, users could manage their works more efficiently and it could provide opportunities for job advancement.

Proposition 6-1: Users demand that mobile communication services help them in their goals of self-improvement.

Personalization

According to the survey, there's significant demand for personalized services. For instance, the respondents wanted services which are tailored to their individual preferences.

Proposition 7: Respondents want to have more customized communication services.

Mobile communication services can provide personalized services. As mobile devices are individual and personal, thus user can easily receive customized services. Personalization needs are usually multifaceted and user specific rather than being of one particular need.

Proposition 7-1: Users demand that mobile communication services provide more customized services.

Discussion

Mobile communication service provider should reconsider their technology-driven approach to survive in current Korean market where expenditure is extremely saturated. Traditional push strategy, "make-and-sell", will not satisfy, thus companies should locate consumers' needs as prerequisite to service development phase. By doing so, companies will be able to satisfy their customers' needs more efficiently [1].

From study I, we identified a total of seven consumer needs regarding mobile communication services: communication, connections, convenience, relief, exciting life, self-improvement, and personalization. Theoretically, these individual needs could provide the basis for development of mobile communication services. However, applying user's need into service development tier would not be an easy task since each individual need frequently combines with one or more needs and become more sophisticated and complex.

In fact, from the FGI, we found out services that combine two or more needs satisfy customers more than services that provide one. Each respondent's need is sophisticated, and tends to amalgamate with other needs thus it become even more complicated. When a certain mobile communication service satisfies more than two needs at a time, the service may be of higher value to its users. Therefore, to develop more successful services, more sophisticated and advanced services must be analyzed. The needs could be combined into whatever combination a particular user wants.

However, not all needs are important for potential service users. When a user wants a certain service, he/she is thinking about his/her own relative importance of the seven needs, which may be different from how another user may prioritize his/her own seven needs. For example, when a person wants to feel relieved they may use the “people tracking service,” and another person wants to feel entertained then they may watch “Videos On Demand”. In this sense, it would be in the best interest of mobile communication service providers to understand the majority of peoples’ priorities as it relates to the seven proposed needs.

FURTHER STUDY

To obtain significant evidence to verify the effectiveness of the extracted needs and also the market response upon them, we designed a quantitative survey based on the result of the FGI and then employed this survey upon six-hundred chosen respondents. Currently, the quantitative survey is in progress and scheduled to be completed in near future. And based on the result of the quantitative survey, we expect to continue study II.

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ENHANCING PERSONAL INTERACTION THROUGH THE WEB INTERFACE IN ONLINE SHOPPING: AN EXPLORATORY STUDY

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ABSTRACT

Recent research has called for a need to infuse social presence into e-commerce websites, suggesting that a website low in social presence will be difficult to satisfy consumers' social needs (for interacting with other humans) when they are shopping online. This study finds that web interface elements of socially rich text and picture and virtual community, which provide means for personal interaction, lead to higher perception of social presence. Results, however, also show that social presence per se is not significant in predicting online purchase intention. Even so, e-vendors may also benefit from offering high level of personal interaction through their web interface as those three website features have influential impacts on trust and perceived value, two predictors of online purchase intention found in this study.

Keywords: Personal interaction, socially rich text and picture, virtual community, e-commerce, social presence, trust, perceived value, satisfaction, technology acceptance model

INTRODUCTION

Thanks to the fast development of information technology, Internet has become the core component of our contemporary society and has brought about multi-faceted impacts. In the field of business, more and more firms, even individuals, begin to use the web to sell their products and services. Though the advantages of electronic commerce (e-commerce) are well recognized, nowadays online vendors are facing two major challenging questions: (1) why consumers do not purchase in an online shopping environment; and (2) how to achieve competitive advantages over other counterparts.

A traditional view is that a user-friendly interface is a vital key to the success of commercial websites. Nielsen [30] calls for a need to improve website usability in a belief that low usability will lead to unsatisfied users and the site will not grow into long-term success. In investigating consumers' reluctance to buy within an online environment, Davis's [11] technology acceptance model (TAM) has also been adopted in extensive e-commerce empirical studies. On the other hand, in industry, most of the design guidelines for generating web interfaces predominantly center on facilitating efficient communications between the website and its users [22].

All of these traditional views, which treat a website simply as an information technology, tend to only deal with functional and performance aspects of websites and they are insufficient in providing online vendors with guidance to satisfy online shoppers' social needs. Therefore, as a supplement to traditional views, social presence theory has been introduced to investigate e-commerce issues [8] [15] [17] [18]. It focuses on one of the major differences between offline and online consumer markets – the lower level of social presence which is characterized by less information richness, reduced interactivity, and decreased presence of human warmth and sociability in an online environment [15] [17] [18]. It gives attention to fulfill consumers' social needs when they are shopping online. Nowadays, many online stores are low in social presence, displaying products with little emotional or social appeal [18] and are relatively lacking social forms of interaction [6].

One of the major objectives of this research is to further the understanding of social presence in e-commerce field: whether it actually is associated with consumers' purchase intention; if so, assessing the relative importance of social presence in comparison with TAM constructs – perceived ease of use and perceived usefulness, trust, satisfaction and perceived value is also necessary in order to evaluate the relative importance of these factors in predicting online purchase intention. Another objective of this study is to investigate how certain web interface features (that help consumers evoke a sense of interaction with other humans) can be manipulated to impact the predictors of online purchase intention found in this study.

LITERATURE REVIEW

Online consumer bears the dual nature of both a traditional consumer and an information technology user [47]. Hence, in order to study online B2C relationships, many variables have been proposed from different perspectives. These include social presence, trust, perceived value, satisfaction and TAM constructs.

Social Presence

While the traditional usability and TAM view focus on the operational aspect of the website, viewing it simply as an information technology, social presence theory borrowed from communication literature, has been recently introduced to explore online shopping environments, indicating that e-commerce settings lack human warmth and sociability [15] [17] [18].

Social Presence and Its Theoretical Foundation

Social presence refers to the degree to which a medium allows a user to establish personal connection with other users [43]. Some researchers stress on its close relationship with the richness or interactivity of the media [9] [38] [44]. The theoretical foundation

of social presence consists of media richness theory and social presence theory [22].

Media richness theory is first brought up by Daft and Lengel [9] and it makes two assumptions: (1) organizations process information to reduce uncertainty and equivocality, and (2) commonly used media in organizations works better for certain tasks than others. Later, using four criteria, Daft, Lengel and Trevino [10] presented a media richness hierarchy which incorporates four media classifications: face-to-face, telephone, addressed documents, and unaddressed documents. And the criteria they use are: (1) the availability of instant feedback, (2) the capacity of the medium to transmit multiple cues such as body language, voice tone, and inflection, (3) the use of natural language, and (4) the personal focus of the medium. According to media richness theory, enjoying the ability to transmit instant feedback, body language, facial expressions and tone of voice, face-to-face communication are regarded as the richest communication media, followed by telephone, e-mail, and memos and letters. Electronic media like e-mail and fax are generally viewed as information-lean because they can only convey facts. Websites are even leaner as their contents are generated by hosting server, representing a machine response rather than that of a social being [35]. Whereas rich medium is rated toward the sociable, warm and personal end of the continuum [22], lean medium (representing decreased level of social presence) is rated as more unsociable, insensitive, cold, and impersonal [37] [42]. Therefore, it is not surprising that currently, most e-commerce websites are viewed as lacking human warmth and sociability. Short, Williams and Christie's [43] social presence theory is similar to media richness theory [5], where high social presence characterizes face-to-face communication as opposed to low social presence characterizes paper-based mail and electronic media [45].

Social Presence and Media Selection

Researchers have long wondered which medium one would use to accomplish an aimed task. Both media richness theory and social presence theory argue that use of a medium is effective when characteristics (which refer to the degree of information richness in media richness theory and social presence in social presence theory) of the chosen medium match the requirements of the aimed task. For example, due to its lower level of social presence, a girl may prefer to use email to refuse the dinner invitation from the boy she has no crush on. Actually, these two theories have been grouped together as the "task-medium fit" hypothesis to explain media selection [45]. However, despite the plethora of research efforts giving empirical evidence to support the "task-medium fit" hypothesis, some fail [39] [40]. A possible explanation is that "task-medium fit" hypothesis fail to take into account other determinants such as social environment and user attributes. For example, as one of the major components of social environment, presence of a critical mass of users is important because a medium cannot be used without sufficient communication partners [26] (Markus, 1987). The impact of user attributes has also been found, Papacharissi and Rubin [32] argue that people who avoid face-to-face interaction tend to use Internet (traditionally thought of as a lean medium) more for interpersonal communication. In discussing consumers' selection of e-commerce websites to perform purchase tasks, this paper excludes such intervening factors in order to simplify research process, which is also consistent with previous e-commerce literature. Here we believe that it will be beneficial if we step back and examine shopping motives within the context of traditional consumer market.

Tauber [46] proposes that apart from those related to the product itself, traditional shopping behavior is also motivated by a variety of social needs, among which four motives (except pleasure of bargaining) can also be applied to Internet settings where online shoppers' needs for social interaction can also be found [33]. Therefore it is reasonable to expect that websites low in social presence may hamper online consumers' purchase intention due to its difficult to satisfy their social needs. Thus we hypothesize that:

H1a: The higher level of social presence consumers perceive when shopping online, the higher purchase intention they will have;

H1b: Consumers' perception of social presence is a significant predictor of online purchase intention.

How to Enhance Social Presence

Dennis and Valacich [12] indicate that one medium may possess different levels of social presence or richness depending upon how it is configured and used. Kumar and Benbasat [22] argue that "the versatility of web allows different configurations to be used to support the avowed goals of a website (from selling products and information to enhancing corporate image)". Hence, consumers' perception of social presence can be enhanced through interface elements that enable personal interaction with other humans. According to Hassanein and Head [18], those elements can be categorized into: (1) features stimulating imaginary interaction with other humans, including socially rich text and picture content, personalized greetings, human audio and video, etc.; and (2) features providing means for actual interaction with other humans, including online communities, message boards, online chat, e-mail after-sales support, human web assistants. As an extension of Hassanein and Head's [17] [18] work, when continuing to use socially rich text and picture content, this study further incorporates virtual community to explore the impacts of enhancing personal interaction in e-commerce settings. By helping online shoppers evoke the imagination of interacting with other humans, socially rich text and picture have been empirically shown to be an effective way of increasing online shoppers' perceived social presence [17] [18]. Compared to its counterparts like human audio and video, socially rich text and picture (if given proper size and resolution) are easy to access on Internet due to their low requirement on bandwidth.

In this study, virtual community is selected as a feature providing means for actual personal interaction. With the increasing development of open source movement, free virtual community software is readily retrievable on Internet. It is so convenient to use that even e-vendors without adequate IT literacy may add this website feature to their online stores. Enjoying the ability to aggregate people who share same interests or other commonalities together, virtual community can be the conduits where interpersonal relationships can be forged [22]. The effect of virtual community may be even more pronounced in that it is superior to socially rich text and picture features in terms of interactivity level. On the other hand, virtual community does enable

shoppers to interact with other social beings who are “real people” and such interaction is realistic, not fictitious.

Trust

Trust is a complex and multidimensional concept [31] which has been conceptualized by the plethora of research efforts in various ways. According to the summarization by Gefen, Karahanna and Straub [14], trust refers to “(1) a set of specific beliefs dealing primarily with the integrity, benevolence, and ability of another party; (2) a general belief that another party can be trusted, or the willingness of a party to be vulnerable to the actions of another; (3) affect reflected in feelings of confidence and security in the caring response of the other party, or (4) a combination of these elements”. This study adopts the second perspective where trust is also viewed as the willingness of a party to behave based on expectation about the behaviors of others when considering the risk involved [25].

Trust in Online Environment

The value of trust has been recognized in various academic fields such as sociology [23], psychology [13], computer-mediated communication [27], economics [48], and marketing [29]. Researchers [14] [35] argue that trust is especially important within the context of an online environment that involves typically high social complexity and risk. Such high social complexity and risk stems from different aspects between the electronic and traditional environment, for example, hacker attacks on consumer credit-card information or increased risks incurred by those who considered “fly-by-night” due to a low barrier to entry and exit, one of the major advantages of e-commerce [49]. Furthermore, in an online environment, social proximity and face-to-face interaction with salespeople and other shoppers are replaced by and converted into a complex human-web-site interaction [41] where the behaviors of e-vendors cannot be monitored [35] and they may engage in a number of undesirable yet possible opportunistic behaviors, for example, send spam email.

Trust has been shown to positively impact intended use [14], transaction willingness [2], and customer loyalty [8] in e-commerce settings. Gefen and Straub [15] further confirm that trust has a strong effect on purchase intention within the context of an e-service website. This study focuses on electronics product website and despite domain difference, we are confident to hypothesize that:

H2: The higher level of trust, the higher purchase intention online shoppers will have.

Perceived Value

A general view is that perceived value represents a trade-off between “give” and “get” components of a product where “give” refers to perceived sacrifices and “get” refers to perceived benefits from purchasing that product [49]. In this study, the notion of perceived value needs to be modified since an e-commerce website per se is not a product that one purchases but a channel to purchase products [20]. Earlier work by Teo, Oh, Liu and Wei [47] provides guidance to help us conceptualize the concept of perceived value of a commercial website. In order to examine the effects of website interactivity on the formation of user attitude, they established a research model where perceived value emerged as a key mediating factor and was measured by the estimation of the usefulness, importance, helpfulness and worthiness of the web site. In this paper, we adopt this perspective where value is defined as conceptions of the desirable means and ends of action. Keeney [20] has suggested that consumers’ perception of commercial website value can be maximized by providing opportunities for personal interaction.

In the context of mobile internet (M-Internet) adoption, Kim, Chan and Gupta’s [21] Value-based Adoption Model (VAM) demonstrates that consumers’ perception of the value of M-Internet is a principal determinant of adoption intention as it represents an overall assessment of the adoption object. Chen and Dubinsky [49] also contend that perceived value is an indicator of online purchase intention. Therefore, we hypothesize that:

H3: The higher level of perceived value, the higher purchase intention online shoppers will have.

Satisfaction

While perceived value is related to cognition, satisfaction is primarily viewed as an affective-based construct [34]. It was initially defined as an evaluation of an emotion that reflects the degree to which a consumer believes that the possession and (or) use of a service evokes positive feelings [7]. When it comes to the IS field, according to ISO 9241-11 (1998), satisfaction can be described as the user’s comfort with and positive attitude towards the use of the system. In the present study, the use of the system refers to purchasing (mobile phone) on the experimental e-commerce website. This study focuses on initial purchase behavior, which is the period when a consumer visits an e-commerce website and makes purchase decision for the first time. It has been suggested that e-vendors may benefit from creating an enjoyable online shopping environment because consumers purchase products both for their utilitarian and hedonic purposes [6]. Other studies have also shown the positive impacts of satisfaction on the outcome of the shopping experience within various contexts [4] [16] [47]. Thus, we hypothesize that:

H4: The higher level of satisfaction, the higher purchase intention online shoppers will have.

TAM Constructs

Proposed by Davis [11], TAM model has long been well regarded in predicting information system usage, a model suggesting that the intention to use a technology is directly affected by PU (perceived usefulness) and PEOU (perceived ease of use). TAM model has been extensively applied in numerous e-commerce empirical studies with the underlying logic that e-vendor interacts with consumers through a website that is, in essence, a type of information technology. Gefen, Karahanna and Straub [14] attest that “the more useful and easy to use is the website in enabling the users to accomplish their task, the more it will be used”. Thus, we hypothesize that:

H5: The higher level of usefulness consumers perceive when shopping online, the higher purchase intention they will have;
 H6: The higher level of ease of use consumers perceive when shopping online, the higher purchase intention they will have.
 More important, as previous mentioned, the present study will evaluate the relative importance of social presence, trust, perceived value, satisfaction, TAM constructs in predicting online purchase intention. Thus, the following research question is raised:

RQ1: What is the relative importance of social presence, trust, TAM constructs, satisfaction and perceived value in predicting online purchase intention?

Effort is also put in exploring:

RQ2: By helping consumers evoke a sense of interacting with other human, how certain website features can be manipulated to impact the predictors of online purchase intention found in this study?

We believe the answers to these research questions will provide the most immediate and attainable recommendations for practitioners.

RESEARCH METHODOLOGY

Task and Procedure

To answer the proposed research questions and test our proposed hypotheses, an empirical study was conducted where personal interaction levels were manipulated within three groups. Each group had 20 members, consisting of 10 male and 10 female. The equal number of male and female in each group allowed us to eliminate confounding effects incurred by gender difference. We had created three versions of websites on behalf of a fictitious electronics product company (called iBuy.com) for these three groups. The website for each group had the same products and followed the same design but differed in terms of personal interaction level that was achieved with different types of web design features as shown in Table 1. In contrast with PI-1 where product information was shown in a simple yet functional form, higher level of personal interaction was infused into PI-2 and PI-3 through imaginary interaction elements of emotive text and picture and through actual interaction element of virtual community respectively. The three groups conducted the experiment entirely online and they might access to the website from any computer, if it has an Internet connection.

Table 1. Experimental Manipulation of Personal Interaction

Website Name	Personal Interaction Level	Available Features
PI-1	Low	<ul style="list-style-type: none"> product information
PI-2	Medium	<ul style="list-style-type: none"> all features of PI-1 socially-rich text and picture
PI-3	High	<ul style="list-style-type: none"> all features of PI-2 virtual community

Subjects were told to assume the role of class presidents who need accomplish the task of purchasing a mobile phone as a gift for a new classmate. Subsequently, they were asked to browse through the experimental website for that purpose. In this experiment, it was not necessarily for subjects to make a real order. Instead, they were told to focus their attention on viewing the specific product information and evaluating the website. Upon the completion of the experimental task, subjects were given a questionnaire to fill in personal information voluntarily. This questionnaire also contained measures for the dependent and independent variables with open-ended questions raised for deeper explanations and discussions.

Subjects

A total of 60 subjects were involved in this study. Considering the exploratory nature of this study, this sample size is acceptable for the purpose of generating statistically reliable results through hierarchical regression analysis. Subjects were undergraduate or graduate students at three major Hong Kong universities and each participated in only one group. They were randomly assigned to three personal interaction groups so as to minimize confounding effects incurred by potential variations in individual characteristics. The three groups were separated by different sessions. The website for each experimental group was only available during its corresponding session and it would be removed from the hosting server after the session was due. Exquisite gifts were prepared for subjects to ensure that they would take this study seriously. Based on personal information provided by questionnaires, ANOVA tests confirmed that there were no significant differences across treatment groups in terms of individual characteristics like age, Internet and online shopping experience. Our randomization of assignment was successful as expected.

Measurements

All the research constructs were measured on seven-point Likert scales adapted from previous studies, with 1 representing strongly disagree, 4 representing neutral, and 7 representing strongly agree. Minor modifications were made to fit the specific context of a B2C website selling mobile phone in this study. Specifically, social presence and purchase intention were measured using questions adapted from Gefen and Straub [15]. Trust was measured using two questions adapted from Gefen and Straub

[15], one question from Gefen, Karahanna and Straub [14] and one question from Pennington, Wilcox and Grover [36]. TAM constructs were measured using questions adapted from Hassanein and Head [18]. Perceived value was measured using questions adapted from Teo, Oh, Liu and Wei [47]. Satisfaction was measured using questions adapted from Li, Browne and Wetherbe [24]. All the items used in this study are presented in appendix. The reliability for social presence, purchase intention, trust, perceived value, perceive ease of use, perceive usefulness and satisfaction were high, with Cronbach's alphas equal to 0.92, 0.91, 0.88, 0.90, 0.80, 0.90 and 0.93 respectively.

Data Analysis

First, Pearson's correlational coefficients were computed to test the proposed six hypotheses. Next, hierarchical regressions were run to determine the relative importance of social presence, trust, perceived value, perceived usefulness and satisfaction in predicting online purchase intention. Finally, a series of one-way ANOVAs was conducted to check potential differences across the three experimental groups in terms of perceived social presence and other factors, if they had been shown to be important predictors of purchase intention.

RESULTS

Hypotheses Testing

In order to test the six hypotheses, correlational analyses were performed. Results presented in Table 2 show that social presence ($r = .64, p < .01$) was significantly related to purchase intention. This indicates that the higher social presence consumers perceived when they were shopping online, the higher purchase intention they would have on the visited website. Thus, H1a was supported. Furthermore, perceived value ($r = .72, p < .01$) also had significant effects on purchase intention. It suggests that perceived value is highly predictive of online purchase intention. Thus, H3 was supported. Purchase intention was also found to be positively related to trust ($r = .83, p < .01$), satisfaction ($r = .77, p < .01$), PU ($r = .58, p < .01$) and PEOU ($r = .53, p < .01$). Thus, H2, H4, H5, H6 were also supported.

Table 2. Hierarchical Regression Analysis of Online Purchase Intention Using Social presence, Trust, Perceived Value, Satisfaction, Perceived Value, Perceived Ease of Use as Predictors

Predictors	Purchase Intention	
	r	β
Social Presence	.64**	.10
Trust	.83**	.52***
Perceived Value	.72**	.25*
Satisfaction	.77**	.21
PU	.58**	-.01
PEOU	.53**	-.09
R ²		.78
Final adjusted R ²		.76

* $p < .05$; ** $p < .01$; *** $p < .001$

Predicting Purchase Intention

In order to answer the first research question, a hierarchical regression was conducted to examine the relative importance of social presence, trust, perceived value, satisfaction, PU and PEOU in predicting online purchase intention. Results presented in Table 2 reveal that trust ($\beta = .52, p < .001$) and perceived value ($\beta = .25, p < .05$) were two important predictors of purchase intention. They combined to explain 76 percent of the variance. While both were important, trust appeared to be a stronger predictor than perceived value. Results also indicate that social presence is not significant in predicting purchase intention in this study. Thus, H1b was not supported.

Analysis of Effects of Website Features

In response to the second research question, a series of one-way ANOVAs was conducted to examine the effects of imaginary interaction elements of emotive text and picture and actual interaction elements of virtual community. ANOVA tests were run comparing PI-1, PI-2 and PI-3 on the aspects of perceived social presence, trust and perceived value, with the underlying logic that the three experimental groups in this study were only differed in terms of personal interaction level, thus any difference across PI-1, PI-2 and PI3 could be directly attributed to the incremental level of personal interaction (as shown in Table 1). Table 3 summarizes the results.

It is showed that the three experimental groups were significantly different in terms of subjects' perception of social presence ($F(2, 57) = 44.91, p < .000$). Specifically, subjects in PI-3 ($M = 27.15$) perceived significantly higher social presence than in PI-2 ($M = 22.05$) and social presence in PI-2 is significantly higher than in PI-1 ($M = 13.75$).

Further, as previously suggested, trust and perceived value were strong predictors of online purchase intention. So next, we explored examining the effects of website features on these two factors. The three groups were significantly different in terms of trust ($F(2, 57) = 8.03, p < .005$) and perceived value ($F(2, 57) = 10.54, p < .000$). Specifically, as shown in Table 3, there were no significant differences for trust and perceived value between PI-1 and PI-2. Hence, while the use of imaginary interaction elements of textual and graphic information did have the impact on perception of social presence, it did not influence the two

predicators of purchase intention found in this study. However, there were significant differences between PI-2 and PI-3 and between PI-1 and PI-3 in terms of trust and perceived value. This finding indicates that in contrast with emotive text and picture, the use of virtual community on website design was a more effective way of increasing users' trust with e-vendor and their perceived value of the website.

Table 3. ANOVA Comparing the Social Presence, Trust, Perceived Value between PI-1, PI-2 and PI-3

	PI-1 Low Mean	PI-2 Medium Mean	PI-3 High Mean	Contrast			Overall F, p≤
				PI-1	PI-2	PI-2 PI-3	
				p≤	p≤	p≤	
Perceived social presence	13.75	22.05	27.15	.000	.001	.000	.000
Trust	14.25	16.50	19.85	.115	.021	.000	.001
Perceived Value	15.70	17.55	20.70	.098	.006	.000	.000
N =	20	20	20				

DISCUSSION

In traditional business settings, Tauber [46] has proposed that consumers' shopping behaviors are significantly motivated by a variety of social needs. Afterwards, with the explosion of e-commerce selling products and services online, Parsons [33] indicated that such social needs for social interaction can also be found within an online shopping environment. However, websites, in their simplest and barest form are low in social presence [15], thus they are difficult to satisfy online shoppers' social needs for social interaction. Hassanein and Head [18] suggested that social presence can be infused into web interface through imaginary interaction elements of socially rich text and picture. Following this line of inquiry, the present study intended to investigate website features that help online shoppers evoke a sense of interaction with other humans and to examine their effects on the predicators of online purchase intention. To accomplish it, in addition to socially rich textual and graphic information suggested by Hassanein and Head, interface feature of virtual community was also selected as it provides means for actual interaction with other humans. We hypothesized that consumers' perception of social presence was a significant predictor of online purchase intention. Results in Table 2 and Table 3, however, indicate that while the selected website features do have influential impacts on it, social presence is not significant in predicting consumers' intention to purchase from an e-commerce website. Rather, trust and perceived value are two important predicators and they are heavily influenced by the selected interface features in this study. Further analysis of the open-ended questions disclosed some interesting insights into our research findings:

- For the low personal interaction website, some subjects commented that it was "ease to use" and presented the product in a "simple and clear" layout that was "convenient to view and understand the main features of the product". Most subjects, however, agreed that "the product information was quite normal that could be found from other electronics product website". This version of website was generally "boring", "of little importance", and at the very least, "lacking trust".
- For the medium personal interaction website, it is interesting to note that the presence of socially rich text was ignored by most subjects. Even for those who had noticed the textual information, comments were made toward the negative end of the continuum due to "a strong advertisement feeling" in description that is "useless in assessing the product". By contrast, the addition of socially rich pictures to web interface were considered as "colorful", "creative", "exciting", "interesting", "entertaining" and "attractive". It offered "a nice shopping experience" that subjects have "an imagination of interacting with the people in pictures" and "a sense of connection with the website". They also consented that it provided more or less additional information useful in assessing the product. Reasons were given like "I am happy to see people showing products in various poses and scenes", "I got some ideas related to the use of the mobile phone" and "it provides me with a new perspective understanding the product". However, socially rich pictures might also be misleading because "they tend to focus on the appearance or style issue of the mobile phone rather than its digital properties". On the other hand, some subjects commented that they "have no trust with the website" as "the sexy girls and the pictures have strong commercial feelings". "I need objective information like other people's comments" another subject said.
- For the high personal interaction website, subjects tended to value high on the addition of virtual community to web interface, the benefits of which can be summarized into three aspects. First, it emerges as "a platform in which consumers can communicate with each other, providing a form of social interaction". The process of viewing other consumers' feedbacks is "interesting" and "quite pleasing". Second, it gives consumers more information. "I can seek for advice from others who have already bought the product". One subject remarked that "it gives me some confidence (in purchase decision)". This website feature becomes particularly "helpful" for laymen because they "need some basic and extra knowledge regarding the product". Third, it helps building trust with the e-vendor. By "displaying other consumers' response", virtual community "reduced the subjective tendency of the website. While some commented that "I am not sure whether these feedbacks are believable" or that "too much information, it makes me upset", the majority agreed that this version of website was "valuable" and "persuasive".

Accordingly, the impacts of socially rich text and picture and virtual community on trust may be attributed to two points. First, trust can only occur within the context of a social environment [3] [15]. Hassanein and Head [18] indicates that in traditional business settings, consumer trust can be established by their assessment of seller's physical investments in geographic location,

decoration and personnel, and the physical evaluation of products can be performed (based on sense of touch or smell). Though absent in an online environment, these factors can be made up with virtual community where potential buyer may seek advice from those who have already bought the product. Second, the addition of these interface features may lead to consumers' belief that the e-vendor is endeavoring to maintain vendor-client relationship and thus increase consumer trust. In other words, the incorporated website features can be viewed as similar to sellers' physical investments in offline environments. Socially rich text and picture and virtual community may impact value perception in a way that provide additional substantial product information that is useful, helpful, and valuable in making purchase decision.

CONCLUSION

Online consumer bears the dual nature of both a traditional shopper and a website user [47]. In traditional business settings, consumers' social needs has long been recognized as a significant motivator of shopping behaviors. The social aspect of shopping has been shown to be a vital contributor to positive emotions [19] [28], which in turn contributes to a series of benefits, for example, increased time spent in the store, increased spending and increased unplanned purchasing [1] [19]. Social motives for shopping can also be found within Internet settings [33]. However, currently, most e-commerce websites are low in social presence, thus keeping online shoppers from interacting with other humans. Following this perspective, past researchers call for a need to improve social presence of e-commerce websites [8] [15] [18]. The present study tentatively indicates that social presence may be less important; at least in this case, it is not significant in predicating online purchase intention. However, it is still worthwhile to enhance personal interaction on e-commerce websites because the addition of social interaction elements to web interface positively impacts consumer trust and perceived value (of the website), two significant predictors of purchase intention in this study. While both are important, trust is a stronger direct predictor than perceived value.

This study confirms earlier work stressing on the importance of trust in e-commerce settings [2] [14] [15] [36]. In response to Teo, Oh, Liu and Wei's [47] findings that perceived value acts as a strong antecedent to attitude towards websites, our results further reveal that it is also highly predictive of online purchase intention. Our findings also show that trust is a stronger direct predictor than perceived value. It provides additional empirical support for Reichheld and Scheffer's [35] proposition that trust rules the web.

Most notably, in order to enhance personal interaction in an online environment, we selected socially rich text and pictures (as suggested by Hassanein and Head [18]) that stimulate imaginary interaction with other humans and virtual community that provides means for actual interaction with other humans. Findings from this study have revealed that the selected interface features positively impact consumer trust and perceived value of the website, which may provide immediate and attainable recommendations for practitioners. In this study, the finding about the positive effects of socially rich pictures on the e-commerce website selling electronic products is inconsistent with earlier research by Hassanein and Head [17]. This disagreement could be attributed to the factor that in our experimental website, a product was presented using more than four emotive pictures which were displayed in the form of Flash. However, practitioners should be cautious about adopting flash because the file size of it has to be optimized for the constraints of consumers' internet bandwidth. The management of virtual community where consumers share shopping and product-use-related experience must be taken into consideration as well. For example, online vendors should provide incentives to encourage consumer to share their relevant knowledge and develop a series of measures to avoid "spam posting" and fake information.

There are a few limitations to the present research. First, only 60 subjects participated in our study. The statistical results may be biased due to the small sample size. Second, all of the subjects are university students. Though the student groups are utilized by the majority of e-commerce studies, they are constrained by a number of issues like economic conditions. Hence, generalizability of the findings to other settings is restricted. Third, though the experimental websites were designed by professionals who have accumulated several years of experiences on e-commerce web interface design, the inherent nature of the experiment was inevitably evident to the participants. Accordingly, asking subjects to indicate their trust, perceived value and purchase intention within an artificial and experimental environment tends to be less meaningful and appropriate.

As B2C e-commerce adoption is a worldwide phenomenon, future studies could be conducted across difference countries. On the other hand, research effort could be put in investigating other social website elements such as "testimony" and other forms of user recommendation system.

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APPENDIX

Social Presence

- SP1 There is a sense of human contact in the web site
- SP2 There is a sense of personalness in the web site
- SP3 There is a sense of sociability I the web site
- SP4 There is a sense of human warmth in the web site
- SP5 There is a sense of human sensitivity in the web site

Perceived Usefulness

- PU1 This web site provides good quality information
- PU2 This web site improves my performance in assessing mobile online
- PU3 This web site increases my effectiveness for mobile assessment online
- PU4 This web site is useful for assessing mobile online

Perceived Value

- PV1 This web site is useful
- PV2 This web site is important
- PV3 This is a user-friendly web site
- PV4 This web site is valuable

Purchase Intention

- PI1 I am likely to buy mobile from iBuy.com
- PI2 I am willing to buy mobile from iBuy.com
- PI3 It's possible for me to consider buying mobile from iBuy.com

Trust

- T1 Even if not monitored, I'd trust this web site to do the job right.
- T2 I can trust this web site.
- T3 I trust the information presented on this web site.
- T4 I feel this online vendor would provide me with good service.

Satisfaction

- S1 I feel satisfied with this web site
- S2 My experience with this web site is very pleasing
- S3 This web site makes me happy
- S4 This web site does a satisfactory job of fulfilling my needs

Perceived Ease of Use

- PEOU1 iBuy.com is easy to use for mobile assessment
- PEOU2 I can quickly find the information I need on this website
- PEOU3 This is a user-friendly web site
- PEOU4 My interaction with this web site is clear and understandable
-

A CONCEPTUAL MODEL FOR NEGOTIATING IN SERVICE-ORIENTED ENVIRONMENTS

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ABSTRACT

Web services have been developed in recent years as a fundamental technique for the new generation of B2B or EAI applications. For their getting more available that imposes a new vision of service-oriented computing, the software industry has shifted its attention on software from developing a product as required to delivering a service on demand. In order to gain the many benefits from such a service-oriented model of software, several critical issues need to be addressed in a service-oriented environment such as differentiation of services with multiple attributes, dynamic selection and provision of services in a supply chain style, and commitment of services with prescribed rules. From the perspective of management, these issues are concerned within a process of negotiating desired services in a service-oriented environment. In this paper, we propose an object-oriented model that specifies such a negotiation process with explicit constructs addressing these critical issues. The model contains an architecture diagram that describes required components and their interactions for fulfilling the negotiation process, as well as a class/sequence diagram that specifies in detail what class objects these components have in order to collaboratively support all required behaviors occurred within the negotiation process.

Keywords: service-oriented model, negotiating, object-orientation, conceptual model

INTRODUCTION

For the rapid advances of Internet technologies in these years, Web services have been developed as a fundamental technique for the new generation of business-to-business (B2B) or enterprise application integration (EAI) applications. Until recently, with their underlying infrastructures such as XML [1,2], SOAP [3], UDDI [4], WSDL [5], WSCL [6], BPEL [7], and BPML [8] getting matured, more Web services have now become available that impose in the literature a new vision of service-oriented computing [9]. For the commonly recognized benefits by taking advantage of such a service-oriented vision [10,11], the software industry has shifted its attention on software from developing a product as required to delivering a service on demand in a service-oriented environment [12]. From the viewpoint of providing services, this means that software services are dynamically selected and delivered for tailoring the needs of an enterprise's business objectives; as one may also recognize, this implies as well many complex behaviors required for achieving the dynamic provision of services in order to deal with such a dynamic and changeable environment on the business/Internet nowadays.

Considerably, for these behaviors required for achieving the dynamic provision of services, their inherent complexity comes from the requirements that address several critical issues in a service-oriented environment. These issues in general include (1) differentiation of services from various providers with multiple attributes such as price, quality, and trust value; (2) dynamical selection and provision of services in a supply chain style where a composite service is possibly composed of a set of constituent services; (3) criticality of time for selecting services where a dynamic selection is required for each service request; (4) volatility of providing services where a service might not be available all the time; and (5) commitment of providing services with prescribed rules such as contract enactment and trust formulation. From the perspective of management, however, these critical issues can be seen as concerned within a process of negotiating desired services in a service-oriented environment [10,11]. It therefore becomes a major focus for all service participants (e.g., service requesters and providers) on imposing adequate mechanisms that support all required behaviors in a collaborative manner to accomplish such a negotiation process with explicit addressing on these critical issues.

Conceptual modeling is an important technique for representing a (part of) complex situation in an abstract manner with concise notations. It has been commonly used, for example, in analyzing and specifying user requirements of a computer-based application, as well as collecting and representing information required for dealing with complex technical and/or managerial issues to be resolved. Thus, to account for those aforementioned requirements, it is not uncommon to think of a conceptual model that specifies the negotiation process with respective constructs to support all required behaviors in dealing with those critical issues. In the literature, many technical discussions related to service-oriented computing and its corresponding negotiation process and considerable issues have already been presented as those in [9-15]. Nonetheless, any thorough conceptual models for specifying these requirements are still few nowadays; such models are indeed needed in that their specifications for these requirements are important in realizing a service-oriented environment – failure to specify these requirements usually results the environment in poor quality and high maintenance costs.

For these necessities, we propose in this paper a conceptual model for specifying the negotiation process with respective constructs to support all required behaviors. In general, conceptual modeling can be achieved by using function- [16-18], data- [19,20], or object-oriented [21-24] ways where the development of object-oriented ones is particularly motivated by the drawbacks and problems in the other two kinds: the significant features and benefits of object-oriented approaches would make

resultant models more abstract and hence easier to be understood, maintained, and reused. As results, our model is object-oriented with UML [25-27] utilized as its modeling tool by taking advantage of such inherent features in the object-oriented paradigm as encapsulation of object specifics and interacted/coordinated nature of object behaviors to make it easier to be configured for an extensive support of specifying these requirements. Particularly, for the specification of the negotiation process, our model contains an architecture diagram that describes required components and their interactions for the fulfillment of the negotiation process. After then, for specifying required behaviors, our model uses class and sequence diagrams that present in detail what class objects these architectural components have in order to collaboratively support the behaviors occurred within the negotiation process.

This paper is organized as follows. Section 2 presents first the architecture diagram used in our model. The class and object sequence diagrams are respectively introduced then in sections 3 and 4. Finally, section 5 has the conclusions and future work.

THE ARCHITECTURE DIAGRAM

In a service-oriented environment, services are dynamically requested and delivered within a negotiation process. For the term negotiation is used in its sense to describe any negotiating among prospect participants for selecting desired services to be delivered by targeted providers. In our knowledge, the discussion in [11] for negotiating in a service-oriented environment presents a sound description about the negotiation process on top of a service-oriented architecture. Based on this idea, our model has first an architecture diagram that supports the negotiation process by imposing specific components required for fulfilling the considerable activities within the negotiation process. Figure 1 shows the most abstract view of our architecture diagram. In this diagram, three components are imposed where each one plays a designated role for participating in the negotiation process.

The service requester

The service requester is responsible for issuing service requests to the selected provider that delivers desired services after its negotiating for these requests with other negotiators (i.e., the service discovery agency and the service provider) has completed such that the service provider is discovered and selected with corresponding contracts signed and enacted. More specifically, for achieving its responsibilities, the requester takes usually the following issues into consideration:

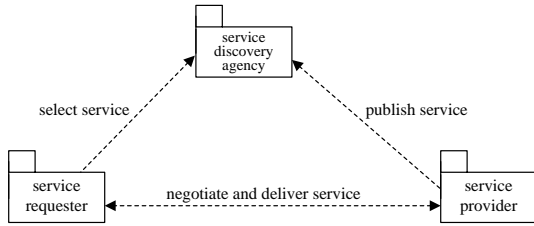


Figure 1: the architecture for negotiating in a service-oriented environment

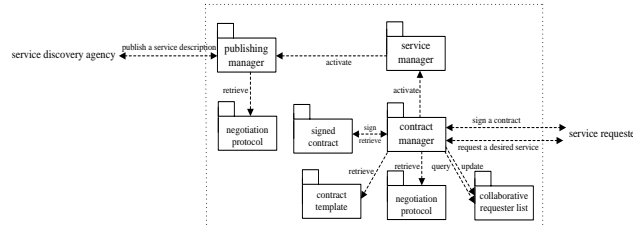


Figure 4: the service provider

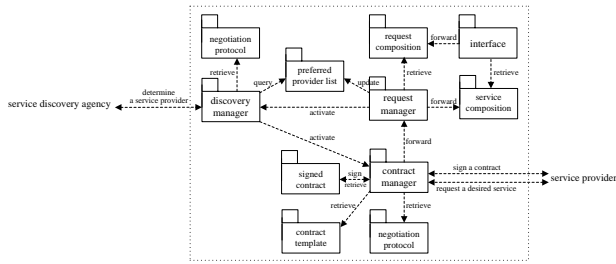


Figure 2: the service requester

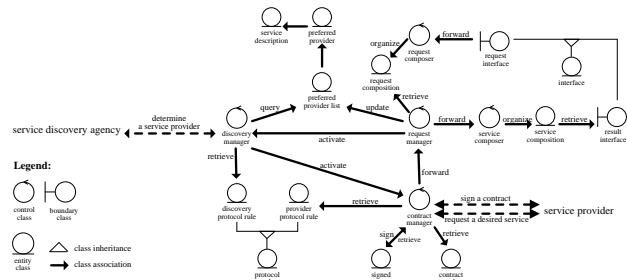


Figure 5: object class diagram for the service requester

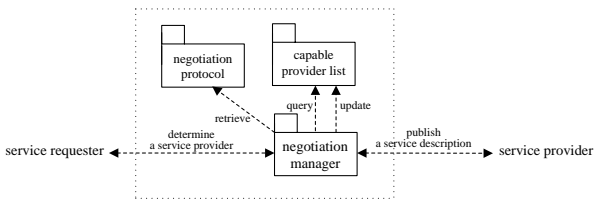


Figure 3: the service discovery agency

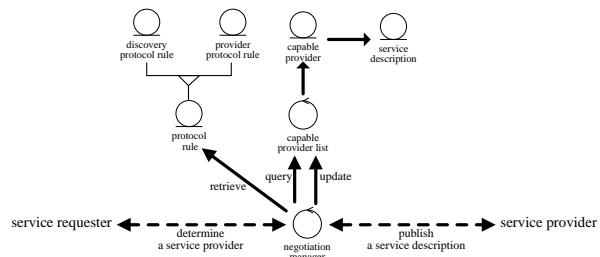


Figure 6: object class diagram for the service discovery agency

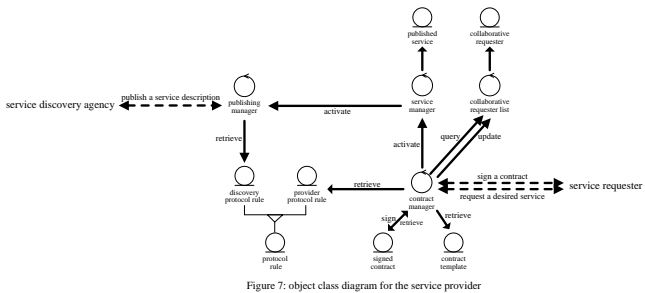


Figure 7: object class diagram for the service provider

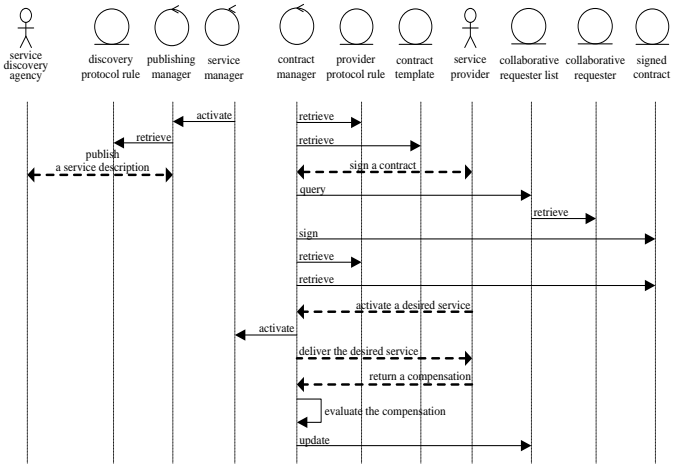


Figure 10: object sequence diagram for the service provider

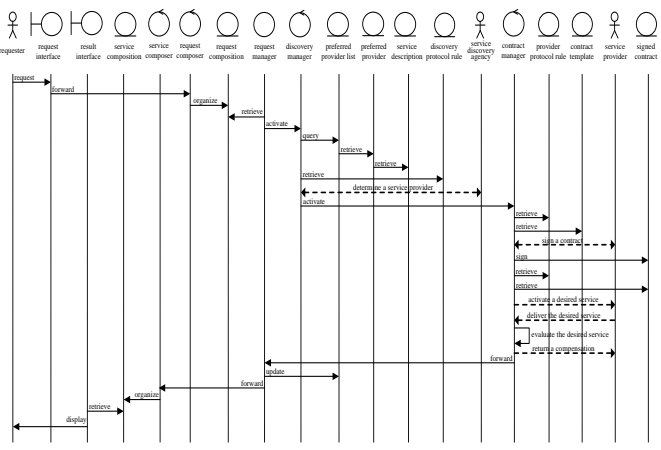


Figure 8: object sequence diagram for the service requester

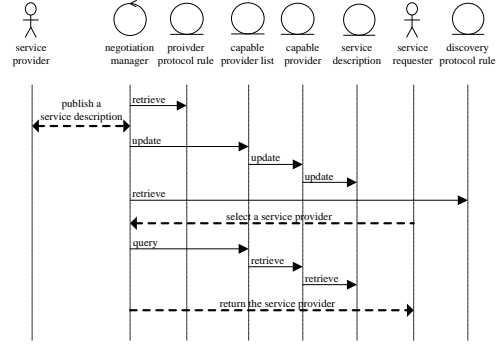


Figure 9: object sequence diagram for the service discovery agency

- (a) for negotiations with the service discovery agency that determines a suitable service provider for satisfying a service request as well as with the selected service provider that responds the service request with delivering the desired service, a least protocol with associated rules to be complied among all negotiators is needed; therefore, the service requester must maintain an interaction protocol for proceeding the negotiations;
- (b) since a negotiation encompasses a number of interactions among negotiators and hence be very time consuming, it is valuable for the service requester to adopt certain approaches that would be able to reduce as many as possible the number of invoked negotiations or to expedite as soon as possible the completion of invoked negotiations; as a common recognition, these approaches include usually (1) keeping a list of preferred providers and their providing services, and then when a request is necessarily issued, determining a selected provider directly and then reaching an agreement with the provider for signing and enacting a contract immediately; or (2) predicting the usage of delivered services based on the pattern of service requests, and then determining a selected provider and preparing a contract with the provider earlier before a request is necessarily issued (thus, the contract can be signed and enacted immediately while the request is necessarily issued);
- (c) since determining a selected provider from a list of preferred providers would be often required for each request, it is valuable for the requester to adopt certain approaches that would be able to expedite as soon as possible the completion of the determination activity; a common approach is to structure the list in a sophisticated way (e.g., in a classified or indexed directory), and then expedite the determination by exploring the list via a convenient access (e.g., traversing the classified or indexed directory);
- (d) service requests may be dependent among themselves due to their resulting from a composite request (e.g., a composite user requirement for achieving a business objective); in such a case, the service requester needs to maintain the relationship among these requests for negotiating and issuing these requests in an adequate sequence and also to deal with the possible consequences from negotiating or issuing these requests (e.g., success to discover and select service providers for these requests or failure to deliver services from these service providers);
- (e) once negotiating for a request has completed and a service provider is discovered and selected, the service requester must sign a contract with the selected service provider; therefore, the service requester must maintain a contract template for completing the signing and enacting of the contract;
- (f) once desired services are delivered under the promises denoted in corresponding contracts, the service requester should evaluate the effects of using these services (i.e., how these services are delivered in accordance with those promises) such that the trust values for the service provider can be updated for helping on the determination of selecting the same (preferred) service provider for further requests;

With the above issues concerned, Figure 2 shows the constituents in the service requester that collaborate to achieve its responsibilities.

