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Table of Contents

ISSN : 1539-1191

or Do Fewer Customers Buy More?
Hisashi Kurata

[16] A CASE STUDY ON THE CLOUD COMPUTING SERVICES IN KOREA
Jong Un Lee, Kyungjin Seo, Hee-Woong Kim

[17] Subordinates' Machiavellianism、Self-efficacy and Impression management tactics, effect on Organizational Citizenship Behavior：Supervisor Perspective
Hsu-Yao Chen, Shuang-Shii Chuang

[19] AN OPTIMAL SUBSIDY STRATEGY OF MANUFACTURER BY CONSIDERING DISTRIBUTOR PROVIDING REPAIRED SERVICE
Ruey-Shan Guo, Ming-Huang Chiang, Jia-Ying Chen, Yu-Han Huang

[20] APPLYING IPGA MODEL TO EXPLORE THE CRITICAL FACTOR FOR IMPROVING SERVICE QUALITY OF MOTEL INDUSTRY
Ching-Chan Cheng, Cheng-Ta Chen, Ya-Yuan Chang, Yu-Chun Hsueh

[21] A CLOUD COMPUTING TECHNOLOGY FORESIGHT STUDY WITH SCENARIO PLANNING APPROACH
Wei-Hsiu Weng, Woo-Tsong Lin

[24] GLOBAL SUPPLY CHAIN COORDINATION
Nasr-Eddine Dhel

[29] The Effects of Abusive Supervision on Organizational Citizenship Behavior: The Moderating Role of Future Orientation
Jih-Hua Yang, Ching-Ying Huang

[30] INVESTIGATING THE IMPACT OF DESIGN FACTOR ON GREEN SERVICE DELIVERY IN CUSTOMER'S PERSPECTIVE: AN EXPERIMENTAL DESIGN IN TAIWAN'S CONVENIENT STORE
Hua-Hung Weng, Chun-Jing Yang

[31] EFFECT OF LONG-TERM ORIENTED CULUTURE ON COMMUNICATION AND PROCESS EFFICIENCY IN SUPPLY CHAIN

Qingyu Zhang, Mei Cao

[34] LIMITED ATTENTION, ATTENTION ALLOCATION AND LIQUIDITY PROVISION
Wei-Ju Chen

[36] UNDERSTANDING ONLINE CUSTOMER REPURCHASE INTENTION: THE PERSPECTIVES OF EXPEXTATION-CONFIRMATION MODEL, TRUST, AND JUSTICE
Chun-Ming Chang, Chiahui Yen

[37] DEVELOPING A HIGHLY RELIABLE CAE ANALYSIS MODEL OF THE MECHANISMS THAT CAUSE BOLT LOOSENING IN AUTOMOBILES
Ken Hashimoto, Takehiro Onodera, Kakuro Amasaka

[39] THE BUSINESS VALUE OF ENTERPRISE RESOURCES PLANNING SYSTEM(ERP): A PRELIMINARY LITERATURE REVIEW
Qiang Zhou, Xiling Cui, Tien-Sheng Lee

[40] THE INFLUENCE OF PRODUCT LIFECYCLE ON THE DEMAND MANAGEMENT PROCESS IN SUPPLY CHAINS
Natalia Szozda, Artur Świerczek

[42] IMPACT OF SURFACE ACTING ON EMOTIONAL EXHAUSTION AND CUSTOMER-PERCEIVED SERVICE QUALITY: MODERATION OF SALES ORIENTATION
Hsiao-Ling Chen, Fong-Yi Lai

[43] ESTABLISHMENT OF ASTAFFALLOCATIONMETHODREFLECTING CUSTOMERINFORMATION
EXAMPLE OF SERVICES IN GUEST ROOMS AT JAPANESE-STYLE HOTEL
Daiki Okihara, Masahiro Nakamura, Kakuro Amasaka

[45] IDENTIFICATION OF HEALTHCARE CLOUD SERVICE DEMAND
Shu-Ping Lin, Chen-Lung Yang, Han-Chung Pi, Thao-Minh Ho

[46] AN INVENTORY MODEL FOR NON-INSTANTANEOUS DETERIORATING ITEMS WITH PRICE- AND STOCK-DEPENDENT SELLING RATE UNDER PARTIAL BACKLOGGING AND INFLATION

Kuo-Lung Hou, Yung-Fu Huang, Li-Chiao Lin

[48] SUPPLIER GOVERNANCE EFFECTIVENESS: MODERATION EFFECTS OF ECONOMIC DEVELOPMENT AND NATIONAL CULTURE
Chenlung Yang, Shuping Lin, Suyuan Lien, Chwen Sheu

[49]A CASE STUDY ON APPLICATION OF G-RD TO BUSINESS INTEGRATION AFTER M&A
Tetsu Saito, Koshichiro Mitsukuni

[50] UNDERSTANDING THE PRICING DECISIONS IN TAIWANESE METROPOLITAN BUSINESS HOTELS
Wei-Ting Hung, Jui-Kuo Shang, Fei-Ching Wang

[52] A STUDY OF CEO TRANSFORMATIONAL LEADERSHIP, ORGANIZATIONAL FACTORS AND PRODUCT INNOVATION PERFORMANCE: A THEORETICAL FRAMEWORK AND SCALE MEASUREMENT
Tharnpas Sattayaraksa, Sakun Boon-itt

[53] THE IMPACTS OF PROCESS RECOVERY COMMUNICATION ON CONSUMER BEHAVIORS
Ja-Shen Chen, Hua-Hung (Robin) Weng, Han-Ming (Henry) Tsai

[54] THE CONCEPTUAL FRAMEWORK TO DEVELOP COORDINATION MECHANISM ENHANCING SUSTAINABILITY IN SUPPLY CHAIN
Nattakarn Sahavacharin, Rawinkhan Srinon

[55] ALIGNMENT BETWEEN PERFORMANCE METRICS AND BUSINESS STRATEGY: DOES IT IMPACT ORGANIZATIONAL PERFORMANCE
Ravi Kathuria, Lorenzo Lucianetti

[56] A STUDY OF PLANE BOARDING STRATEGIES IN THE U.S. AIRLINE INDUSTRY
Ching-Chung Kuo, Jun Ma

[57] Determinants of the cross-region Health Care Utilization
Hsing-Wen Han

[58] THE RELATIONSHIP BETWEEN TIE STRENGTH, ABSORPTIVE CAPACITY, AND INNOVATION PERFORMANCE IN INNOVATION NETWORKS: EVIDENCE FROM CHINA
Xueyuan Liu, Wenjing Ding, Xiande Zhao

[59] EFFECT OF SUPPLY CHAIN INNOVATION COLLABORATION ON ORGANIZATIONAL PERFORMANCE: AN EMPIRICAL STUDY ON CHINESE MANUFACTURING FIRMS
Huma Kaleem, Liu Xueyuan

[60] COST SHARING DECISION FOR COMPLEX PRODUCT CO-DEVELOPMENT IN SUPPLY CHAIN
LAI ChaoAn

[61] Applying the Two Stages Least Square to Explore the Impact of Income on Health
Yen-Ju Lin

[62] APPLIED ANALYTICS IN MANUFACTURING: A CASE STUDY IN THE AUTOMOTIVE INDUSTRY
Jongsawas Chongwatpol

[64] REUSABLE LUGGAGE TAG FOR MOBILE TRACKING AND SUSTAINABILITY DEVELOPMENT
Eugene Y.C. Wong, Collin W.H. Wong

[66] Trilogy of Start-up, Being Mergence and Acquisition, Go into Bankruptcy: The Case of a Start-up High-tech Company Broken-hearted to Insolvency
Mei-Hsiu Tsai, Chun-An Li, Kun-Mei Pan

[67] EFFECTS OF INTELLECTUAL CAPITAL AND SUPPLY CHAIN LEARNING ON SUPPLY CHAIN RESPONSIVENESS: AN EMPIRICAL STUDY IN CHINA
Xiande Zhao, Shanshan Zhang, Zhiqiang Wang, Waiman Cheung

[68] IDENTITY FRAUD: EMPOWERING INDIVIDUALS
Judy Watson, Don Kerr, David Lacey

[69] DETERMINANTS OF SUCCESSFUL CORPORATE ENTREPRENEURSHIP: THE ROLE

OF AUTONOMY, PROCEDURAL JUSTICE AND HARMONIOUS PASSION - THE CASE OF GOOGLE –
Dae Soon Hong, Jung Hoon Lee, Dong Ug Seo

[70] FACTOR ANALYSIS OF THE MOTIVATION ON CROWDFUNDING PARTICIPANTS: AN EMPIRICAL STUDY OF FUNDER CENTERED REWARD TYPE PLATFORM
Chae Rin, Lee, Jung Hoon, Lee, In Sook, Jeon

[71] CASE STUDY ON CORPORATE ENTREPRENEURSHIP PROGRAM FOR INNOVATION: WITH FOCUSING ON THE IN-COMPANY VENTURE SYSTEM AT KOREAN COMPANIES
Jung Beob Geun, Jung Hoon Lee, Hye Won Lee

[72] PATENT ANALYSIS OF THE ORCHID INDUSTRY IN TAIWAN
Jin-Kwan Lin

[73] A STUDY ON THE DEFINITION OF SMART CITY
Jung-hoon Lee, Beob-geun Jeong, Da-som Kim

[74] How country of origin affects purchasing intention: the case of mobile phone in Taiwan
Qi□Run Qin, Chun□Hsun Chen, Yuh□Yuan Tsai

[77] TAX CLIENTELE EFFECT IN MAINLAND CHINAESE STOCK MARKET
Xia Pan, Qiang Zhou, Grace Meina Lee, Yi Jiang

[78] Innovative Supply Chain Technologies for Management Decisions
Galia Novakova, Kamen Spassov, Shahram Taj

[80] A FRAMEWORK FOR INTELLIGENT MIND MAPPING USING COLLABORATIVE FILTERING
Su-Yeon Kim, Sang Hoon Lee

[82] RETAILER SERVICE QUALITY, CUSTOMER SATISFACTION AND CUSTOMER LOYALTY: EMPIRICAL EVIDENCE IN VIETNAM
Phan Chi Anh, Nguyen Thu Ha, Nguyen Hue Minh, Yoshiki Matsui

[83] RELATIONSHIP BETWEEN SERVICE QUALITY AND CUSTOMER SATISFACTION ON

ATM SERVICE: CASE STUDY OF A PRIVATE COMMERCIAL JOINT STOCK BANK IN VIETNAM
Nham Phong Tuan

[87] CHINESE PEOPLE'S PERCEPTIONS OF TELEWORK
Huanjie Luo, Motonari Tanabu

[88] SUPPLY CHAIN RETURN AND RISK MANAGEMENT - A DELPHI STUDY AND AN INTEGRATED OPTIMIZATION MODEL
Wong Wai Hung,

[89] CATEGORIZATION OF SUPPLY CHAINRISK FACTORS IN HEALTHCARE SERVICE OPERATIONS: APPLICATION OF Q-SORT METHOD
Poomporn. Thamsatitdej, Tritos. Laosirihongthong

[93] ROLE OF SUPPLY CHAIN NETWORK FINANCING IN ENHANCING SME OPERATIONS: A TRIANGULATION STUDY IN A CHINESE CONTEXT
Hua Song, Kangkang Yu, Samir Ranjan Chatterjee

[115] CLUSTERING CORPORATE BRANDS BASED ON SOCIAL METRICS: A CASE STUDY OF THE AUTOMOBILE INDUSTRY
Hyun-Seok Hwang, Do-Jin Kim, Young-Ju Bang

[121] Composite Forecasts Accuracy for Automobile Sales in Thailand
Watchareephorn Chaimongkol

[130] Patient Cost-Sharing and Healthcare Utilization in Early Childhood: Evidence from a Regression Discontinuity Design
Hsing-Wen Han, Hsien-Ming Lien, Tzu-Ting Yang

SHAPING RADICAL AND INCREMENTAL SERVICE INNOVATIONS THROUGH ORGANIZATIONAL AGILITY: INSIGHTS ON IT CAPABILITY AND ORGANIZATIONAL LEARNING

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ABSTRACT
Service innovations are central concerns for contemporary firms to obtain sustained competitive advantages in current fast changing markets and innovative customer demandingness. Due to the importance of customers in new product (service) innovation and service operations, a conceptualization of organizational agility is increasing required and emphasized. It behooves businesses to execute innovations and competitive moves with speed, surprise, and competitive disruption has attracted significant attention as a business capability for competing effectively in the current business environments. Further, radical and incremental service innovations have become increasingly more challenging, driving managers to employ different technological resources and organization structures to enhance organizational agility and to attain superior innovation practices that can differentiate from competitors. Therefore, how to utilize IT capability and organizational learning to build organizational agility and how to enhance radical and incremental service innovations via entrepreneurial alertness are strategies to meet this challenge of the organizational agility.

Keywords: IT capability, organizational learning, agility, service innovation, entrepreneurial alertness

RESEARCH BACKGROUND

As competitive pressures intensify and product life cycles shorten, *service innovation* is becoming increasingly important as an emerging paradigm. Companies are searching for ways to develop service innovation to meet specific customer needs in a cost-efficient way. Past service innovation research has addressed topics such as the new service development (NSD) process (Kindström and Kowalkowski, 2009; Song et al., 2009; Zomerdijk and Voss, 2011), service innovation success (de Brentani, 1991), customer involvement (Edvardsson et al., 2011; Magnusson et al., 2003), service innovation typologies (e.g., Berry et al., 2006; Paswan et al., 2009), market orientation (Cheng and Krumwiede, 2012; Jiménez-Zarco et al., 2011), capability development (Den Hertog et al., 2010; Fischer et al., 2010), learning (Stevens and Dimitriadis, 2004), organizational adaptation (Neu and Brown, 2008), culture (Gebauer and Friedli, 2005), and collaboration (Chen et al., 2011; Michel et al., 2008).

However, the existing literature offers little insight on the development or implementation of

these solutions, which many companies have found difficult to apply. An increasing amount of anecdotal evidence indicates the urgent need to advance the existing literature by exploring the antecedents of service innovation. To this end, our study focuses on investigating how firms develop resources and capabilities associated with business processes in pursuit of service innovation. Therefore, we need to look for a capability within organizations that is constantly scanning for signals of potential customer responses and that is able to deploy service innovations to help solve customer problems. Thus, we are seeking to develop and maintain agility.

Organizational agility, or the ability to execute innovations and competitive moves with speed, surprise, and competitive disruption, has attracted significant attention as a business capability for competing effectively in current business environments (Sambamurthy et al., 2003). Agile firms are resilient to shocks and upheavals in their business environments, adaptive to emerging opportunities, and entrepreneurial in creating new business models or making significant competitive moves (Bharadwaj and Sambamurthy 2005). Therefore, with the recent surge in environmental turbulence, increased competition, volatile consumer demand, and rapid product obsolescence, firms are also increasingly concerned about their agility, that is, the ability to sense and respond to opportunities and threats with ease, speed, and dexterity (D'Aveni, 1994; Goldman et al., 1995).

Information technology (IT) plays an important role in the agile organization by increasing the organization's ability to sense and respond (Overby et al., 2006). Firms invest substantial sums of money in IT with the hope of increasing efficiency, effectiveness, productivity, and profits (Banker et al., 2006; Davamanirajan et al., 2006; Mukhopadhyay and Kekre, 2002; Oh and Pinsonneault, 2007). An organization's IT capability should be sufficiently advanced to sense opportunities that are brought about by changing technologies. In addition, there is a growing consensus that organizations must become more effective learners if they are to contend with powerful external and internal forces. In particular, these environmental forces are thrusting many manufacturers toward greater "agility", with attendant increases in product and service diversity and accelerating product and service innovation (Pine, 1993). Our approach examining how *IT capability* and *organizational learning* impact service innovation via organizational agility is consistent with the research of Brynjolfsson et al. (2000), who studied IT, organizational transformation, and business performance. This approach suggests complementarity between the factors of organizational structure and IT, indicating that service innovation is greatest if both IT and organizational structure are emphasized. We consider organizational learning as a type of organizational structure (Cohen, 1991) and a crucial factor that affects service innovation. Although there is evidence indicating a positive relationship between learning and service innovation (e.g., Stevens and Dimitriadis, 2004; Blazevic and Lievens, 2004), specific analyses on the relationship between organizational learning and service innovation are still relatively rare.

In this respect, we argue that IT capability and organizational learning support organizational agility; therefore, the impact of these two factors on service innovation should be assessed, with an expectation of an organizational agility effect. In addition, we examine the relationships between IT capability and organizational learning. Our research is based on Brynjolfsson et al.'s (2000) suggestion and was motivated by a desire to demonstrate from a contingency perspective how IT capability (i.e., IT factor) and organizational learning (i.e.,

organizational factor) enable organizational agility to yield gains in service innovation. This study expects to contribute to the service innovation literature. We integrate insights from contingency theory and organizational agility research to build a better understanding of how to develop service innovation. As a result, we complement the agility view of service innovation, which by and large focuses on the agility side of service innovation (Agarwal and Selen, 2009), by demonstrating the role of organizational agility in cultivating service innovation.

Given the growth and role of entrepreneurship today, it is becoming increasingly important to understand how new entrepreneurial opportunities are developed. The emergence of new ideas and understanding how these ideas can lead to commercializable opportunities are central to the field of entrepreneurship (Short et al., 2010). Alertness is a concept that has the potential to add substantially to our understanding of how new ideas (or innovation actions) are initiated and pursued. Firms act creatively when they introduce new products or services to enhance profits, competitive advantage, and industry position (Schumpeter, 1934). There are three implicit organizational characteristics that influence competitive action (Chen, 1996). These characteristics include (1) awareness of the context and potential opportunities for innovation, (2) motivation of the firm to take action, and (3) the firm's ability to take action. These concepts often work together. For example, a firm that is aware of and able to respond to an opportunity is more likely to execute a competitive action than a firm that is unaware and unable to take action. The alertness component is related to the aspect of judgment that focuses on evaluating the new changes, shifts, and information and on deciding if these changes would reflect a business opportunity with profit potential. Thus, entrepreneurial alertness indicates how well a firm senses and responds to market opportunities for innovation and competitive action (Sambamurthy et al., 2003). Following these findings, entrepreneurial alertness appears to have recognizable empirical analogs in processes of decision-making, evaluation, assessment, environmental recognition, and the like. Therefore, we incorporate *entrepreneurial alertness* as our moderating role of interest.

Figure 1 presents our theoretical model, which shows relationships that exist among IT capability, organizational learning, and service innovation. Furthermore, we indicate the mediating effects of organizational agility between IT capability, organizational learning, and service innovation as well as the moderating effect of entrepreneurial alertness on the relationship between organizational agility and service innovation. This paper aims to contribute to research by studying how to achieve service innovation by IT capability and organizational learning through organizational agility. In doing so, we address four specific questions. 1. Whether and how do IT capability and organizational learning impact organizational agility? 2. Whether and how does organizational agility impact service innovation? 3. Whether and how does entrepreneurial alertness moderate the relationship between organizational agility and service innovation? and 4. Whether and how does organizational agility mediate the relationship between IT capability, organizational learning, and service innovation? In the following sections, we choose contingency theory to support IT capability, organizational learning, organizational agility, and service innovation and use strategic innovation theory to support entrepreneurial alertness. Subsequently, we introduce research hypotheses to specific relationships between these constructs.