The service discovery agency

The service discovery agency is responsible for determining a service provider that provides a service satisfying a desired service request from the service requester. As a common recognition, the determination is based on referring the desired service request to a set of service descriptions published by various service providers. Once that the desired requirements in the service request most suitably refer to a service description is reachable, the service discovery agency returns to the service requester the most suitable service description and its publishing provider. Similar to the service requester, for achieving its responsibilities, the discovery agency takes usually the following issues into consideration:

- (a) for negotiations with the service requester for receiving its service request and determining a suitable service provider as well as with the service provider for accepting its publishing service description and being referred to a service request, a least protocol with associated rules to be complied among all negotiators is needed; therefore, the service discovery agency must maintain an interaction protocol for proceeding the negotiations;
- (b) since determining a suitable service provider from a list of capable ones would be often required for each service request, it is valuable for the agency to adopt certain approaches that would be able to expedite as soon as possible the completion of the determination activity; a common approach is to structure the list of capable service providers that publish intended services in a sophisticated way (e.g., in a classified or indexed directory), and then expedite the determination by exploring the list via a convenient access (e.g., traversing the classified or indexed directory);

With the above issues concerned, Figure 3 shows the constituents in the service discovery agency that collaborate to achieve its responsibilities.

The service provider

The service provider is responsible for delivering its services to the desired service requester after its negotiating for these services with other negotiators (i.e., the service discovery agency for publishing these services and the service requester for delivering these services) has completed such that it is discovered and selected by the service requester with corresponding contracts signed and enacted. More specifically, for achieving its responsibilities, the provider takes usually the following issues into consideration:

- (a) for negotiations with the service requester for receiving its service request and delivering the desired service as well as with the service discovery agency for publishing a service description to be referred to a desired service request, a least protocol with associated rules to be complied among all negotiators is needed; therefore, the service provider must maintain an interaction protocol for proceeding the negotiations;
- (b) since delivering services to a service requester needs proper compensations, the trust values for the requester should be evaluated before delivery for ensuring its qualified collaborative role; therefore, the service provider must maintain a list of collaborative service requesters that possess trusted values for helping on the determination of delivering services to these requesters;
- (c) once negotiating for a service request has completed, the service provider must sign a contract with the service requester for delivering the desired service; therefore, the service provider must maintain a contract template as in the service requester for completing the signing and enacting of the contract;
- (d) once desired services are delivered under the promises denoted in corresponding contracts, the service provider should evaluate also the compensations for delivering these services (i.e., how these services are compensated in accordance with those promises) such that the trust values for the service requester can be updated for helping on the determination of delivering services to the service requester for its further requests;

With the above issues concerned, Figure 4 shows the constituents in the service provider that collaborate to achieve its responsibilities.

THE OBJECT CLASS DIAGRAM

Based on the architecture presented above, an object class diagram is then developed to describe what classes are required for defining objects allocated in architectural components to collaboratively support the behaviors occurred within the negotiation process. In UML, the ingredients in a class diagram can have three kinds of stereotype: boundary, entity, and control classes where a boundary class represents an interface used to interact the application with an actor as a bridge, an entity class models the information and associated behaviors in the real world, and a control class controls the access between interface and entity classes for accomplishing a desired behavior. Figure 5 shows our class diagram for the service requester based on the architectural diagram in Figure 2. It is noticed that as shown in this diagram, various relationships may occur between classes such as association and inheritance. As a common recognition for the object-oriented paradigm, these relationships (together with other features like information hiding in individual classes) are particularly useful for making the application constructed much easier to understand, maintain, and reuse. Figures 6 and 7 present the two class diagrams for the service discovery agency and the service provider based on the architectural diagrams in Figures 3 and 4 respectively.

THE OBJECT SEQUENCE DIAGRAM

With classes identified for creating objects in architectural components to collaboratively support the behaviors occurred within the negotiation process, it is now good time to create an object sequence diagram that specifies how such objects collaborate to realize these behaviors. Figure 8 is our sequence diagram for the service requester based on the class diagram in Figure 5, while Figures 9 and 10 present the two sequence diagrams for the service discovery agency and the service provider based on the class diagrams in Figures 6 and 7 respectively.

For illustration, as shown in Figure 8, the sequence of behaviors supported by objects in the service requester are: after a *'requester'* enters a (possibly composite) request via a *'request interface'*, the *'request composer'* figures out first a *'request composition'* from the request in terms of a sequence of desired service requests to various service providers. This sequence of service requests are then retrieved by the *'request manager'* that activates in turn the *'discovery manager'* for determining service providers that provide services satisfying these requests. For each request, the *'discovery manager'* queries first the *'preferred provider list'* to ensure directly if a *'preferred provider'* can be found that provides a service (published via a *'service description'*) satisfying the request. In the case that none of the preferred providers provides a service satisfying the request, the *'discovery manager'* negotiates with the third-party *'service discovery agency'* (under prescribed *'protocol rules'*) for determining a suitable service provider. After recognizing a suitable service provider by the aid of the *'service discovery agency'*, the *'discovery manager'* activates the *'contract manager'* that negotiates with the *'service provider'* (under prescribed *'protocol rules'*) for the *'signing'* of a *'contract'* (under designated *'contract template'*) to deliver the desired service under the commitment of the *'contract'*. After receiving the desired service, the *'contract manager'* evaluates the effects of using the service and then returns the received service together with the evaluated trust values for the *'service provider'* to the *'request manager'* that in turn updates the *'preferred provider list'* for helping on the determination of selecting the same (preferred) service provider for further requests. Finally, the *'request manager'* returns also the received service to the *'service composer'* that figures out a *'service composition'* to be displayed to the *'requester'* via a *'result interface'*.

CONCLUSIONS

Conceptual modeling is an important technique for representing complex situations in an abstract manner with concise notations. Motivated by the drawbacks in other methods, object-oriented modeling approaches are developed in order to result in a more natural, understandable, and maintainable representation. The method proposed in this paper is based on the most popular UML as its object-oriented modeling tool for an extensive support of the specification about the negotiation process in a service-oriented environment. In order to deal with the modeling complexity for the negotiation of desired services, components/constituents in each negotiator are identified and specified in a top-down fashion. As results, a higher-level architecture diagram is created first that describes required components with each one playing a designated role in the negotiation process. The detailed specification about what constituents these components have and how these constituents participate in various collaborations for achieving the role their containing component plays is then achieved by imposing step-by-step lower-level architecture, object class, and object sequence diagrams. We believe this provides a better way for understanding the negotiation process more naturally and easily. Finally, due to its formal semantics of the object sequence diagram, verification of supporting all required behaviors occurred within the negotiation process can be conducted via formal analysis of the diagram.

The work for negotiating desired services in a service oriented environment has already become a popular discussion. Although some technical researches about it have been done, none of them provides a thorough conceptual model for specifying the negotiation process with considerable issues concerned. In our knowledge, this would usually result the service oriented environment in poor quality and high maintenance costs. Our method presented herein provides an effort on this need by using object-oriented diagrams for specifying architectural components, their containing constituents, objects in these constituents, and how these objects collaborate to support the behaviors occurred in the negotiation process. We believe these diagrams presented in a step-by-step manner are much helpful for specifying those important requirements about requesting desired services and their achievements by negotiating in the service oriented environment.

As the technical issues about Web services are getting rapidly matured in these years, more Web services are expected to be available in the near future and hence a comprehensive mechanism for full supports of such a service-oriented computing environment will certainly become much more desirable. Thus, the development of such a mechanism is a desired field. In our view, using object-oriented techniques together with sound modeling constructs is a promising approach for an effective construction of the mechanism. In our future work, we will explore further some other key issues that our models have not addressed yet, including for an enterprise the recognition of its business objectives and how these objectives are specified and achieved by desired Web services under a committed service-oriented environment. As stated in [29], these issues should also be specifically addressed for keeping an enterprise competitive in a dynamic and changeable business environment on the Internet nowadays by recognizing and achieving its business objectives via the dynamic selection and provision of services in a committed service-oriented environment. Therefore, how to specify them by extending our modeling constructs will be carefully explored. Meanwhile, we will construct a tool to facilitate practical application of our models. These include a design environment for building the high-level architecture diagram and then deriving the detailed object class and sequence diagrams.

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ANALYZING THE PERCEIVED SERVICE QUALITY FACTOR ON CUSTOMER LOYALTY IN BANKING INDUSTRY

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ABSTRACT

Customer loyalty concept has received much attention from both academics and practitioners in different industry. Banking industry is also not excluded and because it has a highly interaction with the customers, getting familiar with this concept would be very important and helpful for managers in defining strategies. According to the previous researches, there are many factors, which influence the customer loyalty. This article tries to define the service quality factor and its influence on the customer loyalty. In order to do this a survey was conducted among bank customers and after analyzing the answers, the results shows that service quality factor can be divided in to two separate factors which are named tangible quality and intangible quality, and both have direct influence on customer

Keywords: Quality, Perceived Service, Loyalty, Bank

INTRODUCTION

Today, a customer loss is a customer gain for a competitor. With so many competitors, companies need to spend as much energy on retaining customers as they do on acquiring them. Businesses that understand churn and invest accordingly will need to invest less in placating dissatisfied customers and less in winning new ones to grow. Businesses that do not will find rivals with better retention machines rapidly overtaking them.

Marketing is also about how to integrate the customer into the design of the products/services and how to design a systematic process for the interaction that will create substance in relationships. In a competitive world, companies have to work hard to gain any added value. They have to work with their customers to discover the new ways for running the business more efficiently for themselves and more effectively for the customers.

Banking has traditionally operated in a relatively stable environment for decades. However, today the industry is facing a dramatically aggressive competition in a new deregulated environment. The net result of the recent competition and legislation is that traditional banks have lost a substantial proportion of their domestic business to essentially non-bank competition. Competition will undoubtedly continue to be a more significant factor. Finding a place in this heating sun becomes vital to the long-range profitability and ultimate survival of the bank. Those banks that are not considering the new atmosphere to build and protect their competitive position will likely become victims of that heating sun [33].

During the past decade, the financial service sector has undergone drastic changes, resulting in a market place which is characterized by intense competition, little growth in primary demand and increased deregulation[9]. In the new market place, the occurrence of committed and often inherited relationships between a customer and his or her bank is becoming increasingly scarce (Levesque and McDougall, 1996). Several strategies have been attempted to retain customers in order to increase customer loyalty, many banks have introduced innovative products and services [22].

Banks begin to realize that no bank can offer all products and be the best/leading bank for all customers. They are forced to find a new basis for competition and they have to improve the quality of their own products/services (prodserv) [32][27].

This paper has two objectives related to customer loyalty in banking industry. First, we analyze empirically whether service quality is one of the antecedents of customer loyalty toward different banks in Iran. Second, we explore the casual direction between service quality and customer loyalty.

To analyze the objectives, we consider two hypotheses as follow;

H1. service quality influence customer loyalty

H2. The greater the service quality, the greater the customer loyalty is.

Prior to developing the relations, we carried out a review of the most important contributions to academic literature about causal relationships between loyalty and service quality.

We reached the conclusion that service quality is the factor affecting the customer loyalty and can be separate in to two factors, which are named tangible and intangible service quality.

The rest of the article is explaining the method and analysis of the research.

LITERRATURE REVIEW

Here the two main factors of this research are going to be explained.

Service Quality

A concept, which is very closely related with satisfaction and loyalty, is perceived quality, and the differences between these have not always been very clearly defined. They have been used on occasion in an indistinct manner. In an attempt to clarify the distinction between satisfaction and perceived quality, [2]consider that satisfaction requires previous consumption

experience and depends on price, whereas quality can be perceived without previous consumption experience and does not normally depend on price. However in circumstances where there is little available information or where quality evaluation is difficult, price can be an indicator of quality. In this sense, [28] starting from [24][25] conceptual model of service quality and service satisfaction, concluded that these constructs are distinct and have different antecedents.

Service quality has been found to have a profound input on customer loyalty as a whole and is defined as the result of the comparison that customers make between their expectations about a service and their perception of the way the service has been performed.

According to [11] service quality is split up into two terms, first the technical quality, which refers to what is delivered to the customer and functional quality, which concerns the end result of the process which was transferred to the customer.

[4] assumed service quality to be “the consumer's judgment about the overall excellence or superiority of a service” [31].

In general, service quality is seen as a critical factors for profitability, and thereby a firm's success. Two underlying processes generally explain the contribution of service quality to profitability. First, service quality is regarded as one of the few means for service differentiation and competitive advantage that attracts new customers and contributes to the market share [29]. Second, service quality enhances customers' inclination to buy again, to buy more, to buy other services, to become less price-sensitive and to tell others about their favorable experiences [29]. For example, Bloemer [9] has pointed out that there is a positive relationship between service quality and repurchase intention, recommendation, and resistance to better alternatives. All these – repurchase intention, recommendation and resistance to better alternatives – are behavioral intentions and constitute customer loyalty.

Service quality has a positive effect on the bottom-line performance of a firm and thereby on the competitive advantages that could be gained from an improvement in the quality of service offering, so the perceived service exceeds the service level desired by customers [11][13].

Loyalty

Asker [3] discussed the role of loyalty in the brand equity process and specifically noted that brand loyalty leads to certain advantages, such as reduced marketing costs, more new customers, and greater trade leverage.

In increasingly competitive markets, being able to build consumer loyalty is seen as the key factor in winning market share and developing a sustainable competitive advantage.

Oliver [25] defines brand loyalty as “a deeply held commitment to re-buy or re-patronize a preferred product/service consistently in the future, thereby causing repetitive same-brand or same brand-set purchasing, despite situational influences and marketing efforts have the potential to cause switching behavior.” This emphasizes the two different aspects of loyalty described in prior studies-behavioral and attitudinal. Chaudhuri and Holbrook [12] suggested that behavioral or purchase loyalty consisted of repeated purchases of the brand, whereas attitudinal loyalty included a degree of dispositional commitment in terms of some unique value associated with the brand. Based on prior studies [21], customer loyalty was defined as the customer's favorable attitude toward a brand, resulting in repeat purchasing behavior.

Based [15][16] IS success model, user/customer satisfaction may be assumed to be the determinant of the net benefit or individual impact (e.g., customer loyalty). Consumer satisfaction is believed to mediate consumer learning due to prior experience and to explain key post purchase behaviors, such as complaining, word of mouth, repurchase intention, and product usage [26][30].

A dissatisfied customer is more likely to search for information for new brand and is more likely to yield to competitor than a satisfied customer.

There are numerous works in marketing that have attempted to explain the relationships between loyalty and the various variables regarded as antecedents. [5] [19] [18][8][14][17][23][1][7][10] [25] [6][21].

Between them two main articles were mostly used. The first one is Beerli et al. in 2004 [6] which is done in banking industry and it shows that the service quality does not influence the loyalty directly and the second article is done by Lin and Wang in 2006 [21] in m-commerce industry and mentioned that service quality influence the loyalty of the customer.

In Beerli model [6] it is mentioned that service quality influence the satisfaction and satisfaction influence the loyalty. It means that these researchers came to this point that service quality has indirect relationship with loyalty.

But in Lin & Wang model [21], which was done in m-Commerce industry, mentioned that service quality has direct influence on loyalty and the coefficient of this relation is 0.36.

METHODOLOGY

A survey was run in order of doing this research. The first 4 banks that have the most market share in the banking industry of Iran, similar to Beerli et al. (2004) [6], were chosen. According to Beerli et al. (2004) [6] and also the statistical results which shows that near to 60 percent of the banking transaction and monetary assessments of Iranian banks are in Tehran, the research was done in the capital. This choosing was because of the time and money limitations. Then for each bank, the same number of branches was chosen randomly. Data were gathered from structured questionnaire, which were given to the same number of respondents at the main door of each branch.

The final sample was consisting of 400 individuals. It is necessary to mention that statistical results of the pilot test shows that having 280 questionnaires is enough for doing the research, but 400 were given to the customers. The item of scales and its reliability measured with Cronbach's alpha and all were above 0.7, and they are mentioned in the next part individually.

To measure the factors individually, five-point Likert scale was used. Then for the relationship between service quality and the loyalty, Lisrel software was used. As it would be discussed in next part, among the statistical analysis of the service quality factors, the results shows that this factor should be divided in to two separated ones.

ANALYSIS

Quality is one of the most important factors which has main role on making a customer loyal or churner. In the banking industry, the product is equal to the service. It means that a customer perceives a service that in the customer's view can be the same as a product of another industry. In previous models the authors considered quality as only one factor. So in this research also at first the quality of the service in banking industry is considered as just one category. After the questionnaires were given to the respondents and I got the filled ones back, by having different analysis on the questions it seemed that it could be divided in to two separate groups. By focusing on the common attributes of each group it became clear that we could break up the service quality in the banking industry into two parts and name them: tangible quality (in which the perceived quality can be seen) and intangible quality (in which the perceived quality can't be seen).

Here are the whole quality questions:

<i>Tangible perceived quality</i>
1. <i>The received interest from the bank is effective to continue my work with this bank.</i>
2. <i>Advertisement in broadcasts or relatives is effective for me to use the services of this bank.</i>
3. <i>This bank's facilities are attractive and modern. (Such as telephone banking, internet...)</i>
4. <i>This bank's employees are tidy in appearance</i>
5. <i>Materials associated with the services are visually clean, tidy, intact, and enough. (Such as pen, chair...)</i>
6. <i>This bank informed me of its side services from the beginning.</i>
7. <i>The opening hours of the bank are convenient to me.</i>
8. <i>My needs and interests are considered in the bank's services.</i>
9. <i>I use this bank because all of its services are available in the branch.</i>
<i>Intangible perceived quality</i>
1. <i>This bank insists on providing the services error-free.</i>
2. <i>Employees of this bank solve your problems when they promise to do so</i>
3. <i>This bank provides its services at the time it promises to do so</i>
4. <i>The bank employees are fast enough in providing the services.</i>
5. <i>Employees of this bank are always willing to help you overcome the problems.</i>
6. <i>Employees of this bank are aware of when exactly services will be performed</i>
7. <i>The behavior of employees of this bank instills confidence in customers</i>
8. <i>Employees of this bank are constantly courteous to you</i>
9. <i>Employees of the bank pay special attention to you.</i>

Table 1: Perceived Quality Questions

The Cronbach's alpha, which was gained from these questions after running the questionnaires, is 0.92 that is a very high one. This means that the questions were reliable and also valid. But having a deeper look at them and considering the situation in Iranian environment and also having the factor analysis could separate these questions separated into two groups. Questions 1 to 9 are in tangible group and the others are in intangible group. Again after separation, Cronbach's alpha was tested. This time the result of the first category was 0.84 and the result of the second was 0.90. They show that the division is done correctly.

By considering the five-point-Likert method and also by considering that "1" is to a very little extent and "5" is to the most extent, table2 shows the mean and variance of the questions which were answered by the customers.

Table 2: Perceived Quality Mean and Std. Deviation Result

	Mean	Std. Deviation
T-Q1	3.33	1.167
T-Q2	3.37	.932
T-Q3	3.63	.989
T-Q4	3.55	1.020
T-Q5	3.42	1.116
T-Q6	3.05	1.064
T-Q7	2.77	1.239
T-Q8	3.03	.978
T-Q9	3.40	1.006
	Mean	Std. Deviation
I-Q1	3.28	1.065
I-Q2	3.46	.970
I-Q3	3.47	.948
I-Q4	3.24	1.165
I-Q5	3.36	1.067
I-Q6	3.33	.945
I-Q7	3.56	.998
I-Q8	3.59	.949
I-Q9	3.18	1.001

Mean column shows the average answers to the questions. In the first category the respondents felt particularly strong about the third question because it has the highest mean in the survey with the average mean of 3.63 and the less highly rated question is the 7th one, with the average mean of 2.77. In the second category the 8th question has the maximum mean and the 9th question got the minimum score.

The table also shows that the modern facilities and also the respect are much more important in the above points, so the managers can increase the perceived quality ratio by considering the points.

Also tables 3 and 4 show the average of means and variances of the questions. Variance and Std. deviation show the spreadness of the answers. The results show that the questions were designed in such a way that most of the customers understand it in the same way.

Table 3: Tangible Quality Average Result

Tangible Quality Category	Mean
Item Means	3.284
Item Variances	1.125

Table 4: Intangible Quality Average Result

Intangible Quality Category	Mean
Item Means	3.385
Item Variances	1.029

In addition to the elements, which were designed and discussed above, some questions are trying to show the loyalty factor directly. Table 5 is showing them.

Table 5: Loyalty Questions

1. *I would always recommend my bank to the others.*
2. *It would be difficult to change my beliefs about this bank.*
3. *I would always use this bank's services.*
4. *I am a loyal customer to this bank.*
5. *I do not like to change to another bank because this bank sees my needs.*
6. *Even if close friends recommended another bank, my preference for this bank would not change.*
7. *My intention to use the services of this bank would not be changed.*

The Cronbach's alpha of the questions is 0.84, which is a very good result.

Table 6: Loyalty Mean and Std. Deviation

	Mean	Std. Deviation
L1	3.63	.858
L2	3.11	.895
L3	3.72	.826
L4	3.48	.946
L5	3.41	1.080
L6	2.95	1.110
L7	2.97	1.005

The results show that highest mean value for the loyalty questions is for the first one; this can help the managers to understand that a loyal person would automatically advertise the services, and it could be an indirect profit program for the banks.

Table 7: Loyalty Average Result

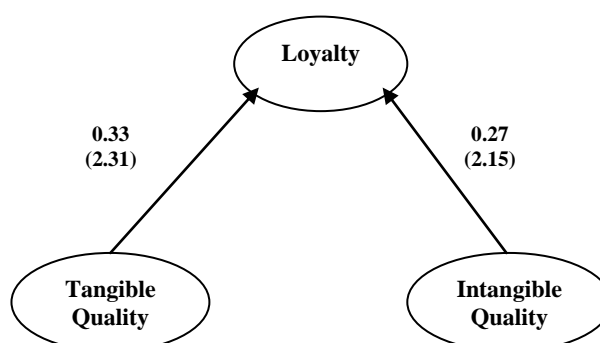
Loyalty	Mean
Item Means	3.323
Item Variances	.932

Also the results show that the questions have the same meaning for the respondents. For finding the relations between the factors, the LISREL software was used. All the questions and the factors were introduced to the software in order to have the factor analysis and also check the links between them.

Table 8: T-value of the factors

Intangible Quality	T-Value	Coefficient	Tangible Quality	T-Value	Coefficient
Q1	14.44	.72	Q1	6.65	.42
Q2	17.45	.75	Q2	7.63	.38
Q3	16.81	.71	Q3	11.44	.58
Q4	16.89	.87	Q4	14.49	.71
Q5	19.73	.89	Q5	15.25	.81
Q6	14.89	.65	Q6	11.61	.62
Q7	14.35	.67	Q7	8.32	.54
Q8	17.34	.73	Q8	13.45	.65
Q9	11.87	.57	Q9	12.42	.63
Loyalty	T-Value	Coefficient			
L1	12.87	.55			
L2	11.02	.50			
L3	13.6	.56			
L4	13.29	.61			
L5	13.05	.70			
L6	15.09	.80			
L7	15.29	.73			

The results of table 8 are made of two parts. First column is t-value that shows the validity of the relationship between each question and the factor. In this research when t-value is greater than 2, it means that the assumption is correct. In the table above all of the results have this attribute so they are trying to estimate their factors.



Model 1: Final Result

The Factors Relationship and Suggestions

After defining the questions and the factors in the software, the relationships between them have been extracted out and explained as below:

As it is mentioned in the previous parts, in the main model, the researchers analyze the quality as one factor. But by having a deeper look at this element, it is found that it could be separated into two factors, and I decided to measure each one as a separate factor.

The first category is about tangible quality. This means the feasible perceived quality in the branches or wherever the customer has the services, for example, the beauty or the neatness of the materials, has influence on the customer loyalty. It is important for the customer to have the financial services in a tidy way. Also the other element that affects this factor is the advertisements and the interest for the customers' investments.

Intangible factor is about the infeasible quality. It also contains behavioral quality, like the respectfulness of the bank's staffs. This factor has also an important relationship with the loyalty of the customer.

Both of these factors got the valid t-value in the analysis, but in comparison the tangible quality has a greater coefficient with loyalty. This shows that the viable perceived quality has a greater role in making a customer loyal or defector.

The perceived quality in the original model has no direct influence on loyalty, while in the perceived model in Iran, both tangible and intangible perceived qualities have influence on loyalty. (Tangible is equal to 0.33 and intangible is equal to 0.27).

CONCLUSION

It is clear that loyalty has a main role in the company success and profit so understanding the elements which influence customer can help the managers to handle their company more proper.

Banking industry is not excluded and because of the nature of this industry, which has very near relationship with the customers, understanding of these elements is more important.

This research tried to find the influence of service quality on the customer loyalty, to do so a survey was conducted and a questionnaire was designed. Analyzing of the gathered data showed that service quality could be separated in to two categories, tangible and intangible one. Analysis was done both statistically and also relationally.

Both have direct relationship with customer loyalty in banking industry and as a result tangible quality has stronger effect on the loyalty.

It shows that managers could define their short and also long term strategies by considering this fact that the perceived tangible and intangible service could make a customer a loyal or a churner. Also the mentioned elements can make the current customer a loyal one. Some limitations were in this research that can be named as time and asset.

Not to let these two influences the research result, according to the statistical analysis, which shows that most of the banking transactions are being done in the capital, this research was conducted in Tehran.

For further research, these factors can be studied in others similar industries and also more factors could be found.

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MEASURING THE RELATIONSHIP UNDER MULTICHANNEL SERVICE QUALITY

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ABSTRACT

Many firms are apt to provide services through multiple channels recently. The trend of multichannel environments is expected to strengthen further as the use of Internet continues to grow and new technologies make available an increasing number of virtual channels of service delivery. Service quality research in traditional services and, more recently, in e-services tends to take a single-channel perspective. This article argues that a multichannel setting provides a broader conceptualization of service quality, and builds on existing research in e-services and extends the relationship quality measurement in marketing.

Keywords: multichannel, relationship quality, service quality.

INTRODUCTION

Many firms are apt to provide services through multiple channels recently. The trend of multichannel environments is expected to strengthen further as the use of Internet continues to grow and new technologies make available an increasing number of virtual channels of service delivery. This growth of services is linked to the proliferation of e-services that operate increasingly in a multichannel environment, combining the Internet with physical facilities, phone, fax, and other channels of service delivery. Many empirical results also suggest that firms integrate traditional channels with Internet-based channels will be more successful than single-channel firms [9][26].

This article is built on existing research in service quality and is to extend the relationship quality measurement in marketing. In the context of marketing, researchers have even argued that service quality may be the most important determinant of long-term success [23][36]. As a result of bloom in service industry, customers are less willing to tolerate poor service and switch to other firms' products or services easily. Thus, to provide high service quality continually becomes a principal source of competitive advantage in practice. In academic research, there are also several articles mention that service quality will affect the customer satisfaction, trust and loyalty [8][27][34].

However, service quality is susceptible to different situations. Since it is not easy to evaluate service quality via single dimension, some scholars classify it into virtual and physical quality [28]. Additionally, they put emphasis on how the physical and virtual components of service quality are delivered for providing good levels of service quality. Although we understand service quality is associated with multichannel services, we still have no idea how the multichannel services affect the relationship with users from the firm's standpoint. For instance, Venetis and Ghauri indicates an interesting avenue for further research is to investigate which dimensions of customers' quality perception contribute to their relationship [31]. Roberts, Varki and Brodie also suggest future research could measure users' ability to maintain a relationship, and this would enable firms to segment their markets [21]. Thus, we attempt to investigate the relationship quality through multichannel services.

Why the relationship quality is so important? Some articles prove that relationship quality can reflect the users' trustworthiness, reliability, intention, and it also represents a measurement of successful long-term relationships with customers [16][17]. More strength of the relationship quality will be greater benefit to the firm. For example, satisfied customers tend to re-purchase products from the same supplier. The customers will have a long and satisfactory relationship with the firms, even a single unsatisfactory experience will not influence their relationship [25]. Colgate and Stewart also mention the prerequisites for successful relationship marketing and management are that the organization is trustworthy and has the ability to measure relationship performance [6]. Though we appreciate the importance of relationship quality, few articles mention relationship quality under multichannel services. Hence, this study tries to explore the direct and moderator effect between relationship quality and multiple channel services.

Our research questions contain three parts: (1) Do the virtual and physical channel services affect firm's relationship quality with users? If so, how? (2) Does the integration of cross channel services also affect relationship quality? (3) How the self-efficacy or frequency of channel use play a moderate role in relationship quality outcome? And does it affect another channel's outcome?

CONCEPTUAL FRAMEWORK AND HYPOTHESS

Our primary research question combines elements of the virtual channel service, physical channel service, and relationship quality literature. We examine relationship quality that is associated with three constructs, including virtual channel services, physical channel services and the integration of both channel services. Furthermore, we investigate some variables that can possibly have moderate effect between the channel service and the relationship quality, such as self-efficacy of virtual service, frequency of physical channel use and frequency of virtual channel use. Following are our definitions of those constructs:

Relationship quality

Relationship quality is used for measuring the interpersonal influence in marketing research, and it has been defined as the "degree of appropriateness of a relationship of fulfill the needs of the customer" [14]. In a interpersonal perspective, high

relationship quality means that one person is able to rely on another person's integrity and has confidence in the future performance because the level of past performance has been consistently satisfactory [7]. Relationship quality represents a measurement of successful long-term relationships with customers [17].

Relationship quality is a high order construct made of several distinct, though related dimensions. Crosby, Evans and Cowles specify relationship quality as a construct consisting of satisfaction and trust [7]. Morgan and Hunt identify commitment and trust as key variables that are critical to the management of relationship marketing [17]. Bauer, Mark and Leach provide a relationship construct of building customer relation on the Internet, which consists of satisfaction, trust and commitment [3]. Similarly, there are some researchers also recognize the overall satisfaction, trust and commitment as key mediating constructs in successful relational exchanges [12, p.74]. *Satisfaction* is the result of a process of evaluation and is benefit for relationship development [3]. *Trust* as "a willingness to rely on an exchange partner in whom one has confidence." Trusting beliefs represent a "sentiment or expectation about an exchange of partner's trustworthiness". An expectation of trustworthiness results from the ability to perform expertise, reliability, and intention [16]. Morgan and Hunt define trust as the perception of "confidence in the exchange of partner's reliability and integrity." [17] Both definitions highlight the importance of confidence and reliability in the conception of trust. Furthermore, Moorman, Zaltman and Deshpande recognize *commitment* as "an enduring desire to maintain a valued relationship" [16]. Morgan and Hunt also define commitment as an essential ingredient for successful long-term relationships [17].

Base on those articles, (1) *satisfaction*, (2) *trust* and (3) *commitment* usually represent the properties of relationship construct, and we decide to use those three aspects to describe the relationship quality. Besides, Roberts, Varki and Brodie summary the dimensions of relationship quality that have been proposed from 1970, and their empirical results also suggest relationship quality as a high order construct consisting of satisfaction, trust and commitment, so we believe those three dimensions are suitable be our measurement [21, p.174].

Multichannel services

Sousa and Voss define multichannel service as a service composed of components (physical and/or virtual) that are delivered through two or more channels. The channels involve complement each other in the provision of the service, Sousa and Voss categorize these service offers as being *complementary channels*, such as e-commerce service with a logistics component. Alternatively, customers can decide to employ in engaging in a particular service as being *parallel channels* [28].

In a multichannel setting, Sousa and Voss recognize service quality comprises three components: virtual (e.g. Web site), physical (people-delivered, including logistics), and integration quality (seamless service experience across channels), they denote the future empirical work is needed to develop measurement instruments for virtual, physical, and integration quality based on the respective proposed construct domains [28]. For this reason, we believe our study is worth exploring. The detail description of each channel will be discussed in the next sections.

Virtual channel services

In Sousa and Voss's definition, virtual service is defined as the pure information component of a customer's service experience provided in an automated fashion and without human intervention [28]. With most virtual channels encompass more than the Internet, several instruments have been developed to assessing the quality of Internet portal, such as Web quality. Up to this context, we also anchor our discussion on the Internet as the present main virtual channel of service delivery.

Zeithaml, Parasuraman and Malhotra first synthesize the quality of electronic services (E-S-QUAL), and define broadly the concept of all phases of a customer's interactions with a Web site: the extent to which a Web site facilitates shopping, purchasing, and delivery [35][36]. E-S-QUAL Scale consists of 22 items on four dimensions, which are defined as (1) *Efficiency*: The ease and speed of accessing and using the site; (2) *Fulfillment*: The extent to which the site's promises about order delivery and item availability are fulfilled; (3) *System availability*: The correct technical functioning of the site; (4) *Privacy*: The degree to which the site is safe and protects customer information.

Zeithaml, Parasuraman and Malhotra's definition refers to the ability of an online retailer's Web site to fulfill the customer trouble-free shopping needs. Nevertheless, Gummerus et al. indicates that E-S-QUAL only focus on the issues of online shopping, and their definition may neither suitable for overall electronic services nor content-based services [13]. Hence, Fassnacht and Koese expand the definition and propose a quality of e-services (QES) with three dimensions, as the dimension (1) *environment quality* is related to the appearance of the user interface, such as text, icons, digital images, and backgrounds to which are visually represented. (2) *Delivery quality* contains not only the interaction between customer and Web site during service usage, but also aspects that are relevant to the customers while they are looking for information, selecting from available options or carrying out transactions. (3) *Outcome quality* is viewed as how the customer feel after service delivery, including their functional benefit and positive emotional feelings [11].

Aladwani and Palvia develop a Web quality (WebQUAL) instrument to assess user-perceived service through virtual channel. The instrument measures four dimensions of web quality: (1) *specific content*, (2) *content quality*, (3) *appearance*, and (4) *technical adequacy*. *Specific content* reflects concerns relating to finding specific details about products and services, customer support, and other important information. *Content quality* consists of information usefulness, completeness, accuracy, and conciseness. *Appearance* means the proper use of fonts, colors, multimedia, and other Web site's attractive factors. *Technical adequacy* reflects to the security, ease of navigation, search facilities, and availability [1].

Similar to what Aladwani and Palvia indicate [1], Yoo and Donthu also develop an instrument to measure quality of an Internet shopping site (SiteQUAL), it includes four dimensions as (1) *Ease of use*: easy to use and search related information; (2) *Aesthetics design*: the Web appearance with excellent multimedia and color graphics; (3) *Processing speed*: interactive

responsiveness to a consumer's requests; and (4) *Security*: concerns about the security setting and privacy protection of the Web site [33].

According to the instruments above, we know quality of virtual channel services have been developed by several measurements, and some researchers mention that quality of virtual channel services is associated with customer's outcome, i.e. individual benefit [11]. Besides, some researchers demonstrate EC channel service quality will positively affect channel satisfaction and performance, and channel satisfaction is an important construct in studying channel relationships because it affects participants' motivation to stay with the channel and makes them less prone to exit the channel [10]. Taylor and Hunter further prove that e-service quality will affect user satisfaction, loyalty and word of mouth [30]. Since, we want to further examine whether quality of virtual services will affect its relationship quality, further we test the following hypothesis.

H1. The quality of virtual services is positively related to relationship quality.

Physical channel services

Quality of physical services is used to denote the quality of a firm delivery service via physical channel, such as real personnel support. In Sousa and Voss's definition, physical service is defined as the portion of a customer's service experience provided in a nonautomated fashion [28]. Additionally, Parasuraman, Zeithaml and Berry first develop an instrument for measuring customer perceptions of service quality – SERVQUAL [19][20]. Afterwards, a number of published studies use SERVQUAL and assess the scale's reliability and validity [5].

SERVQUAL includes five dimensions – *tangibles*, *reliability*, *responsiveness*, *assurance*, and *empathy*. The definition of *tangibles* is a firm's physical facilities, equipment and appearance of personnel. *Reliability* means the ability to perform the promised service dependably and accurately. *Responsiveness* denotes the willingness to help customers and provide prompt service. The definition of *assurance* is the employees' knowledge, courtesy, and ability to inspire trust and confidence. *Empathy* represents caring and individualized attention the firm provides for its customers.

So far, SERVQUAL is still widely applied to measure firm's service, and a great deal of empirical studies verify SERVQUAL is related to customer satisfaction, behavior intention and relationship (e.g. [22][29]). Zeithaml, Berry and Parasuraman propose the results of an empirical study suggesting strong evidence of behavioral intentions (e.g. customer loyalty) being influenced by service quality [34]. Shemwell, Yavas and Bilgin believe delivering high quality service and having satisfied customers are viewed as indispensable for gaining a sustainable advantage in today's competitive milieu. Their research results also show that service quality has a strong direct effect on satisfaction, and further affect commitment [27]. Dabholkar and Overby denote that most of users said they first evaluate service quality and then decide if they are satisfied. In contrast, only few people preferred the opposite order, i.e. deciding if they are satisfied and then basing service quality evaluations on that determination [8, p.21]. Thus, the frequency distribution suggests that service quality as antecedent to customer satisfaction is the typical order of service evaluations.

Hence, we believe that SERVQUAL is suitable for being a physical service measurement in our study. To further examine whether relationship quality would affect relationship quality or not, we test the following hypothesis.

H2. The quality of physical services is positively related to relationship quality.

Integration of cross channel

Although a huge amount of articles have demonstrated that both physical and electronic channel service are important determinant of providing customer products or services, the integration and consistence of both channel are also deserved to pay much attention by us. Such as Neslin et al. denote multichannel customer management presents a myriad of challenging issues that need to be addressed - data integration, channel migration, allocation of resources across different channels, and synchronization of channel strategies [18]. However, we mainly concern about the *consistency* of channel integration, which contains two components representing the *content* and *process consistency*. Content consistency refers to the consistency between the information exchanged with the customer through different channels, and process consistency refers to the consistency between the relevant and comparable process. For example, users would have negative perceptions of service quality if there were inconsistency among information and services of both channels. On the contrary, firms and users (or customers) would benefit from the integration of cross channel – (1) Increasing the transparency of the multichannel configuration [28]; (2) Users easily can choose either channel services depending on their interesting and requirement [24, p.118]; (3) Firms can provide users with more consistence services; (4) Firms could share the channel workload equally.