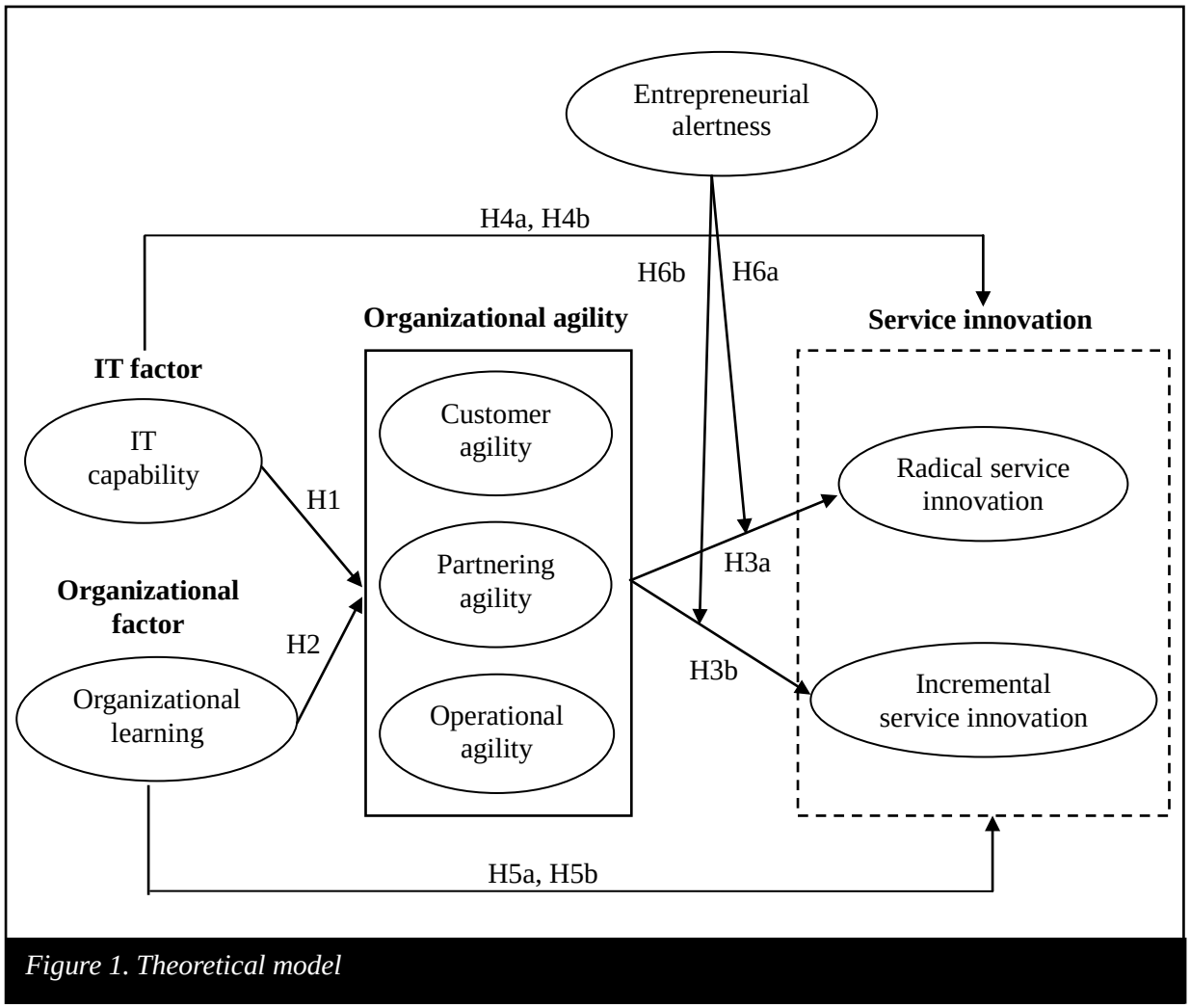

Figure 1. Theoretical model

THEORETICAL FOUNDATIONS

Strategic innovation theory

More recently, globalization has brought new markets, nontraditional competitors and new sources of uncertainty, causing many firms to decide to attain superior performance through innovative strategies and practices. This challenging environment affects emerging and incumbent companies in manufacturing and services. These firms have to find innovative ways to make space for themselves in markets that are already crowded with very capable firms. Viewed from their own perspective, firms are finding new ways to "complement" the strategies of incumbents, such as offering contract services, licensing new technologies, and forming joint ventures and strategic alliances. However, firms with new collaborative practices do not always produce successful products and services. As a result, these firms have to serve (new) customers with new products or services through innovative strategies.

Strategic innovation is "the strategy of breaking the rules" (Markides, 1997) and is more entrepreneurial; it also involves a fundamental or radical reconceptualization of the business

(Markides, 1998). Strategic innovation often leads to dramatically different ways of competing and creating wealth and can encompass product, process, and administrative innovations (Wright et al., 2001). A strategic innovation is a creative and significant departure from historical practice in at least one of three areas: (1) value chain design (e.g., Dell's direct sales model); (2) conceptualization of delivered customer value (exemplified by IBM's shift from selling hardware and software to selling complete solutions); and (3) identification of potential customers (e.g., Canon's pioneering focus on developing photocopiers for small offices rather than large corporations) (Govindarajan and Trimble, 2004). Therefore, any company in an industry needs to identify (1) new, emerging customer segments or existing customer segments that other competitors have neglected; (2) new, emerging customer needs or existing customer needs not served well by other competitors; and (3) new ways of producing, delivering, or distributing existing or new products or services to existing or new customer segments (Markides, 1997). As a result, strategic innovators can identify new products and services to offer before existing customers even think of them (Peters, 1990). Consequently, we refer to the concept of applying strategic innovation to support entrepreneurial alertness.

Furthermore, Jacobs and Heracleous (2005) provided an analytical framework to enhance understanding of the emergent processes of strategic innovation. The authors considered strategic innovation in two approaches: (1) evolutionary, market-driven strategic innovation relates to the introduction of new products and services within an existing strategic paradigm and business model (e.g., P&G and Unilever); (2) revolutionary strategic innovation, in contrast, involves offering a radically improved value proposition to the market and a substantive shift in the strategy paradigm and business model of the firm (e.g., IKEA, Dell, and Amazon).

It must be clear that the focus of strategic innovation is on the reconceptualization of the industry/business model to create fundamentally new services/products and superior customer value. Further, regarding the relationship between strategic innovation and service innovation, strategic innovation emphasizes that a firm’s strategy is the important determinant of innovation practices (Matthyssens et al., 2006). Given the results of Sundbo’s (1997) research, Sundbo indicated that innovation in service firms is a strategically determined process and concluded that of the several paradigms within traditional innovation theory, the strategic innovation theory is the most adequate theory in explaining service innovations. However, empirical research on using strategic innovation to explain service innovation is still relatively rare. Consequently, we refer to the concept of applying strategic innovation to support service innovation, helping people in the academic and industrial circles to get a better idea about it.

Contingency theory

Contingency theory has been used in many contexts, particularly in the field of strategic actions and organizational structure (e.g., Galbraith, 1973). This theory also examines related variables’ (such as strategy and business model) contingent effects on firm performance (Zott and Amit, 2008). Based on the arguments of de Luca and Atuahene-Gima (2007), we note a fundamental strand of contingency theory (Drazin and Van de Ven, 1985): the “fit-as-mediation” view (Venkatraman, 1989), which posits that managers choose or adopt organizational structures, processes, and strategies that reflect the particular circumstances of their organizations (Galbraith, 1973). In this study, we seek to enrich the debate on the

relationship between strategy and structure by focusing on corporate strategic behaviors (i.e., IT capability building and organizational learning) and on a structural construct that captures the firm's organizational innovation practices, namely, the firm's service innovation. Therefore, according to the "mediation" view, when faced with keen competition, one of an organization's predominant approaches is to pursue aggressive innovation practices through IT capability and organizational learning. However, drawing on the above discussion, we concentrate on the salient aspect of a firm's intermediate-level contribution, namely, agility that accounts for the effects of corporate strategic behaviors on innovation practices. Thus, following contingency theory, agility is the way to mediate the link between IT capability, organizational learning, and service innovation.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

IT capability

Extending prior research, we conceptualize IT capability as a latent construct reflected in four dimensions: IT infrastructure capability, IT business experience, IT relationship resources, and IT human resources. *IT infrastructure capability* is a firm's ability to provide the foundation to deliver business applications and services, share information across different functions, and respond to changes in business strategy. Keen (1991) defined IT infrastructure in terms of its "reach" and "range." Whereas reach determines the locations a platform can access and to which it can link (i.e., hardware), range defines the type of information that can be seamlessly and automatically shared across systems and services (i.e., software). Thus, two types of IT infrastructure that are especially relevant for building IT capability are hard and soft infrastructure, referring to the set of general hardware and software (Bharadwaj, 2000; Ross et al., 1996; Weill and Broadbent, 1998).

IT business experience is a firm's ability to integrate IT strategy and business strategy (Sambamurthy and Zmud, 1997). When a firm solves problems through IT, it facilitates the development of IT knowledge and competence of the IT staff. In addition, we adopted Bhatt and Grover's (2005) conceptualization of business experience and extended it to include IT staff's understanding of business. That is, IT staff with higher technical skills and superior knowledge in business operations and strategies would have a better understanding of business advantages.