Bendoly et al. consider the role that perceptions of channel integration have on such beliefs and their impact on purchasing decisions (e.g., repurchase), and their findings suggest that firms simultaneously managing both online and in-store channels should not only reassess the repercussions of availability failures but also consider efforts that encourage the transparency of channel integration [4]. Thus, this mentions us that integration of cross channel might bring the opportunities of encouraging customer behavior [18]. We test the following hypotheses.

H3. The integration of cross channel services is positively related to relationship quality.

Moderate variables

In this study, independent variables (quality of virtual/physical channel service) are chiefly concern with users' behavior; users might have different perceptions according to their experience and condition. For instance, people who use e-services frequently might be more aware of quality of e-service than those who use e-services infrequently. We take into account that some variables might have moderate affects between independent and dependent variables, and further affect the result of relationship quality. Therefore, we summary the four variables that might have moderate effects – *Self-efficacy of virtual service*, *frequency of virtual channel use* and *frequency of physical channel use*.

Self-efficacy of virtual service. This variable means the experience of users who use the e-service functions, which is also called *deftness*. This idea comes from the social cognitive theory [2]. Performance successes strengthen self-beliefs of capability. Failures create self-doubts. However, if people experience only easy successes, they come to expect quick results and are easily discouraged by failure. People's beliefs about their efficacy can be developed by influence. The most effective way of creating a strong sense of efficacy is through mastery experiences [32].

Why this idea is worth to consider in our study? For example, maybe some of people has no experienced of using e-services at all (low self-efficacy on virtual service), they might decide to withdraw and turn to physical service, and further moderate the final research outcome. However, self-efficacy has been empirically extended to contexts and shown to have strong association with performance outcome [32]. Thus, we stated in hypotheses:

H4a. Self-efficacy of virtual service will moderate the quality of virtual service on the relationship quality: the effect will be stronger when self-efficacy is high and weaker when self-efficacy is low.

H4b. Self-efficacy of virtual service will moderate the quality of physical service on the relationship quality: the effect will be weaker when self-efficacy is high and stronger when self-efficacy is low.

Frequency of virtual/physical service use. Dissimilar to “self-efficacy of virtual service”, frequency means the number of use times within a particular period, such as one year. The main discrepancy between them is “self-efficacy of virtual service” emphasizes the users’ past experiences of virtual service, but “frequency of virtual/physical service use” highlights the number of virtual/physical service use times. For instance, maybe some users may be familiar with using e-services, but they are hardly using them. That might has different influence in the perception of relationship quality or other constructs. We divide this concept into frequency of virtual service use and physical service use, therefore predict:

H5a. Frequency of virtual service use will moderate the quality of virtual service on the relationship quality: the effect will be stronger when frequency is high and weaker when frequency is low.

H5b. Frequency of virtual service use will moderate the quality of physical service on the relationship quality: the effect will be weaker when frequency is high and stronger when frequency is low.

H6a. Frequency of physical service use will moderate the quality of virtual service on the relationship quality: the effect will be weaker when frequency is high and stronger when frequency is low.

H6b. Frequency of physical service use will moderate the quality of physical service on the relationship quality: the effect will be stronger when frequency is high and weaker when frequency is low.

Figure 1 provides an overview of our research framework.

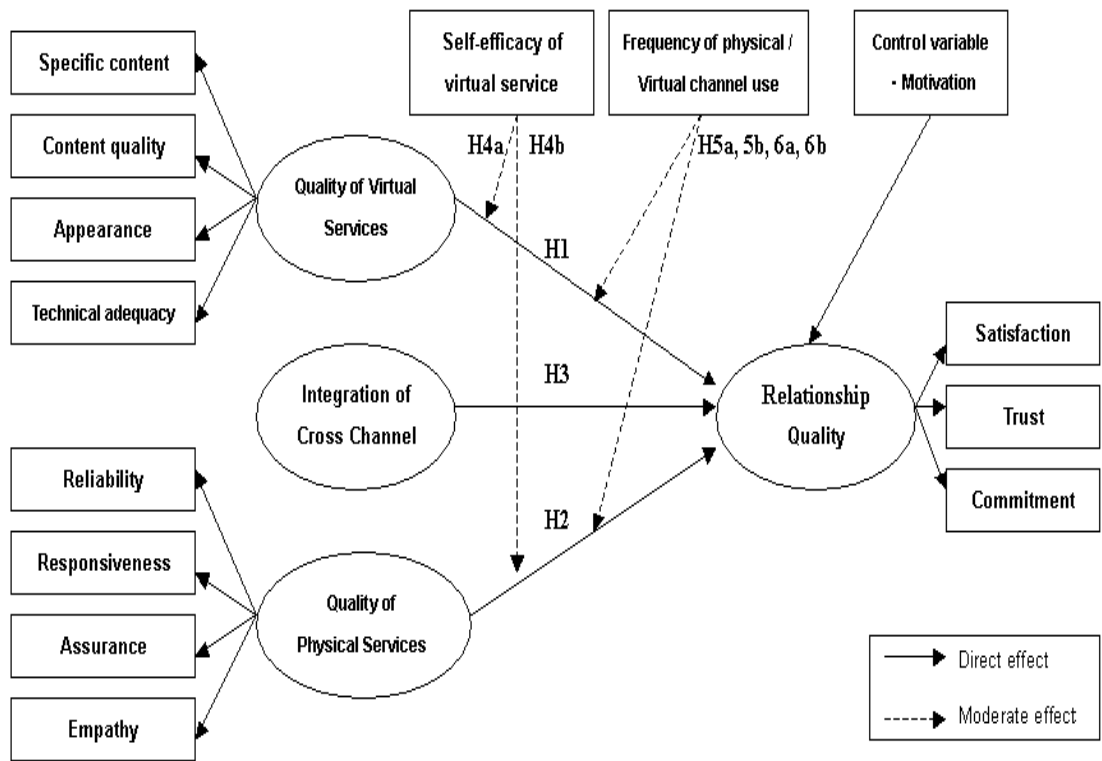


Figure 1. A framework of measure relationship quality in multichannel services

METHOD

Research object and sample

Our research objects are the alumni of Fu-Jen University in Taiwan. The Fu-Jen University has been established more than 40 years, and the amount of the alumni is more than 130,000 persons. The Public Affairs Office (PAO) of Fu-Jen University is an institution responsible for alumni services, and its officers felt the service tasks became more and more heavy because of increasing population of alumni each year. In order to share some tasks, PAO decided to establish an e-service channel on Web. In Sept. 2003, PAO totally hold the three seminars and invited the principal, dean, all the chief managers of department, secretaries,

and major represents of alumni to attend, then PAO illustrated the main purposes of e-service to let them participate in our plan and encourage alumni to use it. In Nov. 2003, e-service of alumni had formally started.

The e-services of PAO include providing alumni to contact other alumni service, helping alumni to seek lost-contact alumni, providing alumni to seek talent pool, updating personal contact data, helping to apply for diploma of graduation and so on. Alike, the PAO also provide those services in physical channel (face-to-face), thus the multichannel setting of PAO belongs to *parallel channel*.

Although university belongs to nonprofit organization (NPO), there are no powerful motivations that school should provide services for alumni, but universities in Taiwan are faced with a radical restructuring, resulting from the government education policy of the unrestrained establishing colleges and universities. According to the report of Ministry of Education from 1998 to 2006 [15], the amount of universities increase 19% (137-163). Thus, they are faced with financial problems and survival issues, such as insufficient students enrollment and diminishing government subsidization. However, most universities in Taiwan are still mainly dependent on public financing, and educational funds are drying up which is due to the general tightening in governmental budgets. There is no doubt that university's enlisting alumni's help is the most efficient way to solve those problems, but the PAO indeed has to provide services and evaluate it's relationship quality with alumni. Therefore, we believe that university is also suited to be a research object.

To let most of alumni get used to e-service, this study uses some ways to assured. (1) We established an administration process: while students are going to graduate, secretaries of department will ask them to use this e-service and make sure they had corrected their personal data. This way also reminded students that there are e-service for them, and they can still use this service even they graduated. (2) During every annual alumni activity, PAO encouraged alumni, who had graduated for many years and have not learnt of this e-service, to use e-services. (3) To make sure most alumni own the experience of e-service use, we decide to provide e-service last for more than 3 years, then finally conduct this survey.

Our research samples only focus on the alumni who have service experience with PAO, service experience in the other departments of university are not include in those because that is hard to investigate via all the departments. This study chose a web survey, the research sample were the alumni who have been serviced by physical or virtual services, and the survey has 46 questions. Our final sample consisted of 862 alumni. Approximately, 54% of the respondents are females, and 46% are males; 57% of the respondents were graduated in near 4 years, and 43% were graduated more than 4 years.

MEASURE

Construct variables

Quality of virtual services. In the quality of virtual service, as our research object is a NPO institution (university), we do not take account of the instruments that is suitable for business context, such as online shopping. Finally, we decided to use WebQUAL instrument to present our quality of virtual service construct, because PAO's e-services was implemented on Web site, and WebQUAL was also suitable for our research context [1]. We total use 15 items to measure this construct, and the sub-dimensions of WebQUAL as *specific content* (2 items), *context quality* (3 items), *appearance* (5 items) and *technical adequacy* (3 items).

Quality of physical services. SERVQUAL is often used to measure service quality in numerous articles, so we also adopted it as our instrument. Deserve to be mentioned in our study, expect "tangible" sub-dimension, other four sub-dimensions - *reliability* (2 items), *responsiveness* (2 items), *assurance* (1 item) and *empathy* (2 items) are include in our construct, like Parasuraman, Zeithaml Berry's definition, "tangible" is appropriate for face-to-face service delivery (such as appearance of personnel) [20], the PAO usually provides physical service via FAX or phone, e.g. alumni reissue a graduation certificate via phone, and hardly through face-to-face. In another reason, if alumni were at school, they could fulfill their requests by themselves, and there was no need to ask PAO for help.

Integration of cross channel. The PAO's channel services are like *parallel channels* [28], alumni can choose any channel that could fulfill their tasks, and acquire the same outcome from both channels. To measure this construct, we asked alumni, "Provided service is consistent between physical and virtual channel" and "I can freely choose physical service and virtual service depending on my demand" two questions - to articulate the integration concept.

Relationship quality. *Satisfaction*, *trust* and *commitment* usually represent the properties of relationship construct (i.e., [21]), so we decide to use those three aspects to describe the relationship quality (totally 9 items).

Moderate variables

Self-efficacy of virtual service. To measure the self-efficacy of e-services, we asked alumni, "How many e-service functions have you operated?" If the alumni didn't have any experience before, the system will request him to link other pages and introduce him the basic functions of e-service. For we wanted our samples to understand our virtual services, we asked them to use at least one function in our e-services. The response items were multiple checkbox, and after gathering samples, we transform this item range from 1 to 5 (1 means only use 1 function; 5 means use more than 5 functions).

Frequency of virtual/physical service use. We divide "frequency" into two parts - the frequency of (1) virtual and (2) physical services to discriminate the channel difference. For instance, we asked alumni, "How many times did you use physical services per year?" The response ranged from 1 to 6 (1 means never used before; 6 means used more than three times per year).

Control variable

Motivation. To measure alumni's motivation for maintaining relationship with the university, we used "the times of participating campus activities after they graduated from university" to represent their perception. In another words, alumni who participated in campus activities frequently denoted they were enthusiastic about keeping and maintaining relationship with university even they graduated. We also use 1-6 scale item, 1 represents they participated infrequently; 6 represents participated frequently.

RESULTS

To ensure the appropriateness of our framework, we first computed reliability coefficients using Cronbach's alpha. The alpha values for quality of virtual service (QVS), quality of physical service (QPS), integration of cross channel (ICC), and relationship quality (RQ) as 0.938, 0.96, 0.811, and 0.931, respectively. Subsequently, we used confirmatory factor analysis to access construct reliability and validity. All constructs show good internal consistency, with construct reliabilities ranging from 0.86 to 0.97, as well as convergent validity, with average variances extracted ranging from 66% to 87%. Table 1 shows the results of discriminant validity, the extent to which a given construct is different from other constructs.

The hypotheses were tested using regression analysis (ordinary least squares: OLS). Table 2 provides the means, standard deviations, and correlations for the variables used in the models. As the result of the correlation of QPS and ICC exceeds 0.8, we also tested the multicollinearity among the QPS, QVS and ICC. The variance inflation factor (VIF) is 3.66 (less than 5), it indicates there is no high degree of multicollinearity among those independent variables. The regression results are presented in Table 3 and depicted in Figure 2. In Table 3, model 1 included all the moderate variables, and model 2 only included significant variables.

Table 1. The result of discriminant validity

	QVS	QPS	ICC	RQ
QVS	0.84			
QPS	0.58	0.91		
ICC	0.63	0.83	0.87	
RQ	0.70	0.65	0.70	0.88

Table 2. Descriptive statistics

Variables	Mean	S.D.	1	2	3	4	5	6	7
1. SEL	1.53	0.76							
2. MOT	1.87	1.11	0.185**						
3. FRE_V	3.02	1.28	0.261**	0.234**					
4. FRE_P	1.88	1.33	0.102**	0.133**	0.147**				
5. QVS	4.31	0.82	0.099**	0.080*	0.217**	0.071*			
6. QPS	4.12	0.93	0.071*	0.026	0.177**	0.230**	0.583**		
7. ICC	4.33	0.94	0.066	0.073*	0.168**	0.161**	0.632**	0.833**	
8. RQ	4.78	0.81	0.071*	0.083*	0.214**	0.089**	0.707**	0.646**	0.705**

n = 862 (* $p < .05$; ** $p < .01$; *** $p < .001$)

Table 3. The results of regression analysis

Variables	Model 1	Model 2	Hypothesis Test
QVS	4.423(.000***)	5.454 (.000***)	H1 supported
QPS	1.981(.048*)	2.339(.020*)	H2 supported
ICC	8.620(.000***)	8.649 (.000***)	H3 supported
QVS x SEL	-.215(.830)		H4a not supported
QPS x SEL	.044(.965)		H4b not supported
QVS x FRE_V	2.668(.008**)	2.670 (.008**)	H5a supported
QPS x FRE_V	-2.313(.021*)	-2.315 (.021*)	H5b supported
QPS x FRE_P	2.356(.019*)	2.020(.044*)	H6a supported
QVS x FRE_P	-2.209(.027*)	-2.194(.029*)	H6b supported
MOT	-1.480(.139)		
Likelihood-ratio	140.216(.000***)	199.911(.000***)	
Adjusted R^2	0.618	0.618	

(* $p < .05$; ** $p < .01$; *** $p < .001$)

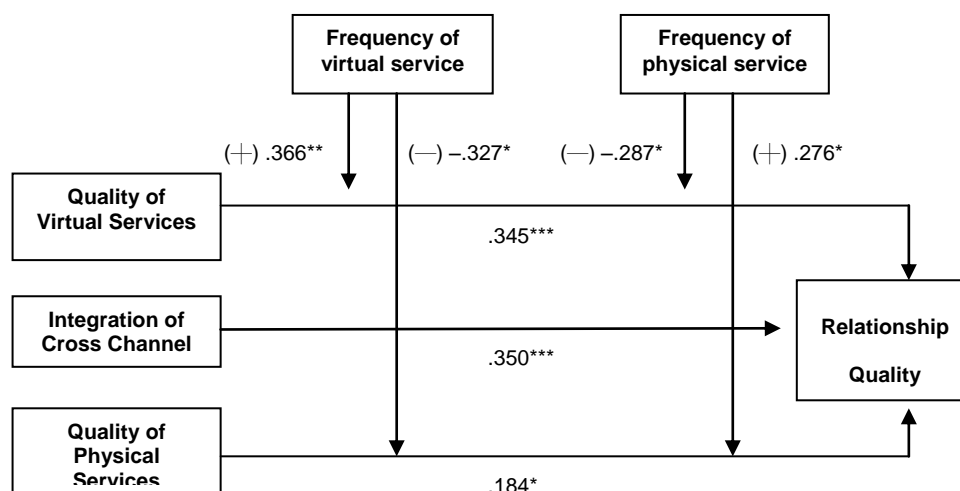


Figure 2. The results of research framework

Hypothesis 1 predicts a positive link between quality of virtual service (QVS) and relationship quality (RQ). The relationship is positive and significant ($\beta = .345, p < .001$), supported Hypothesis 1 as well. Hypothesis 2 and 3 state the same results: quality of physical service (QPS) positively and significantly affect relationship quality ($\beta = .162, p < .05$), and integration of cross channel (ICC) also have positive link with relationship quality ($\beta = .303, p < .001$).

On the predicting moderate effect of our research, self-efficacy of virtual service (SEL) does not have moderate effect between virtual/physical services and relationship quality, and neither motivation (MOT) nor direct effect to relationship quality, so Hypothesis 4a, 4b are not supported. On the other hand, Hypothesis 5a and 5b state frequency of virtual service (FRE_V) plays a moderator role in virtual/physical service and relationship quality, QVS positively affects relationship quality when FRE_V is high ($\beta = .044, p < .01$), but QPS negatively links with relationship quality when FRE_V is high to the contrary ($\beta = -.040, p < .05$). However, Hypothesis 6a and 6b are also supported: frequency of physical service (FRE_P) has a moderator effect between virtual/physical service and relationship quality, QVS is negatively linked with relationship quality when FRE_P is high ($\beta = -.036, p < .05$), and QPS is positively linked with relationship quality when FRE_P was high ($\beta = .034, p < .05$).

Overall, model 1 examines 61.8% variance of relationship quality, and chi-square test is significant ($F = 140.216, p < 0.001$); then model 2 only includes significant variables, and its result is also similar to model 1, explaining 61.8% variance and chi-square test is significant too ($F = 199.911, p < 0.001$).

DISCUSSION AND CONCLUSION

The main contribution of our study lies in providing an insight into how the channel services shapes relationship quality outcomes. There are several major findings in our results. First of all, it shows virtual channel, physical channel, and integration of both channels are equally important for firms to keep relationship. Firms should carefully consider their service management when they develop it in a multichannel context, for any service channel could possibly influence the final relationship outcome and it should not be ignored from services development process. Moreover, firms also have to pay attention to the integration of both channels, such as consistency. It is essential to provide the equal quality of channel services and information, especially when virtual channel and physical channel are parallel.

Second, the most interesting part of this study is that “frequency” plays a moderator role in the evaluation between channel service and relationship quality. In our results, if users were getting used to use virtual service, the importance of the quality of virtual service will increase in affecting relationship quality, whereas, the importance of physical service quality will diminish. If users were becoming used to use physical service, the effect will be reversed. As the service design of our research object belongs to parallel channel, the result might not be the same if users were asked to use both channel (complement channel) at the same time, and other scholars may enrich this part in the future.

Third, self-efficacy of virtual service is not significant for relationship quality. We believe the major reason is that PAO’s e-service functions were fit to ease of use, and self-efficacy (or experience) would not have the moderate effect between channel services and relationship quality; Furthermore, motivation have no direct effect in our analysis, because alumni’s motivation is not a determinant factor in deciding whether to keep relationship with university or not. After further testing, we found there is no differentiation in relationship quality outcome among each motivation subgroup ($F = 1.722; p = 0.127$).

This article also reveals some limitations, and the major issue is self-selection bias, because alumni fill in the questionnaire by themselves, which represents they are willing to keep touch with university. Even so, our sample still shows 76% of alumni originally seldom partake in university activities after they graduated, then we believe self-selection bias is restricted for our

sample.

This article has implications for management. To begin with, this article shows how the service quality plays a decisive role in the overall evaluation of relationship quality. Next that, managers need to aware that each channel could possibly influence the whole relationship, and frequency would strike the balance between those channel services. In brief, managers must realize that users who are used to virtual channel would expect high quality on it. Under such circumstances, managers should understand that the effect of physical channel will diminish.

In conclusion, we hope this article will contribute to developing the conceptual base in the field of relationship quality. As the multichannel environment becomes intensely competitive in recent years, the firms will face the continual pressure from this environment. How to improve the performance of the multichannel utilization and achieve the organizational benefit are current issues that we should pay attention to, and future research might undertake to further expand our framework.

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E-QUAL: A QUANTITATIVE MODEL OF USER CO-CREATION EXPERIENCE QUALITY

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ABSTRACT

This paper sets forth a quantitative model, indicating how a set of measures to assess co-creation experience quality of service providers and customers (E-QUAL) in a service process. Inspired by ecological mutualistic evolution and evolutionary fitness, both partnership and adaptability for service participants in service exchange resemble the relationship of mutualism for species in symbiotic ecosystem. However, the three criteria (PR, ED, and UR) and interactive fitness (IF) are used to test the partnership and estimate the adaptability for assessing user co-creation experience quality within the collaborative service with value co-production. In this article we demonstrate a service system that uses the E-QUAL to evaluate value co-creation experience quality. From the perspective of practice, the measurable model, on the other hand, facilitates an interaction-based self-service system to meet (semi-)automated value co-production.

Keywords: experience quality, value co-production, interactive fitness, service performance, adaptability, mutualism,

INTRODUCTION

In recent years considerable concern has arisen over the collaborative e-services on Internet, for example, Ask Yahoo!, Google groups, Wikipedia. Given experience economy, interest in service quality has shifted to reflect current developments in user experience quality which emphasize the experience with value co-production. E-QUAL is to assess the user co-creation experience quality during a service process for service providers and customers using service performance assessment. Particularly, this model is applicable to the interaction-based self-service systems that are able to conduct service exchange with benefits (i.e., value co-production). For E-QUAL, the service system is able to examine if the service participants can afford to build the relationship that meet the condition of mutualism. In other words, the model can assess and track the partnership and adaptability for evaluating user co-creation experience quality.

Mutualism is the mutually beneficial interaction between the individuals of two species [4]. Lifetime Reproductive Success (LRS) is to estimate of fitness of an individual in ecology. A service system involves a set of elements such as service encounter, operation, process, delivery, and recovery et al., which are deemed an ecosystem. As a result of the similarity between the species ecosystem and service systems, the three criteria have been tested mutualism using proximate response (PR), ultimate response (UR), and evolve dependence(ED). In service system E-QUAL proposes a quantitative model to examine both partnership and adaptability for evaluating value co-creation experience quality according to service performance assessment.

The remainder of this paper is organized as follows. Section 2 describes the related works including customers' experience quality and interaction-based self-service systems with value co-production, and Section 3 presents the E-QUAL model. Concluding remarks are presented in Section 4.

RELATED WORKS

Unlike a product with physical features that can be objectively measured, service quality contains many intangible factors such as psychological features [17]. Measures of service quality can be examined based on the quality difference (gap) between the customer expectations and the customer-perceived quality (e.g., the PZB model) [1]. Furthermore, a means-end framework conceptualizes, constructs, refines, and tests a multiple-item scale (i.e., E-S-Qual, E-RecS-QUAL) for measuring service quality delivered by web sites that allow customers to shop online [1,2,3]. Measuring service quality is a challenge because customer satisfaction is determined by many intangible factors [17]. In addition, on the basis of the conceptual problems associated with SERVQUAL P-E model and using the EP model as a theoretical foundation (i.e., NQ model) [14]. A mixed-model specification that assumes some features to be vector attributes and other to be classic ideal point attributes would be conceptually more appropriate. The mixed-model specification considers service-attribute type and interpretation of the comparison standard [3]. Service performance is a bottom-line issue, that is, services should be developed and delivered to achieve maximum customer satisfaction at minimum cost [10]. Gronroos proposed that the two most important service attributes were intangibility and interaction with clients. Intangibility and interactivity are elements common to countless service products [9]. For experience quality in service research, the related works include (1) customer experience quality, and (2) interaction-based self-service systems with value co-production.

Service Experience Quality

User experience is the internal and subjective response customers have to any direct or indirect contact with a company [5]. Customer experience encompasses every aspect of a provider offering so that customer satisfaction is the culmination of a series of customer experiences. Service inherits time-perishable, intangible experience performed for a customer acting in the role of co-producer [17]. A customer experiences encounters with a variety of service providers, and each moment of truth is an opportunity to influence the customer perceptions [17]. To measure service experience, customer satisfaction is the culmination

of a series of customer experiences or, say, the net result of good experiences minus bad experiences [5].

Customer Experience Management (CEM) captures the immediate response of the customer to its encounters with the company [5]. In terms of psychological underpinnings, the service encounter is viewed as a core task surrounded by the customer's psychological experience during the transaction [15]. User experience is cumulative service productivity and customer satisfaction [20]. Tracking user experience quality can be captured from the course of interactions and coordination, especially, their cognition from interaction for collaborative intelligent [19]. It should be noted, however, that there have been few attempts to measure the service experience quality. Some service attributes need advance methodologies to attack such tough problems.

Interaction-based Self-Service Systems with Value Co-Production

In most cases, an interaction-based self-service system comprises service providers and clients working together to co-produce value in value chains or networks [10]. A service system with value co-production is composed of people, technology, other internal and external service systems, and shared information [9]. The characteristics of service systems, such as measures, and other shared information types, evolve over time as service systems attempt to improve productivity, quality, compliance, and innovation [9]. In general, an e-service involves a negotiated exchange between a provider and a customer for the service provision of intangible assets [6]. For example, the knowledge workers depend on their knowledge, tools and social-organizational networks to solve problems, be productive, and continually develop, generate and capture value (e.g., IT outsourcing, call centers, patents, and educational service systems) [12]. Considering service activities, service systems are complex adaptive systems comprising people who are complex and adaptive [9]. That is, an interaction-based self-service system is likely to be closely related to a collaborative service system. Our main goal is to understand the interaction of service activities to determine how the user experience quality would be inferences from service performance.

User co-creation experience quality is determined by many intangible factors such as the cognition and impression user perceived, for this reason, the evaluation of service performance and service quality taking for the user co-creation experience quality is critical. In order to address the critical issue, this study addresses a set of quantitative measures to track the critical questions. This study intends to tackle the issue of developing a quantitative method for user co-creation experience quality within a service process. The purpose of this research also gives rise to a slew of new opportunities and challenges for systematic service innovation. Thus, it is crucial that service systems exert to control good customer experience quality at all times and it's worthy of further investigation.

USER CO-CREATION EXPERIENCE QUALITY

By cross-domain mapping, the model derives mainly from both ecological mutualistic evolution and evolutionary fitness. This study explores how a set of measures estimate user co-creation experience quality according to testing the relationship (mutualism), and estimating the fitness (adaptation).

Antecedent of Ecosystem—Species Mutualism versus User Value Co-Creation

The origin of this study derived from ecosystem on account of the similarity between the phenomenon of ecological species' mutualism and the users' value co-creation. Mutualism can afford to be mutually beneficial exchange to empower the species to live in nature. Value co-creation is also benefit exchange to empower the co-production between providers and customers. In the service process, evolution shows how customers and providers build the partnership as mutualism over time; adaptation shows how customers and providers delivery the service ideally.

Evaluating Species Mutualism

Mutualism is mutually beneficial interaction between individuals of two species, and the degree of benefit (i.e., performance) resulting from the interaction depends on adaptation is considered. Mutualistic evolution examines the performance of species using the three criteria—proximate response (PR), ultimate response (UR), and evolved dependence (ED)—in order to test mutualism. That is, the performance deviation between partner absence and partner presence can test the relationship of mutualism. Lifetime Reproductive Success (LRS) is to compute the number of recruits of the subsequent generation that an individual produces over its entire lifespan, which is generally assumed as a relatively good estimate of fitness [4]. LRS is to assess the absolute fitness of an individual [7], and can be regard as an indicator for the adaptability.

For evaluating mutualism, PR is associated with the performance deviation observed between partner absence and partner presence. ED is responsible for decreased performance resulted from partner removal in the certain partnership. UR is influenced by PR and ED when the species has been evolved into mutualism through the two stages of evolution and adaptation. Moreover, LRS of PR (LRSP) represents a new LRS after a partner addition. LRSP-LRS represents the individual performance change owing to partner appearance. LRS of UR (LRSU) also represents a new LRS when they have been evolved into mutualism, namely, the holistic performance on account of evolution and adaptation. In the meantime, LRS of ED (LRSE) represents a new LRS when they form the loss of performance owing to change/quit partnership. ED is then LRSE-LRS (Fig.1)

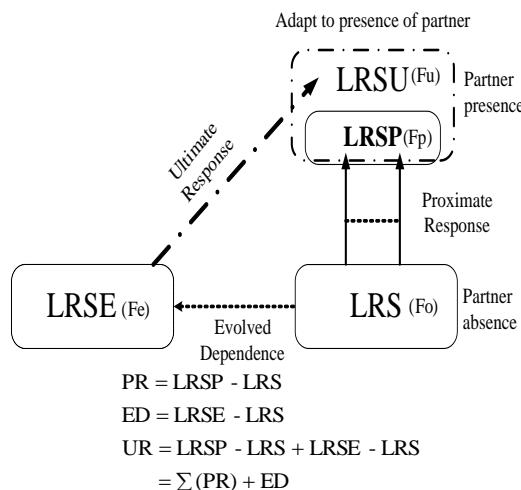


Figure 1 LRS with PR, ED, and UR

The performance deviation between Fo and Fp shows that the increments of performance from partner absence to partner presence. However, the loss of performance Fe-Fo occurs when the species exchange/drop their existing partnership. Fu is the holistic performance Fp-Fo+Fe-Fo

Evaluating User Value Co-Creation

In order to examine the experience with value co-creation, this model is to explore both partnership and adaptability between the provider and customer who occur in service systems. Using the synthetic methodology [19], the measures are centered on the experiences that derive from two parts of evolution and adaptation during a service process. Whereas both mutualistic evaluation and evolutionary fitness (LRS) resemble the notions of service with value co-production, this study utilizes the synthetic methodology to emerge the way of evaluating user experience quality. This study address a set of measures to assess the user co-creation experience quality using analytic and synthetic methodology based on the service performance assessment. Our research methodology in this study is addressed from the ‘science of the artificial’ (i.e., science (analytical) of engineering (synthetic)). Once synthesized, the artifact can be characterized in terms of its functions, goals, and adaptability. Artifacts are frequently discussed in terms of imperative and descriptive methodologies (i.e., design science). By design for emergence, the model can be used to test the partnership (mutualism) during the service process. For the service with value co-production, the both incremental and holistic service performance are assessed by IF_{PR} and IF_{UR}. The species mutualism in ecosystem is characterized by (1) assessing performance for species, (2) testing mutualism using PR, ED, and UR, and (3) estimating virtually absolute fitness by LRS. By contrast, the proposed E-QUAL is characterized by (1) assessing the performance for providers and customers, (2) testing value co-creation using criteria, and (3) estimating virtually interactive fitness using IF in the interaction-based self-service systems (Table1).

Table1 the analogy between species mutualism and user value co-creation

Species Mutualism in Ecosystem	User Value Co-Creation in Service Systems
<ul style="list-style-type: none"> ● Assessing performance for species ● Testing mutualism using criteria—PR,ED,UR ● Estimating absolute fitness—LRSP, LRSE,LRSU 	<ul style="list-style-type: none"> ● Assessing performance for providers and customers ● Testing value co-creation using criteria— PR, ED, UR ● Estimating interactive fitness — IF_{PR}, IF_{ED}, IF_{UR}

As fitness essentially matters to understand microevolutionary process in a metapopulation, the fitness is accordingly defined to explore whether achieving performance due to evolution. Notably, much of the discussions regarding the performance deviation derived from co-production between provider and customer has centered on how service participants behave from without to with partners to meet value co-production. Thus, a service system uses interactive fitness (IF) to assess the realistic adaptability to observe and to control the experience during a service delivery process.

Testing Partnership Using the Criteria

The mutualism in ecology can be regarded as the partnership between the service provider and customer for human being. For testing partnership, we borrow from the criteria which test mutualism between two species into the criteria which test partnership between service provider and customer in a service circumstance. Building the partnership needs exchange benefits to develop the advantage of relationship as mutualism. In this article the three criteria (i.e., PR, UR, and ED) indicated that the incremental performance, the possible loss of performance, and holistic performance during a service process when the service participants conduct service exchange. A study examine if the relationship between providers and customers evolve into superior partnership to observe the part of value co-creation experience quality.

- PR : Assessing the service performance that resulted from the service interactions with customer input in a service process.
- ED: Assessing the loss of performance once provider or customer exchange/drop partner (as switching cost).

- UR: Assessing the holistic service performance resulted form PR and ED.

PR refers to the short-term response without adaptation, namely, customer may increasingly adapted to service provider. ED refers to a loss of performance in service process resulted from change/quit partnership. Yet all the cases among service participants occur the event that resulted in ED. UR shows that two species have been evolved into mutualism via long-term response and adaptation.

Estimating Interactive Fitness

In order to further assess the user co-creation experience quality, the measurable methodology is necessary. Thus, we proposed a qualitative indicator—Interactive Fitness (IF), integrating the measures of service performance into three criteria. Figure 2 depicts E-QUAL characterizing the realistic service performance instead of IF. IF_{UR} is to present an estimate of adaptability between the service provider and customer through PR and ED. Tracking the increasingly increased fitness allows the service systems to ensure the superior adaptability. In other words, UR embraces the difference from LRS to LRSP (during the evolution) and the difference from LRS to LRSE. An adaptive LRS (LRSU) is formed with a number of interactions of customer input and possible loss of performance. $LRSU = \sum(LRSP_{t+n}) + LRSE$ can be viewed as a holistic service performance when service delivery.

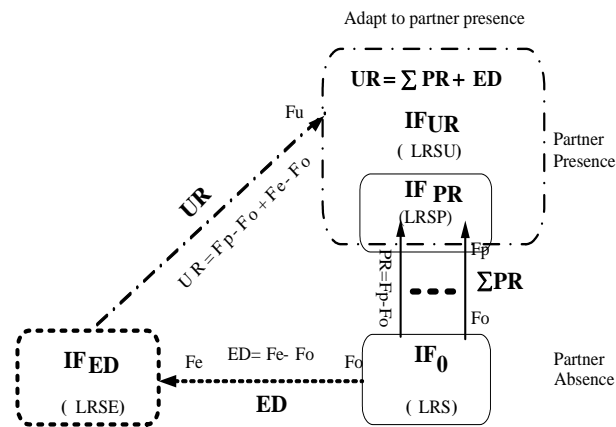


Figure 2 Assessing user co-creation experience quality using IF

The study uses the performance-based on fitness to estimate of adaptability. Assessing LRSP attempts to address the stage of concern by shedding light on the effects of interaction. IF₀ represents the original service performance as adaptability at that time. IF_{ED} is a new adaptability when service participants encounter partnership change or terminate. IF_{PR} includes the individual effect of interaction with customer input. Finally, IF_{UR} accumulates the all IF_{PR} and IF_{ED}, namely, the holistic service performance LRSU is cumulated by all the increments of fitness LRSP and LRSE. Examining the all effects of PR and ED, the service performance can be examined in the interaction-based self-service process. The user feedback in service systems can be used to assess IF, which also can be regarded as the experience quality perceived by the service participants.

E-QUAL centers on both partnership and adaptability development as user co-creation experience quality in a service process with value co-production. As the service participants engage in value co-production point through PR and ED, Figure 3 shows that the fitness occurs to estimate in the whole service process. In Figure 3 the starting point IF₀ increasingly accumulates each increment of fitness $\Delta IF_{PR1} + \Delta IF_{PR2} \dots$ till IF_{PR}. IF_{UR} is $\Delta IF_{PR1} + \Delta IF_{PR2} \dots + \Delta IF_{ED}$ with all IF_{PR} and IF_{ED}.

$$\begin{aligned}
 IF_0 &= F_0, IF_{PR} = F_P, IF_{ED} = F_e \\
 \sum(PR) &= \Delta IF_{PR1} + \Delta IF_{PR2} + \dots \Delta IF_{PRn} \\
 ED &= \Delta IF_{ED} \\
 UR &= \sum(PR) + ED \\
 &= \Delta IF_{PR1} + \Delta IF_{PR2} + \dots \Delta IF_{PRn} + \Delta IF_{ED} = IF_{UR} \\
 n &= 1, 2, \dots n
 \end{aligned}$$

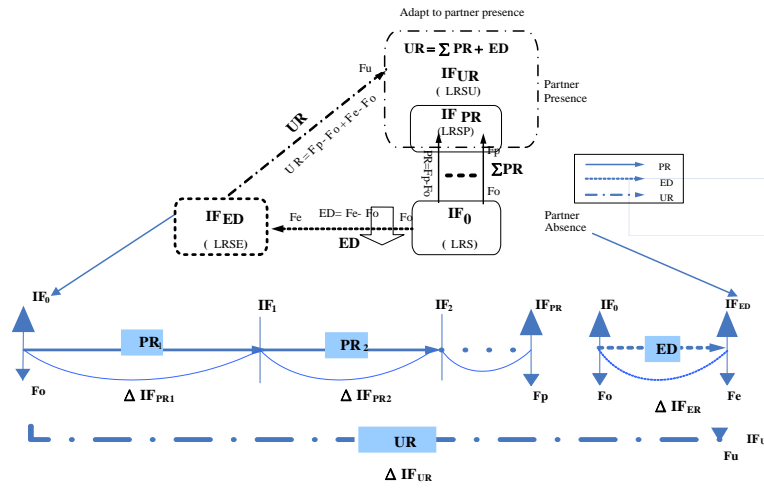


Figure 3 the estimates of IFPR, IFED, and IFUR in a service process

E-QUAL can be examined by the absolute fitness of any individual in each interaction of customer inputs, using the parameters of L and \bar{R}_g . Based on the analogy for the measures, the interactive fitness will be applicable for evaluating the user co-creation experience using the fitness derived from service performance through service exchange with value co-production. LRS-based measures provide a good theoretical framework for attacking the problem of estimating fitness of value-co-production between providers and receivers. The primary measures to be addressed in E-QUAL are how the effects of the fitness can compute \bar{R} and L. The log of expected service delivery is modeled as a linear function of the parameters of interest. In this model, L is defined as the part of cost relative to service. The expected average of service performance is estimated by analogy with the equations for expected average reproductive success $E(\bar{R})$. A model for the total effect of customer input through evolution and adaptation according to the ‘proximate factors’ x on $E(\bar{R}) = e^{[\beta^T x]}$ is then shown in Table 2.

Table 2. the equations of IF

The components of IF	
(L) : service cost (i.e., input)	
$\frac{1}{L}$: $\frac{1}{\text{servicecost}}$	
$E(L) = e^{[\alpha^T x]}$	(1)
\bar{R} : average outcome performance (i.e., output)	
$E(\bar{R}) = e^{[\beta^T x]}$	(2)
where β is a vector of coefficients, x are specific factors	
$E(\text{IF}_g) = E\left(\frac{\bar{R}}{L}\right)$	
$= e^{[(\alpha-\beta)^T x]}$	(3)

For the measures of service performance, Eqs (1), (2), and (3) refer to the estimates of adaptability using IF for observing user co-creation experienced quality within a service system.

The Proximate Factors for PR

The proximate factors studied here may be of importance in assessing the fitness (Table 3). In ecology the variation in LRS of individual to morphological characteristics (i.e., factors) that probably can influence service performance [7]. Using a synthetic methodology, the proximate factors are associated with the effects of PR in a service exchange process. Based on the empirical study of service quality, for example, the service quality model (SERQUAL) provides the criteria fall into 10 key categories [1]. It should be noted, however, the service systems take into account the factors which relate to service performance. The determinants also require serving as the basis of measuring value co-creation experience quality.

In order to estimate IF, the service systems takes into account the various factors ($X_n, n=1 \dots n$) that influence the service performance when they conduct service exchange. Most particularly, the user feedback can afford to assess service performance through the factors whose service system defined. Thus, a service system that automated value co-production using adaptive methodologies requires defining the important factors. For example, an interaction-based self-service system for collaborative

music content creation, the three defined factors —PF1: content originality, PF2: integration flexibility, PF3: content diversity can be the X in equation to compute $E(\bar{R}) = e^{[\beta^i x]}$ as the outcome of service performance (Table 3). β is the corresponding weight depending on the level of importance among these factors which selected by service system designer. The service performance derived from PR are $e^{[\beta^i x]}$ (e.g., 2.61). UR will be estimate by $\bar{R} = \sum e^{[\beta^i x]}$ and L (e.g., 1.73).

Table 3 an example of E-QUAL

I.	PF1	PF2	PF3	$e^{[\beta^i x]}$
1	0.36	0.32	0.28	$e^{0.96} = 2.61$
2	0.21	0.16	0.16	$e^{0.53} = 1.70$
3	0.03	0.02	0.02	$e^{0.07} = 1.07$
4	0.16	0.10	0.12	$e^{0.38} = 1.46$
5	0.24	0.18	0.18	$e^{0.60} = 1.82$
$\frac{\bar{R}}{L} = \frac{\sum e^{[\beta^i x]}}{L} = 8.66 / 5 = 1.73$				

CONCLUSION

According to a cross-domain mapping [18], the study borrowed the mutualistic evolution and evolutionary fitness to develop analytic and synthetic methodology for evaluating value co-creation experience quality. In a interaction-based self-service system with value co-production, the service participants exchange service as similar as an ecological mutualism, E-QUAL is then introduced to assess user co-creation experience quality through the testing partnership and estimating adaptability. For testing partnership, PR, ED, and UR are used to measure the service performance deviation before and after being partnership within a service system. The interactive fitness serves as the assessments of adaptability provided by service process. The service systems track fitness to ensure user value co-creation experience quality underlying service performance assessment.

This study proposes a set of measures to facilitate the interaction-based self-service system enabling value co-creation experience quality. Although the quantitative model contributes to achieve the fundamental proposition of value co-production, this model uses the theory of ecological mutualism and evolutionary fitness for examining the experience quality among service participants. The experience quality might be associated with the internal and subjective response, so the model needs to assess user experience quality service participants perceived using the important proximate factors in service exchange process. However, how a service system defines and selects the proximate factors to evaluate can be further validated. The theory borrowed from the other social or natural science can further investigate.

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SEE: EXTENDING SERVICE ENGINEERING METHODOLOGY FOR ACHIEVING EXPERIENCE INNOVATION

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ABSTRACT

This study is concerned with improving the Service Engineering methodology for experience-oriented service systems. It critiques the Service Engineering methodology based on the motivating example of automotive navigation service system design, and it describes the Service Experience Engineering (SEE) methodology, which extends Service Engineering by making three improvements, namely the use of formal models of experiences, service-experience requirement analysis, and the simulation of service experiences. The example presented here demonstrates that SEE can help capture context-wide service-experience requirements and translate them into functional requirements. This study further indicates that a methodology for engineering service experiences is possible and promising.

Keywords: Service engineering, service design, methodology, experience innovation.

INTRODUCTION

Services have been generally developed based on the assumptions that customer value systems have been fully understood and are easily translated into system requirements. This assumption is problematic for two reasons. First, this assumption suffers a manager level bias. As noted by James Allen, et. al. [4], traditional market research frequently leads firms to view customers as statistics. Meaning managers become so focused on data that they stop hearing the real voices of their customers. Second, customers themselves do not explicitly understand their hidden needs, and it is difficult for them to express their ideas [14][24]. Furthermore, developing new services in the current increasingly competitive business environment is quite challenging since companies often need to surpass customer expectations. Therefore a service design/engineering methodology, that provides appropriate support for engineering service experiences and thus enables the overall service experience to exceed customer expectations, is significant and useful.

Methodologies for experience innovation have not yet emerged, although general concepts regarding experience innovation have been discussed in [21]. Since we lack the experience innovation capabilities to facilitate the development of experience-oriented service systems, systems still need to be tested to determine whether the experiences are acceptable to customers. Service Engineering established by Fraunhofer IAO may be the most developed service innovation methodology [5], and they managed to establish a ServLab [2] for testing new services. This study improves the Service Engineering methodology to permit enhanced engineering of customer experiences. The required improvements are discussed based on a motivating example, involving an automotive navigation service system.

The remainder of this study is organized into the following sections. Section 2 introduces the navigation service system. Section 3 then reviews the Service Engineering methodology. Next, section 4 describes SEE, and the ways in which it extends Service Engineering. Section 5 then provides example artifacts of the extended models based on the motivating example. Subsequently, section 6 discusses related works and section 7 presents conclusion.

MOTIVATING EXAMPLE: AN AUTOMATIVE NAVIGATION SERVICE

Imagine an automobile with a GPS navigation system. The navigation system is equipped with an embedded cell-phone for call center services. This setup enables the driver to request the call center to create a navigation path for him/her. This service is particularly useful for drivers that require a customized navigation path but are unable to set it up themselves for fear of distracting them from other tasks, particularly, drivers who cannot take a break from driving. While the call center records confirm the demands of customers' frequent requests on customized navigation path, the reason for requesting alternative navigation paths is unknown to the call center. Another application of an automotive navigation service incorporating a call center is providing security management. For example, whenever a car is moved without a standard unlocking procedure, a message will be issued to the owner via SMS, and the call center can then help track down the suspected stolen car.

Since the navigation service provider is planning to develop new services over the current navigation service platform, it is important that they create new "experiences" for existing customers. Following the Service Engineering approach, ideas are gathered and discussed during the idea management phase. However, service developers soon found it very difficult to innovate new experiences owing to them lacking an understanding of how to define experiences for customers. Furthermore, service developers need to ensure that that Service Engineering methodology ensures the engineering of the experience requirements.

The navigation service company, Yulong, is one of the largest car manufacturers and telematics service providers in Taiwan,

and is attempting to differentiate its services from those of competitors. Yulong has established a user experience team to implement the company vision. The best means of identifying hidden customer needs and transforming those needs into technological-functional service requirements is considered the key capability that this company needs to develop.

SERVICE ENGINEERING

Definition of Services

The literature contains numerous definitions of service [11][7][12]. In national economic statistics, the service sector is frequently defined as all sectors other than agriculture or manufacturing. The North American Product Classification System (NAPCS) [15] defines service as follows:

A service is a change in the condition of a person, or a good belonging to some economic entity, brought about as the result of the activity of some other economic entity, with the approval of the first person or economic entity.

Fitzsimmons et al. [7] provided a simpler definition: A service is a time-perishable, intangible experience performed for a customer acting as a co-producer. According to this definition, a service is actually an “experience”. In fact, “selling experience” is one of the optimum strategies for fighting low-cost rivals [10]. In the digital economy, a new service definition can focus on the technical nature of modern services, such as cyber-infrastructure-based service enterprises [9]. Cyber-infrastructure-based services enable standardization and mass customization, and are thus more complex than traditional services. A systematic approach for new service development is therefore required to ensure new service quality and service innovation efficiency. Bullinger et al. [5] used the attributes of contact intensity (CI) and variety (VI) to further define four types of services:

- Type A services (low CI and low VI) are characterized by low contact intensity and low variety, making them especially suitable for highly standardized delivery,
- Type B Services (low CI and high VI) have low contact intensity and high variety, and the focus from the perspective of the developer is on systematic variant creation,
- Type C Services (high CI and low VI) have high contact intensity and low variety. Such services essentially comprise a single, clearly defined standard service, which may be customized by the customer up to a certain point,
- Type D Services (high CI and high VI) have high contact intensity and high variety, and their performance typically requires considerable customization.

Currently, Type A services are the main targets for service engineering, and are detailed below.

The Service Engineering Methodology

Fraunhofer IAO first initiated research activities focused on Service Engineering (SE) in 1995, and subsequently initiated several related projects: Holistic service engineering, Computer aided service engineering (CASET), customer oriented service development. Their partners for R& D projects include AUDI, C& E, Fein, Dekra, DIW, ETAS, IWKA, Oce, R+V and Zwick. The ServLab has recently been established for service simulation and testing.

According to the Fraunhofer IAO experiences, several methods from traditional product development are used for services with relatively low contact intensity, namely, Type A services. These methods include quality function deployment (QFD), structured analysis and design technique (SADT), failure mode and effects analysis (FMEA) as well as service blueprinting and other process modelling methods. For Type D services, social and behavioral science methods are encountered. This study thus concludes that the contact intensity criterion appears to be the main determinant of preferred engineering methods in practice.

Besides methods used to devise new services, the development process (the order in which activities occur within the development) is also important. Because companies regularly developing new services are compelled to seek ways of avoiding redundant work, preventing repetitions of past mistakes and enabling the reuse of existing know-how. Therefore, the companies frequently attempt to standardize individual development steps to a certain degree. This standardization in no way implies that development processes are constrained within a rigid straitjacket [5]; on the contrary, it means that these processes stop being arbitrary. Instead defined guidelines exist according to the services being developed. Both linear processes (waterfall models) and iterative processes (spiral or prototyping models) are accepted as options for new service development.

Simply put, the Service Engineering methodology proposes a set of methods (QFD, SADT, FMEA, service blueprinting, conjoint analysis, product modeling, process modeling, role concepts, target costing and pricing) and a set of process models (waterfall, spiral and prototyping) for service developers. The overall service development process is further subdivided into six broad phases: brainstorming and idea appraisal, requirement analysis, conceptualization, implementation, market launch and support. A New Service Development Manual, detailing all phases, has been provided in the form of a guide book. Service developers are then free to apply process and engineering methods that best suit their projects. The next section discusses the requirement analysis in detail.

Requirements Analysis of SE

According to the SE manual, the requirement analysis phase comprises the following processes: strategic requirements, functional requirements, organizational requirements, general market requirements, customer analysis, competitor analysis, partner involvement, binding requirement profile, project planning, and review. The instruments used during the customer analysis process include: customer survey, customer focus groups, case studies undertaken for selected customers, survey of front-line employees, assessment of information from the perspective of sales, and assessment of complaints.

This study includes a special focus on requirement analysis, which involves formal analysis of *service experience requirements* (SER). Unfortunately, requirements analysis in SE involves no defined experience-related requirements and no defined process for eliciting SERs. To improve requirements analysis of SE, this study add three instruments: customer needs discovery, service experience modeling and simulation, for SER generation. QFD is then used to convert SERs into functional requirements. The details are described in the next section.

SERVICE EXPERIENCE ENGINEERING

Definitions of Experiences

In the requirements engineering field, customer experience requirements (CERs) are defined as customer perceived attributes of the interaction with the service provider that contribute to satisfaction and adoption of the service [18]. The term experience requirement includes both the outcome and process attributes of the interaction between customer and service provider. Restated, CERs include: outcome-oriented performance requirements and process-oriented emotional requirements (such as autonomy and pleasurability). Generally, the emphasis of CER elicitation gradually shifts from interaction system requirements, viewed from a system internal perspective, to user experience requirements, viewed from the customer perspective [22]. Some studies [17] have advocated the inclusion of experience goals and emotional requirements in CER.

In the Marketing field, the role of experiences in service provision is becoming increasingly important. Since the differentiation of goods and services has become increasingly difficult, enhancing the customer experience has become the new source of differentiation and value creation [19]. Experiences are defined by questions involving the following: how the service made customers feel and their emotional associations. Since service experiences are co-production values resulting from interaction between customers and service providers, they are considered unique and context-specific.

This study defines service experience requirements (SERs) as follows: given a specific context, the performance requirements and emotional requirements of a service described so as to enable service designers to translate them into system functional requirements. The next section defines a more rigorous service experience model based on this definition.

Discovery of Customer Needs

There are numerous methods of identifying customer needs, including expert reviews, user testing, focus group interviews and surveys. Recently, new methods adopted from social sciences have been applied to discovering customer needs, including ethnographic methods [16] and naturalistic inquiry [20]. These qualitative methods of data collection contribute to enhanced understanding of customer goals and needs. However, these methods suffer from difficulty in generalizing the drawn conclusions from a small sample of customers. Fortunately, quantitative marketing methods [6] may resolve this problem, although the method of questionnaire administration does not permit elicitation of rich information as is the case for qualitative methods.

To effectively analyse hidden customer needs, it is recommended that certain qualitative methods should first be applied to discover hidden needs, especially emotional needs. Second, needs are categorized using psychological models such as Maslow's Hierarchy of Needs [13] and efforts are made to ensure that both performance and emotional needs are identified. Finally, the model is generalized using quantitative methods. For qualitative research, the 51 methods of IDEO cards [1] can provide a good reference. It is recommended that customer research be conducted by a mixed team of designers, engineers, social scientists, and even customers.

Service Experience Modeling & Simulations

A state machine [8] may be the best reference model for modeling a service experience, since events result in experiences and states can be used to represent needs satisfaction. A service experience system can also be considered a real-time system, in which all service activities are performed concurrently and in a timely manner, thus optimizing the customer experience. Formal techniques exist for modeling real-time systems, such as: Real Time Logics, Duration Calculus, Process Algebras and Formal languages [8]. Nevertheless, many of the techniques do not include visual system representations, and are focused on formally verifying a system rather than modeling appropriate system behavior. This study suggests that service experience modeling be achieved via Petri Nets. Although cognitive problems exist when using Petri Nets to understand complex structures and processes, this study argues that a useful experience model should remain simple for the sake of model generalization (using quantitative methods).

In the last section, customer needs are classified according to Maslow's Hierarchy. By turning each category into a state

indicating the satisfaction of needs (see Fig.3), all service activities that help achieve the state can be represented by transitions. In Fig.4, the experience model is further refined into a Petri Net. Strict and precise timing constraints are modeled in Petri Nets. These timing constraints help in identifying possible system bottlenecks during the analysis stage, and may be useful in fault identification. Other analysis can be performed to formally verify these models and also to improve upon them. Models like TCPN (Timing Constraint Petri Nets) can be used for schedulability analysis [23]. Using state machines and Petri Nets, Service Experience Model (SEM) and Service Experience Requirements (SER) are defined as follows:

Given a specific context, customer service experience models (SEM) are described using a state machine including states indicating different levels of needs. Common customer states transit to higher level states when all needs of the current level are satisfied. Customers perceive a good service experience when all needs are fulfilled in a timely manner such that the customer feels that: whenever there is a need, there is a satisfaction. This state machine can be further refined to a Petri Net, with transitions representing service activities that trigger token firing. The resulting Petri Net is considered a service experience requirement (SER).

Notably, each customer might have different service needs, and different (timing) wishes regarding needs fulfillment. Therefore, service experience is optimized when all needs are addressed according to the distinct preferences of each customer, i.e., when a tailored service is provided.

Service Design & Implementation

Following the principles of Service Engineering, the requirement analysis phase is completed by converting SERs into functional and organizational requirements via QFD. During the next phase, the conceptualization phase, these requirements are further refined into: service definition, organizational concept (process description, roles and resources, trainings), and marketing concept (product policy, price policy, place policy, and promotion policy). Next, during the implementation phase, the service system is implemented and tested internally. The new service is officially offered to customers during the market launch phase. Feedbacks are continually monitored for further development or replacement of services in the support phase.

EXAMPLE

Background

This section describes a real world example and an ongoing project involving the innovation of a new car navigation service. The development project will continue for two years. The first year involves the brainstorming, requirement analysis and conceptualization phases. Emphasizing the differences between SE and SEE, the work done during the requirement analysis phase is presented in detail below.

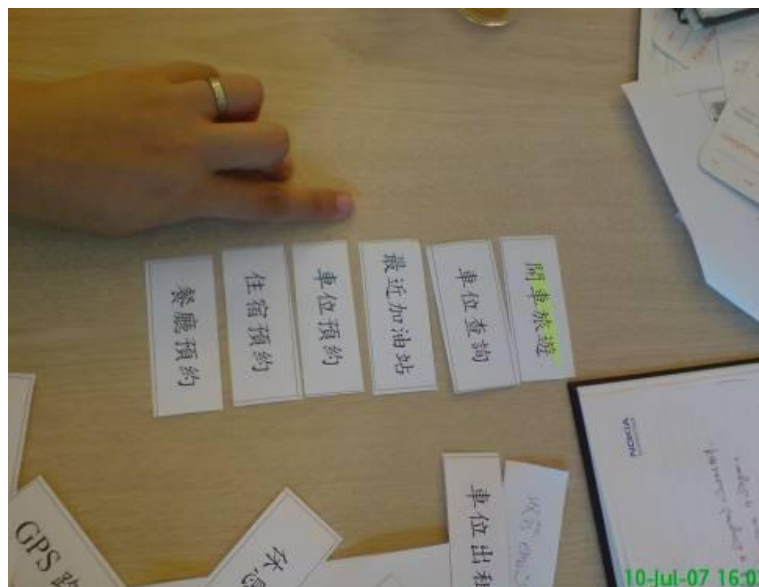


Figure 1: Customer doing card sorting

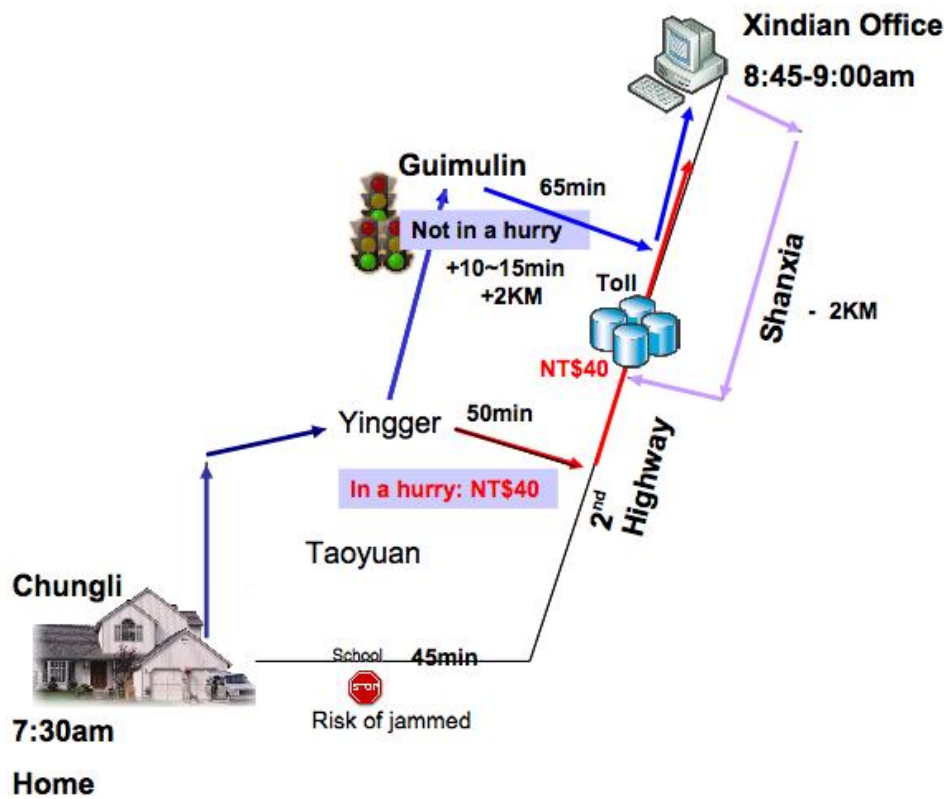


Figure 2: Customer's commuting experience

Customer Needs

To understand the service needs of drivers using car navigation systems, nine methods from IDEO are used to conduct a study of our customers, including: Behavioral Archaeology, Social Network Mapping, Draw the Experience, Card Sort, Error Analysis, Scenario Testing, Survey and Questionnaires, Character Profile, and "A Day in the Life". Figure 1 displays a customer performing card sorting, and Fig. 2 shows the customer drawing of his own driving experiences. A total of eight customers participated in this investigation, and 20 customers participated in the investigation of "A Day in the Life". The resulting service needs are classified using Maslow's Hierarchy of Needs, as shown in the following list and Fig. 3.

- To Move (smoothly)
 1. Auto map update
 2. Routing by number of lanes
 3. Routing by number of traffic lights
 4. Toll-free routing
- To be Safe
 1. Car-only routing
 2. Routing to avoid schools during peak traffic times
 3. Routing to avoid funeral parlors
 4. Routing to include branded gas stations
- To Share (love and joy)
 1. In-car Karaoke
- To have an Assistant
 1. Dynamic routing assistant
- To Guide others
 1. Share one's driving experiences to other drivers

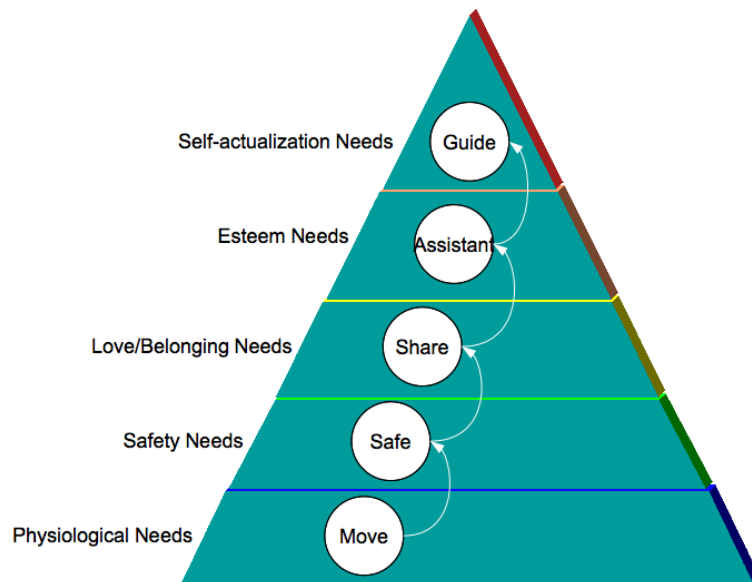


Figure 3: Customer experience state machine

Service Experience Models & Requirements

Figure 4 shows the customer experience model expanded from the original state diagram (Fig. 3). For simplicity, only three experience states: move, share and assistant (with names in brackets), are preserved in this diagram. In the initial state "Start", the driver starts the car. Once the navigation map is updated, the "Move" state begins. Based on the user preferences, the navigation system calculates a "smooth" and safe route for the driver, and the system switches to a "Safe" state. If the driver turns on the function of navigation assistance, the system switches to the "Assistant" state. In the "Assistant" state, the call center watches over the movement of the car. If the driver presses the assistance button, he can request immediate help from the call center to provide customized navigation. Otherwise, the call center monitors the navigation system and provides assistance if the driver continues to diverge from the correct route.

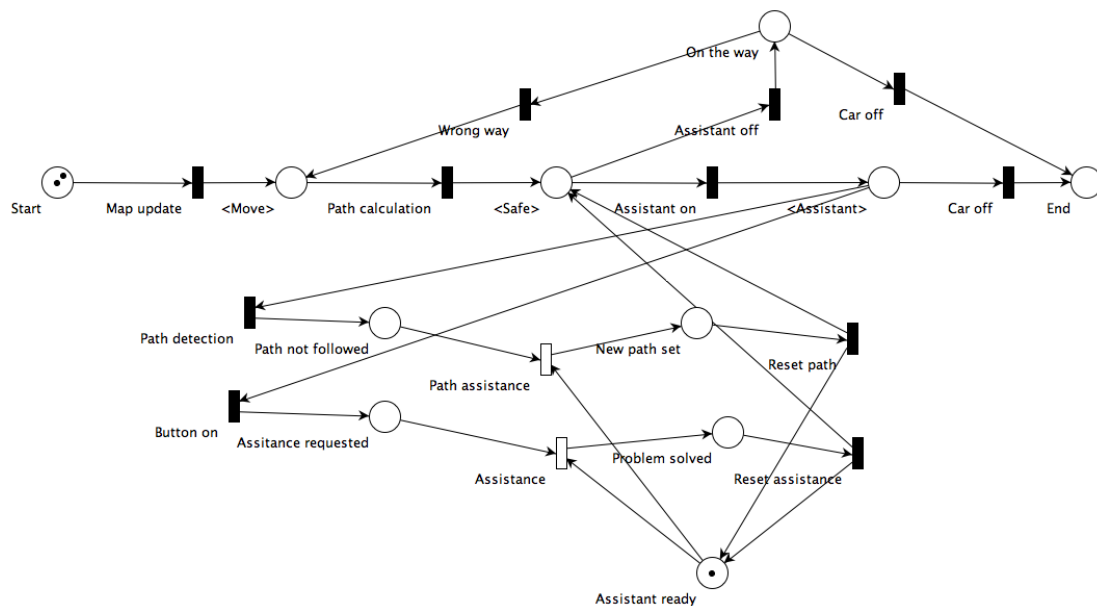


Figure 4: Customer experience Petri Net

Since this model is created using Petri Net, it can be simulated to provide preliminary analysis. Furthermore, the model becomes a useful input when implementing the system. The customer experience model can be built into the in-car navigation system, enabling the system to keep track of driving experience of the driver.

Functional And Organizational Requirements

According to the principles of service engineering, the SERs are analyzed using con-joint analysis and QFD. Figure 5 shows the result of QFD. The functional and organization requirements include: providing update service, enriching map details, enriching location database, routing algorithm, customer service staff training, human-assisted planning system, and expanding customer service staff.

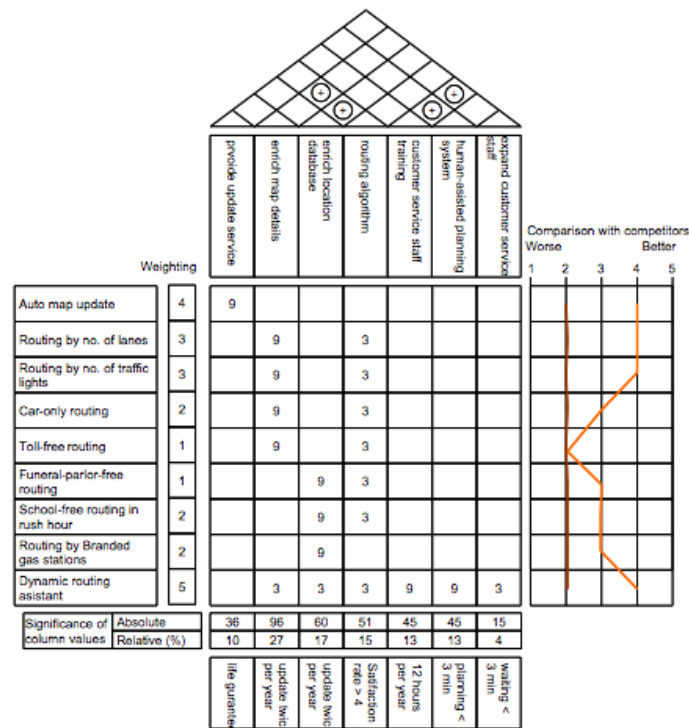


Figure 5: Quality Function Deployment

RELATED WORK

This project combines service engineering methodology with experience engineering to establish an extended methodology named Service Experience Engineering (SEE), which permits experience identification, modeling and simulation. This study argues that SEE helps service designers to develop new services that meet hidden customer needs and create unexpected experiences.

CorSE [3] is a similar project that focuses on extending Service Engineering to facilitate customer integration. However, methods for experience innovation are not available. We believe that service providers should be proactive in innovating experiences. Given a specific service context, service experience innovation is defined as the activity of finding hidden customer needs and designing the new value delivery system, such that all hidden needs are satisfied and the overall service experience exceeds expectations. This definition differs from that of Prahalad et al. [21], which emphasizes on personalized interaction and value co-creation.

To obtain hidden customer needs, IDEO methods are used to investigate customer behavior. The discovered hidden needs are then classified according to Maslow’s hierarchy of needs. Using state machines, the manner and timing of the satisfaction of a need are formally modeled. Offering the right services and correctly timing service deliveries improved the service experience. This study referred to the state machine as an experience model, and also context-wide service experience requirements (SERs), which differ from CERs. While CERs are mainly considered system-dependent, SERs are customer-oriented, context-specific and system-independent. The SERs are later transformed into functional requirements using QFD.

CONCLUSIONS AND FUTURE WORK

This paper notes the importance of experience innovation and the weaknesses of Service Engineering. Specifically, this study proposes an SEE method to overcome the difficulty of experience innovation. SEE includes three parts: model of customer experience, analysis of hidden service needs, and simulation of customer experience. An example of a car navigation service is used to demonstrate SEE. The example revealed that SEE helps innovators to systematically identify customer needs and thus improve customer experiences. The resulting new services become more competitive as a result of enhanced customer experiences and service optimization. The objective of this study is to establish a methodology for service experience innovation, and creates an associated discipline. Further work is underway to clarify the quantitative benefits of SEE.

ACKNOWLEDGMENTS

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THE VALUE PROPOSITION AND SERVICE ORIENTATION PRINCIPLE VIEW OF SERVICE ORIENTED ARCHITECTURE (SOA)

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ABSTRACT

Businesses have become increasingly complex over the past few decades. Every aspect of business operation and service requires the use of information technology (IT), and many enterprises are showing a growing interest in service oriented architecture (SOA). Because they recognize the competitive advantage that can be achieved by linking all phases of the business operations and deliver business services to customers. However, the adoption of SOA in organizations and the configuration of IT in direct support of their business are a very complex process. This paper provides a broad discussion on the building of service oriented architecture from value proposition and service orientation principle point of view. A SOA model will provide the technology underpinnings for working with services that are value business activities. This will transform IT into building blocks and services that are easy to assemble and configure or reconfigure. In today's changing business environment, the SOA provide a viable solution for enterprises to keep moving forward to the next level of business operations.

Keywords: SOA (Service Oriented Architecture), Value Chain, Value Proposition, BPM (Business Process Management), Web Services

The SOA Paradigm

In today's e-business practices, the demands for optimization and greater efficiency become particularly urgent when the flow of business data, information, and service extend beyond the borders of the enterprises. Traditional portal-driven integration and SCM data transparency are complex problems for many enterprises as they struggle to integrate hundreds/thousands of applications in order to provide business services and get the right information to the right people in real time. Existing portals are mostly supported by simple integration architectures, for example point-to-point or rigid portal-to-application-to-database that were cumbersome to build and maintain. In many cases, the underlying integration infrastructure will have to be rebuilt to solve business problems, such as M&A, outsourcing, and partnering. These changes always mean excess costs and frustrated users that negate the overall outcomes of IT projects.

Today, many enterprises are showing a growing interest in service oriented architecture (SOA). They recognize the competitive advantage that can be achieved by linking all phases of the business operations and deliver business services to customers. In SOA, application integration is moving from a low-level issue to a critical managerial issue. Service oriented architecture (SOA) is a business driven IT architectural approach that supports integrating enterprise business as linked, repeatable business activities or services. SOA is also an architectural approach that follows service orientation principles to make IT resources more flexibly available. Therefore, the shift from enterprise applications to service platforms is significant and becoming reality. SOA helps today's businesses innovate by ensuring that IT systems can adapt quickly, easily, and economically to support rapidly changing business needs [1]. It helps customers increase the flexibility of their business processes, strengthen their underlying IT infrastructure, and reuse their existing IT investments by creating connections among disparate applications and information sources.

Service Orientation and Value Proposition

Service oriented architecture begins with a service: a service being simply a business task, such as opening an account and making a purchase. It is important to note that the business tasks are part of enterprise business processes that complete the business activities. In SOA point of view point, the day-to-day business operation processes can be breaking up into repeatable business tasks or components. Service orientation is focused on the business and is the way an enterprise views different business functions that make up a company. In other words, SOA deconstruct enterprise business into a set of processes made up of components. These repeatable business tasks could be implemented by services. Services are the building blocks of flexible IT systems that support business processes. A SOA enterprise uses a service orientation approach to bring high value goods and services to the market.

SOA is based on standards that enable interoperability, business agility, and innovation to generate more business values. The SOA strategy focuses on what "value" might be created for the enterprises in the marketplace. To gain competitiveness and create values, the enterprise should target on redesigning their core business processes in response to key competitive factors. These competitive factors can be derived from the Porter's value chain [2]. The value chain divides the organization into a set of generic functional areas, which

can be further divided into a series of value activities. In the value chain, there are two distinct types of functional area: primary and support (Table 1). Primary activities are concerned with the direct flow of production (such as inbound logistics, operations, outbound logistics, marketing, sales, and service), whereas support activities (firm infrastructure, human resource management, technology, and procurement) support the primary activities and each other. Starting with its generic value chain categories, a firm can subdivide into discrete activities, categorizing those activities that contribute best to its competitive advantage. The value is measured by the amount customers are willing to pay for an organization's product or service. Primary and support activities are called value activities, and an enterprise will be profitable as long as it creates more value than the cost of performing its value activities [3]. In this way, a value chain is defined and a better organizational structure and business process can be created around those value activities that can most improve an organization's competitive advantage [4]. In deeds, Porter also recognized linkages outside the enterprise, as they relate to the customer's perception of value. This provides the possibility that one value chain could be linked to another value chain, because one business partner could be the other's customer. This interconnected value chain system can act as a supply chain that encompasses the modern business world, and participating organizations can readily extend their technologies to their partners.

Effective management involves many managerial functions, such as scheduling, budgeting, quality control, resource management, and so forth. The ultimate purpose of these management functions is to allocate resources (manpower, equipment, material, etc.) and then monitor, control, and keep all processes on track during every stage of the project cycle. Many business management share many of the same business activities as derived from the value chain, because Porter's value chain activity is the backbone of every type of organization in every type of industry.

The SOA Transforming Roadmap

The ability to capture, organize, integrate, transform, and use information to create value is a goal of most enterprises [1]. Based on a value chain analysis, several business activities are identified, and a series of decomposing efforts will render more detailed processes and service blueprints. The business process management (BPM) enables enterprises to better manage and improve customer-oriented processes (such as purchase, after sales service), identify customer needs and exceed their expectations, achieve better product design, along with improving information sharing and collaboration.

Table 1 The Value Activities

Activities		Business Functions, Components, Processes, Services
Primary	Inbound Logistics	Material receiving, handling, warehousing, inventory control, quality control, and return to supplier.
	Operations	Manufacturing and assembly of final products, production planning and scheduling, material control, testing and so forth.
	Outbound Logistics	Receiving outputs form operations, warehousing, inventory control, order processing, packing, and delivery.
	Marketing & Sales	Product design, forecasting, pricing based on corporate strategies, advertising, selling, and so on.
	Service	Installation, repair, adjustment, training, CRM, and public relations.
Supporting	Firm Infrastructure	General management, quality management, strategic business planning, legal issues, finance, and accounting.
	Human Resources Management	Recruiting, hiring, training, work and payment, compensation policy, labor, and personnel relations.
	Technological Development	Product R&D, engineering, process and specification design, and work automation.
	Procurement	Material purchases, contracting, according to the specifications set by designers.

BPM focuses on achieving strategic business objectives by directing the deployment of resources from across the organization into efficient processes that create customer value. Similar to quality management cycle, intrinsic to BPM is the principle of continuous improvement, perpetually increasing values and sustaining the market dominance of the enterprises. With BPM, enterprises adopt greater process management disciplines and transform from functional integration to process aware business services.

Since the BPM emphasizes continuous improvement to both business and IT processes, the “governance” is very important in the corporate SOA transformation process. Governance is the rules, policy, and measurements that direct the alignment of business and IT. For example, SOA governance can help by establishing rules for shared services, enforcing standards, facilitating communications, and service platforms. SOA adds value by identifying and implementing shareable services. Typical issues, such as “What common business services are needed?” or “What potential applications will reuse the services?” are major concerns in SOA governance. Therefore, governance is involved in making sure that the process is enforced when services are developed and delivered.

The Multi-tier Service Model

Typically SOA is a set of building blocks (file transfers, directory, media, and application servers) that enable multi-device and multi-channel information services. The business value of SOA is to help solve the IT challenge by integrating fragmented middleware applications to run composite processes [5]. This is achieved by providing one service platform that can replace many separate application interfaces from multiple IT sources.

These tools and theories can now be combined to provide an enterprise-wide business service scheme. The SOA transformation roadmap is shown in Figure 1. The first step is to transform a functional organizational structure into a process-based structure based on the value chain and business process management (BPM). The second step is to use the UML to build a component and object view (Class Diagrams) of business operations that follows the organizational business rules, policies, and business serviced scenario. In this study, we focus on the process modeling techniques and web service deployment scheme. In such case, a SOA project usually starts with modeling business activities. Some of the Computer-Aided Software Engineering (CASE) tools provide a deep analysis of organizational business activities and transform into a component view of an enterprise. For example, the Unified Modeling Language (UML) is an object-oriented modeling technique that provides a comprehensive methodology for designing object-oriented or component-based applications in a logical, structured manner, and it is available for the development of multi-tier distributed applications. An object-oriented approach is used to map the corporate business process with the information system in terms of a series of reusable business objects, which encapsulate complex business rules and services. By applying the modeling methodology, these business service relationships can be transformed into object or component based interactions. In UML process, for example, the governance is the governance of the modeling, assembly, and deployment of the SOA. The third step is to translate the object-oriented blueprint of the enterprise processes model into machine recognizable codes that can be compiled into a series of reusable business services. Several programming languages (such as C++, and Java) can be used in this transformation.

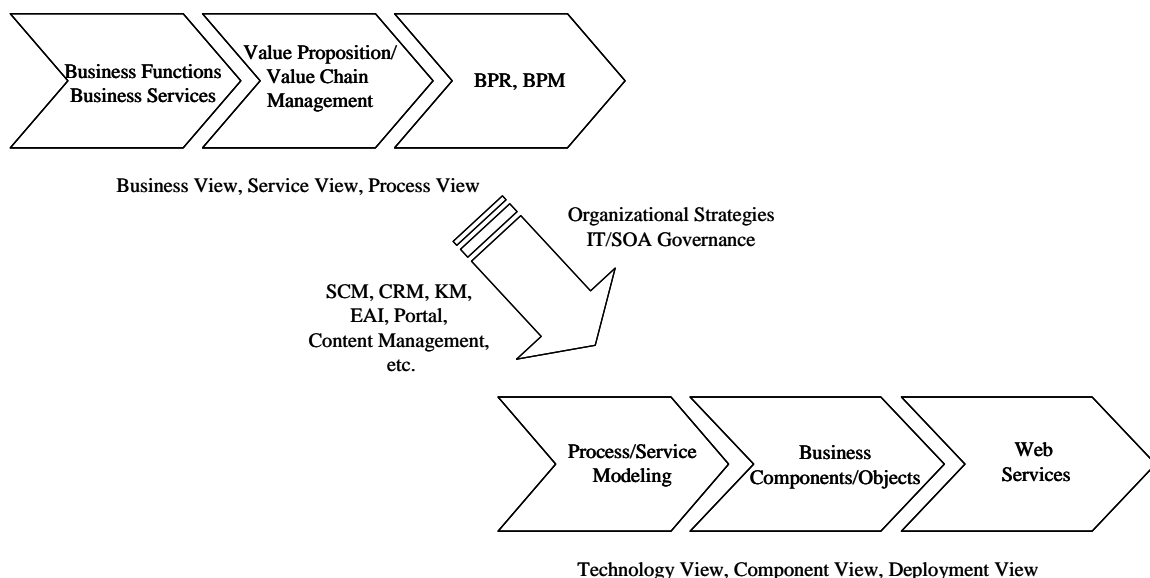


Figure 1 The SOA Transformation Roadmap

The business objects/components presented thus far depict business services, in that each represents in artifact that is encountered or produced in the daily business routine. Each module in the user services part of the model actually relates to a single use case [6] statement, which, in code terms, would actually have to be divided into a number of distinct routines. These routines deal with the methods and properties of the business objects/components in the business services tier, and the user interface uses these objects/components to display

needed information and feed user input into the system. The business objects/components, in turn, use objects/components in the data services layer to get their data. In this way the user interface could change without impacting the underlying way in which the application dealt with the business, and the database could be replaced with a new database without affecting the rest of the system. As long as the interface to the data service objects/components remains intact, the rest of the code will compile and run properly. The final step is to migrate these business objects into IT systems to deliver services using web services scheme, as shown in Figure 2.

The SOA Reference Model

The transform and modeling process involve many technologies, such as service-driven principles, components, transactional technologies, loose coupling, object-oriented design/development, web services, event-delivery, CORBA, DCOM, .NET, J2EE and EJB. These technologies exist together in SOA through standards, well-defined interfaces, and service orientation to reuse key services. As one usually says SOA is not just about technology, but about how technology and business link themselves for a common goal of business flexibility. In order to routes messages between services, handles business events from disparate IT sources, and transport protocols between users and services, a hub for flexible connectivity to integrate applications and services is needed. It is a message exchange channel or infrastructure that sometime called service bus or enterprise service bus (ESB). The ESB can help organizations to achieve the goal of SOA project. An objective of SOA is to focus on what services can do for the business and treat its capability to connect to other parts of the environment as a given. The service bus that exchange message and invoke services across organizational information system. It is a flexible connectivity infrastructure for integrating applications and services.

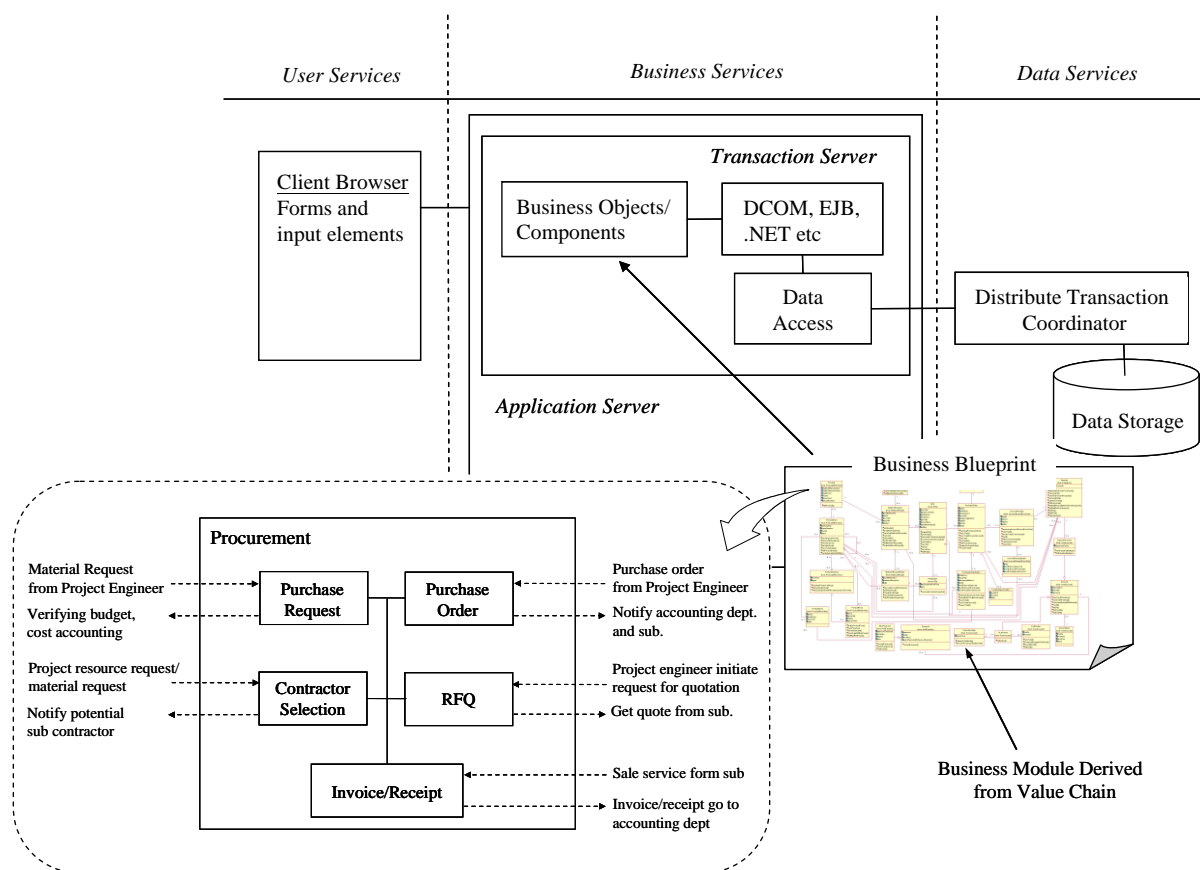


Figure 2 Multi-tier Share Service System Architecture

Since SOA services are assembled from existing applications and services, they share the underlying applications and IT resources. One of the challenges that enterprises have to deal with is to coordinate where to store and how to manage services, both the newly created ones and the ones that may be reused in the computing environment. For services in adaptive information system, the enterprises need a type of mechanism that helps with reusability, visibility, and manageability of services. A registry for system will serve as a service index to help enterprise with the business and IT linkage. It is a record and index service where enterprise can share best practices and knowledge about the business models and processes.

The SOA for Inter-Enterprise Application Service Integration

Most business plans are unique, complex, extensive, expensive, and subject to tight schedules and budgets. Configuring service oriented operations among different trading parties is very important, because enterprise business services represent the cross-functional integration of all activities that cross the borders of the participating organizations. Using the value chain concept to identify an enterprise's competitive advantages and then reengineering its core business processes accordingly is the best way to make a company more process-aware, and that is the beginning of inter-enterprise application service integration. Based on previous discussion, a more complete SOA reference model is shown in Figure 3.