IT relationship resources are the firm's ability to incorporate IT functions into business units and exploit IT resources. The stronger the relationship between IT and business unit management, the more effective those IT resources will be. Karimi et al. (2007) indicated that relationship resources facilitate the free flow of information, allowing the firm to transform and exploit information; a cooperative IT–business relationship, in turn, enables knowledge or information dissemination throughout the organization. In addition, IT leads to the decentralization of organizational decision making (Malone, 1997) and supports employees with greater responsibilities and empowered roles (Psoinos et al., 2000). In the context of building IT capability, knowledge dissemination and trust building require building relationship resources, which can be accomplished by IT groups' and business units' involvement in implementation (Karimi et al., 2007).

IT human resources are a key component of the IT asset base and represent a strategic

organizational resource and a significant organizational capability. To identify the key dimensions of IT human resources, this study includes two critical dimensions based on Grant's (1991) classification scheme, namely, technical IT skills (e.g., competencies in emerging technologies) and managerial IT skills (e.g., the effective management of IS functions). This categorization is commonly used when measuring IT human resources from the resource based view (RBV) perspective (e.g., Bharadwaj, 2000; Ross et al., 1996). More specifically, we focused these resources on the ability of IT staff to use (new) IT (Ross et al., 1996). Firms with these capabilities can enable organizational changes and achieve greater organizational effectiveness (Roepke, 2000). In this definition, IT capability is the higher-level general construct with four underlying dimensions. IT capability thus reflects the extent to which a firm is good at managing its IT resources to support and enhance business strategies and processes. IT capability captures the commonality shared by all four dimensions. A firm with superior IT capability, for example, should be expected to exhibit to a great extent each of the four IT capability dimensions.

Organizational learning

Organizational learning is the continuous testing of experience and the transformation of that experience into knowledge – accessible to the whole organization and relevant to the organization's core purpose (Senge et al., 1994). Learning is regarded as an important process enabling a firm to perform better on tasks and to quicker identify new production opportunities (Teece et al., 1997). Kessler et al. (2000) and Schroeder et al. (2002) distinguish two types of organizational learning processes: internal learning and external learning. *Internal learning* encompasses the training of multifunctional employees and the incorporating of employee suggestions into process and product development (Schroeder et al., 2002). *External learning* starts with the identification of a new idea by an outside source (Kessler et al., 2000), and it is defined as interorganizational learning through problem solving with customers and suppliers (Schroeder et al., 2002).

Organizational agility

Agility is defined as a firm's ability to interact well with customers, properly leverage the resource, and effectively integrate operational processes (Sambamurthy et al., 2003). Agility contains two elements: exploration and exploitation of opportunities in an uncertain environment for profiting (March, 1991). Exploration is an organizational examination of new alternatives and an acquirement of information on currently unknown opportunities for competition. Exploitation is the use of already existing resources through improvements and extensions of competencies, technologies, and knowledge. Furthermore, Sharifi and Zhang (2001) extract two major factors from agility: (1) responding to anticipated and unexpected changes in a reasonable time and (2) exploiting and taking advantage of changes as opportunities.

This study is based on the research of Sambamurthy et al. (2003); we indicate that agility encompasses three interrelated capabilities: customer agility, partnering agility, and operational agility. *Customer agility* is the collaboration with customers in exploring and exploiting opportunities for innovation and competitive action moves. *Partnering agility* is the ability to leverage the resources of supply members through alliances, partnerships, and joint ventures. Partnering agility enables firms to build a network of strategic, extended, or virtual partnerships to explore opportunities for innovation and competitive action.

Operational agility is the ability enabling firms' business processes to reach efficiency and effectiveness in the exploitation of opportunities for innovation and competitive actions.

Firms must have an adequate level of IT capability to be able to anticipate changes relevant to their business that are brought about specifically by advances in IT. Firms that exploited the opportunities created by emerging technologies such as interactive HTML pages and secure sockets layer protocols were able to implement electronic commerce strategies before many of their competitors (Kalakota and Robinson, 2001). In addition, IT capability is important for firms who rely on IT to support customer and supplier channels (Bharadwaj, 2000). The changing dynamics of customer and supplier relationships often require frequent modifications and enhancements to supporting information systems. As such, Sambamurthy et al. (2003) argue that IT management capabilities provide a platform for firms to develop the appropriate digitized processes and knowledge systems that enhance their agility. We propose that a firm with superior IT capability would be able to constantly scan and process changing environmental signals, monitor internal information, make fast innovative decisions, quickly adjust internal processes, and, consequently, realize greater organizational agility. Hence, we present the following hypothesis:

H1: Firms with a higher degree of IT capability will have better organizational agility.

In a dynamic environment, organizational learning is valuable to a firm and its customers because it is assumed to support the understanding and satisfying of customers' expressed and latent needs through new products, services, and ways of doing business (Day, l994; Sinkula, 1994). Organizational learning not only helps to create products ahead of competitors but also before the recognition of an explicit customer need (Hamel and Prahalad, 1991; Slater, 2001). According to Senge (1990), ‘the rate at which organizations learn may become the only sustainable source of competitive advantage’. A firm's ability to acquire and maintain a sustainable competitive advantage is based on the firm’s capability to create organizational knowledge, along with strategic flexibility (e.g., Garud and Kumaraswamy, 1995; Hayes et al., 1988; Sanchez, 1995). Thus, organizational learning can translate into business agility (Hult et al., 2000). We propose that the importance of capturing knowledge and learning from experience is recognized as a vitally important facet of an agile company. Therefore, to efficiently respond to changing environments, an agile firm should be a learning organization (Gunasekaran and Yusuf, 2002). We present the following hypothesis:

H2: Firms with a higher degree of organizational learning will have better agility.

Service innovation

Service innovation can be regarded as the development of new processes for the delivery of core products and services (Oke, 2007) involving interaction with partners (Agarwal and Selen, 2009; Eisingerich et al., 2009) with the objective of improving existing services (incremental innovation), creating new value propositions (offerings), or creating new service systems (radical innovation) (Wooder and Baker, 2012). Thus, the degree of service innovation ranges from a service involving a minor adaptation or improvement of incremental nature to a completely new or discontinuous innovation (Avlonitis et al., 2001). In the service innovation literature, an ongoing debate concerns the extent to which radical and incremental innovations are meaningfully separable aspects of innovativeness (e.g., Avlonitis et al., 2001;

de Brentani, 2001; Menor et al., 2002). Because this study is concerned with the greatest and least degree of service innovation, we differentiated service innovation into incremental and radical service innovation. Such a differentiation has been frequently used in similar service innovation research (Avlonitis et al., 2001; Cheng and Krumwiede, 2012; Garcia and Calantone, 2002; Olsen and Sallis, 2006; Paswan et al., 2009).

Incremental service innovation is related to customer-led strategies that focus on manifest needs (Connor, 1999; Slater and Narver, 1999) and is posited to be the most common form of innovation (Bell et al., 2002; Slater and Narver, 1998, 1999). Incremental service innovation is oriented toward improving the features and functionality of existing products and services. In addition, the development of incremental service innovation tends to limit the range of potential service innovations because it relies on customers' current view of the service market (Becheikh et al., 2006). In contrast, *radical service innovation* is defined as fundamental changes in new services that represent revolutionary changes in service benefits (Berry et al., 2006; Nijssen et al., 2005). Radical service innovation is oriented toward creating wholly new products and/or services. In sum, incremental service innovation describes a new service that entails improvements, extensions, or adaptations to a currently available service product, whereas radical service innovation refers to a "truly novel" service product that is very different from industry norms.

Our understanding of the relationship between organizational agility and service innovation is limited. Agility is the ability to detect opportunities for innovation and seize those competitive market opportunities by assembling requisite assets, knowledge, and relationships with speed and surprise (D'Aveni, 1994; Goldman et al., 1995). Agility within an organization is the collective ability to adapt rapidly, be cost efficient, and overall, to operate as economically as possible in response to customer needs and changes in the competitive business environment. Therefore, agile firms are able to adapt to and perform well in rapidly changing environments by capitalizing on opportunities for innovation and competitive action, such as launching new products and services (Brown and Eisenhardt, 1997). Hence, we present the following hypotheses:

H3: Firms with a higher degree of organizational agility will have better a) radical service innovation; b) incremental service innovation.

The mediating role of organizational agility

The preceding hypotheses link the relationships among IT capability, organizational learning, organizational agility, and radical/incremental service innovation. These hypotheses suggest that IT capability and organizational learning affect radical/incremental service innovation through organizational agility. That is, firms can use IT resources and capabilities and external/internal learning strategies to cultivate a certain level of capacity in customer agility, partner agility, and operational agility, which in turn will foster firm's radical/incremental service innovation practices. Thus, we argue that organizational agility plays a mediating role in the relationships between the independent variables of IT capability and organizational learning and the dependent variables of radical and incremental service innovation. Therefore, by combining the arguments this study made when discussing H1 and H2 with the arguments for H3a and H3b, this study can also make predictions regarding the mediating effect of organizational agility between IT capability, organizational learning and radical/incremental

service innovation. Hence, we present the following hypotheses:

H4: Organizational agility mediates the influence of IT capability on a) radical service innovation; b) incremental service innovation.

H5: Organizational agility mediates the influence of organizational learning on a) radical service innovation; b) incremental service innovation.

The moderating role of entrepreneurial alertness

Underpinning the logic of opportunity and innovation, entrepreneurial skills are likely to help front-of-house staff maintain customer satisfaction and provide operations staff with a higher-order ability to explore and exploit options when subjected to varying customer needs, thus arming them with an ability to spontaneously deliver customized solutions to customers. Kirzner (1979) developed the term "entrepreneurial alertness" as the ability to see where products (or services) do not exist or have unexpectedly emerged as valuable. Alertness exists if one individual has an insight into the value of a given resource when others do not. From this perspective, entrepreneurial alertness refers to "flashes of superior insight" that enable one to recognize an opportunity when it presents itself (Kirzner, 1997). Entrepreneurial alertness is the capability of a firm to explore its marketplace, detect areas of market place ignorance, and determine opportunities for action (Sambamurthy et al., 2003).

Although agility is an important business capability, entrepreneurial alertness is essential for the activation of continuous innovation. Innovation has been defined as the process of identifying and utilizing opportunities to create new products, services, or work practices (Van de Ven, 1986). Alert entrepreneurs are likely to discover something new and to increase innovations of their firms. Researchers have long recognized that some ventures offer products or services that are truly novel (i.e., radical innovation) and that represent new and different combinations of resources (Schumpeter, 1934), whereas other new ventures provide products or services that are mere imitations of existing offerings or that are reproduced with incremental variations (Kirzner, 1973). Given our conceptualization of alertness, we expect alertness to be significantly related to firms' innovation actions. This assumption is consistent with Kirzner (1973, 1997) who believed that entrepreneurs have a natural alertness to signals on possible opportunities; Kirzner described entrepreneurs as being at all times spontaneously on the lookout for hitherto unnoticed features in the environment (present or future) that might inspire new activity. Hence, we present the following hypotheses:

H6a: Organizational agility augments entrepreneurial alertness, and the two jointly have a positive impact on radical service innovation.

H6b: Organizational agility augments entrepreneurial alertness, and the two jointly have a positive impact on incremental service innovation.

DISCUSSION AND CONCLUSIONS

IS research provides significant insights into how IT affects firm agility (Overby et al., 2006, Sambamurthy et al., 2003; Tallon and Pinsonneault, 2011). We now need to understand how IT capability (such as IT infrastructure capability, IT business experience, IT relationship resources, and IT human resources) and organizational learning affect the two types of service

innovation: radical and incremental. It is also important to better understand the role of mediating variables, such as organizational agility. This paper extends literature on the topic by analyzing how two key factors of business resources, IT capability and organizational learning, affect the two practices of service innovation (radical, incremental). We also examined how the organizational agility variable mediates the business resource-service innovation relationships. Further, we were able to explain how entrepreneurial alertness affects the relationships among organizational agility and service innovations of the firm.

Contributions to research

This proposal makes four primary theoretical contributions. First, it contributes to the theoretical development of a conceptual model for explaining the relationships among IT capability, organizational learning, organizational agility, entrepreneurial alertness, and service innovation. Despite the increasing importance of IT capability, organizational learning, and service innovation, few studies in the literature have discussed these relationships, and this deficiency is serious because of the increasing importance of organizational agility. Accordingly, from the "fit-as-mediation" view, this study develops a conceptual model and hypotheses to indicate the mediating role of organizational agility between IT capability, organizational learning, and service innovation. We propose that organizational agility is a critical mediator through which IT capability and organizational learning positively affect service innovation. However, for organizational agility to succeed, they still must be addressed because they are foundational.

Second, our research highlights an integrated perspective to link IT capability, organizational learning, organizational agility, entrepreneurial alertness, and service innovation. In particular, we highlighted two service innovation dimensions, namely, radical and incremental service innovation. We propose that service innovation is important because it visualizes how firms continually develop their IT capabilities and focus on their organizational learning processes to shape their agility strategy. Furthermore, service innovation captures the interactions among organizational agility and entrepreneurial alertness in shaping competitive advantage. Attention to the radical and incremental service innovation in our model will be important for researchers.

Third, our conceptualizations of organizational agility illustrate the complementarity between entrepreneurial alertness and radical/incremental service innovation. We argue that organizational agility (i.e., customer agility, partner agility, and operational agility) is the key enabler for service innovation. Our research model suggests that achieving radical and incremental service innovation will require attention to entrepreneurial alertness. In addition, researchers should examine the nature of organizational designs, governance structures, and managerial skills that will foster such innovation practices and facilitate the development of customer agility, partner agility, and operational agility described in our model. Fourth, the framework developed in this study also provides a starting point for empirical research on organizational agility and can be used for developing testable research hypotheses. Thus, research should empirically determine the relative importance of each of the various preconditions or of the various drivers that induce firms to engage in organizational agility. In sum, organizational agility is recognized as the method of choice for generating service innovation to improve a firm's competitive advantage.

Contributions to practices

This proposal has five practical managerial implications. First, firms need to consider the effective integration of organizations, people, and technology with flexible organizational structures supporting highly skilled, knowledgeable and motivated people (Goldman and Nagel, 1993; Gunasekaran, 1999). Consequently, firms may quickly respond to unanticipated demand changes with customer value-based products/services in a competitive environment (Dove et al., 1991). In addition, we suggest that if firms consider a synthesis of existing technologies and methods of integrating production systems, they may be able to sense changes, organize capital, knowledge, and relations, meet changing customer needs in a timely manner, and convert market change challenges into opportunities (D'Aveni, 1994; Goldman et al., 1995).

Second, an understanding of the key organizational agility affecting radical and incremental service innovation will put practitioners in a better position to develop appropriate innovation strategies for resource deployment and, consequently, enhance a firm's innovation practices. Firms need to continue to emphasize organizational agility to sense and respond to customers' need. Firms should pull more technological and business resources into related programs and campaigns and foster closer relationships with customers to identify market opportunities accordingly. Third, IT plays a critical role in the implementation of agility practices. Given the different dimensions of IT capability, such as IT infrastructure capability, IT business experience, IT relationship resources, and IT human resources, it is imperative for top management to carefully consider the role of IT managers in agility initiatives. Before beginning major agility programs, managers may want to consider implementing managerial mechanisms that will improve IT capability. Similarly, IT managers are often faced with supporting organizational agility programs, and having a managerial mechanism in place can guide them in adopting guidelines and managerial postures that will ensure successful IT capability.

Fourth, managers need to actively manage their firm's human capital through a variety of organizational learning practices to stimulate the firm's capability in managing agile production. Furthermore, a better level of organizational agility can stimulate proactive and responsive customer orientation that may eventually lead to better radical and incremental service innovation. To facilitate the link of organizational learning and favorable service innovation, managers first need to recognize the importance of organizational agility. Then, they should utilize external and internal learning to cultivate a better level of customer agility, partnering agility, and operational agility, which, in turn, will result in facilitating service innovation.

Fifth, managers would be advised to think carefully about entrepreneurial alertness, innovation, and judgment, even within the context of existing practices, products, and business units. Uncertainty and novelty are hardly the domain of a few industries or business practices but are ubiquitous in an advanced industrial economy. Managers must consider the core questions of strategic positioning, organizational design, and contracting that are central to processes of creating and capturing economic value. In conclusion, we want to examine the relationships among IT capability, organizational learning, organizational agility, entrepreneurial alertness, and service innovation. In the future, we hope that our empirical evidence could support a contingency view and indicate that IT capability and organizational

learning can facilitate radical and incremental service innovation, primarily through improving organizational agility.

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A novel approach to fulfill customer-driven product positioning and product recommendation for smart phones and wearable devices

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Abstract

In recent years, the market shares of mobile-phone suppliers have dramatically fluctuated, especially when wireless technology was rapidly shifting from the second to the third generation. To avoid market saturation in smart phones, global companies start to develop wearable devices like smart watches or smart glasses because these wearable devices have been recognized as next-generation star products. In order to better understand the strengths and weaknesses of smart alternatives (i.e. phones, watches, and glasses), this paper presents a novel framework to help product planners accomplish product positioning and product recommendation. For conducting product positioning, correspondence analysis (CA) is applied to customer perceptions to visualize which features best characterize different smart alternatives. Then, analytical hierarchy process (AHP) is employed to elicit customers' prior information (initial preferences for smart alternatives). Finally, by means of Naïve Bayes classifier (NBC), product recommendation is accomplished in an unsupervised way. Experimental results justify the validity of the proposed framework, particularly in tackling a scenario in which customer purchase records are lacking in new products.

Keywords: product positioning, product recommendation, smart phones, wearable devices.

1. Introduction

In an extremely turbulent business environment, product positioning and product recommendation are two important business strategies to enhance customer retention and customer acquisition. Today, owing to dynamically changing customer desires coupled with rapid technology evolution, mapping customer needs with appropriate alternatives to fulfill customer satisfaction have become much more challenging than before (Wang 2013). For instance, owing to market saturation in smart phones, Nokia and Motorola lost huge market shares and were merged by Micro-soft and Google, respectively (Cha *et al.* 2009, Oküdan *et al.* 2013). In contrast, both Apple and Samsung have reported their brilliant revenues resulting from hot-selling smart phones, smart pads and other consumer electronic products. Because the market is distinctly fragmented and full of numerous product offerings, one of the most critical

factors is learning a way to facilitate customer perceptions or preferences into the process of product design and development.