As mentioned before, SOA is a style of architecture that enables the creation of applications that are built by combining loosely coupled and interoperable services. Web services are open standards that support interoperability. In SOA, since the basic unit of communication is a message exchange rather than an operation, web services are usually loose coupled. XML is the basis for all web services technologies and the key to interoperability. Because almost every web services specifications are based on XML. With innovate technologies, such as web service, XML and Internet-based systems can offer functionality, service, and information to users through a standard Web browser, thereby eliminating requirements for traditional electronic data interchange (EDI) or client-based software and reducing IT implementation and maintenance costs, cycles, and burdens.

Today, e-business solutions should be built on a web service architecture that leverages standard Internet communication protocols and enterprise intranets, extranets, and the global Internet to provide low-cost and universal access to all members of the e-business ecosystem. The winners in the Internet economy will be those companies that can respond most rapidly and efficiently to the customer's demands. As a result, SOA solutions provide support for the capture and communication of customer demand, as well as enable this demand to automatically trigger business events and initiate process workflow. This SOA also needs a common data model, because to be effective an e-business solution will need to deliver an accurate and common view of customer demand data as well as any subsequent events, plans, or other business data. This new SOA offers virtually unlimited business opportunities in the alignment of processes and technologies. In today's changing business environment, the SOA provide a viable solution for enterprises to keep moving forward to the next level of business operations.

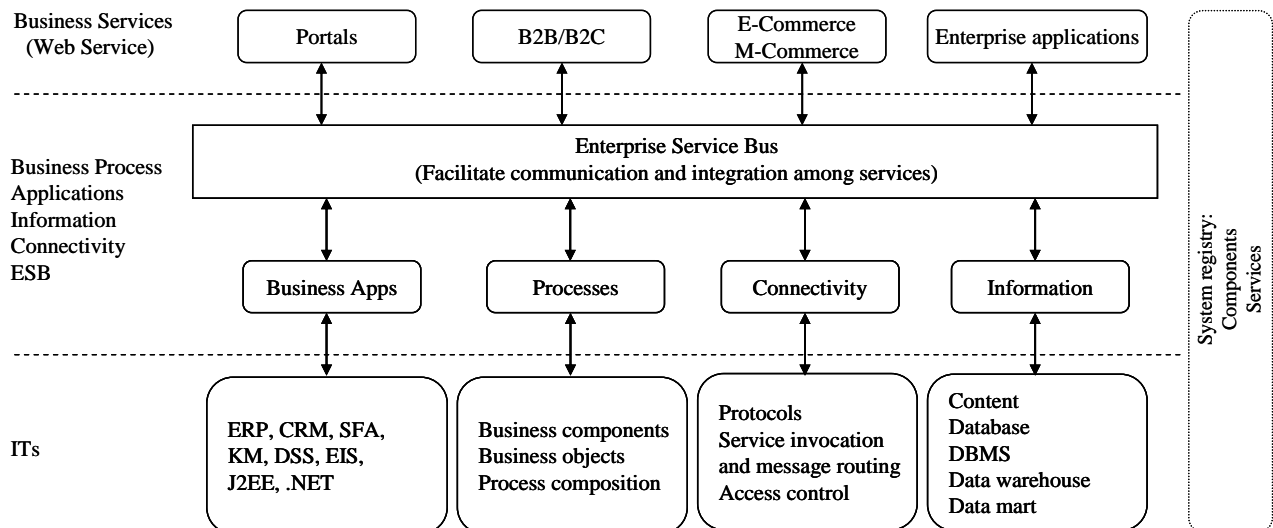


Figure 3 The SOA Reference Model

CONCLUSION

The challenges of global competitions are increasingly forcing today's process-centered enterprises to utilize more fully the skills, knowledge, competencies, and resources found in their integrated service networks. The enterprises must acknowledge that adaptivity is increasing becoming a measure upon which its productivity will be evaluated. This adaptivity requires enhancing communication among all team members and aligning their actions toward a common goal, and IT will be a key "enabler" for this SOA transformation effort. This paper provides a broad discussion on the building of service oriented architecture from value proposition and service

orientation principle point of view. As mentioned, SOA helps today's businesses innovation by ensuring that IT systems can adapt easily, quickly, and economically to support rapidly changing business needs. The implementation of SOA for flexibility always involves web services because of their value proposition around interoperability for flexibility. A well-designed and well-integrated SOA will improve upon existing cost sensitive services and processes. The central idea of SOA is to bring high value goods and services to the clients. In today's business, the customer is in control, and a business must realign its value chain around the customer to eliminate inefficiencies, and custom information, products, and services. SOA becomes a new challenge for today's industries. Enterprises will need to learn that in the SOA transformation process, the business managerial perspective is as important as technological infrastructure to the enterprise application architecture. The Collaborative Commerce (CC) SOA scheme that enables a dynamic enterprise to fulfill many mission-critical business processes and have organizational agility will undoubtedly be the best business solution for today's changing business environment.

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E-PROCUREMENT FRAMEWORK FOR A SUCCESSFUL E-REVERSE AUCTION

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ABSTRACT

This research applies the balanced scorecard concept to measure the success factors of e-procurement adoption. The survey results show that organization learning is determined by service capability, organization support policy, good governance intention, and organization readiness factors. The internal process improvement and employees' satisfaction can be identified by service capability and organization support policy. Trust in e-procurement online intermediaries has no impacts on the four measures of the balanced scorecard. Employees' satisfaction has the strongest impact on financial cost improvement but organization support policy has a negative impact on financial performance improvement.

Keywords: e-procurement, balanced scorecard, e-reverse auction success factors

INTRODUCTION

Electronic business via the Internet has the great potential to transform the way business is conducted. Electronic business has the capability to broaden the choices available to buyers, to provide sellers access to a larger customer base, and lower transaction costs. Many organizations seek beneficial approaches from electronic business to assist them lower operating and investment costs. Procurement is one major area where firms try to reduce cost and inefficiencies. This function is an important activity found in all organizations e.g. public, private, and governmental sectors. The use of electronic procurement (e-procurement) is one approach that has been adopted to streamline the purchasing processes and lower purchasing costs. Electronic procurement can be defined as the use of Internet-based platform for procurement processes - from requisition through payment [17]. The use of electronic procurement seems to promise substantial benefits [12]. Traditionally, most organizations measure their performance by reviewing their financial aspects [1, 2]. Nevertheless, a financial measure alone is not a balanced inspection of the success factors because financial figures tend to measure the past. Hence, many studies have applied the balanced scorecard to measure the value of information systems and information technology, such as Hong Kong [10], Australia [5].

The balanced scorecard is a formal management tool that translates an organization's mission and strategy into a comprehensive set of key indicators performance measures and provides the framework for strategic measurement and management [9]. The balanced scorecard is based on four critical perspectives: finance, customer, internal processes, and learning and innovation. Han and Tibbits (2000) have developed the electronic commerce scorecard in four perspectives: value of the business, relationship, internal processes and structures, and information technology and telecommunications. However, there is little empirical evidence exists to support claims concerning the success factors to obtain the value of e-procurement adoption. In addition, it is more constructively to measure the impact of the success factors of e-procurement adoption on each perspective of the balanced scorecard. This paper is thus intended to investigate the success factor elements of e-procurement adoption and to examine the relationship between the success factors and the four perspectives of the balanced scorecard. The study focuses on the reverse auction of e-procurement and focuses on the reverse auction via the online intermediary.

THEORETICAL FRAMEWORK AND RESEARCH MODEL

Procurement activity is traditionally an internal service provided by purchasing department personnel. This function consists of many procedures including identifying internal customers or employees' needs, translating of the needs into service / goods specification, communicating with suppliers in terms of sourcing, request for tendering, price negotiation, ordering receipt, and assessment of the internal customer satisfaction of the service or goods. Many internal customers spend a lot of time on purchasing because of the bureaucratic functions. It is often perceived by its internal customers who see the purchasing department purchases with the higher price but with poor quality goods or service [13]. To decrease these problems, many firms have adopted the e-procurement to make the procurement processes more economical, efficient, and effective. In addition, adoption of e-procurement greatly assists in the reengineering of the purchasing processes [17] and off-process purchase – so called “maverick” [3]. Therefore, e-procurement adoption has to be managed to satisfy the internal customer and achieve firm's goal so that the goals of e-procurement adoption can be obtained.

One factor relating to the success of e-procurement is the technical capability of the e-procurement system. Johnston (1995) proposed technical service quality in terms of system quality (e.g. security, reliability, easy to use,

accessibility) and functional quality (e.g. responsiveness of service).

Trust in the service provider is one major success factor for electronic service adoption. The main attributes that have been found to create trust in the service provider are benevolence, integrity and the ability of the service provider [11]. Benevolence is the perception that the trusted party desires to do good things rather than maximize profit. Integrity means the trusting party believes that the trusted party will be honest and make an acceptable set of policies. Finally, ability consists of the skills and competencies of the trustees to do what needs to be done successfully. In this study it relates to the competencies of the e-auction intermediary of the e-procurement service. Higher trust can create better relationship between customer and service provider [15].

In addition, organization readiness is seen to be key driver for increasing internal process improvement, enhancing learning and innovation, such as knowledge of purchasing personnel, computer skill and resources. Management support is another key influence of e-procurement adoption. Good attitude of management of e-procurement can make the system adoption success. Besides, providing training to related personnel is the best support which enables personnel can use the e-procurement more efficiently. Moreover, organization culture also plays the major role in e-procurement adoption success. The organizations that are more likely to adapt or respond to the change faster can adopt new technology more effectively. In particular, the role and process changes in the organization. Finally, good governance intention of the organization can decrease malpractice purchasing within the organization.

Many organizations have applied the balanced scorecard as measurement tool for strategic management. Kaplan and Norton [7,9] suggested that financial measures provide incomplete and narrow view of organization performance. Measurement of company performance must be supplemented with the customers' satisfaction, internal processes improvement, and learning and innovation ability of the organization. As a result, the balanced scorecard is designed to measure past performance and the drivers of future performance. Moreover, the balanced scorecard reflects an intention to keep score of a set of items that maintain a balance between financial and non financial measures, and between internal and external performance perspectives [9]. Conceptually, the balanced scorecard is based on four perspectives: financial, customer, internal processes, and learning and innovation. The financial perspective is the shareholders' view. The goal is to succeed financially, by delivering value to the firm's shareholders (e.g. profit, dividends, lower long term cost). The customer perspective is a value-adding view. The goal is to deliver value to the firm's customer and improve the customer's satisfaction. Specific to this context, e-procurement is an internal service. The benefits of procurement processes compliance are related to internal customers or organization employees' satisfaction [14]. Thus, this research uses the internal customer satisfaction as one scorecard measure for e-procurement success. The internal processes perspective is a process-based view. The goal is to satisfy the firm's shareholders and customers by promoting efficiency and effectiveness in the firm's business processes. Lastly, the learning and innovation perspective is future-oriented view. The goal can be achieved by sustaining the firm's innovation and change capability, through continuous improvement and preparation for future challenges [8,9]. Prior research showed that technical service capability, trust in service providers, organization support policy and good governance policy can enhance internal processes, and learning perspectives [4]. Hence, the proposed hypotheses for the research are:

H1: The higher the level of e-procurement technical capability, the higher the level of learning in the organization.

H2: The higher the level of trust in online e-procurement intermediaries, the higher the level of learning in the organization.

H3: The higher the level of e-procurement support, the higher the level of learning in the organization.

H4: The better the good governance policy of e-procurement, the higher the level of learning in the organization.

Moreover, technical service capability, trust in service providers, organization support policy and good governance policy can enhance internal processes perspectives [4]. Hence, the proposed hypotheses for the research are:

H5: The higher the level of technical e-procurement capability, the higher the level of internal process improvement.

H6: The higher the level of trust in online e-procurement intermediaries, the higher the level of internal process improvement.

H7: The better the e-procurement support policy, the higher the level of internal process improvement.

H8: The better the e-procurement good governance policy, the higher the level of internal process improvement.

This research proposes the relationship between e-procurement success factors and internal customers' satisfaction as the following:

H9: The higher the level of technical e-procurement capability, the higher the level of learning in the organization.

H10: The higher the level of trust in online e-procurement intermediaries, the higher the level of learning in the organization.

H11: The better the e-procurement support policy, the higher the level of learning in the organization.

H12: The better the e-procurement good governance policy, the higher the level of learning in the organization.

Finally, the effects of the four success factors of e-procurement on financial perspectives are proposed:

H13: The higher the level of technical e-procurement capability, the higher the level of learning in the organization.

H14: The higher the level of trust in online e-procurement intermediaries, the higher the level of learning in the organization.

H15: The better the e-procurement support policy, the higher the level of learning in the organization.

H16: The better the e-procurement good governance policy, the higher the level of learning in the organization.

RESEARCH METHODOLOGY

A survey research approach was used to measure the constructs in the proposed model. The research questionnaire was divided into three sections, the first of which asked about the success factors of e-procurement. In section two, a number of statements were used to measure the results of e-procurement adoption in terms of the balanced scorecard concept. The questions were measured using a Likert scale ranging from 1="strongly disagree" to 5="strongly agree". The last section requested general information about the respondent's demographics. A small-sample pretest with 35 respondents, among purchasing personnel in public, private and government organizations, was conducted to check the reliability of the items before going ahead with the main study. Respondents were selected using judgment sampling, selected from three sectors: private, public, and government organizations. Informant data collection was used to collect data from at least two respondents from purchasing personnel from the e-procurement adoption firms. At least one of the respondents is in manager position. The demographic of the respondents is shown in Table I.

Table I: Respondent Profile

Characteristics	N	Percent
Type		
Private	38	21.1
Public	59	32.8
Government	83	46.1
Gender		
Male	101	56.1
Female	79	43.9
Age		
< 20-30	4	2.2
31-35	21	11.7
36-40	57	31.7
41-50	78	43.3
> 50	20	11.1
Education		
Less than bachelor	9	5.0
Bachelor	138	76.7
Masters	30	16.7
PhD	3	1.7

DATA ANALYSIS

Exploratory factor analysis identifies two technical success factors: system capability and service capability (Table II). In addition, two important success issues are related to e-auction intermediaries: online intermediary ability and reputation (Table III). Organization factors are grouped into three factors: organization readiness, management support policy, and good governance policy (Table IV).

Table II: Dimensions of technical capability

Items	Factor Loading
Factor 1: System capability	
System Reliability	.809
System Security	.799
Easy to use	.788
Accessibility	.645
Speed	.574
Factor 2: Service capability	
Responsiveness of service	.891
Transaction	.865
Cummulative Variance = 62.328%	

Table III: Dimensions of trust in online intermediary

Items	Factor Loading
Factor 1: Service provider ability	
Honesty	.858
Keep contact policy	.837
Ability to solve problem	.786
Service efficeincy	.679
Factor 2: Service provider reputation	
Reputation	.891
IT leadership	.848
Cummulative Variance = 68.233%	

Table IV: Dimensions of organization support policy

Items	Factor Loading
Factor 1: Management support policy	
Training support	.780
Organization adaptation	.744
Management attitude	.700
e-procurement group	.694
Response to change faster	.672
Process re-engineering	.552
Factor 2: Good governance	
Define seller specification	.872
Define penalty for malpractice	.860
Define product specification	.836
Factor 3: Organization readiness	
Knowledge of IT usage	.846
IT readiness	.790
Personnel knowledge e-procurement	.530
Cummulative Variance = 67.273%	

The complete set of factor scores for each respondent served as inputs to further regression analysis. The impact of the e-procurement success factors on organization learning consists of four factors. The results are summarized in Table V. As can be seen, one of the two sub-dimensions of technical capability is significant: service capability. Trust in online intermediaries has no impact on enhancing organization learning. Organization support policy, organization readiness, and good governance policy intention show positive effects on organization learning (Table V).

Table V: Regression analysis for the impact on Organization learning

Independent Variables/ Constant	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	Beta	S.E.	Beta		
(Constant)	.014	.067		.206	.837
System capability	.050	.099	.051	.504	.615
Service capability	.257	.080	.259	3.217	.002**
Online Intermediary ability	-.118	.099	-.119	-1.188	.236
Online Intermediary reputation	.083	.075	.085	1.114	.267
Organization support policy	.214	.080	.216	2.676	.008**
Good governance intention	.213	.086	.215	2.468	.015**
Organization readiness	.263	.078	.248	3.356	.001**
R ² = .262 Adjusted R ² = .231 F = 8.237 Sig. = 0.000					

The impact of the e-procurement success factors on internal process improvement consists of two factors. Service capability is significant. Again, trust in the online intermediary has no impact on enhancing internal process improvement. Only organization support policy shows a significantly positive effect on internal process improvement at $p > .10$ (Table VI).

Table VI: Regression analysis for the impact on internal process improvement

Independent Variables/ Constant	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	Beta	S.E.	Beta		
(Constant)	.006	.070		.085	.933
System capability	.098	.103	.099	.950	.343
Service capability	.343	.083	.348	4.145	.000**
Online Intermediary ability	-.069	.102	-.069	-.670	.504
Online Intermediary reputation	.010	.078	.010	.130	.896
Organization support policy	.143	.084	.144	1.710	.089**
Good governance intention	.121	.089	.123	1.356	.177
Organization readiness	.125	.081	.119	1.543	.125
R ² = .215 Adjusted R ² = .181 F = 6.233 Sig. = 0.000					

The impact of e-procurement success factors on internal customer satisfaction consists of two factors. Service capability has a positive impact on internal employee satisfaction. Trust in online intermediaries has no impact on enhancing internal employee satisfaction. Only organization support policy shows a significantly positive effect on internal process improvement (Table VII).

Table VII: Regression analysis for the impact on internal customer satisfaction

Independent Variables/ Constant	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	Beta	S.E.	Beta		
(Constant)	-.015	.071		-.218	.828
System capability	.140	.105	.140	1.330	.185
Service capability	.275	.084	.276	3.265	.001**
Online Intermediary ability	-.147	.105	-.146	-1.402	.163
Online Intermediary reputation	-.001	.079	-.001	-.012	.990
Organization support policy	.262	.085	.262	3.097	.002**
Good governance intention	.084	.091	.084	.918	.360
Organization readiness	.056	.083	.052	.676	.500
R ² = .191 Adjusted R ² = .156 F = 5.449 Sig. = 0.000					

Finally, the employee's satisfaction influences financial performance improvements. However, organization support policy has a negative impact on the financial performance.

Table VII: Regression analysis for the impact on internal customer satisfaction

Independent Variables/ Constant	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	Beta	S.E.	Beta		
(Constant)	-.089	.056		-.159	.874
Organization learning	-.123	.074	-.122	-1.665	.098
Internal process improvement	.200	.107	.199	1.867	.064
Employee satisfaction	.616	.102	.615	6.013	.000**
System capability	.081	.083	.083	.983	.327
Service capability	.003	.070	.004	.054	.957
Online Intermediary ability	.049	.083	.050	.595	.553
Online Intermediary reputation	.035	.063	.036	.568	.571
Organization support policy	-.154	.071	-.155	-2.181	.031**
Good governance intention	-.084	.073	-.085	-1.153	.251
Organization readiness	.016	.068	.016	.244	.808

$R^2 = .510$ Adjusted $R^2 = .478$ $F = 16.205$ Sig. = 0.000

CONCLUSION

The results of this paper have identified four main perspectives of e-procurement scorecards. The organization learning is determined by service capability, organization support policy, good governance intention, and organization readiness. The internal process improvement and employees' satisfaction can be identified by analyzing the service capability and organization support policy. Surprisingly, trust in online e-procurement intermediaries plays an insignificant role in the four measures of the balanced scorecard. Finally, employees' satisfaction has strong impact on financial performance improvement. However, organization support policy has a negative impact on financial performance improvement. This can imply that the firms adopting e-procurement do not support much about adapting the organization practice to use e-procurement efficiently. The e-procurement scorecard will allow managers to see positive and negative impacts on the e-procurement adoption. The value of the e-procurement scorecard rises if it is used to improve the organization support policy, for example through management attitude, and the organization's adaptability to change. Building upon this viewpoint, management can be evaluated in terms of efficiency and effectiveness. Internal process improvement is related to efficiency enhancement, which is related to service capability and organization support policy in this context. Effectiveness is addressed by cost improvement and employees' satisfaction. The major concern is the organization support policy has to be taken into account for improvement the performance of adopting the e-procurement system. Further, the results show that increased service capability is critical to the achievement of organization learning and internal process improvement. The implications of this research are that the organization support policy and service capability deserves a greater awareness and attention, since these are critical for a successful e-procurement adoption. In order to quantify the negative impact of the organization support policy on financial performance, future research can extend the longitudinal observation of e-procurement systems in order to model the impact of this issue in the e-procurement scorecard.

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A CASE ON MEASURING ENTERPRISE RESOURCE PLANNING SUCCESS

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ABSTRACT

The implementation of the enterprise resource planning (ERP) system is considerably highly complex, and the cost is relatively expensive and risky. As such, not all enterprises have successful ERP implementation. While success or failure of an ERP implementation from project management perspective is straight forward, for example by measuring the project's time, cost, scope or number of user requirements achieved attributes, the success of the delivered system in the post-implementation phase is more difficult to measure. We are interested in how the success (i.e. continuance use) of the system changes over time and what factors influence the ERP system success. This study uses the "IS Success Model" proposed by DeLone and McLean to measure the ERP post-implementation success (from system user's perspective) using six fundamental items – success quality, information quality, information use, user satisfaction, individual impact and organizational impact. Adopting the case study approach, a well-known "System Integrator" from the e-industry was investigated. The case-organization implements and uses the Oracle ERP. Two round of survey using the same survey questions were carried out on the same pool of 100 respondents at two different point of time, one after six-month of using the system and the other after another extended four-month of usage.

Our results show that, in overall, after an extended four months the same sample of respondents evaluates higher rank on each item on their ERP system quality, the impact of the ERP system on their organization, and information use from the ERP system. This could be due to improvement in users' experience and familiarization with the system. However, for information quality of the ERP system the same sample of respondents gives a lower rank after an extended four months of use. As the use of the system increases, the information needs for the system also increase and new information (previously unknown or not used) may also be discovered over a longer period of use.

In general, the three success dimensions (system quality, information quality and organizational impact) are on average slightly higher than "4" or neutral and we can say that the ERP system success is marginal. However, the organizational impact dimension is below "4". With this, we argue that this dimension of benefits indeed requires a longer period of time in order to observe to its outcomes or the benefits potentially bring about by an ERP system.

In analyzing the impact of each factor in predicting enterprise system (ES) success, simple regression considering a single factor at a time is run. It is found that "quality" factor alone successfully explains 62.1% of the total variance in the sample; "net benefit" explains 50.6% of the total variance; and "information use" explains 7% of the total variance. Thus, in comparison, both "quality" and "net benefit" are salient dimensions in predicting ESS but not "information use". This pretty much confirms the study by Sedera and Gable (2004). Based on these results, we can say that among the three factors, "quality" is the best predictor of ES success in this sample.

A PROPOSED MODEL FOR THE INVESTIGATION OF IMITATION BEHAVIOR ON ERP ADOPTION

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ABSTRACT

In the proposed project, we will investigate the imitation effect on technology adoption using Enterprise Resource Planning (ERP) systems as an example. This approach will offer a completely new perspective on IT adoption as a less rational behavior, even for critical ERP investment at the organizational level. Along with this investigation of the imitation-adoption relationship, our research will evaluate the moderating effect of experience on imitation behavior. We believe that imitation behavior will be strongest when an organization is considering ERP for initial adoption. However, when an organization has accumulated ‘experience’ of ERP over time, its adoption of subsequent ERP modules will probably follow a more rational decision process, as explained by traditional adoption theories.

Keywords: Imitation model, ERP Adoption

INTRODUCTION

In the last two decades, various well-tested models, such as the technology adoption model (TAM), task-technology fit (TTF) model, diffusion of innovation (DOI) theory and Triandis model, have been applied to explain the information technology (IT) adoption behaviour. Many researchers (such as Chau [5], Mathieson et al. [33], and Venkatesh and Davis [47]) then attempted to further expand and/or modify the original models to make them more complete theoretically. However, by nature of their assumptions, these models still focus primarily on the logical side of human behavior: that all adoption processes are systematically conducted and followed a rational path, i.e. they assume that a person or an organization has a complete picture of the situation and is able to anticipate the consequences that will follow each choice [30, 41]. Furthermore, they presume that there are rules by which one can follow to select the best alternative [20]. Yet, they are only able to describe a portion of the adoption behavior, and it is also well known that a lot of the IT adoption initiatives failed wasting millions of dollar in the process [26, 48].

In reality, it is simply impossible to obtain perfect information for a rational evaluation of new or emerging ITs. Without perfect information, and the awareness of the lack of it brings forth uncertainty. When uncertainty occurs in a decision making process, the logic sequence failed as it would not be possible to anticipate the consequences and to select the best alternative accordingly. In situations with uncertainty, sometimes the “best alternative” may not be the direct result of logical deduction described in the various adoption models, instead we may turn to sometime different all together – we imitate. Imitation does not remain only on an individual level, it occurs at an organizational level as well. DiMaggio and Powell [11] argued that initial adoption of innovation was largely caused by the desire to improve performance. However, as the innovation gains increasing popularity, a threshold is reached and beyond that adoption of innovation becomes a pursuit for legitimacy rather than necessity. From this perspective, imitation can also be regarded as an optimal response to a particular type of uncertainty [3].

In this paper, we evaluated the direct impact of the rational and imitation behaviours on the beliefs of ERP systems. The imitation model adopted in this research is based on the framework proposed by Haunschild and Miner [18], which is comprehensive in its classification of imitation modes. Furthermore, we chose to use DOI as a reference model for the rational IT adoption behavior due to its maturity and theoretical completeness, along with its capacity to investigate organizational ERP systems. Our research also evaluated the moderating effect of adoption experience on imitation and ERP belief, along with the moderating effect of uncertainty, competition, and innovativeness on the relationship of the imitation-rational behaviors in the ERP adoption process.

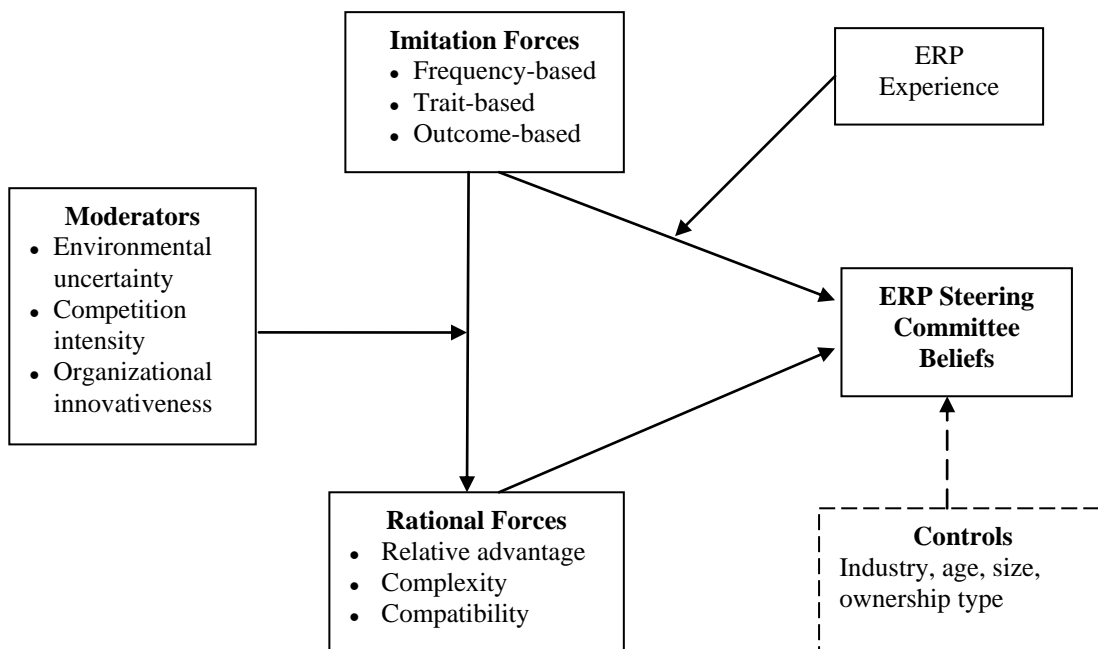
THEORETIC BACKGROUND

Drawing on the institutional and learning theories, Haunschild and Miner [18] distinguished three distinct modes of inter-organizational imitation – frequency-based, traits-based, and outcomes-based. The *frequency-based imitations* proposed by March [30] suggests that if there is enough social actors to do a particular action, this action will be taken for granted and other social actors will take similar action. The *trait-based imitation* can be seen as a more selective form of imitation [28]. Organizations often identify themselves with other organization which they view is more legitimate or successful, because it is what they are all striving to achieve. In doing so, they mimic their course of action due to the belief that actions taken by successful organizations will more likely to yield positive outcome. Trait-based imitation is based mostly on social, rather than technical, consideration, because it is often the “trait” that influence the decision making process

and not the potential outcome. The *outcome-based imitation* is based primarily on technical consideration, since this type of imitation arises from the perceived consequences of the practice, therefore outcome-based imitation is more likely to be a technical process than a social one. It is commonly believe that, in outcome-based imitation, organizations will tend to adopt practices of other organizations that yield positive or successful outcome.

RESEARCH MODEL

The purpose of this research is to identify and understand the interaction of rational and imitation behaviors on ERP evaluation and to offer a completely new way to look at technology adoption at an entirely different angle. Our proposed research model adapted Haunschild and Miner's [18] three forms of imitation behavior: frequency-based, trait-based, and outcome-based, in an attempt to evaluate their effects on the belief of the ERP Steering Committee, and subsequently the adoption decision. Moreover, ERP experience is proposed as a moderating variable of this imitation-belief relationship. The term ERP experience in here represents whether the company has already adopted an ERP module prior to our research.



RESEARCH HYPOTHESES

Effects of Imitation

Frequency-based imitation suggests that organizations are more likely to imitate a certain action if that action has been taken by a large number of other organizations. The massive introduction of ERP systems to organizations is bound to have critical implication to those that are still considering or have not adopted ERP. The sixty-seven percent adoption rate of ERP among the mid- and large-size organization [26] enhances the legitimacy of the ERP practice and suggests the technical value of ERP, which in turn causes more adoption consideration by others. The increase in the frequency of ERP adoption directly creates positive externality and change the landscape of competition. Consequently, companies were “forced” to adopt ERP because their major clients did; while others decided to do so because many of their rivals in the same industry have already done so. In many cases, companies are afraid that they will lose their competitive advantage without the technology or that they will be deemed “old fashioned” or “layback” if they do not follow the current trend and risk losing support from their stakeholders. Hence, frequency of ERP adoption may serve as a valid proxy indicator of its technical value, which in turn could shape the beliefs of top management favourably for its subsequent adoption. These phenomena have been described in the theories of Bandwagon [1] and validated in studies such as Fligstein [12] and Palmer et al. [36]. Therefore, we postulate that:

Hypothesis 1: The perceived number of organizations using a particular ERP system will have a positive impact on the belief of the Steering Committee in the ERP adoption process.

Trait-based imitation refers to a set of more specific imitation behavior. Organizations may selectively imitate practices that have been used by a certain type of organizations, namely higher-status, larger, and more successful organizations [3]. ERP is seen to be a good way of cutting cost and increase profit margin [39] as demonstrated by Wal-Mart, Dell etc which is crucial for their success and turn them into the leader in their respective industry. Unfortunately, many ERP initiatives fail because

organizations do not understand the resources and commitment required for an ERP implementation and plunge themselves in just because other big players already have it [40, 49]. Despite these failures, management still believes the effectiveness of imitating the large and successful organizations in reducing the chances of ERP failures. Liang et al. [26] argue that top management succumb to imitating their successful peers or competitors to maintain the legitimacy of their ERP adoption decisions and avoid any potential loss of face. Hence, members of ERP Steering Committee mediate the impact of trait-based imitation forces on ERP adoption. In other words, they serve as a gatekeeper to evaluate the ERP practices and benefits from the leading organizations for a favourable or unfavourable belief that could be translated into actions for adoption decision and implementation. Consequently, we posit that:

Hypothesis 2: The perceived size and success of organizations using a particular ERP system have a positive impact on the belief of the Steering Committee in the ERP adoption process.

Outcome-based imitation refers to the practice when organizations use the outcomes that occur in other organizations as a basis to determine if, they too, should adopt the same practice [17, 18, 25]. ERP systems have emerged as complete business software systems that, ideally, facilitate enterprise-wide integration of information worldwide without geographical restrictions [38]. In practice, however, ERP implementation is complex and ERP success is even harder to achieve [49]. Therefore, potential ERP adopters have to imitate successful ERP adopters, by analyzing their adoption outcomes, and evaluate these possible outcomes in their own context. Hence, ERP vendors often publicize the positive outcome of their customers, as a marketing strategy to change the perceived ERP values, particularly in the turmoil of low success rate of ERP. Copy organizations from their successful ERP use generates a second-mover advantage of unexpected or unsought unique benefits, including the accrual of an external referent of prestige. These unanticipated benefits, along with the expected benefits of lower adoption risks and costs, could become a driver for the management to favourably shape their beliefs of ERP systems for their eventual adoption. Therefore,

Hypothesis 3: The perceived performance of organizations using a particular ERP system has a positive impact on the belief of the Steering Committee in the ERP adoption process.

In this research, experience is proposed as a moderating variable of the imitation-belief relationship to understand the effects of ERP experience, in term of its adoption and use, on changing the imitation behavior and belief of ERP among the Steering Committee members. Since ERP systems can be adopted in modules, therefore in the initial adoption stage, an organization will perhaps only consider a few critical ERP modules for implementation. At this stage of adoption, the effects of imitation might be stronger. This could be because the users still perceive ERP to be vague and ill informed (uncertainty), and are thus motivated to imitate others as a basis of their decision [11]. However, it is also possible that the direct effect of imitation on ERP adoption may subside over time as the organizations become more familiar with the ERP system and its operations. When the ERP Steering Committee members are more informed of the risks, benefits, and acceptance associated with the continued use of ERP, their decisions on the subsequent ERP system upgrade will rely more on the usefulness, ease of use, and other information that have been accumulated from the earlier ERP experience. In other words, the Committee will perceive and evaluate ERP systems independently of other organizations, which suggests that their adoption decision are less susceptible to the imitation forces. Hence:

Hypothesis 4a: Organizations that have not adopted any ERP systems are more likely to imitate because their Steering Committee has a weaker belief in the ERP systems.

Hypothesis 4b: Organizations that have adopted at least one ERP module are less likely to imitate because their Steering Committee has a stronger belief in the ERP systems.

Effects of Innovation Characteristics

The findings from DOI research have identified a strong correlation between an innovation's relative advantage and the user's attitude towards its use. Chau and Lai [7] and Liao et al. [27], for example, have empirically confirmed that relative advantage has a significant direct effect on attitude towards the use of Internet banking. In so far as intention to adopt and actual system use are concerned, Tan and Teo [44] also provided evidence to support the criticality of relative advantage to intention to use and the eventual use of an innovative IT. It is obvious that the benefits of ERP supersede most of its competing systems, which in turn could favourably influence the belief of the steering committee for possible ERP adoption. Hence:

Hypothesis 5: The relative advantage of ERP has a positive impact on the belief of the steering committee in the ERP adoption process.

The incompatibility of ERP to the existing values, past experience, and needs have negative effects on its adoption and diffusion. An incompatible innovation would inhibit further innovation use and implementation due to adoption resistance and implementation complexity. Prior DOI research (for example, Moore and Benbasat [34] and Tornatzky and Klein [46]) have already validated that practical compatibility and value compatibility are both essential for enhancing adoption decision and incompatibility of either consideration could significantly negatively affect the innovation's use and adopters' attitude. Chau and Hu [6] also validated that when users are accustomed and entrenched in a particular working habit, it is unlikely that they will accept a technology that is

perceived to be incompatible with their practices. Subsequently, it is likely that the ERP incompatibilities will have an adverse effect on the steering committee's beliefs which in turn will lead its members to evaluate ERP negatively for adoption.

Hypothesis 6: The compatibilities of ERP have a positive impact on the belief of the steering committee in the ERP adoption process.

ERP systems are difficult to understand, use and implement [13, 19, 21], though they exhibit higher performance across a wide variety of financial metrics [35]. When the new system or tasks performed with the new system is complex, an individual will spend more time learning and understanding the new system, thereby adversely affect their attitude towards the system. In other words, when there is less or little extra cognitive learning effort required for the use and implementation of ERP, the steering committee's belief on ERP may be more favorable. The association between learning, complexity, and IT adoption has also been validated in prior TAM and DOI investigations. These studies have identified the positive effects of perceived ease of use [5, 10, 32] and negative effects of perceived complexity [2, 14, 22, 37, 46] on the innovation's attitude, intention to use, and its eventual adoption. Hence, we postulate our hypothesis as follow:

Hypothesis 7: The complexity of ERP has a negative impact on the belief of the steering committee in the ERP adoption process.

Effect of Imitation Behavior on Rational DOI Behavior

Plenty of research has been conducted on the cognitive biases in managerial decision making and it has been consistently shown that managers are boundedly rational and not perfectly rational [e.g. 4, 15, 41]. Managers make biased decision because they can only handle a fraction of the available information during the decision-making process [15, 31, 42]. Therefore, based on the theory of bounded rationality, a manager (or a group of them) will be unlikely to digest the large amount of statistical reports, financial analyses and case studies while trying to make an ERP adoption decision; and at the same time relates to every single piece of the available information (thus the manifestation of bounded rationality). Instead, he/she will likely be focused on only a few salient subsets of the entire available information, such as if other companies have been using it with very good results. Hence, we are proposing that the imitation force has an impact on the effort being put into evaluating ERP adoption because once managers regard that imitating bigger, more profitable competitors is "satisficing" (under the bounded rationality concepts), this will be enough to stop further investigation into the matter.

Hypothesis 8: The three-mode of imitative forces will have a direct impact on the rational evaluation of ERP's characteristics. More specifically, higher levels of frequency-, trait-, and outcome-based imitation will lead to less emphasis on the relative advantage, compatibility, and complexity of ERP in the adoption process.

Environmental uncertainty does not only have a direct cause of imitation, it can also assert a moderating effect on the imitation-rational ERP evaluation relationship. The fundamental idea behind this argument is due to the belief that in an uncertain environment where organization has very limited information to judge whether their adoption decision could provide a favorable result, and that the result of the adoption cannot be immediately apparent, organizations simply do not have enough data to base their logical judgment on. Along with the increase pressure to find a way to better manage the current uncertain situation, the "logical" action to take is to imitate (in this case, frequency, traits, or outcomes) and less on the rational evaluation of the ERP system, since the contrary cannot be ascertained with any degree of confidence. As such, high environmental uncertainty suggests difficulty in appraising the means-ends relationship of ERP acquisition and the consequential reliability of the appraisal. In fact, the greater the uncertainty, the more the organizations model themselves upon others as a social comparison to base their decisions on ERP adoption. Thus, we propose:

Hypothesis 9: The more uncertain the business environment is, the more the imitation behavior and the less the rational evaluation behavior in ERP adoption.

Competition intensity refers to the degree of competitive strength within the industry. It is generally agreed and empirically shown that the more intense competition is, the higher adoption rates of innovation [24, 45]. We believe in an ERP adoption decision, the intensity of competition will moderate the interaction between the imitation and rational force by increasing the dependency of imitation force in relation to its rational counterpart. When competition is intense, organizations will have more pressure and less time to evaluate ERP rationally to respond to the competition challenges. This coercive competitive pressure within the industry or market segment, according to the DiMaggio and Powell [11], forces organizations to imitate leading competitors, thus making them less likely to make rational decisions. If the successful companies within the industry have already adopted ERP to boost their efficiency in order to improve the profit margin, the remaining companies will run a very high risk of losing their competitiveness or cutting small their profit margins. Even if the Steering Committee does not regard adopting ERP as the best solution to survive the competitive arena, it will still recommend adoption in order to level out the playing field. Hence:

Hypothesis 10: The more intense the competition is with the industry, the more the imitation behavior and the less the rational evaluation behavior in ERP adoption.

The effect of *organizational innovativeness* on the relationship of imitation-rational technology evaluation has been widely discussed and explored in the DOI literature. Innovativeness, in the context on IT adoption, can be measured by the number of new innovations adopted and the relative earliness of their adoption [9, 37]. ERP promises a single, integrated platform to fulfill the basic information needs to all the functional areas within an organization, but this system is expensive, complex and difficult to operate, thus resulting in a low success rate [49]. These problems, associated with the uncertainty about the consequences of ERP, have restrained organizations from the adoption of this innovation. Innovative organizations, however, have a higher degree of slack resources, which provide the time and resources for the scanning, experimentation, and learning of ERP systems [23, 43]. They are also larger, more open, and with a greater extent of norms that encourage change [23, 37]. Hence, they are able to perform the gate-keeper's role and rationally evaluate and exploit ERP to create additional competitiveness. By the time the followers evaluate ERP for adoption, this innovation may have become a necessity due to economic or social pressure. Thus, we believe that an innovative organization is more likely to implement an ERP system ahead of its peers. Since an innovative organization is among the first mover and does not have others to model itself on, the steering committee must based their decision heavily on the rational force.

Hypothesis 11: The more the innovativeness of an organization, the less the imitation behavior and the more the rational evaluation behavior in ERP adoption.

Control Variables

To fully account for the differences among organizations, this research also included four control variables that had potential impact on ERP adoption as suggested by prior literature. These controls include organization size, age, ownership type, and industry type.

CONCLUSION

The above is only a proposed theoretical model. It needs further refinement and thorough operationalization in order to be tested empirically. Besides, the considerations given in this theoretical model is of limited caliber. We only consider DOI as the representation of the rational-evaluation force, while only imitation force was considered on the irrational side. However, this paper, we believe, could open up a new area of research in the MIS field probing into the intrinsic behavior of individual(s) and how it effects the organization as a whole.

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ADOPTION OF OPEN-SOURCE SOFTWARE

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ABSTRACT

Although the open-source software (oss) adoption is highly discussed in public, the same topic has not drawn much intention in research. This work is closing the gap by presenting a detailed analysis of open-source software adoption. We construct a new model to explain the adoption of oss within this paper. Therefore, we do a meta-analysis of established oss migration studies and identify the factors which are influencing the decision to adopt oss in companies. To evaluate this model we perform a case study. The statistical results of this study are also used to classify and compare the influencing factors and the case study's participants.

Keywords: Open-source Software, Adoption, Adoption Research, Adoption Model, Case Study.

INTRODUCTION

Open-source software (oss) has become an highly recognized phenomena in recent years as the source code is freely available and the products often free of charge. In the past, open-source-products focused on a few, often specialized areas of application but nowadays a vast spectrum of oss, ranging from operating systems to office products, exist. Most of these products are similar to commercial once. Not only is the functional range comparable but also the software quality. This results in an increasing proliferation of oss in companies, organizations and the public administration.

Although the open-source software adoption is highly discussed by these organizations, it is astonishing that this topic has not gained much attention in the research community. This work is closing the gap by presenting a detailed analysis of open-source software adoption in companies. Therefore, we will answer the following research questions: Which factors influence the adoptions of open-source software? How does a model to explain the adoption of oss look like? Which findings regarding the adoption of oss in companies can be derived from such a model?

To answer these research questions, we present our research methodology (case study research) in Section 2. In Section 3 we introduce the foundation of adoption research, first in general and second for the application to oss. Furthermore, we discuss the strength and weaknesses of existing approaches and develop a model to explain the adoption of oss in Section 4. In Section 5 we apply this new model within a case study. This paper will close in Section 6 with a summary of the most important results.

RESEARCH APPROACH

Several analysis of the most important approaches in implementation research have shown that two methods prevailed in recent years. These two methods are the survey and the case study method [4]. Overall the survey method is used most often. However, by looking closer at the geographical differences one can see that the two methods are nearly equally distributed in European publications [4, p. 7]. Furthermore, Choudrie and Dwivedi show that the application of one of the two methods is also determined by the objectives of the analysis [4, p. 6].

Research which breaks - like this one - new ground and where the objective is to develop new models to explain an issue, usually exploit the case study method. In contrast, the survey method is usually used for research which validates existing models. Based on this information, the case study method seems to be the most promising approach for this work and will be used within this paper. Yin defines a case study as follows: "A case study is an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" [21].

INTRODUCTION TO ADOPTION RESEARCH

Definition

The term adoption goes back to innovation research and describes in this context the decision of a person or organization to accept an innovation. Within this work the term also subsumes that the decision to adopt includes "the positive attitude [of a company] toward an innovation and the decision to use resources for the implementation of this innovation". Despite this focus, one can not equate the term adoption with the broad and lasting application of innovation. In fact, the adopter can desist from a further use of this technology if the expectations are not met, the technology is subsidiary or other reasons motivate it. This is the point where the decision-oriented adoption research differs from the more user-oriented acceptance research [2].

The term adoption is closely linked to the term diffusion. Diller defines diffusion as follows: "Diffusion is the aggregated result of the adoption decisions of the members of a social system (individuals, groups, organizations)" [8]. Therefore, diffusion is often defined as the result of the sum of all adoption decisions [10, p. 39] and mainly goes back to the work of Rogers [15] [16] [17] [18]. Based on statistical analysis, Rogers differentiates five categories of adopters over time,

- innovators: 5% of all adopters
- early adopters: 11% of all adopters
- early majority: 34% of all adopters

- late majority: 34% of all adopters
- laggards: 16% of all adopters

Review Of Existing Adoption Models

Several models exist in research, which describe the adoption of innovations - especially the adoption of open-source software. In the past, researchers developed a broad range of **general adoption models** which are usually empirically validated. Therefore, it is difficult and not useful to list all existing models. Despite the long research tradition in adoption research and the large number of general models, only a small number of **oss-specific models** exist. We will select and present four of these models more in detail. The models are:

- Model for open systems adoption from [3]
- Open-source platform adoption model from [5] [6]
- Conceptual model for the enterprise adoption of open-source software from [13]
- Commercial adoption model of open-source software [11]

First, we will have a closer look at the model which explains the **adoptions of open systems** from Chau and Tam [3]. The authors use a theory-building research design. Based on their own research and the model from Tornatzky and Klein [19], they developed a framework to explain the adoption of open systems. This framework was finally evaluated and expanded with a survey of 89 participants. After summarizing the results from Chau and Tam [3], one realizes that only three of the seven factors, which the authors use during their analysis, have a statistically significant impact on the adoption decision. Therefore, the part of the adoption decision which the model explains is with 14.0% relatively low [3, p. 13]. From these results, the authors derive several implications for future research. They propose to use more factors (e.g. technical knowledge of a company are the competitive position of a company).

Dedrick and West [5] [6] select a similar approach like Chau and Tam [3] within their **model to explain the adoption of oss**. They also use an explorative, theory-building research design to identify the relevant factors. In contrast to Chau and Tam [3] they do not use a quantitative approach but a qualitative design based on the grounded theory. The authors did 15 structured interviews with employees from ten different companies out of different industries. The result is a list of 17 factors, which the interview participants marked as a significant impact on the decision to adopt an innovation. It is not possible, not only because of the qualitative research design, to quantify the scale used by Dedrick and West [6]. The scale contains citations of the individual interview participants, which are hardly comparable without a concrete knowledge about the corporate environment where they are coming from. (e.g. "Phasing out Unix" and "Internet and Database Applications" [6, p. 242]).

The next model is the conceptual **model for the enterprise adoption of open-source software** from Kwan and West [13]. Analogical to its description, the model is of conceptual nature, this means that it is theory-based. In fact, the authors mention different interviews as an extension to the theoretical foundation. However, they do neither explain the survey method, the outline, the interview questions nor the number of participants.

Last, we will have a closer look at a **model to explain the commercial adoption of open-source software** from Glynn, Fitzgerald and Exton [11]. The model was developed with a case-study design. First, based on an analysis of several adoption models, the authors created a new model. Second, this model was operationalized and third, the new model was evaluated with a large survey of 111 members in different industries in Great Britain. Glynn et al. show that the 13 out of 16 factors have a large significance as they have a significant correlation with the adoption decision. Furthermore, they could prove a significant correlation between the factors company size, risk awareness and the availability of resources. A further analysis of the results was not done.

Although several models to explain the adoption of oss in companies exist, one can see that they all have restrictions. The need for a new, funded model to explain the adoption decision for this sector is immanent.

CONSTRUCTION OF THE OPEN-SOURCE ADOPTION MODEL

We discussed several models in the last section, which can be used to analyze companies' decision to adopt oss. Based on this discussion and the weaknesses of existing models, we will develop a new, oss-specific adoption model in this section. This model will be the foundation for a case study.

Several (professional) studies exist, which can help companies to decide whether an implementation of oss makes sense or not. These studies were mainly done by well-known market research companies (e.g. Gartner Group, Berlecon Research, Yankee Group, TechConsult, IDC). They usually used accepted methodical and statistical tools to develop these models [1]. We selected 36 studies to derive the influencing factors on the adoption of oss as a basis for the following analysis. A first overview over the 36 studies resulted in a list of 153 influencing factors. All these factors represented different aspects in different granularity of an adoption decision. For example, this list includes a very broad factor like the company's characteristics and very detailed factors like the test period for the open-source software.

As these factors were overlapping and sometimes even similar, we decided to structure the factors again. Out of the 153 factors from the first step, we distilled 44 basic factors. These 44 factors were compared to each other and after that we finally identified 29 different influencing factors (cp. Figure 1). The influencing factors contain not only factors which encourage the adoption of oss, like the free of charge or cheap availability of oss, but also factors which constrain the adoption of oss. The complexity to implement open-source software is such an example.

The large number of factors motivated us to classify them with the help of existing adoption models. Most models are dominated by three classes of technological, organizational and external conditions. This classification can be found in the general adoption models (cp. [7] [20]) but there are also several oss-specific models which use them (cp. [3] [6] [11]). By using a similar classification we are also able to better compare our results with other models.

- **Technology:** The dimension technology contains all influencing factors which can be directly linked to the technology. The technology is in our case the open-source software.
- **Organization:** The adoption of a new technology is also influenced by the organizational surrounding. Examples for this category are factors like the cost for training or planning the migration.
- **External Context:** The external context is the last of the three dimensions and describes factors, which are independent from the technology and the organization. Usually factors like the availability of professional support or the missing liability of oss are part of this category.

To assure the significance of the identified factors, we asked oss-practitioners to evaluate the relevance of these factors in an adhoc-survey. Therefore, we built a survey based on all influencing factors and the concrete specification and definition of this factor. Based on the positive experience with such a scale in the past, we used a six-stepped scale again. The scale goes from very relevant (1) to not relevant (6). Overall we asked 59 participants on open-source-conferences to fill out the form. The result shows, that two factors were marked as very relevant (1), 20 factors as relevant (2), seven factors as somehow relevant (3) and one factor as hardly relevant (5). Based on the argumentation in Section 3 we decided to integrate all influencing factors in the adoption model and therefore in the following case study. The categories and the remaining 29 factors can be found in Figure 1.

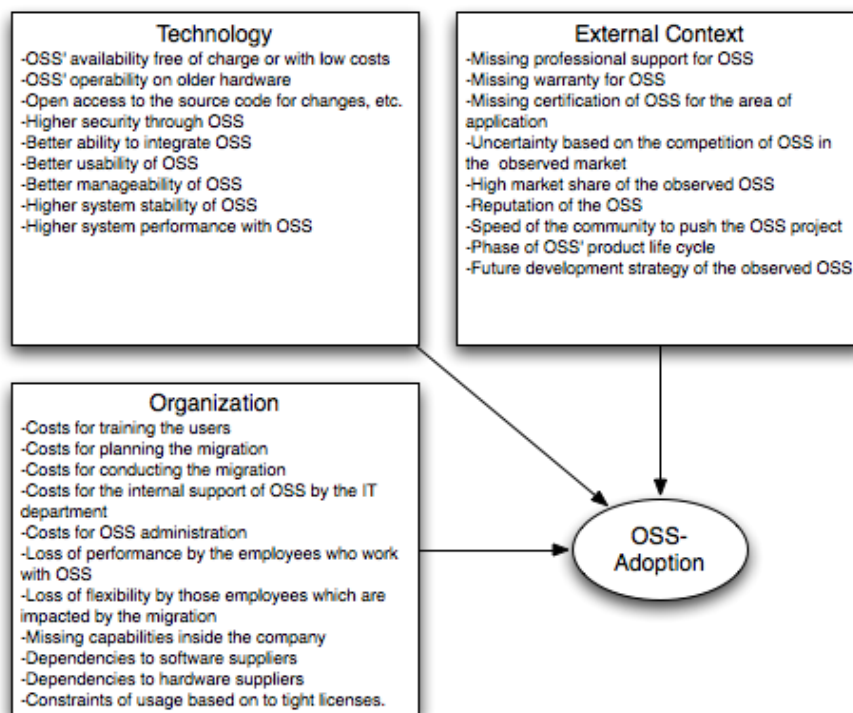


Figure 1: Model to explain the adoption of oss in companies

EVALUATION OF THE OPEN-SOURCE ADOPTION MODEL

Until now, we developed a model to explain the adoption of oss in companies. This model was based on a meta-analysis of several other studies. To evaluate the model, we will now design a case study.

Based on the objective to explain the adoption oss in companies, it is important that the described adoption model has to be evaluated in practice to gain valuable results. Therefore, we transformed the model into a survey, which was filled out by participants of different industries, branches, positions and oss-degrees of adoption. The objective of this survey was to evaluate the significance of this model for oss and to identify further insights regarding the different influencing factors and how they are interacting.

Project Setting

To evaluate the model, we transferred it into a survey. This survey covered two parts. First, a general socio-demographic part and second, a specific part in which the focus was on the 29 factors of adoption. In the general part, we asked for the participants'

background. This included her own position in the company, the profile of the company and how the company already deployed open-source software. For the latter information, we used a seven-step scale which was based on research done by Fichman and Kemerer and Glynn [11] [9]:

- **Unknown**
- **Awareness**
- **Interest**
- **Evaluation**
- **Decision to adopt**
- **Restricted use**
- **General use**

The specific part was mainly about the different adoption factors which we identified in the meta-study. We used a simple evaluation schema to allow a fast response to the already long list of factors. Therefore, we operationalized each factor, like it was done by [11], with only a single question. This methodology is accepted in adoption research on the organizational level. We decided that the survey's participants should rate each identified factor on the rating scale. The scale had six steps from not important (6) to very important (1).

Results Of The Case Study

In the next sections we will present the results of our case study. Overall, we contacted 263 known participants. Out of these 263 participants 56 took part in the case study. This is a rate of return of 23.23%.

Correlation Analysis

The correlation analysis is a statistical method, which aims at the degree and direction of correlation between two sizes and is often used within adoption research. A positive correlation of a variable with the adoption is known as adoption supportive (+) and a negative correlation as adoption retardant (-). The correlation analysis will be used with the same objective within this paper. Although the correlation coefficient is already a first sign of a similar development of two factors, we have to add the significance level. A higher significance level shows that the similar development of two variables is not random [14].

In our study, the correlation analysis proved the factors which supported an adoption and the factors which retard an adoption. Furthermore, we calculated the significance for the correlations. This analysis showed that only 13 of the 29 influencing factors (44.4%) correlated significant with the adoption. Such a number of factors is not unusual but was also found in other studies [3]. The other factors should be seen as noise and therefore eliminated from the model to improve its significance.

Factor Analysis

Another established method to identify common dimensions behind a number of variables and influencing factors is the factor analysis. The application of this analysis is useful, if a high correlation between different variables exist and one assumes that these variables measure a common dimension. Within the adoption research the factor analysis is often used (cp. [9]). This method is typically used to identify or confirm a common dimension of different influencing factors. For the factor analysis, we have to select the number of factors to extract. According to the convention to select factors with an eigenvalue of larger than one, we identified four factors. As mentioned in literature, we just interpreted factor loading with a value of larger than 0.5 [12]. The first identified factor can be interpreted as the **Technical Advantages of OSS**. This factor interpretation is similar to the factor **Relative Advantages** which was formed by Rogers [18]. We grounded this study on the technological features and characteristics of open-source; therefore we stepped away from the relative advantages and put the technological aspects into the focus. The second factor is regarding to the categories organizational aspects. Therefore, we interpret this factor as the **Anticipated Costs of Implementation**. This factor has an eigenvalue of 2.64 and thus is a very strong factor. It can be seen as the counterbalance to the technical advantages of oss. In adoption research the costs for implementing an innovation is often seen as something which reduces the relative advantage [18]. The third factor is the **Perceived Inadequacy of OSS for an Operational Area** (eigenvalue: 1.36) and the last factor is the **Existing Dependency** of companies with a weak eigenvalue of 1.14. The **Existing Dependency** is an organizational factor, which has its roots in the dependencies of a company to software- and hardware suppliers. Regarding the impact, we anticipate that if this factor gets stronger it also results in a reduction of adoption.

We finally analyzed whether the four factors show any correlation between each other. The results were correlations between 0.01 and 0.10 and therefore, we can assume that the factors are nearly not correlated. This allows us to perform further analysis like regression- and cluster analysis. However, detailed results for the latter two methods won't be presented within this paper.

CONCLUSION AND OUTLOOK

During this paper, we first gave an overview about adoption research and the predominant general and oss-specific adoption models. After a critical analysis of the existing model, we proposed a new model to explain the adoption of oss in companies. Therefore, we did a meta-analysis of 36 established oss-migration studies and identified 29 influencing factors on the decision to adopt oss in companies. These factors were evaluated in a first, independent survey. Based on these factors we developed a

conceptual model to explain oss adoption.

This conceptual model was carefully analyzed with the help of a case study. The objective of this case study was to evaluate the expressiveness of this model based on a empirical study. Furthermore, we wanted to gain insights about the influencing factors and how they are linked together. We gave a quick introduction into the case and discussed the methodology of the case study before we analyzed this case with a detailed statistical analysis.

The statistical analysis proved that the influencing factors of the oss-adoption model can be seen as the occurrence of four independent dimensions: **Technical Advantage of OSS**, **Anticipated Costs of Implementation**, **Perceived Inadequacy of OSS** and **Existing Dependency**. Especially the first three dimensions have a significant impact on the final decision to adopt oss in companies. Regarding the evaluation of the proposed model, we were able to prove that 40% of the decision to adopt oss can be explained with this mode. This factor can be seen as satisfying enough for such a model. Different tests of the model's quality did not show any weaknesses. By summarizing all the results in one graphical representation, we visualized the proposed model in Figure 2.

A classification of the participants showed that the well known fragmentation within the implementation research into innovators, early adopters, early majority, late majority and latecomer can be also found within the implementation of oss. However, even if the results suggest the general applicability of our approach, researchers and practitioners should be aware of several limitations mainly originated in our research approach. Further analysis will be required to test and extend the boundaries of the model presented. For instance, the general applicability, the validity and reliability of our results need to be further analyzed in one or more longitudinal field studies including a higher number of projects, different migration strategies, varying implementation levels and even with a different impact on the employees' daily business. Our future work yields into that direction.

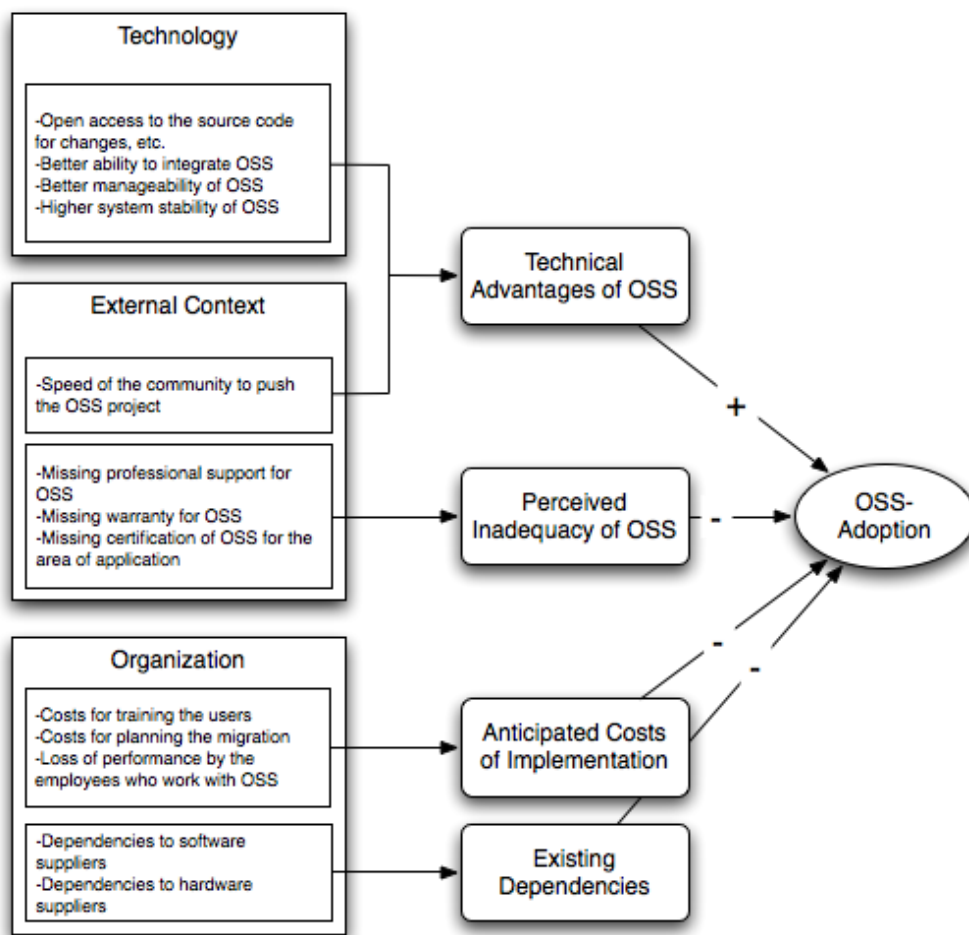


Figure 2: Case study adoption: Proposed model to explain the adoption of OSS in companies

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AN EVALUATION AND SELECTION OF 3G MOBILE VALUE-ADDED SERVICE

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ABSTRACT

As the wireless communication and mobile phone market develop rapidly, telecommunication dealers provide diverse mobile value-added services for consumers to choose from. However, which mobile value-added services are those consumers need have become a worthy issue for discussion. In this empirical study, cluster analyses and analytic hierarchy processes are used to investigate and understand the need for cognition in the young users (20-29 years old). The selected subjects' preferences for services, like mobile communication service, mobile entertainment service, mobile information service and mobile transaction service are evaluated. By surveying the subjects' need for recognition, cluster analysis can further be used to cluster diverse mobile value-added services. Furthermore, by means of the Analytic Hierarchy Process (AHP), services that subjects pay more attention to can be sifted out for the further development of service functions. The results of analysis indicate that the mobile value-added services young users pay most attention to are: wireless emergency services in the communications category, mobile mapping in the information category, mobile taxi services in the communication category, contact list in the communication category and short messaging service in the communications category.

Keywords: Mobile commerce, Third generation, Mobile value-added service, Analytic hierarchy process, Cluster analysis

INTRODUCTION

Because of the rapid development of the wireless communication and mobile communication industry, the issue of mobile commerce is getting more attention. Mobile commerce is derived from traditional e-commerce and realized by means of mobile devices like PDAs or Smart Phones. With the advances of information technology, the capabilities of mobile internet devices also expand from original communication function into Data Acquisition, Data Transmission, Transaction Service and Entertainment Service, which influence more and more in our lives. The characteristic of "anywhere and any time" makes these functions be an indispensable part of our daily lives. Since NTT DoCoMo successfully promoted the i-Mode mobile value-added service, the whole world had paying its full attention to the development of this emerging commercial mode, and many manufactures start to follow this trend to increase their competitiveness. However, under the keen competition, the mobile value-added service market is gradually saturated. "Enterprises who plan to offer the m-commerce service must be aware of the primary concerns of customers to raise the adoption of mobile value-added services so as to raise the ARUP" [10]. To have a further understanding about this emerging mobile value-added service market, young consumers have been chosen as the subjects of this research. This empirical study is aimed at analyzing and understanding a users' preference in an attempt to serve as a reference for future system development. Firstly, the mobile value-added services provided by Taiwan's five 3G (Third Generation) communication service providers, including Chunghwa Telecom, Taiwan Cellular, FarEasTone, VIBO Telecom and Asia Pacific Broadband Wireless Communications, Inc., are gathered, and a Likert-scale questionnaire is used to sift out function items, and then categorize these items by means of a cluster analysis. After organizing related literatures, mobile value-added services are placed into four categories, including Mobile Communication Service, Mobile Entertainment Service, Mobile Transaction Service and Mobile Information Service. Finally, The Analytic Hierarchy Process (AHP) is used to observe the importance of each item to the users, and consumers' preference can be further learned.

MOTIVATION AND APPLICATION OF MOBILE VALUE-ADDED SERVICE

Compared to other media, the mobility of mobile phones is a unique feather that can break down the barriers of space and time and provide communication service anytime, anywhere. Mobile value-added services are, like other media, able to provide diverse services to the users. Consumers' motivations to use mobile value-added services claimed by Lin [6] are organized as followed:

- (1) For society evading: Consumers can find great pleasure in chatting, relaxing and wasting time using mobile phones [7]. Meanwhile, mobile value-added services provide diverse recreational services including on-line games, picture and music download or audio and video appreciation for users to get away from reality and to drive away feelings of loneliness.
- (2) For information: People surf online to search for information, discover new things and to do self-education, in an attempt to satisfy their needs and to get excitement and stimulation [9] [14]. Take the information services provided in mobile value-added services, for example, news & weather report, real-time traffic information and restaurant guide indeed satisfy users' needs for rapid and real-time information.

- (3) For social motivation: For social motivation means users increase interpersonal communications and activities by using mobile phones [9]. Leung and Wei [7] believe that mobile phones can help people get closer. For example, the relationships between user and families are improved, and also become closer to families. Besides, mobile phones make immediate contact possible when there is an emergency, which makes them stay in secure.
- (4) For the convenience of time and space: Leung and Wei [7] think that the mobility of mobile phones can address the trouble of finding a pay phone, which brings users' convenience. Except for this "anytime" service, some mobile value-added services even provide account transfer service so that users don't have to go to the certain places for it.
- (5) For fashion: Using mobile phones is a fashionable trend and even a symbol of status [7]. We can also know if one catches up with the trend by the usage of mobile value-added services. For example, whether one has ever downloaded screen savers, whether one has updated ring back tone or whether one can send messages all shows whether one catches up with the latest trend or not. As a result, mobile value-added services may also be something for the peers to compare.

"Wireless networks need to strengthen the 4C (convenience, customization, cost effectiveness, and cost iron security) characteristics of the customers [11]. And it must also provides timely information, enabled simple transaction, and location-base service" [4]. Combine related literatures, the definition of mobile value-added services goes as follows, mobile phone service operators decide the service contents themselves, or they cooperate with the service operators through strategic alliance, and they provide mobile phone users information service of mobile data other than general call service, such as games, pictures, ring back tone, coupon messages, electronic transaction and so on [5] [10] [17] [20].

Generally speaking, the applications of mobile value-added services can be divided into the following four categories in accordance with consumers' purposes [2] [10] [12] [13] [18] [19]:

- (1) **Mobile Communication Service:** To provide consumers with communication services like messages, e-mails and multimedia message exchanges. Mobile communication service is the most successful application among all the value-added services. As the 3G communication services grow mature, multi-media messages combining images, video & audio with messages encourage consumers to make use of the multi-media message service to entertain themselves and their friends.
- (2) **Mobile Entertainment Service:** To provide consumers with recreational application services, such as download of ring back tone, pictures and games. Currently, mobile recreational service is the second largest application of mobile value-added services, just second to mobile communication services. The combination of mobility and entertainment appears intuitively appealing for many customer segments due to the chance to waste time and have fun when wired entertainment appliances are inaccessible.
- (3) **Mobile Transaction Service:** To provide consumers with financial and commerce services, such as mobile shopping service, mobile banking service and mobile ticket booking service. Financial and commerce services are targeting at the buyers, namely individual users, and through the retail service, banking services and payment mechanism, users can buy things they want to buy easily.
- (4) **Mobile Information Service:** To provide real-time information services including news, weather report, stock information, map inquiry and parking space inquiry. The biggest characteristic of mobile information service is that it can provide real-time information that consumers need. Therefore, consumers make use of this type of mobile value-added service for their conveniences in their lives.

METHODOLOGY

Methodology Structure

Concerning the evaluation and filtration of mobile value-added service items, a questionnaire is used to see the consumers' preference for mobile value-added service, and suggestions are then presented. The research process is as shown in Figure 1.

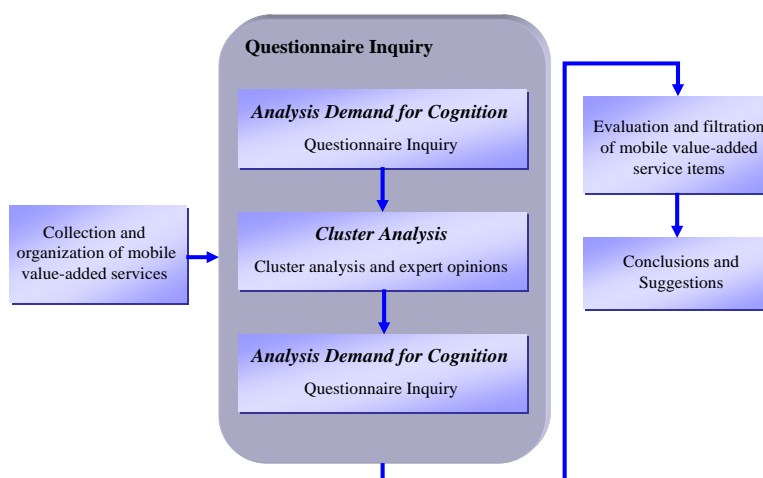


Figure 1. Research Structure

The followings are the steps for AHP:

- (1) Define the attributive items of the matter.
- (2) Establish a pair-wise comparison matrix of the defined attributive items. If there are attributive items of Item1~Item n, then a matrix of $n \times n$ can be established.

$$A = \begin{bmatrix} 1 & A_{12} & \cdots & A_{1n} \\ 1/A_{12} & 1 & \cdots & A_{2n} \\ \vdots & \cdots & \ddots & M \\ 1/A_{1n} & 1/A_{2n} & \cdots & 1 \end{bmatrix} \quad (1)$$

- (3) The pair-wise importance comparison of attributive items is made.

In the pair-wise comparison matrix of the defined attributive items, a pair-wise and directional comparison is made, and a specific value for comparison is then filled. A scale of values ranging from 1 (equally important) to 9 (extremely more important) was used to express the evaluators' preferences. The main diagonal element is the comparison of attributive items themselves, so the ratio is 1. This pair-wise comparison enabled the decision-maker to measure the contribution of each factor to the objective independently, thereby simplifying the decision-making process.

- (4) Operations of comparison values of each attributive item. Numerical analysis is used to calculate the weight of each attributive item, and generally, the geometric mean is used. For example, there are n attributes of Attribute L : $L_1 L_2 L_3 \dots L_n$. The importance of sequence of the pair-wise comparison of Attribute L_1 and other attributes are: $L_{11} L_{12} L_{13} \dots L_{1n}$. The geometric mean of the L_1 sequence can be calculated by means of the following equation:

$$\left(\prod_{i=1}^n L_{1i} \right)^{1/n} \quad i = 1, 2, 3, \dots, n \quad (2)$$

Geometric mean calculated from each attributive item has to be normalized, and W , the weight of each attributive item can be obtained. As a result, W can be calculated by means of the following equation:

$$W = \left\{ \left(\prod_{i=1}^n L_{1i} \right)^{1/n} \right\} / K, \quad (3)$$

$$K = \sum_{j=1}^n \left(\prod_{i=1}^n L_{ij} \right)^{1/n} \quad i, j = 1, 2, 3, \dots, n$$

Cluster Analysis

Cluster analysis is a technique used for the classification of data, in which data elements are partitioned into groups called clusters that represent collections of data elements, which are proximately based on a distance or dissimilarity function [8]. The Hierarchical Method is the more commonly used method currently. By means of the correlation coefficient or distance between samples, two samples that are closest to each other form a cluster, and a new cluster will be formed by combining the sample nearest to it. This cluster-forming continues until all the samples are combined into one category. In this continuous combination process, a tree-shaped or hierarchical structure can be formed. The calculation of the Hierarchical Method is to cluster by means of minimum distance, namely, that the distance between two categories is the shortest distance between two samples, and its equation is as follows:

$$M_{ij} = \min \{ r_{mn} \}, X_m \in r_i, X_n \in r_j \quad (4)$$

where r_{mn} is the distance between sample X_m and another sample X_n ; r_i represents Category i while r_j represents Category j . In addition, in this research, an Euclidean distance equation is used for the distance between attributes in each sample:

$$r_{ij}^2 = (x_i - x_j)^2 + (y_i - y_j)^2 \quad (5)$$

where r_{ij}^2 represents the square distance of attribute i and j on the plane of geometry. x_i is the assessed value of attribute i on Index x while x_j represents the assessed value of attribute j on index y .

Experiment Design

According to the investigative report of the E-ICP [3], 45% of the mobile value-added service users in Taiwan spread from 20 to 29 years old. In terms of occupation, 34% of such users are students. Accordingly, college students were taken as the

subjects for this study. The subjects in this research were a group of youth aged 20 to 29, and there were 30 people in total for each phase.

This experiment was conducted in three phases. In the first phase, subjects tried every simulated mobile value-added service. After filtration and analysis of need for cognition, 38 items were decided. In the second phase, cluster analysis was conducted on the filtered mobile value-added services, concerning nine characteristics, including: Inquiry Function, Practical Function, Entertainment Function, Convenience, Real-time Character, Personalization, Business, Regional Character and Safety. Finally, the experts suggest to adjust the results into seven groups, and to be grouped under four categories including: Communication, Information, Transaction and Entertainment. Finally, an AHP was conducted in the third phase, and the ranking of group importance and function-item importance within one single group was obtained.

RESEARCH RESULTS

According to the demand analysis questionnaire in Phase 1, the function items are graded and listed in order by numbers, as shown in Table 1. In Table 1, since there is a larger gap between the grade of Item 38, "Mobile blog", and that of Item 39 "Mobile match-make", only Item 1 to Item 38 are intercepted and numbered.

Table 1. Results of Demand Analysis

Ranking Number	Service item	Sum	Average	Ranking Number	Service item	Sum	Average
1	Wireless emergency services	135	4.5000	23	Mobile taxi services	110	3.6767
2	Contact list	133	4.4333	24	Memorandum	109	3.6333
3	Mobile mapping	130	4.3333	25	Medical consultation	108	3.6000
4	Transaction security	130	4.3333	26	Ringtone and image download	108	3.6000
5	Call catcher	124	4.1333	27	Broadcast	108	3.6000
6	Short messaging service	124	4.1333	28	Receiving and sending e-mail	107	3.5767
7	Ticket booking	123	4.1000	29	Ring back tone	105	3.5000
8	Real-Time traffic information	122	4.0767	30	Push Mail	104	3.4767
9	Credit card transaction record inquiry	122	4.0767	31	Bookkeeping	103	3.4333
10	Popular music download	119	3.9767	32	Job-search information	102	3.4000
11	Mobile calendar	119	3.9767	33	Instant messaging	101	3.3767
12	Multimedia messaging service	118	3.9333	34	Mobile book	101	3.3767
13	On-line coupons	118	3.9333	35	Financial information	100	3.3333
14	Fee payment	117	3.9000	36	Electronic games	100	3.3333
15	Virus protection	116	3.8767	37	Video Conferencing	100	3.3333
16	Electronic dictionary	116	3.8767	38	Mobile Blog	97	3.2333
17	Real-Time weather information	115	3.8333	39	Mobile match-make	89	2.9767
18	Electronic transactions	114	3.8000	40	Mobile e-paper	86	2.8767
19	Mobile micro payment	113	3.7767	41	Mobile broker	83	2.7767
20	Mobile banking	112	3.7333	42	Horoscope	82	2.7333
21	Life information	111	3.7000	43	Chat rooms	77	2.5767
22	Mobile video streaming	111	3.7000				

Between-groups linkage is adopted in the cluster analysis on Phase 2. After clustering, in according to the tree diagram shown in Figure 2, these 38 function items are placed into nine clusters, with a merge level of six in this research. Experts suggested adjusting to seven clusters. Detailed items of the seven clusters are listed in Table 3. According to the natures of these function items, these seven clusters are categorized into four parts: (1) Communication, including General Communication Service, Life Communication Service and Application Communication Service, (2) Information, (3) Transaction and (4) Entertainment, including General Entertainment Service and Entertainment Application Service.

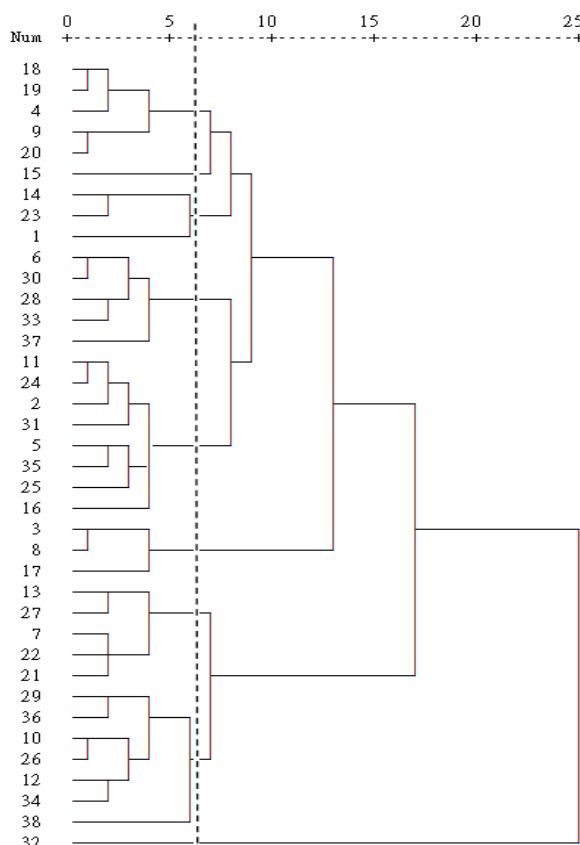


Figure 2. Hierarchical Cluster Tree

In Phase 3, the category of each cluster and every item in each cluster is transformed into pair-wise comparison matrix. This is then input into AHP software package (AHP maker) for importance ranking analysis.

Table 2. Priority Ranking of Mobile Value-added Service Categories

Priority ranking	Service category	Weight
1	Communication	0.3478
2	Information	0.2163
3	Entertainment	0.1219
4	Transaction	0.1149

Table 2 indicates the importance weight of the 4 categories of mobile value-added services. Table 3 shows the importance weight of each service item in the 7 clusters. The importance rankings of the 4 mobile value-added service categories are: Communication, Information, Entertainment and Transaction. From the results, it is very obvious that the importance of Communication Category is higher than the other three categories. As a result, for future development of mobile value-added services, function design of Communicative Services should be emphasized more. The qualities of Information Service and Entertainment Service should be enhanced to meet the consumers' differing needs. For Transaction Service, mechanism of safe transaction should be strengthened so that consumers will feel much safer to conduct transactions through their mobile device.

Table 3. Weights of Mobile Value-added Service Items

Cluster	Service item	Weight	Cluster	Service item	Weight
<i>Entertainment</i> General entertainment service	Pop music download	0.2063	<i>Communication</i> General communication service	Contact list	0.1714
	Electronic games	0.1629		Electronic dictionary	0.1528
	Ring back tone	0.1614		Call catcher	0.1302
	Mobile book	0.1393		Mobile calendar	0.1009
	Ringtone and image download	0.1169		Memorandum	0.0895
<i>Entertainment</i> Entertainment application service	Broadcast	0.1923	Medical consultation	0.0875	
	Life information	0.1453	Financial information	0.0604	
	Mobile video streaming	0.1277	Bookkeeping	0.0554	

	On-line coupons	0.1236	<i>Communication</i>	Wireless emergency services	0.6013
			Life communications service		
	Ticket booking	0.1177		Mobile taxi services	0.1772
	Mobile blog	0.0761		Fee payment	0.1153
<i>Transaction</i>	Transaction security	0.3493	<i>Communication</i>	SMS	0.1664
			Real-time communication service		
	Credit card transaction record inquiry	0.1680		MMS	0.1514
	Mobile banking	0.1456		Push Mail	0.1483
	Mobile micro payment	0.1051		Instant messaging	0.1230
	Electronic transaction	0.0846		Receiving and sending emails	0.1118
<i>4. Information</i>	Mobile mapping	0.4348		Video conference	0.1079
	Real-time traffic condition	0.2446			
	Real-time weather report	0.1941			

From the orders of the mobile value-added service items in Table 4, it is very clear that the top 5 services that consumers pay most attention to are: Wireless Emergency Services in the Communication Category, Mobile Mapping in the Information Category, Mobile Taxi Services in the Communication Category, Contact List of the Communication Category, and Short messaging service (SMS) in the Communication Category. To consumers, the 5 least important service items are: Ticket Booking in the Entertainment Category, Ringing Tone and Image Download in the Entertainment Category, Mobile Micro Payment in the Transaction Category, Electronic Transaction in Transaction Category, and Mobile Blog in the Entertainment Category.

Among all the mobile value-added services, Emergency applications are the most important items. Thus, we can see how people value unpredictable emergencies. When an emergency occurs, sending messages by mobile phone is a real-time guard that can protect us. As for Mobile mapping, the development of GPRS and LBS (Location-Based Service) made it possible to provide a real-time location of a moving object through a mobile communicative device, and through the notice and log-in function, the service center can provide positioning services, including road guides, restaurant guides, parking space information and traffic information. As to the contact list, it brings convenience to consumers to contact friends or to inquire about a friend's information, and therefore, it is also of high importance. It is very common that consumers receive and send messages to their relatives and friends. The application of messages also enables consumers to subscribe to some personalized messages like e-paper.

Table 4. Ranking and Weight of Mobile Value-added Service Items

Ranking	Service item	Relative weight	Service category	Ranking	Service item	Relative weight	Service category
1	Wireless emergency services	0.20913	Communication	19	Medical consultation	0.03043	Communication
2	Mobile mapping	0.09405	Information	20	Pop music download	0.02515	Entertainment
3	Mobile taxi services	0.06163	Communication	21	Broadcast	0.02344	Entertainment
4	Contact list	0.05961	Communication	22	Finance information	0.02101	Communication
5	SMS	0.05787	Communication	23	Electronic games	0.01986	Entertainment
6	Electronic dictionary	0.05314	Communication	24	Ring back tone	0.01967	Entertainment
7	Real-time traffic information	0.05291	Information	25	Credit card transaction record inquiry	0.01930	Transaction
8	MMS	0.02566	Communication	26	Bookkeeping	0.01927	Communication
9	Push Mail	0.05158	Communication	27	Life information	0.01771	Entertainment
10	Call catcher	0.04528	Communication	28	Mobile book	0.01698	Entertainment
11	Instant messaging	0.04278	Communication	29	Mobile banking	0.01673	Transaction
12	Real-time weather report	0.04198	Information	30	Mobile video streaming	0.01557	Entertainment
13	Transaction security	0.04013	Transaction	31	On-line coupons	0.01507	Entertainment
14	Fee payment	0.04010	Communication	32	Ticket booking	0.01435	Entertainment
15	Receiving and sending e-mails	0.03888	Communication	33	Ringing tone and Image download	0.01425	Entertainment
16	Video conference	0.03753	Communication	34	Mobile micro payment	0.01208	Transaction
17	Mobile calendar	0.03509	Communication	35	Electronic transaction	0.00972	Transaction
18	Memorandum	0.03113	Communication	36	Mobile blog	0.00928	Entertainment

CONCLUSIONS

The subjects in this research are a group of college and graduate students aged from 20 to 29. In the diffusion of innovation

theory, much research indicates that the demographic characteristics of innovative users are of higher income, from higher educational background, and are younger than the non-innovative users [1]; namely indicating that young people have a higher acceptance of new things than older people. Therefore, when introducing new services, service providers can target young people as their target group, and the focus of the service content should belong to the “Entertainment Category” [6].

Concerning the ranking of service importance among mobile value-added services, suggestions are presented as followed:

- (1) Concerning the Life Communication Services, it is found in the research that subjects especially value personal safety services. Therefore, service providers can focus on users’ needs to design the services, such as a reliable nighttime taxi-calling service.
- (2) Concerning the Information Service and Communication Service, real-time content and personalization are what consumers attach importance to. Thus, relating information about the basic necessities of life should be provided to meet the consumers’ differing needs.
- (3) Concerning the Entertainment Service, epidemic and abundant contents are emphasized. Telecommunication companies can work together with many domestic service providers, in an attempt to provide interesting games or music to consumers.
- (4) In addition to the basic communicative nature of message services, practicability should also be noticed. As a result, message services can also combine with Web services to cope with the consumers’ unique needs and provide customized message services, such as schedule-reminder messages or personal financial management services. Besides, the multi-media characteristics of multi-media messages (MMS) can be used to increase a users’ interests. The application of it can also apply into other service categories and create innovative services like interactive message games or digital learning.
- (5) Safety is the most important element in the Transaction Service. It was found in this research that the subjects’ preference was low. Thus, service providers should provide a safer transaction mechanism to enhance consumers’ confidence.