In reality, customers are too scattered in their perceptions, preferences, behaviors, and even their demographics or psychographics backgrounds. Thus, a "STP" (segmentation-targeting-positioning) approach is commonly adopted. In particular, product positioning is of importance to help companies cultivate differentiation capability and consolidate customer loyalties (Luo *et al.* 2010, 2012). Owing to limited resources, companies usually focus on specific characteristics of a product and select the *ad-hoc* segment(s) for running their businesses. Furthermore, to avoid a fierce price war, incorporating customer feelings into the process of product development has been recognized as an effective way (Wang and Hsueh 2013). Unfortunately, customer feelings are difficult to be quantitatively captured and measured. Moreover, product recommendation becomes very challenging when customer profiles or transaction records are scarce and unavailable with regard to new products. To overcome the aforementioned deficiencies, a novel framework is proposed in this context. The rest of this paper is structured as follows. Section 2 briefly reviews product positioning and product recommendation. Section 3 introduces the proposed framework. An industrial case study is illustrated in Section 4. Concluding remarks are finally drawn in Section 5.

2. Literature review

In order to achieve successful new product development, product positioning and product recommendation are two critical techniques to help firms better recognize the complicated relationships between product features, competing alternatives, and diverse consumers (Lilien and Rangaswamy 2003, Petiot and Grogent 2006, Cha *et al.* 2009). Actually, product positioning is not what you do to a product but it is what you do to the prospect of customers. On the other hand, product recommendation can assist companies in developing customization strategies for implementing one-to-one or target marketing (Luo *et al.* 2010, Luo *et al.* 2012). For convenience, both of them are briefly overviewed here.

2.1 Product positioning

"Product positioning" refers to implementing a set of tactics to ensure these characteristics can occupy a unique position in the minds of customers (Lilien and Rangaswamy, 2003). Optimal product positioning corresponds to determining which attributes and associated levels should be configured in a product and then licking product varieties to customer requirements such that the revenues or market shares of a firm could be satisfied (Kwong *et al* 2011). Specifically, a perceptual map has been

recognized as a powerful tool to visualize the underlying associations between competing products (brands) and characteristic features (criteria) in a lower dimensional space. To the best of our knowledge, two typical ways are usually used to construct a perceptual map: the first is multi-dimensional scaling (MDS) and the second is correspondence analysis (CA). According to Hair *et al.* (2009), CA is not limited to ratio or interval-scale input variables because it can accommodate categorical variables. Moreover, without requiring a tedious multiple-regression process, CA is computationally efficient to display the benchmarking objects associated with characteristic features on a joint plot. Thus, CA is adopted in this context to perform product positioning.

2.2 Product recommendation

Rapid advances in information technologies greatly assist companies in gathering or analyzing customer profiles from various channels to provide decision supports on fulfilling customer retention or acquisition (Liu and Shih 2005a, Liu and Shih 2005b). For example, collaborative filtering (CF) and association rule mining (ARM) are deficient in tackling a scenario in which transaction data is sparse and insufficient to derive corresponding similarities in terms of user interests. Besides, rough set theory (RST) and *K* nearest neighbor (KNN) are limited to handling discrete and numeric input variables, respectively. Obviously, most conventional schemes conduct product recommendation in a supervised way and thus they are weak in handling a scenario in which customer buying profiles are insufficient or unavailable (Agard and Kusiak 2004, Song and Kusiak 2009). When a new product is initially introduced or launched into the market, it's very difficult to gather sufficient training samples for constructing intelligent recommender systems (Wang and Tseng 2013a, 2013b). Because Naïve Bayes classifier (NBC) is particularly appropriate to process a small dataset, this study employs Bayes theorem to convert a respondent's preference pattern into the similarities with corresponding alternatives and then product recommendation can be realized in an unsupervised manner.

3. The proposed methodologies

In order to understand the strengths and weaknesses of smart alternatives (i.e. phones, watches, and glasses), this study proposes a three-step process to incorporate customer perceptions and customer preferences into the entire framework.

3.1 Employing correspondence analysis (CA) to perform product positioning

Recently, CA has been very popular for developing the positioning maps because it can show the spatial relationships between variables (attributes) and data samples. It

was developed in 1970 on the basis of *R*-type (handling attributes) and *Q*-type (handling samples) factor analysis. The original concept of CA is to present the underlying structure of a contingency table in the form of low-dimensional points (Hair *et al.* 2007). Suppose a $m \times n$ data matrix with elements of x_{ij} is shown and normalized as:

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix}, \tag{1}$$

$$T = \sum_{i=1}^{m}\sum_{j=1}^{n} x_{ij}\ ,\ \ T_i = \sum_{j=1}^{n} x_{ij}\ ,\ \ T_j = \sum_{i=1}^{m} x_{ij}\ , \tag{2}$$

$$z_{ij} = \frac{x_{ij} - T_i \cdot T_j / T}{\sqrt{T_i \cdot T_j}},\ \ 1 \le i \le m\ ,\ \ 1 \le\ j \le n\ , \tag{3}$$

where *m* stands for the number of competing objects and *n* denotes the number of attributes. Hence, the *R*-type CA needs to work out the matrix of $Z^T Z$ whereas the *Q*-type CA needs to work out the matrix of ZZ^T. Following an eigen-decomposition process, dominant eigenvalues associated with their corresponding eigenvectors are utilized to plot a perceptual positioning map. Furthermore, to recognize significant (positive or negative) association between the attributes and the objects, the signed *Chi*-square (SC) is defined as follows:

$$SC = \frac{f_o - f_e}{\sqrt{f_o(1 - r_p)(1 - c_p)}}\ , \tag{4}$$

where f_o and f_e represents an observed and the expected value, r_p is the row proportion, and c_p means the column proportion. Notice that Gaussian distribution is assumed to derive Eq. (4).

3.2 Using analytic hierarchy process *(AHP) to elicit customer preferences*

The AHP was originally proposed Saaty (1980) and it comprises the following steps (Wang and Hsueh 2013):

- Constructing a hierarchy for assessing the entire system: it is followed by a top-down approach to decompose the problem into multi-levels characterized by specific criteria, sub-criteria (attributes) and alternatives. In this study, a question like "*How much degree of is alternative i preferred to alternative j*?" is applied to

a respondent for conducting a pair-wise comparison among smart alternatives.

- Asking decision makers to make pairwise comparisons: A 9-point numerical scale is commonly used to express respondents' preference degrees among criteria or alternatives. Specifically, the rating scales are linguistically described as *equally, slightly, moderately, strongly, and extremely* preferred corresponding to the values of 1, 3, 5, 7, and 9, respectively,
- Employing eigenvalue computation to derive the weights of criteria and the ratings of alternatives: Suppose there are *S* evaluators, *n* criteria (attributes), and *m* alternatives, then a symmetric $n \times n$ $(m \times m)$ matrix *A* with elements of a_{ij} is defined by the preference degree of attribute (alternative) *i* over attribute (alternative) *j*. The maximal eigenvalue and associated eigenvector can be computed as follows:

$$AW = \lambda_{\max} W, \tag{5}$$

where *A* has unity diagonal elements, $\lambda_{\max}$ is the largest eigenvalue of *A* and *W* corresponds to its associated eigenvector which represents the importance weights of criteria or the performance ratings of alternatives,

- Assessing the overall decision consistency for each respondent: the decision quality is related to the consistency of judgments that decision makers demonstrated during the process of pairwise comparisons. For example, the property of transitivity implies that "*if A is preferred to B, and B is preferred to C, then A should be preferred to C*". The consistency index (*CI*) and consistency ratio (*CR*) are defined as follows to judge consistency of decision quality:

$$CI = \frac{\lambda_{\max} - n}{n-1}, \tag{6}$$

$$CR = \frac{CI}{RI}, \tag{7}$$

where *CI* represents the inconsistency index and *RI* denotes a random index. When the *CR* value is less than the value of 0.1, the decision process is considered to be consistent.

- Using a geometric mean to aggregate the weights and the ratings among all respondents: recall that there are *S* respondents, *n* attributes and *m* alternatives:

$$W_i = \sqrt[S]{\prod_{j=1}^{S} w_{ij}}, \tag{8}$$

where w_{ij} means the weights of attribute (alternative) *i* for respondent *j*.

3.3 Using Naïve Bayes classifier (NBC) to conduct product recommendation

Referring to Wang and Tseng (20131, 2013b), a product is characterized by a set of features $F = \{f_1, f_2, \cdots, f_n\}$ where each variable f_i represents the *i*th feature of the product. For convenience, we assume f_i takes on values from its choice set $f_i = \{f_{i1}, f_{i2}, \cdots, f_{im}\}$ and m denotes associated levels (possible values). In this context, the aforementioned expression is used to formulize customer perceptions of smart alternatives. After aggregating all respondents' answers, an alternative can be characterized by A_{ik} (where $0 \le A_{ik} \le 1$ denotes alternative k's importance percentage in its *i*th feature, $1 \le i \le n$, and $k = 1 \sim 3$ sequentially denotes smart phones, watches, or glasses). Following a similar way, an individual's preference for product features can be expressed by using a binary pattern like $X = (r_1, r_2, \cdots, r_n)$, where $r_i = 1$ or $r_i = 0$ means preferred or not preferred for feature *i*.