Finally, though research is targeted at young people as research subjects, different age groups have different needs and preferences for mobile value-added services. Therefore, to enlarge other target markets, research on other age groups are still needed in the future, to establish innovative application services, and therefore, to enable the enterprises to have more competitiveness.

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AN INTEGRATED MODEL OF INNOVATION VALUE CHAIN FOR SUSTAINABLE COMPETITIVE ADVANTAGE IN HIGH-TECH INDUSTRY

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ABSTRACT

Measuring innovation outputs has been accomplished mainly through the relationship between innovation management and product design and development, especially for patenting. Today, companies are facing increased turbulence and complexity in the business environment, such as globalization, digitalization and mobilization. To meet these challenges, both the popular and the academic press are advising companies to focus their attention toward innovation in order to create and sustain competitive advantage. A firm's performance depends on how much its managers can mobilize the knowledge resources of individuals and teams in its value chain and how well they can turn these resources into activities that lead to value creation in hyper-competitive markets.

Knowledge management literature reveals the increasing importance of innovation in those high-tech manufacturing firms, in which knowledge turns into the main source of competitive advantage. Innovation in high-tech firms is progressively turning into a systematic process, especially for determined high-tech industries such as electronic products.

The study aims to develop an integrated model of innovation value chain (IVC), the model integrates knowledge management and innovation management in high-tech Industries from a knowledge-based theory perspective and integrates IVC to reach value creation and then to achieve sustainable competitive advantage. IVC is a thinking tool which can be used to define those enterprises involved in innovation activities such as product development. Each link in the chain needs to add value to innovation. IVC helps think through the often-complex relationships in product development and look for improvements in relationships (with suppliers, customers, partners and competitors) and partnerships.

The integrated model inputs from knowledge-based competition (Globalization, digitalization and mobilization) to integrate IVC to reach value creation (employees', suppliers', partners' customers' and competitors' value) and then to achieve the outcome: sustainable competitive advantage. The importance of the proposed model was theoretically discussed for practitioners and future researchers. The integrated IVC model can act as a list of items for high-tech Industries to address when adopting innovation value chain. This helps to ensure that the essential issues and approaches are covered during implementation. For academics, it provides a common language for them to discuss and study the approaches crucial for the success of innovation value chain in high-tech Industries.

Keywords: knowledge management, knowledge-based innovation, high-tech industries, Innovation value chain

INTRODUCTION

Measuring innovation outputs has been accomplished mainly through the relationship between innovation management and product design and development, especially for patenting (Pavitt, 1984). Today, companies are facing increased turbulence and complexity in the business environment, such as globalization, digitalization and mobilization. D'Aveni (1994) categorises the situation in its extreme form as hyper-competition. To meet these challenges, both the popular and the academic press are advising companies to focus their attention toward innovation in order to create and sustain competitive advantage.

From value chain to value grid

Porter's basic model describes an industrial organization buying raw materials and transforming these into physical products. In 1985, when Porter introduced the Value Chain, around 60% of most western economies' workforces were active in service industries. In 2006, most service industries in western countries employ over 80% of the workforce.

Critique on the Value Chain model and its applicability to services organizations has since been voiced by both academics and practitioners. See for example (Peppard and Rylander, 2007) and (Van Middendorp, 2005). Porter's focus on 'either or' strategies and competition as the main driving force in any industry, are not that well suited to the complexity of most industries today. Collaboration in addition to competition and differentiation in addition to low cost are common drivers. Furthermore, Porter is focused on the tangible outcomes of cost, revenue, margin and basic configuration of business activities. The Value Network may be the mental model that embraces the linear Value Chain Model and that adds an extra dimension for those seeking to make sense of complexity as we see it in organizations and their environment today.

More recently, the term "value grid" has been developed to highlight the fact that competition in the value chain has been shifting away from the strict linear view defined by the traditional 'value chain' model (Pil and Holweg, 2006).

The value chain in its original sense was defined as a sequence of value-enhancing activities. In its simplest form, raw

materials are formed into components, which are assembled into final products, distributed, sold, and serviced. Frequently, the activities span multiple organizations. This orderly progression of activities allows managers to formulate profitable strategies and coordinate operations.

However, it can also put a stranglehold on innovation at a time when the greatest opportunities for value creation (and the most significant threats to long-term survival) often originate outside the traditional, linear view. Traditional value chains may have worked well in landline telecommunications and automobile production during the last century, but today innovation comes in many shapes and sizes—and often unexpectedly.

Pil and Holweg hence argue for seeing value creation as multidirectional rather than linear. Given the constant tension between opportunity and threat, firms need to explore opportunities for managing risks, gaining additional influence over customer demand, and generating new ways to create customer value. Nokia, for example, is legendary for having the foresight to lock in critical components that were in short supply, allowing it to achieve significant market share growth. However, a few years ago it suffered a setback when competitors used the same strategy to take advantage of shifts in the demand for LCD displays.

Protection against such fickle reversals calls for a more complex view of value—one that is based on a grid as opposed to the traditional chain. The grid approach allows firms to move beyond immediately recognizable opportunities and across industry lines. This permits managers to identify where other companies—perhaps even those engaged in entirely different value chains—obtain value, line up critical resources, or influence customer demand. The new paths can be vertical; horizontal; and even diagonal. Successful managers need to learn how to assemble multi-faceted value grids that leverage new opportunities and respond to new threats.

Innovation value chain in high-tech industries

Innovation - the introduction of new products or processes - involves sourcing, transforming and exploiting knowledge to improve the performance of the innovating business. The study calls this process the innovation value chain. Modelling the innovation value chain for a large group of manufacturing firms in Taiwan highlights the drivers of innovation, productivity and firm growth. The study finds strong positive links between different forms of knowledge sourcing (R&D, supply chain links, links with universities etc). Each of these forms of knowledge sourcing also makes a positive contribution to innovation in both products and processes although public knowledge sources have only an indirect effect on innovation. In the exploitation phase, innovation in both products and processes contribute positively to company growth, with product innovation having a short-term 'disruption' effect on labour productivity. Modelling the complete innovation value chain highlights the structure and complexity of the process of translating knowledge into business value.

In high-tech manufacturing firms, there is an increasing importance of innovation, in which knowledge turns into the main source of competitive advantage (Miles, 1993). The importance of knowledge as a source of competitive advantage is still higher for those sectors on which innovations are being continually developed (Decarolis and Deeds, 1999; Pisano, 1994). Also, knowledge management is crucial for the successful launching of new products (Li and Calantone, 1998) and for the innovation process (Powell *et al.*, 1996). Therefore, organisations base competition on efficiency when acquiring (Nonaka and Takeuchi, 1995), transmitting and integrating (Grant, 1996a; Zander and Kogut, 1995) and applying (Spender, 1996) knowledge.

Today, economic competition has become increasingly important in international commerce. High-tech dominates economic competition. Governments around the world realise that only by strengthening technological innovation, possessing their own intellectual properties and grasping high-tech resources can they take the initiative in economic competition. Therefore, technologically advanced countries adopt various policies to protect their intellectual property rights. They try to achieve a market monopoly through a technology monopoly. This is spurring the public to place greater value on knowledge-technological resources. They realise that in the future world, knowledge is the most important basis for economic growth. A country's "capability of creation, distribution and use of knowledge" (Hongjin, 1997) will become the core of its competitive power.

Innovation in high-tech firms is progressively turning into a systematic process, especially for determined high-tech industries such as electronic products. Specific departments for management of R&D activities are created (Gadrey *et al.*, 1994). Also, a greater contact with customers increases the role that customers play in the innovation process (Czepiel *et al.*, 1985). Therefore, both R&D departments and customers become the main source of inputs for innovation.

However, innovation patterns in high-tech manufacturing are for organisational and process innovations, The impossibility of patenting this kind of innovation and, therefore, protecting the returns generated out of these innovations shortens the life cycle of innovations dramatically (Barras, 1990). Hence, the innovation process must be intensive because innovations are implemented and copied at such a speed that continuous innovation efforts are required to keep up with a determined degree of differentiation in order to support the firm's strategy (Voss, 1992).

The study aims to develop an integrated model of innovation value chain, the model integrates knowledge management and innovation management in high-technology industry from a knowledge-based theory perspective and integrates IVC to reach

value creation and then to achieve sustainable competitive advantage. The details are as follows.

LITERATURE REVIEW

The definition of high-tech Industries

The definition of high-tech is based on the percentage of high “human-capital” jobs in an industry. High human-capital jobs include engineers, technicians, scientists, mathematicians or some combination thereof (Markusen *et al.*, 1986). By this definition, there are 100% high-tech industries. One of the most important advantages of this definition over others is that human skills correlate highly with other indicators of “technological” performance, such as R&D (Berman *et al.*, 1994), stock of capital, information intensity and, more importantly for the study, innovations.

There is no widely accepted standard definition of high-tech industries. The criteria used to define high technology ranges from judgment to technology-oriented employment and research and development spending. The choice of a definition for technology should be dependent on how the research will be used, as well as data availability. The definition applied in this study updates Hecker’s (1999) definition, which includes employment in technology-oriented occupations and more narrowly, employment directly involved in R&D. According to the updated Hecker definition, industries qualify as high-tech if they possess at least double the percentage of employment in technology-oriented occupations as that of the average for all R&D companies, and if their percentage of employment in R&D is at least 80% of the average of all R&D performing companies. The firms defined as high-tech can be updated over time to incorporate newly emerging research, development and technology sectors.

In summary, the study adopted above definitions of high-tech industries as “industries qualify as high-tech industries if they possess at least double the percentage of employment in technology-oriented occupations as that of the average for all R&D companies, and if their percentage of employment in R&D is at least 80% of the average of all R&D performing companies.

The genesis of knowledge-based competition

Lang (2001) assumed that two intertwined strategic forces are compelling companies to reconsider fundamental business assumptions.

1. Globalisation
2. Digitisation with connectivity brought about by revolutions in information processing, telecommunication (or infocom) and Internet technologies.

These two forces – more aggressive global competition and accelerating technological change – translate into competition that is increasingly knowledge-based. This increasingly knowledge-based nature of competition is driving change in how value chains are being managed within and across firms. Managers will certainly have to augment their ability to manage diversity, complexity and ambiguity in employee, supplier and customer relationships in the New Economy (Lang, 2001). Driven by these two forces, we are in the midst of an economic transition from an era of competitive advantage based on information to one based on knowledge creation.

Furthermore, Lang (2001) assumed some perspectives for the knowledge-based nature of competition:

1. In most businesses today, most value added is in the form of knowledge, not material. But in most firms, the bulk of management time and attention is still spent on tangibles. Today, intangibles such as customer service, innovation, speed, agility, etc. are more important than tangibles such as equipment, materials and hardware.
2. But, too often, too little time and attention are focused on managing the soft elements of knowledge like creativity, customer love, foresight, fun, cultivation of talent, etc. There is huge hidden value in such companies that is not visible in traditional accounting.
3. Increasingly, larger investments are being made in these hidden assets. Such investments concern customer relations, information technology, networks and competence, for example; or, in a word, knowledge.
4. To survive in the knowledge economy, new business models must be created, because many business axioms of the old economy are no longer applicable. Scarcity is a non-issue for digital assets. As such, the competitive dynamics of digital products differ greatly from that of physical products. In cyberspace, new economies of scales and economies of scope prevail (Rayport and Sviokla, 1995).

A firm’s performance depends on how much its managers can mobilise the knowledge resources of individuals and teams in its value chain and how well they can turn these resources into activities that lead to value creation in hyper-competitive markets. Challenges presented by the knowledge economy make it necessary for organisations to harness the competencies of its knowledge workers, customers and suppliers, if sustainable competitive advantage is to be achieved, as illustrated in Figure 2-1. (Lang, 2001)



Figure 2-1: New management imperatives
Source: Lang (2001)

Lang (2001) argues that there are linkages between aspects of the New Economy, including globalisation and digitisation, knowledge generation and competencies. Harnessing worker, customer and supplier competencies within the context of knowledge-based competition is the response that is called for.

The coming of globalised knowledge-based competition demands that management must attend to its knowledge workers, suppliers and customers in a new way. The real value of information systems lies in connecting people to people to enable them to share what expertise and knowledge they have at the moment, given that cutting-edge knowledge is always changing. The solution is not to try to warehouse everything your workers ever knew but to connect questions to answers or to people who can help you find answers (Stewart, 1997).

Innovation value chain (IVC)

Rather than reflexively importing innovation best practices, managers should adopt a tailored, end-to-end approach to generating, converting, and diffusing ideas. Executives in large companies often ask themselves, “Why aren’t we better at innovation?” Morten and Julian (2007) assumed some advice to answer this question. After all, there is no shortage of sound advice on how to improve:

1. Come up with better ideas.
2. Look outside the company for concepts and partners.
3. Establish different funding mechanisms.
4. Protect the new and radically different businesses from the old.
5. Sharpen the execution. (Morten and Julian, 2007)

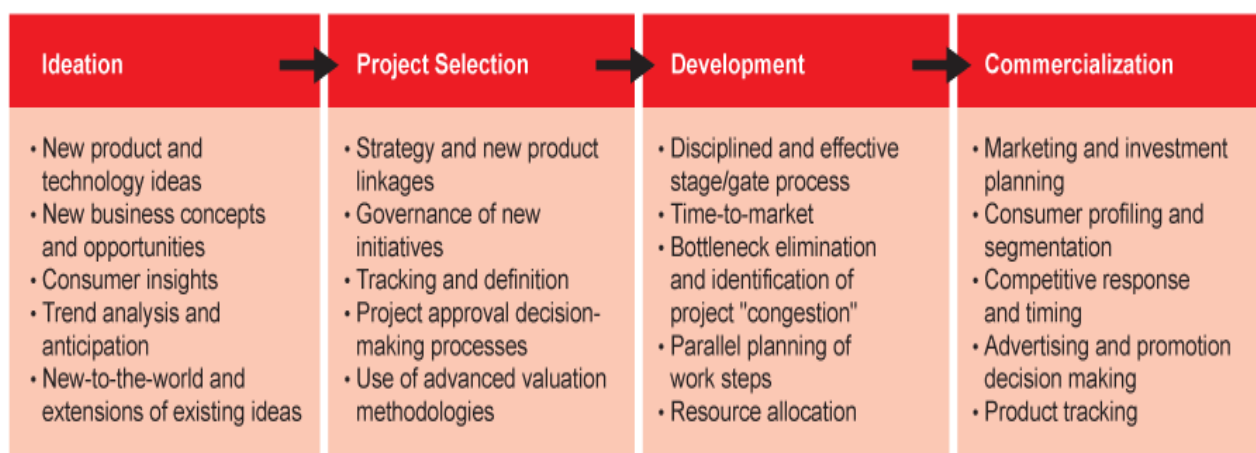
Such strategic counsel, however, is based on the assumption that all organizations face the same obstacles to developing new products, services, or lines of business. In reality, innovation challenges differ from firm to firm, and otherwise commonly followed advice can be wasteful, even harmful, if applied to the wrong situations. (Morten and Julian, 2007)

Likewise, companies can’t just import the latest fads in innovation to cure what’s ailing them. Instead, they need to consider their existing processes for creating innovations, pinpoint their unique challenges, and develop ways to address them. The study offers a comprehensive framework—“the innovation value chain”—for doing just that.

In practice, the innovation value chain is derived from the findings of five large research projects on innovation that Morten and Julian (2007) undertook over the past decade. They interviewed more than 130 executives from over 30 multinationals in North America and Europe. They also surveyed 4,000 nonexecutive employees in 15 multinationals, and they analyzed innovation effectiveness in 120 new-product-development projects and 100 corporate venturing units.

IVC is a thinking tool which can be used to define those enterprises involved in innovation activities such as product development. Each link in the chain needs to add value to innovation. IVC helps think through the often-complex relationships in product development and look for improvements in relationships (with suppliers, customers, partners and competitors) and partnerships. (See Figure 2-2.)

Exhibit 3: The Innovation Value Chain



Source: Booz Allen Hamilton

Figure 2-2: The innovation value chain
Source: Booz Allen Hamilton (2004)

Booz Allen Hamilton (2004) indicated that raising the inherent innovation effectiveness curve requires senior management to understand that innovation is not a discrete activity, but a multifunctional capability that requires several types of competencies. In fact, executives ought to look at successful innovation as the expression of a well-organized value chain or value web. An innovation capability requires owning or sourcing four critical sets of capabilities: ideation, project selection, development, and commercialization. Since a chain is only as strong as its weakest link, the innovation effectiveness curve cannot be raised unless all four elements are mastered.

This value chain is relevant for any development process, whether for consumer products, industrial equipment, or services. The best practices adopted by superior innovators along each link of the chain also, in the experience of Booz Allen Hamilton (2004), transcend industry boundaries.

THE DEVELOPMENT OF AN INTEGRATED IVC MODEL FOR SUSTAINABLE COMPETITIVE ADVANTAGE IN HIGH-TECH INDUSTRIES

Based on above literature review and discussions, and combined the theoretical models from Stewart (1997), Lang (2001), Booz Allen Hamilton (2004) and Morten and Julian (2007), the study developed an integrated model of IVC for sustainable competitive advantage in high-tech Industries as figure 3-4. The integrated model inputs from knowledge-based competition (Globalization, digitalization and mobilization) to integrate IVC to reach value creation (employees', suppliers', partners' customers' and competitors' value) and then to achieve the outcome: sustainable competitive advantage.

Morten and Julian (2007) proposed the innovation value chain view presents innovation as a sequential, three-phase process that involves idea generation, idea development, and the diffusion of developed concepts. Across all the phases, managers must perform six critical tasks—internal sourcing, cross-unit sourcing, external sourcing, selection, development, and companywide spread of the idea. The study increases “commercialization” into the IVC. Each is a link in the chain. Along the innovation value chain, there may be one or more activities that a company excels in—the firm’s strongest links. Conversely, there may be one or more activities that a company struggles with—the firm’s weakest links. (See the Figure 3-1)

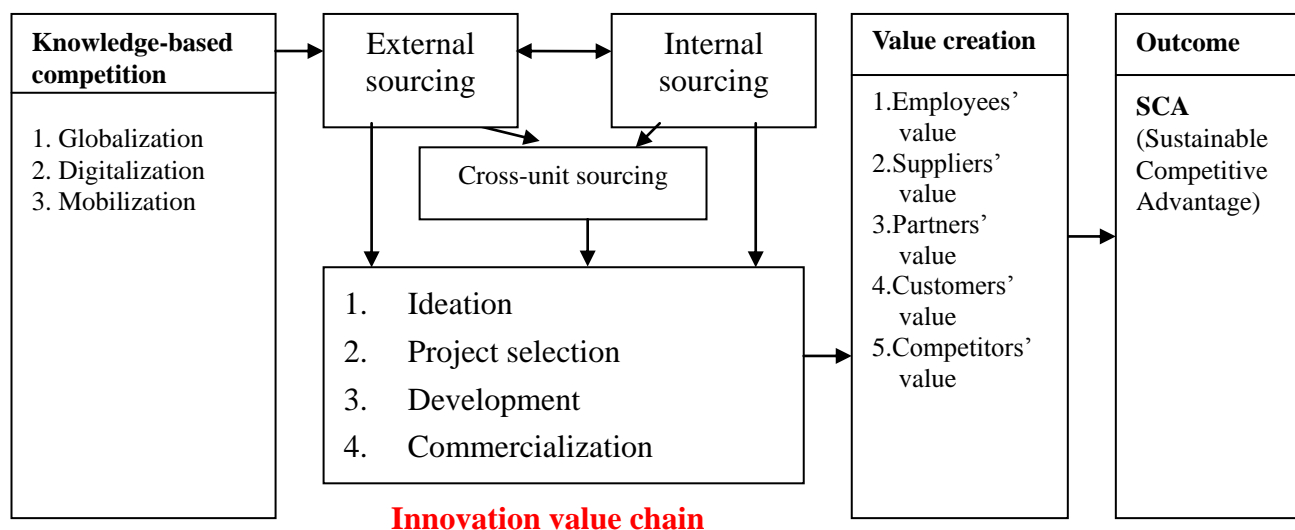


Figure 3-1: An integrated model of KBI and IVC for sustainable competitive advantage in high-tech Industries

CONCLUSIONS AND RECOMMENDATIONS

Throughout this paper a broad managerial perspective is taken to innovation, as distinct from solely that of technical innovation and R&D (Research and Development). Thus, the dimensions of innovation value chain (IVC) include internal and external sourcing and cross-unit sourcing into ideation and then to project selection to development, finally to commercialization. Only through the processes of IVC, high-tech industries can create value then to achieve SCA.

In summary, the study developed an integrated model of innovation value chain to explore how high-tech industries apply KM to implement the innovation process and integrate IVC as an integrated flow of knowledge and innovation to reach value creation and then to achieve sustainable competitive advantage. The integrated model can be an easy-to-follow innovation model for high-tech Industries to address when adopting innovation value chain. This helps to ensure that the essential determinants and approaches for innovation process are covered during knowledge-based competition, IVC and value creation to achieve SCA. For industries, it provides a practical and complete business model for them to be reference and study the innovation approaches, which are crucial for the success of innovation value chain in high-tech Industries.

The study provides valuable insights and recommendations for the owners/ managers in Industries, academics and practitioners for future research. The integrated innovation model is to assist high-tech Industries to leverage knowledge assets for innovation, internal and external supporting structure for supporting and accumulating innovation capacity to reach value creation through IVC and then to achieve sustainable competitive advantage.

The study suggests high-tech Industries to utilize the innovation value chain then the company has about itself and its customers, partners and suppliers, and applying it to the marketplace. Then, these companies, even if very small, have the opportunity to outmaneuver all bigger players and come in ahead of last year's champions. For the limited resources, personnel and monetary, high-tech Industries especially need to construct their innovation model step by step and to integrate KM, innovation to accumulate innovation capacity and therefore to form corporate core competence (Prahalad and Hamel, 1990) to maintain sustainable competitive advantage. Furthermore, due to the integrated IVC model, the study suggests the future researchers are able to do the empirical study for more high-tech industries to obtain a generalization results in specific industries. Also, the integrated IVC model can be used to do case study or empirical study for the other industries.

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CREATING SUCCESSFUL TRAVEL GUIDE SERVICES INNOVATION THROUGH WIRELESS TECHNOLOGY ADOPTION: THE TAM PERSPECTIVE

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ABSTRACT

This paper's research starts at consumer experience, examining 'relative advantage' effects of new technologies and business models. By stimulating experienced economy development as well as construct novel business models for the recreational industry, this paper's research targeted the Taipei populace in the survey process, being as the city is the global leader in WLAN accessibility, possessing the largest scope of WI-FI network. Extensive analysis of the 240 returned surveys affirms the level of acceptance to mobile guide services. Surveyed Taipei citizens showed positive response to vital factors such as operating convenience, usage security, and cost. Evaluation of such feedback indicates directions for business models, guiding to increase service usage willingness. Research pinpointed significant attributes, such as saved-costs in information storage, improved time/location convenience, secure transmission mechanisms, and reliable privacy-rights policies.

Keywords: Mobile Travel Guide Services, Mobile Commerce, M-tourism Service, Technology Acceptance Model (TAM), Wireless Technology Adoption.

INTRODUCTION

In recent years, as 'wireless' and 'mobile' connectivity to the internet advanced and matured, the public's usage and demand of internet access through these means has gradually surfaced. On the global scale, many countries are adapting to the new trend, developing the infrastructure to support a 'wireless city'. Envisioned with the concepts of 'any location', 'any time', and 'any device' in wireless internet access, hopes are to promote public WLAN usage while stimulate the communications industry as well as related research and development.

The factors which influence the populace's use of such services have long been subject to scrutiny and discussion. Most notably, in an era of mobile devices and new added-value services, service planners and providers must seek to understand consumer acceptance levels, for future strategic business purposes. This paper will focus on three points as research targets: (1) Factors influencing the user's choice of innovative mobile guide services. (2) Fusion of TAM (Technology Acceptance Model) and DOI (Diffusion of Innovation) to construct a compiled and acceptable mobile guide service model. (3) Derive from research results and provide mobile servicers with business suggestions, for effective strategy planning in the mobile guide industry.

LITERATURE REVIEW

In 1989, Fred Davis posited TAM (Technology Acceptance Model) as a means to explain computer usage behavior, track external variables, and relationships between the user's recognition, attitude, and willingness, so as to explain and predict the user's operating behavior in IT (Information Technology). TAM explains that a person's 'actual use' is affected by 'intent to use', while 'intent to use' is influenced by 'behavior', 'perceived usefulness', and 'perceived ease of use'. 'Perceived usefulness' and 'perceived ease of use' directly influence attitude in operation of technology and eventual actual use. Also, the model's 'external variables' are TAM's internal beliefs, identifying attitude, intent, and differences in individuals and environments as the connecting bridges in controlling behavior; these act as potential indirect factors in actual technology usage. Research results from latter scholars indicate that by de-emphasizing 'behavior', it is easier to understand the relationships between 'perceived usefulness', 'perceived ease of use', and 'intent to use'. As such, this research disregards 'behavior' so as to maintain TAM simplicity.

Within the multitude of innovative application and diffusion models, Rogers' theory of DOI (Diffusion of Innovation) in 1983 is most commonly used to explain and predict IT usage and diffusion behavior. Rogers asserts the existence of recognition differences in innovative features (relative advantage, complexity, compatibility, usability, evaluation), from the individual's as well as other decision makers' standpoints. Such will consequently affect acceptance rate of such innovations, and so these innovative features can be used to explain the process in user acceptance and decision to employ new technologies. Principally, 'relative advantage' purports to increased advantage levels when comparing new technology to its predecessor. This includes economic efficiency (cost reduction), image (evaluation and acceptance from the social view), advancements, convenience, and satisfaction. These are pivotal issues which influence acceptance of fresh innovations. Essentially, increased recognition in relative advantage will lead to faster adaptation and diffusion. Currently, Taiwan's mobile guide services are in the initial stages of development, thus the majority of consumers have not used these on a practical level. Therefore, this research will focus on and utilize the concept of relative advantage, with the intent to surface benefits from innovative technologies to potential users. As mentioned, the more recognition in relative advantage, the quicker adaptation and diffusion will occur.

From the consumers' standpoint, cost is an important facet in the intent to use of mobile devices/services. [11, 12, 13, 24] In addition, multiple research results have indicated that cost relatively affects diffusion and use of innovative technologies. [17, 22] In an age of advanced information, where 'time equals money', 'convenience' is what consumers desire. [15] This is another key factor of influence to be considered, as 'convenience' is a main factor when using mobile devices and related

services to connect to the Internet. Many scholars also believe that as service providers implement improved convenience, services will attract increased attention from consumers, thereby generating sales and usage willingness. [6, 20] Additionally, Coursaris, Hassanein, and Head [5] identified security, reliability, cost, usability content and personal privacy issues as another main concern of mobile consumers, and when unaddressed will decrease usage of mobile services. Scholars have stressed that when it comes to transmitting important data through the wireless medium, establishing feelings of confidence and security to the consumer are a must, so as to maintain and increase willingness of such services. [9, 10] As such, security regarding information exchange, confidentiality of data, user authentication, etc. must be seriously monitored, as the issue has heavy influence on consumers' willingness in usage of mobile business services.

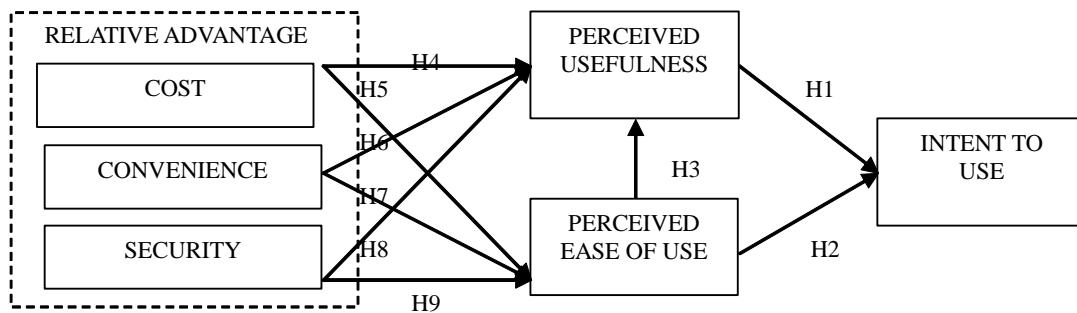
RESEARCH FRAMEWORK AND METHODOLOGY

Research Framework

This research framework (Figures 1) uses TAM as the theoretical basis and combines the DOI concept of relative advantage, adding external factors of cost, convenience, and security to construct research hypothesis. This paper proposes:

- H1: 'Perceived Usefulness has a positive effect on 'Intent to use'.
- H2: 'Perceived ease of use' has a positive effect on 'Intent to use'.
- H3: 'Perceived ease of use has a positive effect on 'Perceived Usefulness.
- H4: 'Cost' has a positive effect on 'Perceived Usefulness'.
- H5: 'Cost' has a positive effect on 'Perceived ease of use'.
- H6: 'Convenience' has a positive effect on 'Perceived Usefulness'.
- H7: 'Convenience' has a positive effect on 'Perceived ease of use'.
- H8: 'Security' has a positive effect on 'Perceived Usefulness'.
- H9: 'Security' has a positive effect on 'Perceived ease of use'.

Figures 1. Research Framework



Questionnaire Dynamics

At the initial phase of survey development, this research first focused on definitions in operating variables, referencing to reliable and effective charts to correct for validity in regards to mobile guide services. Additionally, this research used the Likert five-point scale and results were evaluated by associated scholars and experts to correct for minor errors. A pretest was also initiated before the actual survey, so as to identify and rectify unclear issues and other problems. This research structure also possesses a Cronbach's alpha value of over 0.734, thereby attesting to its validity and credibility.

Table 1. Operating Definition in Research Framework

Frame	Operating Definition	Reference	Topic Item
Perceived Usefulness	User acknowledgement level: Mobile guide services are useful in improving recreational quality and enhance efficiency.	[6]	1~4
Perceived Ease of Use	User acknowledgement level: Ease to learn and use such mobile guide services.	[6],[20]	5~8
Cost	User acknowledgement level: Understanding of costs related with mobile guide services, such as equipment, storage, and transfer costs.	[23]	9~12
Convenience	User acknowledgement level: Mobile guide services can save time and energy.	[4],[13]	13~18
Security	User acknowledgement level: Mobile guide services provide mechanisms for secure data transmission, preventing personal and private data.	[15],[8]	19~20
Intent to Use	User's willingness/likelihood to use services in the future	[3],[7]	21~23

As the intent of this research is to understand the consumers' intention of using mobile guide services, survey mainly targeted those in Taiwan with mobile phones and handheld devices equipped with internet connectivity. Due to limitations in manpower, 500 surveys were sent at random through postal service. After eliminating incomplete and invalid questionnaires, 240 returned

surveys were deemed valid for analysis, resulting in a return ratio of 48%.

STATISTICAL ANALYSIS

Descriptive Statistical Analysis

Within the returned samples, male respondents had a 57.9% weighting, while respondents under the age of 35 had an 81.7% weighting. 97% of respondents had an educational level of a college degree or above, in which 63% were students and employees in the telecommunication and finance industry. Overall, 76.7% of respondents indicated that frequency of service usage was 'on average no more than once a month'. Such result shows that the profile for mobile business providers remains in a small niche: the upper-tier of society, and has not reached the general populace as of yet. Evidently, such newly innovative services and related business models have much room to expand upon.

Correlation Analysis

Variables with high relativity degrees imply significantly similar concepts, and when factored into regression analysis could adversely affect analysis and explanation of such variables. As such, this research adopts the Pearson method of analysis to test variable correlation levels. If correlation values deviate over the acceptable level, collinearity problems will occur during regression analysis. As indicated in (Table 2), all correlation values are under 0.587, with variables showing positive correlation, thereby verifying the absence of collinearity problems.

Table 2. Pearson Correlation Analysis

		Perceived Usefulness	Perceived Ease of Use	Cost	Convenience	Security	Intent to use
PU	Pearson Correlation Sig. (2-tailed)	1					
P EOU	Pearson Correlation Sig. (2-tailed)	.346** .000	1				
C S	Pearson Correlation Sig. (2-tailed)	.450** .000	.563** .000	1			
C O N	Pearson Correlation Sig. (2-tailed)	.538** .000	.321** .000	.512** .000	1		
S E	Pearson Correlation Sig. (2-tailed)	.383** .000	.200** .002	.273** .000	.509** .000	1	
B I	Pearson Correlation Sig. (2-tailed)	.587** .000	.345** .000	.523** .000	.522** .000	.479** .000	1

** : Correlation is significant at the 0.01 level (2-tailed)

Regression Analysis and Test of Hypothesis

Each variable's regression analysis and test of hypothesis are organized in (Table 3). Three regression models are applied; Durbin-Watson analysis shows low correlation levels, while VIF and CI analysis also show low tolerance levels. Such empirical result assures our research methodology, confidently eliminates possibilities of collinearity problems, and affirms consistency to the proposed hypotheses.

Table 3. Basic Hypothesis Test

Dependent Variable	Independent Variable	Normality	Durbin-Watson Test	Tolerance	VIF	CI
PU	PEOU	Consistent	2.122	0.677	1.477	1.478
	CS			0.561	1.782	1.541
	CON			0.607	1.646	2.055
	SE			0.748	1.336	2.474
PEOU	CS	Consistent	1.859	0.765	1.308	1.358
	CON			0.693	1.443	1.685
	SE			0.769	1.301	1.905
BI	PU	Consistent	2.018	0.948	1.055	1.109
	PEOU			0.948	1.055	1.262

Note : Perceived Usefulness (PU) , Perceived Ease of Use (PEOU) , Cost (CS) , Convenience (CON) , Security (SE) , Intent to Use (BI), Data Source: Internal Research

Path Analysis

This research utilizes SPSS 13.0 to estimate path values, and through t-value validation verifies the significance of paths. Results from path analysis are shown in Table 4. Research results found no significant influence between ‘Security’ and ‘Perceived Ease of Use’, indicating no cause-and-effect relationship between the two. As such, H9 (Hypothesis 9) is disregarded, while the remaining hypotheses stand.

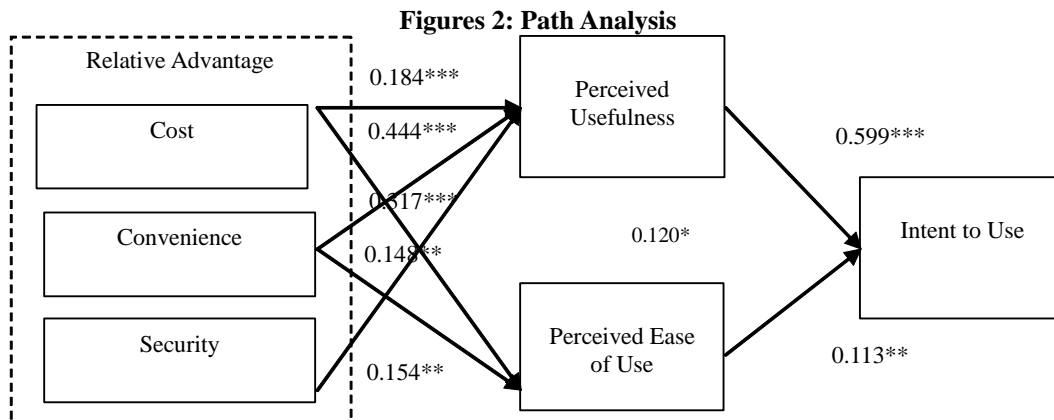
Table 4. Path Analysis Results

Dependent Variable	Independent Variable	Standard-izedβ	A-R2	Residual Value	T	Sig.	Hypot-hesis	Sustai-nable
Perceived Usefulness	Perceived Ease of Use	0.120	0.357	0.802	1.874	0.062*	H3	Yes
	Cost	0.184			2.605	0.010**	H4	Yes
	Convenience	0.317			4.683	0.000***	H6	Yes
	Security	0.154			2.525	0.012**	H8	Yes
Perceived Ease of Use	Cost	0.444	0.251	0.865	6.885	0.000***	H5	Yes
	Convenience	0.148			2.180	0.030**	H7	Yes
	Security	-0.076			-1.185	0.237	H9	No
Intent to Use	Perceived Usefulness	0.599	0.397	0.776	11.588	0.000***	H1	Yes
	Perceived Ease of Use	0.113			2.186	0.030**	H2	Yes

Note : *=p value<0.1; **=p value<0.05; ***=p value<0.01

In regards to ‘intent to use’ of mobile guide services, path analysis (Figures 2) reveal ten significant paths.

- (1) Perceived Usefulness -> Intent to use mobile guide services.
- (2) Perceived Ease of Use -> Intent to use mobile guide services.
- (3) Perceived Ease of Use -> Perceived Usefulness -> Intent to use mobile guide services.
- (4) Cost -> Perceived Usefulness -> Intent to use mobile guide services.
- (5) Cost -> Perceived Ease of Use -> Intent to use mobile guide services.
- (6) Cost -> Perceived Ease of Use -> Perceived Usefulness -> Intent to use mobile guide services.
- (7) Convenience -> Perceived Usefulness -> Intent to use mobile guide services.
- (8) Convenience -> Perceived Ease of Use -> Intent to use mobile guide services.
- (9) Convenience -> Perceived Ease of Use -> Perceived Usefulness -> Intent to use mobile guide services.
- (10) Security -> Perceived Usefulness -> Intent to use mobile guide services; this result comes from indirect influence.



RESEARCH RESULTS

First, analysis results indicate the impact on the user’s ‘Intent to Use’ in the mobile guide service, identifying factors of ‘Perceived Usefulness’ and ‘Perceived Ease of Use’. In the area of ‘Perceived Usefulness’, this research proposes for service providers to offer products of practical cost to the user, thereby taking the first step in promoting the practicality and

saved-costs in its basic services. As for 'Perceived Ease of Use', industry players should scrutinize difficulty issues in learning and using offered services, so as to assure consumers' concern over the operation of such new services. Regression analysis show that 'Perceived Usefulness' is of higher consideration than 'Perceived Ease of Use', clearly indicating respondents are more focused on the usefulness of services, and satisfaction of service usefulness directly guides to 'Intent to Use'. In other words, users should first be shown the increased benefits of newly innovative services, become comfortable with the learning process, and by adapting to usage with ease will ultimately increase intent to use.

As for external variables, 'cost', 'convenience', and 'security' all affect 'Perceived Usefulness'. If the user feels mobile guide services will save costs in information storage, provide convenience in time/location, and possesses the security mechanisms for transmission and privacy, such will influence the user's 'Perceived Usefulness' of mobile guide services and steer towards 'Intent to Use'. Regarding 'Perceived Usefulness', we classify 'Convenience', 'Cost', and 'Security' respectively, in order of importance. Respondents showed high interest in 'Convenience' with influence to 'Perceived Usefulness', and as such providers should stress the simplicity in operating its services, as to enhance 'Intent to Use'. Looking at current hardware, usage of mobile phones to check data (through added-value services) is common, but the devices are not at the convenience level for further internet purposes (small keypads, complicated functionality). With the introduction of the i-Phone and current devices including the Blackberry, palmtops, and advanced PDAs, providers should maintain focus on such hardware as well as future smart phones (with enhanced capabilities in voice recognition/command, portable keypads, user-friendly interface, etc.), to improve what consumers seek: the vital issue of convenience, and employ imminent opportunities as the abovementioned devices grow in visibility and popularity while decreasing in cost.

The user's considerations of 'cost' and 'convenience' have an effect on 'Perceived Ease of Use' as well, and if providers improve the consumers' concerns regarding cost and convenience, 'Perceived Ease of Use' will improve and positively affect 'Intent to Use'. In terms of importance regarding 'Perceived Ease of Use', 'Cost' is of high importance, followed by 'Convenience'. Such indicates the consumer's focus on cost concerns, and providers should concentrate on related cost-saving issues, such as information storage and information exchange costs. Again, the purpose of this is to increase acceptability and 'Intent to Use'. Additionally, path analysis shows that 'Perceived Usefulness' is influenced by 'Perceived Ease of Use', indicative of the difficulty in learning and operating innovative services as a major factor in user acceptance. As such, providers must strengthen operating ease of its services while providing added assistance in familiarizing the user with such innovations, thus lowering operating barriers. The main focus should be on reducing complexity in the user's service access. Otherwise, consumers will discourage from unfamiliar and complicated procedures.

DISCUSSION AND IMPLICATIONS

Research results show a limited number of users in mobile guide services, indicating a vast range of potential for development in the market. With this in mind, primary objective should focus on the attraction of potential customers. The creation of appropriate business strategies and tactics, increasing visibility, and service promotion through appealing devices are the first tasks to consider in enhancing user recognition and acceptance. Based on the DOI viewpoint, as new innovations and products enter the initial stage of development in the market, 'innovators', defined as educated in areas of expertise as well as venturesome, are usually the first to purchase. 'Early adopters' are the second to enter, as they are educated and more importantly, possess significant social standing and popularity. Thereby, 'early adopters' are likely to grasp the future importance of innovations. The ensuring entry of the 'early majority' will indicate the spark of market growth. This third wave of adopters tends to deliberate issues of product benefit and relative cost, and upon reaching a satisfactory level will enter the market. In accordance with the abovementioned and based on this paper's research results, future business strategy should expand upon the 'relative advantage' aspect of mobile guide services. By introducing new innovations to the public on a large scale, consumers will be able to easily recognize points of convenience, derived added-value, and eventually come to accept such innovative products and services. At the same time, other issues must be taken into consideration to complement the innovations, such as new devices or application of telematics and multimedia required in mobile service. Under a reasonable level of cost control, such tactics will effectively stimulate mobile business services, notably in the area of convenience.

Since these innovative services are in the initial stage, users are obviously limited. As such, providers need to create methods for consumers to use and experience trial services, free of charge. The low cost associated with this is insignificant compared to the potential impact on consumer willingness of usage. Such market strategy inherently has positive effects in the diffusion of innovative services and acts as a guide for potential users on all levels to enter the market as consumers.