For simplifying the analysis, the conditional independence assumption (see Eq. (9)) is commonly applied to the Bayes rule (see Eq. (10)):

$$\Pr ob(x_1 = r_1, \cdots, x_n = r_n | Y = A_k) = \prod_{i=1}^{n} \Pr ob(x_i = r_i | Y = A_k) \tag{9}$$

If the value of the feature set $X = (r_1, r_2, \cdots, r_n)$ is known, the information regarding *Y* can be formulized as:

$$\Pr ob(Y = A_k | x_1 = r_1, \cdots, x_n = r_n) = \frac{\Pr ob(Y = A_k) \times \prod_{i=1}^{n} \Pr ob(x_i = r_i | Y = A_k)}{\sum_k [\Pr ob(Y = A_k) \times \prod_{i=1}^{n} \Pr ob(x_i = r_i | Y = A_k)]} \tag{10}$$

According to Bayes theorem, an individual's preference pattern *X* can be converted into associated similarities with three alternatives, such as $X = (S_1, S_2, S_3)$, where the similarity S_k $(1 \le k \le 3)$ is derived by using the posterior probability:

$$S_k = Posterior(Y = A_k | X) \propto Likelihood(X | Y = A_k) \times \Pr ior(A_k) \tag{11}$$

$$Likelihood(X | Y = A_k) = \prod_{i=1}^{n} [r_i A_{ik} + (1 - r_i) \times (1 - A_{ik})] \tag{12}$$

In order to obtain the prior information, the AHP is applied to investigate respondents' preferences for smart alternatives in advance.

4. An industrial example

Referring to Chang *et al.* (2009), the popularity of smart phones arises from many drivers, including wireless internet access, geographical positioning services, electronic wallet applications, video games and multimedia contents, and high computing and communication performances. For providing more managerial insights on understanding the associations among three alternatives, this section constructs a customer-driven framework to assess the relative strengths and weaknesses of smart phones, smart watches, and smart glasses.

4.1 Incorporating customer perceptions into the process of product positioning

For convenience, the main criteria composed of 15 product features shown in Table 1 are selected to design questionnaires. In order to enhance the reliability and validity of this survey, the questionnaires were sent to 130 experienced industry engineers who work in the Hsinchu science park of Taiwan. Based on a binary rating scale, the following questions, such as "*How do you perceive of feature A_i for smart phones, smart watches, and smart glasses?*" is applied to elicit customer perceptions of product features. After gathering and aggregating customer perceptions (see Table 2), correspondence analysis (CA) is employed to derive the signed *Chi*-square association for visualizing the underlying associations between product features and smart alternatives (see Eqs. (1) - (4)). Following the assumption of Gaussian distribution, it is noted that a positive (negative) value which is more (less) than 1.96 (minus 1.96) indicates a significant association (repulsion) between product features and a specific alternative and this concept is utilized for revealing which features best characterize a specific alternative.

According to Fig. 1, smart phones are close to F1 (photo picture), F2 (video recording), F3 (game entertainment), and F5 (data transmission), and F10 (clear visualization). In contrast, smart watches are good at F6 (message reminding), F7 (anti-tumbling), F8 (pedometer & timer), F9 (pulse rate monitoring), F13 (safety monitoring), and F14 (audio recording) to imply its potential application in the area of health care. Finally, smart glasses are perceived to be powerful in F4 (wireless communication), F7 (anti-tumbling), F12 (eye-ball control), and F15 (face detection and image recognition) since they have advantages on a hand-free interface. Therefore, in additional to the conventional smart phones, wearable devices like smart watches or smart glasses are systematically assessed to reveal their potential markets, such as medical healthcare, security checking, and logistics services.

Referring to Table 2 again, customer perceptions of 15 product features are integrated and measured in terms of five evaluation criteria. Based on Table 3, Fig. 2 displays a five-dimensional radar plot for conducting benchmarking analysis. Not surprisingly, P1 (smart phones) performs the best in C1 (multi-media) and C2 (social media), concurrently. In contrast, P2 (smart watches) is perceived to be more powerful in C3 (health care) while P3 (smart glasses) outperforms other smart alternatives on criteria C4 (user-interface). More interestingly, in the dimension of C5 (industry application), three alternatives demonstrate almost equivalent potential for industry practitioners.

[Table 1 – Table 3 Here]

[Fig. 1 – Fig. 2 Here]

4.2 Incorporating customer preferences into the process of product recommendation

Secondly, a question like "*Do you think feature A_i is important for you?*" is sent to a respondent to capture his/her individual preferences. By virtue of Bayes theorem (see Eqs. (9)-(12)), customer binary preferences for product features (see Table 4) are sampled and converted into the similarities with three alternatives (see Table 5). For instance, respondent 1's preference is explained as 62.5% for smart phones, 4.6% for smart watches, and 32.9% for smart glasses. Prior to justifying the validity of unsupervised product recommendation (via Bayes theorem), the AHP is applied to respondents for attaining the prior information (initial weights) of smart alternatives. The relative weight (prior probability) of smart phones, watches, and glasses are derived as (0.44, 0.25, 0.31), respectively. A sequential pattern is found to estimate initial market attraction (*Phones*>*Glasses*>*Watches*) of three smart alternatives. For predicting consumers' purchase intentions on three alternatives, 75% classification accuracy indicates that validation process is on average satisfactory, especially historical profiles or consumers' transaction records are not required in advance. Furthermore, to elicit more managerial insights, Table 6 demonstrates the results of three segments and their corresponding centroids. Here, the centroids stand for the mean similarities with smart phones, watches, and glasses, sequentially.

[Table 4 – Table 6 Here]

5. Conclusions

Product positioning and product recommendation are two critical activities to help firms enhance customer satisfaction and consolidate customer loyalties. For new products, however, these two activities are becoming very challenging because of lacking purchase records or historical transaction data. Consequently, a novel approach is presented in an unsupervised manner to overcome the aforementioned

difficulty and three points are summarized as follows: (1) smart phones are good at providing a platform for satisfying home entertainment, (2) smart watches are perceived as auxiliary carriers to accomplish health care and safety monitoring, and (3) smart glasses are promising to fulfill industrial operation, logistics service, and homeland security. In future studies, market segmentation and product differentiation deserve to be further addressed for these similar alternatives.

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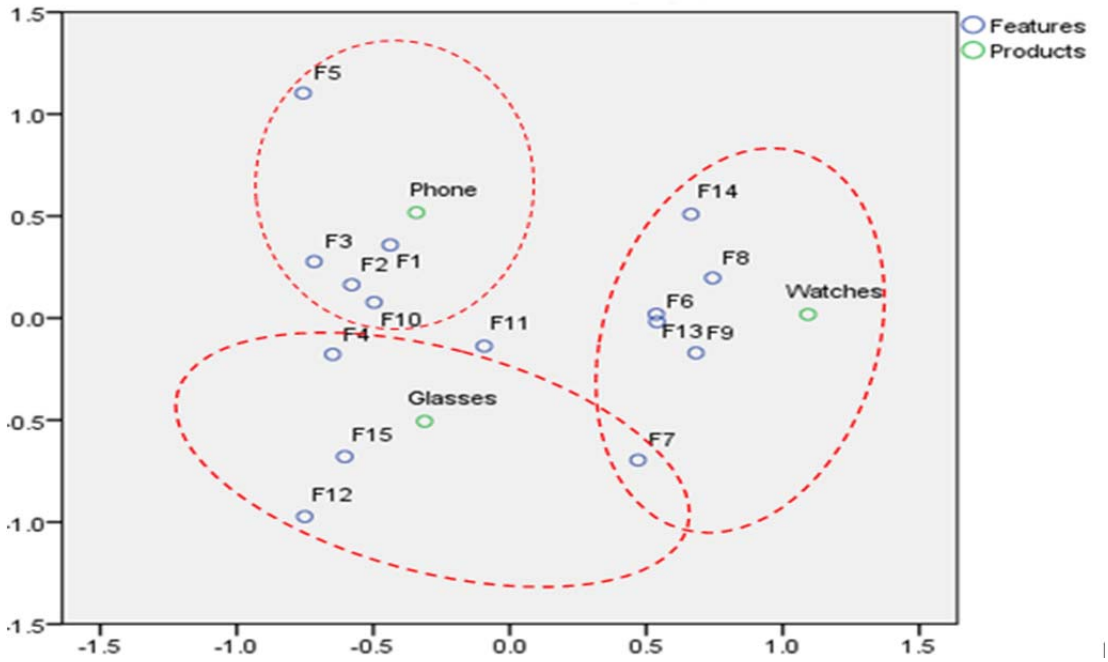

Fig. 1. A perceptual map to visualize smart alternatives associated with product features

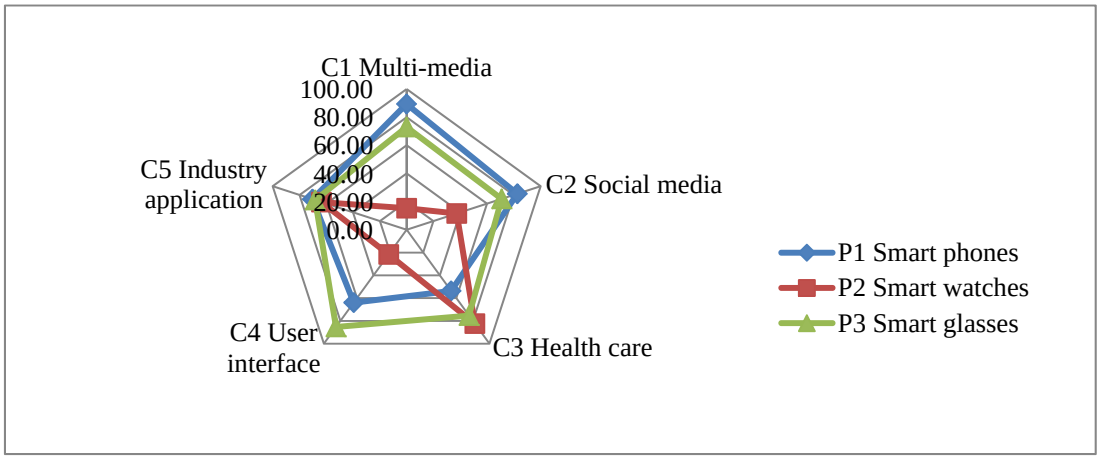

Fig. 2. A radar plot to demonstrate the relative strengths and weaknesses

Table 1. Main evaluation criteria associated with product features

Main criteria	Product features
C1 Multi-media	F1 photo picture (static)
	F2 video recording (dynamic)
	F3 entertainment (game & media player)
C2 Social-media	F4 wireless communication (video conference)
	F5 data transmission (i.e. voice, text, photo, etc.)
	F6 message reminding (e-mails, phone calls, etc.)
C3 Health care	F7 anti-tumbling (gravity sensor)
	F8 pedometer & timer (body calorie counter)
	F9 pulse rate monitoring (chest strap)
C4 User interface	F10 clear visualization
	F11 speech recognition and control
	F12 eye-ball based control
C5 Industry application	F13 safety monitoring (GPS tracking)
	F14 audio recording
	F15 face detection and image recognition