Considering the number of mobile added-value service providers in Taiwan, market competition is considerably intense. Needless to say, development of competitive advantages is a must. Customer satisfaction is a key factor; the provider must be able to offer diversified services while reduce consumer costs. To effectively develop mobile added-value services and applications, strategic scope should encompass mobile service in areas such as food, clothing, housing, and travel. New innovations from the mobile guide industry in these sectors could be a breakthrough point, distinguishing the provider from its competitors. On the other hand, service providers need to develop new business models, and through WLAN applications provide the consumer with affordable and enriched mobile services. One feature would be a mobile guide service; the user is able to make travel activities without an actual guide, operating language support, GPS (Global Positioning System), and LBS (Location-based Service) features with ease and comfort. In addition, at any given time and/or location, the user is able to view multimedia and use functions such as travel guides and video/image applications. The quality and flawless integration of such

services will help to attain the ultimate goal: complete customer satisfaction. Collateral benefits incurred from this include increased consumer spending at the local area of travel, improved mobility for travelers, broader visibility of such new innovations, and create new needs for additional enhanced services. The results from such a win-win setting between providers and consumers will lead to more business opportunities, multi-faceted growth, and further innovations. Ultimately, the vision of an accomplished networked system benefiting society in boundless aspects can be truly realized.

In addition, in order to make conditions for consumers in respect to Perceived Usefulness, the tasks address the issues of cost, convenience, and security, subject to not only m-tourism service providers but business users as well. However, the m-reachability and location communication applications are indispensable to m-tourism services, and the innovative business model, sufficient public information, trust-worthy demonstration and interesting content from the business users are critical factors for the successful adoption of m-tourism. The pervasion of the novel m-tourism service needs to promote collaborations and interdependence among business users, m-tourism service providers and telecommunication operators. In order to provide consumers with affordable and numerous m-tourism content and services, successful partnership among parties, innovative services provision and business model redesign will influence the perceived usefulness of consumers and reinforce the intention of use as well as the acceptance.

CONCLUSION

This paper identifies the significant factors of consumers' cognition on acceptance of mobile guide service and manifests user adoption to novel technology and services that rely on the relative advantages of the m-tourism service. These findings will contribute to the facilitation of the factors that will influence the user's choice of innovative mobile m-tourism services. Furthermore, this paper provides suggestions of different mobile business strategies for effective strategic planning and action in the mobile guiding industry based on research findings. Therefore, these suggestions will be beneficial to the penetration of 3G and/or WiMAX in the future, accelerating the development of wireless technology application, and spawning the success of m-service modes. However, given that the initial stage of m-tourism services provision in Taiwan, and that users are few and opportunities to experience the service are scarce, the use of these results in regards to this research has taken into consideration this limitation in this study.

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DOES NON-INNOVATIVE TECHNOLOGY EXPLAIN THE “IT PRODUCTIVITY PARADOX”?

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ABSTRACT

Contrary to theoretical arguments that suggest a positive association between investment in IT and improved financial performance, some empirical evidences suggested that no statistical association between IT spending and financial performance. This phenomenon is known as the “IT productivity paradox” Dos Santos et al. [21] argued that non-innovative technologies are not likely to improve a firm’s market value or financial performance. Automatic teller machines (ATMs) are one of the well-known and non-innovative representatives of IT investment. By examining the relationship between ATMs investment and financial measures, we find that ATMs investments improve financial performance and lower cost rates, but no consistent conclusion on the measures of growth. Contrary to Dos Santos et al. [21] which argued that non-innovative technologies are not likely to improve a firm’s market value or financial performance. The empirical results show that the phenomenon of “IT productivity paradox” does not come out in this case. The non-innovative technologies do not always result in productivity paradox.

INTRODUCTION

For the past half-century, modern organizations have been increasing their investments in information technology (IT). In a 1996 survey, The Economist reports that America’s investment in computers has risen by 20-30% a year in real terms; the share of IT in firms’ total equipment investment has jumped from 7% in 1970 to over 40% in 1996[7]. The IT spending in 2001 for the United States and Japan were \$546,681 and \$188,012 (in millions of US dollars), respectively [29]. Firms invested in IT presumed that such investments could enhance their efficiency, performance and reinforce their competitive edges. IT has played an increasingly important role in modern organizations and the business value of IT investment has become a crucial but controversial issue.

Contrary to theoretical arguments that suggest a positive association between investment in IT and improved financial performance, some empirical evidences, especially in 1980s and early 1990s, suggested that no statistical association between IT spending and financial performance. This phenomenon is known as the “IT productivity paradox” and debated for the past decade [12, 13, 26]. Dos Santos et al. [21] argued that non-innovative technologies are not likely to improve a firm’s market value or financial performance. The IT investments were classified as non-innovative if the investment was following investments already made by its competitors; or the investment was intended to maintain an existing application. The innovative investments represented the first use of a technology within the industry, or would result in a new product or service based on information technology, or the development of new information technology for the industry. So the firms which invest in innovative may take more risk and cost more money.

For banking industry, applications of information technology have been prevailing for many years, especially for the automatic teller machine (ATM). Nowadays, ATMs are one of the well-known representatives of IT investment and have been utilized for several decades. And the banks that invested in ATMs are intended to maintain an existing application. Following the definition of Dos Santos et al. [21], the investment on ATMs should be classified as non-innovative. We wonder if the follow-up investment can not enhance efficiency or performance, why the banks are willing to invest in ATMs continuously so many years. It seems very worthy to revisit the relationship between non-innovative IT investment and firm’s performance, and search some explanations for banks which continuously invest in ATMs.

Strassmann [36] claimed that the productivity impact of a new technology takes time to materialize. Brynjolfsson [12] suggested that one of the explanations for the IT productivity paradox is time lags due to learning and adjustment. ATM is not a new technology utilized by banks, and has been accepted by the clients. Studying the relationship between ATMs and performance will not encounter the time lags proposed by Strassmann [36] and Brynjolfsson [12] which may cause the productivity paradox. From the empirical results, we find that ATMs investment leads better financial performance and lower cost rates, but no consistent conclusion on the measures of growth. The main contribution of this paper is that this paper provides evidence to invest on non-innovative IT. As we know, the investment of new technology is risky and will incur large fixed cost, especially for innovative IT. The firms in some industries, for example the banking industry and airline industry, are not adaptive to take this kind of risk. They may be seriously affected if their IT-based system failed even for a short time. This paper can provide some evidence to support the adoption of non-innovative IT, and future insights to assess the IT investment project.

The data used in this paper are mainly extracted from the Bureau of Monetary Affairs, Financial Supervisory Commission at Taiwan. Further, the data set is composed of 35 banks, and the time period of this empirical study is from 1995 to 2005.

LITERATURE REVIEW AND IT PRODUCTIVITY PARADOX

Porter and Millar [33] suggested that IT has affected competition in three aspects. First, IT has led to changes in industry structure and competition. Second, IT was used to support the creation of new business. Third, companies using IT outperformed

the corrivals. From the strategic point of view, IT could affect the strategies, including cost leadership, differentiation or specialization in a market niches, or efficiency in the activities involved in the value chain [32]. Besides, IT could reduce the cost of coordination between activities and risks inherent to the transaction and create value for the client [4, 14].

Over the last two decades, scopes of papers and books have been devoted to the issue of IT and productivity or financial performance. Some studies found that IT could improve productivity [2, 31, 24]. Some prior studies found that IT could not improve productive [7, 9, 29, 34, 37]. The term “IT productivity paradox” was introduced to describe the phenomenon that no statistical association between IT spending and financial performance [12], [24]. Productivity paradox was originally defined at the economy level [12]. Most of researchers have addressed the productivity issue at the firm level [18]. This phenomenon also exists in the research of banking industry [6].

Strassmann [36] examined the relationship between productivity and computers. He found that no links between computers and productivity and provides several explanations for the paradox. First, the data used in his work was collected on a marco level. It is highly aggregated and may not capture the reality very well. Second, the productivity impact of a new technology takes time to materialize. Third, at the corporate level, computers may help enterprise stay in the race, but not increase competitiveness. Brynjolfsson [12] suggested four explanations for the IT productivity paradox. The first is mismeasurement of output and input. The second explanation is time lags due to learning and adjustment. The third explanation is that of redistribution of profits. The fourth explanation is that IT is not really productive at the firm level.

Other studies offered different explanations for productivity paradox. Based on economic theory, innovators may obtain superior performance if they can capture favorable market positions, secure scarce resources, etc, before their competitors can imitate them. So the innovative investments in IT may result in greater rewards for investors than follow-up investments. Following this logic, Dos Santos et al. [21] argued that non-innovative technologies are not likely to improve a firm’s market value or financial performance. Stratopoulos and Dehning [38] argued that productivity paradox is due to the fact that companies implement IT projects ineffectively. Like other assets, IT must be utilized effectively to result in increased financial performance. Successful users of IT have superior financial performance relative less successful users of IT. Dehning, Dow and Stratopoulos [16] proposed that IT might increase organizational slack, but neither organizational output nor profit. One possible source of productivity paradox was the increased slack. Besides, the structure of market might cause the productivity paradox, Belleflamme [7] suggested that in the oligopolistic competitive market each individual firm might find it is profitable to invest in cost-reducing IT, but total investment might then be excessive from the industry’s point of view.

There are several kinds of performance measures used in correlative studies. The measures of productivity were used in Cron and Sobol [15], Bender [8], Dos Santos et al. [21], Strassman [36], Hitt and Brynjolfsson [26], Weill [39], Dewan and Min[19], and Dewan and Kraemer[20]. The measures of profitability were used in Cron and Sobol [15], Bender [8], Dos Santos et al. [21], Strassman [36], Hitt and Brynjolfsson [26]. The measures of consumer surplus were used in Cron and Sobol [15], Bender [8], Bresnahan [11], Dos Santos et al. [21], Strassman [36], Hitt and Brynjolfsson [26]. Mukhopadhyay et al.[30] relied on quality and Banker et al. [5] utilized operational efficiency, and Bharadwaj et al. [10] based on Tobin’s q. Recently, Wu and Chen [40] suggested a hybrid performance measure system which is an integrative assessment framework with a three-level structure of corporate strategies, manufacturing decisions, and operational activities. Performance should be examined at different levels. Lin and Shao [29] estimated the IT business value in terms of the impact of IT on technical efficiency, based on the constant elasticity of substitution stochastic production frontier model.

SAMPLE SELECTION AND RESEARCH METHOD

The data used in this paper are mainly from the Bureau of Monetary Affairs, Financial Supervisory Commission at Taiwan. These data belong to 35 banks. In the short run, the investment on information technology is not necessarily related to superior financial performance, but will pay off only in the long term[Kivijarvi and Saarinen [28]. To this end, the empirical period of this paper is from 1995 to 2005 and the total number of sample is 284.

We examine the dependent factors from three firm perspectives, namely financial profitability perspective, operating cost perspective, and growth perspective. The profitability measures are return on assets (ROA), return on equity (ROE), net income rate (NIR), and operating income rate (OIR) (Stratopoulos and Dehning, [38]). Previous papers indicated that IT could reduce the cost of coordination between activities and risks inherent to the transaction and create value for the client [1, 4, 14]. The cost measures should be treated as performance measures. The cost measures are operating expense rate (OER), employee fee rate (EFR) and finance cost rate (FCR), and the revenue-expense rate (RER). And the growth measures are the growth rate of sales (GRS), growth rate of gross margin (GRNI), growth rate of operating income (GROI) and growth rate of ROA (GRRO).

The problem what we concern is whether the ATMs investment will lead the financial performance or not. Here we propose a simple regression model that regressed performance measures on the number of ATMs lagged one period along with the control variable reflecting performance measures of previous period. The model as follows:

$$y_t = \alpha_0 + \alpha_1 ATM_{t-1} + \alpha_2 Pre - Ratio + e \tag{1}$$

Where

y_t : Financial ratios of period t; ATM_{t-1} : The log value of the number of ATMs of period t-1; $Pre - Ratio$: The Financial ratios of period t-1; α_0 : Constant term; α_j : Coefficients of independent variables, j=1, 2; e : Error term.

As pointed out by B. L. Dos Santos and Peffers [22], Innovative information technology (IT) applications are risky investments. Unless successful applications provide innovators with exceptional returns, these investments would not be justified. The business size represents the ability to take risk and become another factor to affect IT adoption. Some researches claimed that

larger banks tend to install more ATMs than smaller banks in order to get the advantage of economic scale and relatively larger banks are likely to get more profit by adopting ATMs ([23], [27]). IT investments may take time to achieve a positive payback and desired return and require additional resource from external stakeholders, such as creditors and investors [17, 25, 35]. So the financial health and operating size of banks may affect the banks' performance.

From the previous paper, we know that the total assets is a very popular proxy for enterprise size. In our case, we find that the number of ATMs and the total assets of banks are highly correlated. The Pearson's correlation coefficient between the log value of the number of ATMs and log value of total assets are 0.874, the P-value for significantly differing from zero is smaller than 0.0001. This fact forces us to give up the consideration of banks' size.

We modify the regression model that take into consideration of the impact of financial health, but out of consideration the effect of size. The proxy of financial health is Z-score which propose by Altman [3]. The regression model is expressed as the equation (2). Again, this regression model is along with the control variable reflecting performance measure of last one period. The second regression model as follows:

$$y_t = \beta_0 + \beta_1 ATM_{t-1} + \beta_2 y_{t-1} + \beta_3 Health_t + \varepsilon \quad (2)$$

Where

y_t : Financial ratios of period t; ATM_{t-1} : The log value of the number of ATMs of period t-1; $Pre - Ratio$: The Financial ratios of period t-1; $Size_t$: The log value of total assets; $Health_t$: The Altman's Z-score; β_0 : Constant term; β_j : Coefficients of independent variables, j=1,2,and 3; ε : Error term.

EMPIRICAL RESULTS

Table 1 shows the regression results of equation (1) which simply examined whether the ATM investment would lead the performance. In the circumstance that the profitability measures are the proxies of the financial ratios, the coefficients of ATM_{t-1} are 0.226, 1.312, 3.953, and 4.052 respectively. All of these four coefficients are significantly positive. This figures represent the ATMs investment will lead the ROA, ROE, net income rate, and operating income rate positively. These results are opposite to the evidences of Strassman [36] and Hitt and Brynjoflsson [26] which claimed the existence of productivity paradox.

In the circumstance that the cost measures as the financial ratios, all the coefficients of ATM_{t-1} are negative, they are -0.222, -0.107, -4.344, and -4.052. The independent variable, ATM_{t-1} , has significantly negative impact on FCR and RER. This results shows that the ATMs investment will lower the finance cost rate and revenue-expense rate. Finance costs of banks include the operating expense, promotion expense, and other expense which are relevant with financial transaction. From the transaction cost of view, IT could reduce the cost of coordination and risks inherent to the transaction [14]. These results are consistent with the previous work that the ATMs will cause the cost-saving.

Finally, we check the relationship between the growth rates and the ATMs investment. In the circumstance that the growth measures as the financial ratios, all of four coefficients of ATM_{t-1} , are positive. The coefficients are 0.799, 74.985, 92.039, and 1.333. The ATM_{t-1} has positive and significant impact on the growth rate of ROA only. So the ATMs investment can not improve the growth rate generally and significantly. ATMs are used for cash transactions and for account transfers. The investment of banks on ATMs is intended to maintain an existing application and can not result in a new product or service for the future. It makes sense that ATMs investment can not spur the growth for banks.

In brief, we find that ATMs investment is positively related with profitability measures, and negatively related with cost measures, but no consistent relation exists between ATMs investment and growth measures. The ATMs investment was neither first usage within the banking industry nor result in a new product or service. These empirical results indicate that the ATMs investment, a classical representative of non-innovative technology investment, will lead higher profitability and lower cost. The phenomenon of "IT productivity paradox" does not come out in this case. Contrary to Dos Santos et al. [21] which argued that non-innovative technologies are not likely to improve a firm's market value or financial performance.

Table 2 shows the regression results of equation (2) which examined the impacts of ATMs investment, and financial health on financial ratios along with the control variable reflecting performance measures of last period. From the empirical results, we know that ATM_{t-1} is positively related with profitability measures, and negatively related with cost measures, and there is no consistent relation with growth measures. In the circumstance that the profitability measures are the proxies of financial ratios, the coefficients of ATM_{t-1} are 0.242, 1.833, 3.155, and 2.881. Three of them are significantly different from zero, the coefficient of ATM_{t-1} does not different from zero only in the circumstance that ROE as the financial measure. Again, these figures show the ATMs investment will improve the ROA, net income rate, and operating income rate significantly.

In the circumstance that the cost measures are the proxies of financial ratios, the coefficients of ATM_{t-1} are -0.994, -0.284, -1.962, and -2.881. Only the coefficients of OER and RER are significantly different from zero. This evidence support that the ATMs investment will lower the operating expense rate, and revenue-expense rate. In the circumstance that the growth measures are the proxies of financial ratios, the coefficients of ATM_{t-1} are -0.994, -0.284, -1.962, and -2.881. No consistent and significant relation exists between ATMs investment and growth measures.

In sum, the empirical results of equation (1) and (2) are consistent, basically. Although the ATMs investment does not cause higher growth rate, these empirical results support that the ATMs investment will improve the profitability and cause cost reduction. The phenomenon of "IT productivity paradox" does not emerge. The coefficients of health are positive for the

profitability measures and growth measures and negative for the cost measures. All the coefficients of health are significantly different from zero except when the financial ratio is growth rate of net income. These results imply that the banks with healthy financial status will enjoy the higher profitability, lower cost rate, and higher growth rate.

DICCUSSION AND CONCLUSION

Dos Santos et al. [21] which argued that non-innovative technologies are not likely to improve a firm’s market value or financial performance. So the investment on non-innovative technologies may be one of the explanations of “IT productivity paradox”. Contrary to the arguments of Dos Santos et al. (1993)[21], this paper find a case that non-innovative technologies can improve the profitability and cost saving. Although the non-innovative technologies can not ensure the competitive edges for the growth in the future. We investigate the banking industry of Taiwan and examine the relationship between ATMs investment and financial measures. The empirical results suggest that the ATMs investment will improve the profitability measures such as ROA, ROE, net income rate, and operating income rate. The empirical results also suggest that the ATMs investment will lower the cost ratio such as the operating expense rate, employee fee rate, finance cost rate, and revenue-expense rate. Besides, the financial health of banks is positive for the profitability measures and growth measures and negative for the cost measures. The banks with healthy financial status will enjoy the higher profitability, lower cost rate, and higher growth rate.

As we know, the investment of new technology is risky and will incur large fixed cost, especially for innovative IT. Investing on non-innovative technology can promote the profitability and reduce the operating cost, it can be a conservative alternative to reduce the investment risk and help firms afford other project which can spur the development and growth.

Table1: Regression results for model (1)

$$y_t = \alpha_0 + \alpha_1 ATM_{t-1} + \alpha_2 Pre - Ratio + e$$

Financial ratio	Intercept	ATM t-1	Pre-Ratior-1	Adjusted R2
Profitability measures				
ROA	-1.088 (-2.85) ***	0.226 (3.11) ***	0.336 (5.99) ***	0.165
ROE	-13.102 (-1.90) *	1.312 (2.17) **	0.024 (0.40)	0.011
NIR	-19541 (-2.67) ***	3.953 (2.85) ***	0.294 (5.16) ***	0.126
OIR	-19.442 (-2.38) ***	4.052 (2.60) ***	0.283 (4.95) ***	0.111
Cost measures				
OER	7.487 (4.09) ***	-0.222 (-0.70)	0.741 (18.08) ***	0.540
EFR	3.371 (3.47) ***	-0.107 (-0.58)	0.767 (18.06) ***	0.553
FCR	76.734 (7.64) ***	-4.344 (-2.77) ***	0.267 (4.61) ***	0.108
RER	91.093 (8.53) ***	-4.052 (-2.60) ***	0.283 (4.95) ***	0.111
Growth measures				
GRS	-0.646 (-0.09)	0.799 (0.60)	0.454 (8.24)***	0.192
GRNI	-511.825 (-1.02)	74.985 (0.79)	-0.042 (-0.70)	0.000
GROI	-616.101 (-2.06) **	92.039 (1.63)	-0.045 (-0.76)	0.003
GRRO	-0.502 (-0.13)	1.333 (1.89) *	0.332 (6.08) ***	0.101
ps: the values in parentheses are t-value; *, ** and *** represent the significant level 0.1, 0.05 and 0.01 respectively.				

Table 2: Regression results for model (1)

$y_t = \beta_0 + \beta_1 ATM_{t-1} + \beta_2 y_{t-1} + \beta_3 Health_t + \varepsilon$					
Financial ratio	Intercept	ATM t-1	Pre-Ratiot-1	Health	Adjusted R2
Profitability measures					
ROA	-3.221 (-7.075)***	0.242 (3.01)***	0.137 (2.33)***	6.474 (9.68)***	0.423
ROE	-44.950 (-5.38)***	1.833 (1.22)	-0.179 (-2.89)***	116.752 (9.59)***	0.308
NIR	-54.752 (-6.31)***	3.155 (2.06)**	0.114 (1.88)*	121.160 (9.61)***	0.389
OIR	-55.853 (-5.87)***	2.881 (1.71)*	0.115 (1.88)*	130.615 (9.37)***	0.373
Cost measures					
OER	13.878 (6.15)***	-0.994 (-2.71)***	0.780 (17.38)***	-11.034 (-3.83)***	0.610
EFR	5.639 (4.49)***	-0.284 (-1.25)	0.808 (17.39)***	-5.851 (-3.36)***	0.614
FCR	116.708 (9.74)***	-1.962 (-1.16)	0.103 (1.62)	-120.571 (-8.56)***	0.327
RER	144.361 (11.36)***	-2.881 (-1.71)*	0.115 (1.88)*	-130.615 (-9.37)***	0.373
Growth measures					
GRS	-7.018 (-1.00)	-0.153 (-0.12)	0.451 (7.76)***	30.928 (2.99)***	0.283
GRNI	-113.569 (-0.18)	-74.337 (-0.65)	-0.058 (-0.83)	1268.897 (1.40)	0.000
GROI	-694.516 (-1.75)*	22.813 (0.32)	-0.051 (-0.73)	1385.989 (2.44)***	0.017
GRRO	-0.631 (-1.11)	-0.080 (-0.77)	-0.377 (-5.71)***	3.080 (3.76)***	0.161
ps: the values in parentheses are t-value; *, ** and *** represent the significant level 0.1, 0.05 and 0.01 respectively.					

Taiwan government initiated a number of institutional changes, including the allowance for setting up the new financial institutions, since 1989. The empirical period of this paper is from 1995 to 2005. Due to the increasing number of banks, the competition was intensive and cruel. Some banks survived but some failed. Our sample contains all the banks whose data are available. So the results are robust not only for the banks with superior performance but also for the whole banking industry. For the multiple-national banks which want to penetrate an emerging economy, for example China, these banks still have to struggle hard to maintain the competitive edges. Because these banks have not built up a complete branch network nationwide to compete with domestic banks. From our study, non-innovative technology is low-risk and positive for profitability and cost-saving. Therefore, taking advantage of IT, such as the ATMs, may be the best alternative at this stage.

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**EXAMINING AN ERP CUSTOMIZATION SYSTEM: IMPLICATIONS TO SYSTEM FIT,
ACCEPTANCE AND MAINTENANCE COSTS**

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ABSTRACT

Enterprise Resource Planning (ERP) system is a complete and complex information system that consists of firms' business best practices. However, the business best practices provided by the supplier do not always suitable and/or sufficient for all organizations. Misfit happens when differences exist between what the ERP system can provide and what a company actually requires and expects from the system.

This study examines an ERP add-on/bolt-on system of a medium-sized computer memory producer that has global business units around the world. This study aims to provide the implications of the customized system from the perspectives of (i) system fit, (ii) user acceptance, and (iii) subsequent maintenance and upgrade costs. We adopt the survey method to collect data on system fit (using the IS Balanced Scorecard and the well-established task-technology fit questions), user acceptance on the system (using the popular technology acceptance survey instrument), and conduct cost and benefit analysis of subsequent maintenance and upgrade costs on the add-on/bolt-on system.

The results of the study show that from the overall organizational point of view the system fit, acceptance and performance of the add-on/bolt-on is only marginal. There are a lot of improvements for the add-on/bolt-on system. Although in developing the add-on system the case organization follows the best practices of obtain full support and involvement of top management, utilize reasonable work flow as a focus direction, provide tutorial and employee training to each level at different stages and conduct regular performance review and feedbacks, these are not sufficient. The empirical data indicates that IS personnel needs to understand more of the user's business needs and monitors the users daily business operation before developing an add-on/bolt-on system for the ERP system so that the users will use the customized system to assist their daily job. Also, IS department need to provide more training to improve ease of use of the system and users' attitude towards the add-on system and IS department. Based on cross-tabulation, we find that job title and the degree of automation/computerization in a module (or system) may affect the system users' rating for system fit and user acceptance.

From the cost-benefit analysis, the additional maintenance costs for the add-on do not necessarily cost more, when the opportunity costs of not having the custom system are taken into consideration. Instead, the benefits of having an idiosyncrasy system may actually bring a lot of benefits to the company.

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WHY DOES DIFFERENTIATION STRATEGY FAIL?

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ABSTRACT

Differentiation strategy has been considered critical for securing a competitive advantage. However, not all firms can create competitive advantages through differentiation. In this paper, we draw on a Taiwanese hotel, restaurant, and TV program provider to show why differentiation strategy fails. On the basis of these three cases, three failed differentiation strategies are proposed and a framework for implementing a differentiation strategy is provided. Finally, we present the discussion and conclusions for the theory and practice of differentiation strategy.

Keywords: differentiation strategy, competitive advantage, service industry

INTRODUCTION

Over the two decades, scholars and practitioners have recognized that cost- and differentiation-based strategies [1], are important sources of competitive advantage. Porter's [1] generic competitive strategy has become the dominant paradigm [2]. Of particular interest is the question of how to leverage Porter's [1] generic strategies to attain superior performance. There is an ongoing debate over whether the two strategies are mutually exclusive or whether they can be combined [3]. In this paper, we argue that the differentiation strategy is more effective and practical than the cost-based strategy. The basis of the cost-based strategy is the firm's resources. In contrast to the differentiation strategy, it may be achievable even with limited resources. For instance, prior research has shown the benefits of differentiation strategy in gaining and sustaining key business relationships [4], even in a stalemate context for value creation [5].

However, although differentiation strategy has been influential in securing competitive advantages, not all firms can enjoy competitive advantages by adopting a differentiation strategy. In other words, a differentiation strategy does not guarantee a competitive advantage. Further, we have to explore into the reasons why differentiation strategy fails.

To explain this phenomenon, we draw on three service firms in Taiwan: a hotel, a restaurant, and a television program provider. We use these cases to describe three failed differentiation strategies and provide a framework for a successful one.

Understanding the mechanisms will extend the literature on differentiation strategy for creating competitive advantage.

This paper consists of five sections. First, we describe competitive strategy including cost leadership strategy and differentiation strategy and explain why differentiation strategy is critical for competitive advantage. Second, we present the data and methodology. The third section describes the three firms with failed differentiation strategies. The conclusion discusses the implications of differentiation strategy for managers and researchers.

THEORETICAL BACKGROUND

Porter [1] developed three generic strategies for creating competitive advantage. First, the cost leadership strategy emphasizes low cost relative to competitors. Second, differentiation strategy maintains a firm's need to create a unique product or service. Third, the focus strategy argues that firms should focus on a particular group of customers, geographic markets, or product lines. Karnani [6] indicated that the focus strategy involves achieving low cost or differentiation. Therefore, there are only two ways of securing competitive advantage: a cost leadership strategy and a differentiation strategy [6].

Dess and Davis [7] suggested that firms concentrate on either cost leadership strategy or differentiation strategy to avoid being "stuck in the middle" characterized by Porter. In other words, according to Porter, the two strategies are unlikely to be pursued simultaneously for a sustainable competitive advantage. Miller [8] argued that the differentiation strategy is most likely to be pursued in uncertain environments, while the cost leadership strategy is connected with stable and predictable environments.

Other research has examined firms will benefit the highest market share and profitability from the integration of the two competitive strategies. Kim, Nam, and Stimpert [9] argued that the integration of both cost leadership and differentiation strategies will outperform cost leadership or differentiation strategies. Hall [10] and Murray [11] also considered that the generic strategies are not mutually exclusive. Each strategy may be associated with a variety of strategic means [11].

Elaborating on Murray [11], we argue that a differentiation strategy can be an important way for a firm to acquire a competitive advantage regardless of whether a cost-based strategy has already been implemented or not. In other words, firms can adopt differentiation strategy to reduce competition [12]. Specifically, a differentiation strategy is an effective and profitable means of securing a competitive advantage in a stalemate situation [5]. Hill [13] viewed that differentiation strategy can be a way for firms to establish an overall low-cost position. Thus, differentiation strategy can always be a critical competitive weapon for a firm regardless of whether a cost leadership strategy exists and despite whatever competitive advantages firms have.

Yet, although firms can apply their skills and resources to meet environmental needs and create enduring competitive advantage [14], differentiation strategy is not guaranteed to succeed. Therefore, firms should need to consider how to avert

failure when pursuing differentiation strategy. In this paper, we use the examples of three service firms to show why some differentiation strategies fail. Accordingly, we propose three critical mechanisms of a differentiation strategy.

METHOD

The primary objective of this paper is to explain why differentiation strategy fails. This study is based on three Taiwan's service firms: a hotel, restaurant, and TV program provider. The three cases were chosen because they demonstrate some interesting and overlooked phenomena. The cases are thus ideal for expanding Porter's [1] competitive strategy of differentiation.

There are two main sources in this study: primary data (interviews) and secondary data (archives). The primary data are collected through focused interviews [15]. Eight 1- or 2-hour interviews were held with three general managers who are responsible for running the hotel, restaurant, and TV station. The secondary data were drawn from both internal and external documents. Internal sources consist of press releases, the company websites, and presentations. External sources include business and management periodicals, public company records, and virtual communities on websites. The data is triangulated among sources to increase the construct validity of this study [16, 17]. We stop data collection upon reaching a level of saturation [18].

For data analysis, this study adopts the iterative [17] and narrative [19] process of switching among data collection, data analysis, literature review, and theory building in order to construct a theoretical framework that explains why differentiation strategy fails. The explanation-building process enhances the internal validity of this study [20]. Finally, this study is written as a teaching case for EMBA and MBA program class discussion to gain important insight on increasing the validity of this study.

Case 1 The SML Teacher's Hotel

In the middle of Taiwan, Nantou County is characterized by its glorious landscape of lakes and mountains. Sun Moon Lake in Nantou is one of the most beautiful scenic spots in Taiwan, and attracts many tourists hoping to enjoy its climate every year. Therefore, more and more hotels have opened in the area. There are three kinds of hotel in this area.

The six-star Lalu Hotel is the first type. Its decor and facilities are brilliant and comfortable. Amenities include a spa, sauna, gym, fishing trips, bike rental, and swimming pool. In particular, the hotel overlooks Sun Moon Lake. Besides, the best service in this hotel is also delivered to its customers. The Lalu Hotel won the World Travel Award in 2006 and has become the leading spa resort in Taiwan. This type of hotel is differentiated from the others by its first-rate services.

The second type of hotel in the Sun Moon Lake area is the guesthouse. Guesthouses provide homey rooms and breakfasts prepared by the hosts. Every host creates a unique living environment. Each guesthouse has a highly personal services and decor. For example, one guesthouse is a wooden house building with naturalism. One guesthouse boasts strong coffee and superbly friendly service. One guesthouse is a Japanese garden building. In sum, these guesthouses have distinctive personalities.

The third type of hotel in the Sun Moon Lake area is the public hotel, such as the SML Teacher's Hotel. It opened on Teacher's Day in 1960. It is located on Sun Moon Lake. The public hotel once catered to teachers. Nowadays, it is open to everyone but teachers receive discounts. Since few people know this, most travelers assume that this is just a hotel for teachers. In addition, the hotel staff had a reputation of being unfriendly. In short, although the hotel had differentiated itself in the past by catering to teachers, the hotel ceased to differentiate itself by appealing to everyone. In contrast to the first and second types of hotel, the third type of hotel is differentiated because it is neither a six-star hotel nor a guesthouse. In other words, it plays the role of the passive recipient of ready-made differentiation. However, customers who are looking for a hotel on Sun Moon Lake will be inevitably attracted by the six-star hotels and guesthouses. Consequently, the third type of hotel is ignored. Its revenue thus did not significantly improve even after it opened to everyone.

Case 2 The CS Restaurant in Taichung

The CS Restaurant is located on a famous food street in Taichung. The restaurant was founded before two years ago and has already closed its doors. The famous food street is next to a high school so students are the majority of customers. Therefore, although there are many restaurants there, more are opening. The street is a natural place for restaurants to compete.

At the start-up stage, the CS Restaurant attempted to stand apart from its rivals. Although differentiation was the dominant strategy to this restaurant, its differentiation strategy had the wrong emphasis. The CS Restaurant believed that if it offered many kinds of differentiations in foods or services, then it would dominate the market. At first, each of the three floors of the restaurant served a different cuisine. The first floor served teppanyaki, the second floor delivered served Japanese shabu, and the third floor offered Thai cuisine. The Thai cuisine was the only one that became popular. The first and second floors could not generate enough money to cover the restaurant's high overhead (employee salaries, rent, and utilities).

In order to improve its service, the CS Restaurant paid a lot of money to install an elevator. The owner considered the service is an important differentiation strategy in the highly competitive market. However, although customers enjoyed the convenience, the costly elevator was not a necessity for young and able-bodied students who were the restaurant's main customers.

Again, considering the targeted customers as high school students, the owner of the restaurant thought of ways to create more differentiations to attract more student customers and increase revenues of the first and second floors. Finally, it considered that installing a television could be a good way to gain and keep student customers. However, there was no improvement in revenue.

The restaurant laws in Taiwan prohibit restaurants from blowing kitchen exhaust outside. Therefore, restaurants had to re-modulate their exhaust fan apparatus. The CS Restaurant tried to meet this requirement. The owner of this restaurant even re-modulated exhaust fan apparatus so that the indoor air was better than that of its rivals. However, it was a basic requirement for customers. Further, adopting a different apparatus as one more differentiation strategy can not guarantee a growth in

revenue.

In sum, although the CS restaurant indeed had created many differentiations such as combining different cuisines in one restaurant, installing an elevator, providing TV shows, and even setting up an unusual exhaust fan apparatus, it ignored the importance of value-based differentiation exploitation. In other words, it enjoyed achievement of quantity of differentiation but suffered from low revenue. Finally, the restaurant closed down.

Case 3 TV program provider - Chunghwa Telecom

Chunghwa Telecom is the largest telecommunication company in Taiwan. It launched HiNet Internet Services on April 1, 1995. HiNet is the Taiwan's largest Internet Service Provider (ISP) and was voted as "Best ISP" and "Best ADSL (Asymmetric Digital Subscriber Line)" by both the consumers and information managers, in surveys conducted by Information and Computers Institute for Information Technology for five consecutive years. The number of ADSL customers has passed four million.

In 2005, Chunghwa Telecom entered the market of providing TV programs based on a digital set-top-box, Multimedia on Demand (MOD). MOD is installed on the basis of ADSL platform. The TV program service enables customers to freely choose their favorite TV contents any time. It also provides an interactive function such as fast forward and rewind. The differentiation the TV program provider created enables customers to watch what they want when they want. The unique differentiation is totally different from the cable TV provider because the cable TV subscribers can only watch TV programs that are broadcast at specific times.

Yet, the TV program provider with MOD still has a very low market share. Although the target customer number is one million for the TV program provider with MOD, the number of customer with MOD was 6,307 in 2005, 22,926 in 2006, and 43,974 in 2007. The growth is far below its market goal. Besides, it only provides 28 basic TV channels. In contrast, its rivals, the cable TV program providers (the five major cable TV providers in Taiwan), deliver more than one hundred TV channels and have more than four million customers in Taiwan. If customers switch to MOD, the opportunity cost is the loss of the programs broadcast by cable TV providers.

Although the TV program provider has a distinctive differentiation, multimedia on demand, its complicated pricing strategy increases switching cost of customers from cable TV program providers. The cost of subscribing to cable TV is between NT\$500~600 per month. Subscribing to MOD includes an installation fee of NT\$800 and a basic monthly fee of NT\$150 for only 28 channels. If customers need more program channels such as finance or entertainment, they must pay more fees of about NT\$200. In addition, customers also need to pay NT\$80 for every video program they selected. Moreover, customers must enter a password to watch a video that costs more than NT\$100. Customers are also restricted to watch a program in 24 hours and 72 hours with different fees.

In addition, the video programs provided by the TV program provider with MOD are often the older movies. In contrast, customers of the cable TV program providers do not need to have extra charge for older movies or any other programs. Even a DVD/VCD video rental company as Blockbuster providing the older movies only costs an average of NT\$60 per movie. If a customer rents three DVD movies, he or she just pays NT\$140.

In sum, the cable TV program providers have clear pricing strategies and a wealth of TV programs. However, the high uncertainty and complexity of payment for basic and extra TV programs increases switching cost of customers. In other words, if customers of the TV program provider with MOD want to enjoy the same number of TV programs, they have to pay much higher fees than customers of the cable TV program providers. Even they only choose only a few of TV programs; they cannot clearly tell if the payment is going to be higher or lower than the fee for watching the cable TV programs. Indeed, the innovative value-based differentiation of the TV program provider with MOD is unable to create outstanding growth and revenue in that customers cannot understand how high the switching cost will be. Therefore, the TV program provider with MOD needs to simplify its differentiation content (e.g. pricing strategy), and externalize its value-based differentiation to change customers' opinion.

DISCUSSION AND CONCLUSIONS

Understanding the effects of differentiation strategy on competitive advantage is very important to both the theory and practice of management. Much discussion has examined how differentiation strategy leads to superior performance (e.g. [4, 21]). However, little research has been undertaken into the explanations about why differentiation strategy fails. In this paper, we propose three failures of differentiation strategies in Table 1. We suggest three levels of pursuing successful differentiation strategy in Figure 1. On the basis of these, this study extends Porter's (1980) differentiation competitive strategy. That is, we suggest that a successful differentiation strategy process involves (1) creating differentiation; (2) exploiting value-based differentiation; and (3) simplifying and externalizing value-based differentiation.

Table 1 Three failed differentiation strategies

Firms	The role for differentiation activity	The shouldn't-have enjoyment in differentiation	The lack of differentiation activity
Type 1	The passive recipient of ready-made differentiation released from rivals	Enjoying surplus value of rivals' differentiations	Lack of differentiation creation
Type 2	The actor greedy for more differentiation exploitation	Enjoying achievement of quantity of differentiation	Lack of value-based differentiation exploitation
Type 3	The active deliverer of innovative	Enjoying achievement of consumer value-based differentiation	Lack of effective simplification and externalization of differentiation

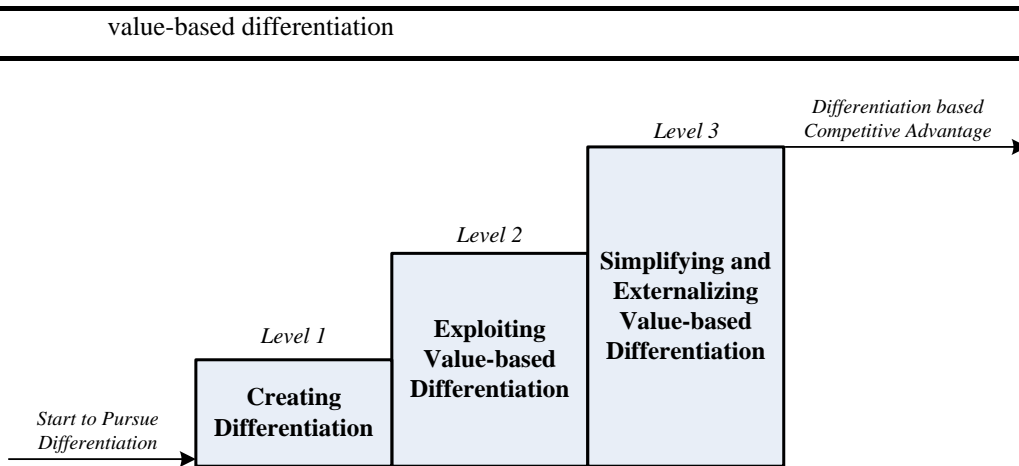


Figure 1 The three-level differentiation strategy

We propose three suggestions based on the three cases in this paper. First, creating differentiation establishes a competitive advantage. More importantly, a firm should be more than a passive receiver of ready-made differentiation. In other words, if competitors of a firm all have unique or evident differentiation in an industry, then the focal firm without actively creating differentiation will receive the remained differentiation from its competitors. Accordingly, the focal firm receives the surplus value of its rivals' differentiations. However, even though the differentiation has been shaped, the focal firm cannot secure a high competitive advantage in that consumers do not see the differentiation. In contrast, consumers would be easily attracted by the remarkable differentiations of other rivals. The firms with the failed differentiation strategies usually do not have a competitive advantage.

Second, exploiting value-based differentiation is the second level to establish a competitive advantage for firms. Some firms tend to struggle for more differentiation. In other words, they believe more differentiation means more satisfied customers. Accordingly, they think that quantity of differentiation such as creating value and gaining competitive advantage can be fulfilled. However, quality of differentiation is more important than quantity of differentiation. Firms must clearly realize what customers care about differentiation. If firms provide many differentiations that customers do not value, the differentiation strategy is likely to fail. Therefore, it is more important for firms to emphasize customer value-based differentiation. Firms like the failed restaurant often lack a competitive advantage.

Simplifying and externalizing value-based differentiation is the third level to establish competitive advantage. Indeed, some firms create innovative value-based differentiations. However, they still cannot secure substantial competitive advantages. This is because they only manage to achieve innovative differentiation without simplifying and externalizing differentiation. In other words, consumers cannot understand how the innovative value-based differentiation functions, such as the complicated pricing strategy of TV station. The complicated differentiation will be recognized as a high switching cost to consumers, so they will resist the differentiation. Indeed, it is imperative for firms to simplify and externalize the innovative value-based differentiation. Otherwise, the firms that have failed to adopt a differentiation strategy would be likely to have only a small competitive advantage.

This paper develops three mechanisms of a differentiation strategy. Future research could explore what other possible failed differentiation mechanisms in the process of implementing differentiation strategy in the service industries. Future research could also use a longitudinal study to explore how firms eliminate the possible failed mechanisms during the process of implementing differentiation strategy. Additionally, this study focuses on the implementation of differentiation strategy, while future studies may concentrate on the planning of differentiation strategy. Relying on the investigation of the planning process of differentiation strategy, firms may be able to avoid some failed differentiation strategies. On the basis of these findings, the differentiation strategy adopted in the service industry could be more complete. Furthermore, the service firms would benefit from more sophisticated differentiation strategies.

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