Table 2. The signed *Chi*-squares based on customer perceptions (in percentages)

	P1 (smart phones)		P2 (smart watches)		P3 (smart glasses)	
	Counts	Association	Counts	Association	Counts	Association
F1	91	3.60	22	-3.59	68	-0.50
F2	85	3.00	15	-4.71	76	1.08
F3	92	4.13	9	-5.82	75	0.92
F4	77	1.40	12	-5.41	92	3.27
F5	93	7.67	6	-5.25	36	-3.09
F6	78	-2.53	94	5.41	85	-2.15
F7	35	-5.84	67	3.95	92	2.39
F8	68	-1.79	89	6.76	56	-4.05
F9	58	-3.92	91	6.37	78	-1.60
F10	82	2.26	19	-4.10	79	1.29
F11	72	-0.45	41	-0.84	86	1.16
F12	38	-2.28	5	-5.43	91	6.94
F13	75	-2.19	89	5.20	69	-2.31
F14	89	0.45	91	6.32	48	-5.89
F15	47	-1.40	11	-4.56	88	5.32

** The value more (less) than 1.96 (minus 1.96) denotes positive (negative) association*

Table 3. The aggregated performance scores with respect to main criteria

Aggregated in percentiles	P1 (phones)	P2 (watches)	P3 (glasses)
C1 multi-media	89.33	15.33	73.00
C2 social media	82.67	37.33	71.00
C3 health care	53.67	82.33	75.33
C4 user interface	64.00	21.67	85.33
C5 industry application	70.33	63.67	68.33

Table 4. Sampled customer preferences for product features

Features	Respondent 1	Respondent 2	Respondent 3
F1	1	1	1
F2	1	1	1
F3	0	0	0
F4	1	1	1
F5	0	0	0
F6	1	1	1
F7	0	1	0
F8	1	1	1
F9	1	1	1
F10	1	0	0
F11	1	0	1
F12	0	0	1
F13	1	1	1
F14	1	1	0
F15	1	0	0

Table 5. Converting customer preferences into the similarities to three alternatives

	Respondent 1	Respondent 2	Respondent 3
P1 (smart phones)	0.625	0.007	0.078
P2 (smart watches)	0.046	0.988	0.055
P3 (smart glasses)	0.329	0.005	0.867

Table 6. Offering decision supports on the recognized segments

Segments	Count	Centroid	Recommendation	Key determinants
S1	42%	(0.66, 0.11, 0.23)	Smart phones	F1, F2, F3, F5, F10
S2	23%	(0.27, 0.57, 0.16)	Smart watches	F6, F7, F8, F9, F13, F14
S3	35%	(0.19, 0.22, 0.59)	Smart glasses	F4, F7, F12, F15

QUALITY MANAGEMENT MEASURES IN FOOD SUPPLY CHAIN: AN OVERVIEW AND CASE STUDIES IN HONG KONG

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ABSTRACT
Food is an indispensable item in the daily life of people. Quality and safety food is not only important to the health of people, but also to the sustainable development of a country. Therefore, the issue of stability and quality of food supply chain has become a global concern. This paper examines the common quality management measures currently applied in food supply chain and describes three Hong Kong cases in which food companies adopt those quality management measures in managing their food supply chains.

Keywords: quality management, food supply chain, Hong Kong

INTRODUCTION
Without doubt, food is one of the indispensable elements in people's daily life. It provides us with energy, raw materials essential for our well-being, and a defense against illness (Bourlakis and Weightman, 2007). Food also influences and dominates the performance of our economy. Over the last decade, the concepts of "Food Supply Chain" and "Food Supply Chain Management" have become popular and have gained much attention in the market (Govindan et al., 2013).

This paper examines the common quality management measures currently applied in food supply chain. It also describes three Hong Kong cases in which food companies adopt those measures in managing their fresh food and FMCG food supply chains. The paper aims at reviewing those quality management measures in the distribution of food and identifying quality control elements that can serve as useful foundation for building framework for efficient food supply chain management.

DEFINITION AND OVERVIEW OF FOOD SUPPLY CHAIN
The distribution of food plays an important role in the operation of the economy and the health of people. With the increasing demand from people for higher living standard, it is essential for the food industry to ensure an efficient and seamless global movement of food worldwide.

Food supply chain is a logistic system of food-related business, which represents a sequence of economic activities involved in the movement of food from production to consumption, including pre-production and post-consumption activities. It involves a set of interdependent companies working closely together to ensure a smooth flow of agricultural and food products (Folkerts and Koehorst, 1998). Similar to other types of supply chain, the food supply chain is also affected by the regulatory system at different stages of the chain, from upstream stages (involving mainly the agricultural sector) to the downstream stages (involving mainly the retail sector).

There are numerous key stakeholders and players in a general food supply chain, including farmers, manufacturers, warehouses, vendors, wholesalers, and retailers. The close relationship and cooperation between these stakeholders are crucial to the success of the food supply chain and, to certain extent, could influence the level of agricultural commodity prices and consumer food prices (Bukeviciute et al., 2009).

Traditionally, a food supply chain starts at upstream parties such as farmers and raw material providers. The agricultural products and raw materials will be sent to manufacturers for production. They become the final goods or intermediate goods after the process. In contrary to the final goods, the intermediate goods need to go through one more step and be further processed before being sold as final goods. Final goods will be shipped to warehouses for intermediate storage or repackaging. Finally, they will be sent to wholesalers and retailers for re-sale to the general public. As mentioned previously, this paper mainly focuses on the supply chain of two types of food, namely fresh food and FMCG food.

1. Fresh Food

The two main types of fresh food are vegetables and fruits. In addition, there are seafood and meats. Fresh food is the essential component of healthy diets, bringing good health to people (Mozaffarian and Rimm, 2006; Anderson et al., 2009). However, as fresh food is perishable, the supply chain of fresh food is therefore different from the supply chain of other general goods.

1.1. Vegetables

Vegetables are very critical to people's health. They help us to maintain a healthy digestive system and cure various diseases (Sharma, 2005; Armstrong and Clapham, 2007). There are five types of final products of vegetables that are sold in the market, namely fresh vegetables that are sold directly, canned products made with vegetables, frozen vegetables, fresh vegetables that are cut and put into plastic bags, and cooked and pre-cooked food with vegetables (Rábade and Alfaro, 2006). Among these five types of final products of vegetables, the fourth type (i.e. fresh vegetables that are cut and put into plastic bags) is the most highly perishable one. From reaping to processing, the cycle of these vegetables cannot last for more than 5 days. Some of these vegetables will be transported by air in order to shorten the travel time.

In order to keep their quality, most vegetables will be kept in warehouses with temperature control (Bevilacqua et al., 2009). Nowadays, the trading of vegetables is becoming a crucial entity for the supermarkets because of the increase in customer expectations and time arrests (Ahmad and Fehér, 2010).

1.2. Fruits

Fruits are another type of fresh food. European Union (EU) has one of the largest and best systems in fruit supply chain. Its fruit supply chain system is simply divided into 4 parts, production, wholesaling, retailing, and consumption (China Commodity Net, 2007). China is another big country that produces fruits. However, fruit supply chain in European Union is different from the one in China. In European Union, "processing" is treated as part of the production stage, whereas, in China, "processing" is commonly regarded as a separate stage. The processing of fruits certainly includes quality control and repackaging. European fruit producers and marketers have close link with various supermarkets, retailers and agencies for distributing and selling their fruits. Together with good quality control and high efficiency, European fruit supply chain sets a good "sample" for foreign countries, such as China and Korea.

Similar to vegetables, fruits need to be refrigerated after they have been harvested in order to keep them fresh and crisp. This has some implications on the tools to be used to ensure their quality throughout the supply chain.

1.3. Meats

Pork and beef are the most popular meats consumed worldwide. However, there were incidents where deceases spread from cows and pigs to humans. Two of the major incidents in the last decade were the mad cow disease in Canada in 2003 (Poulin and Boame, 2003) and the Streptococcus Suis in China in 2005 (Yu et al., 2006). With the great concern of public towards quality and safety of meats, the quality measurement in meats is taken more seriously thereby.

Zhao and Li (2012) illustrated the way that RFID (Radio Frequency Identification) is used in the supply chain of pork in China. Once the pigs are born, they will be raised in the farm. The pigs will have the RFID tags attached to their ears. The purpose is to record their sex, date of birth, medial and quarantine record…etc. When the pigs are sent to the slaughter house and even the supermarket, the tags are still essential for updating the status of the pigs and the pork. RFID is an important measure to help identify a pig's origin in case of an outbreak of decease. Similar technology is also used in cow supply chain in Australia, Canada, Europe, Japan and the USA (Ribeiro et al., 2010).

1.4. Seafood

Seafood is also a main food for humans. Seafood includes different kinds of fishes (like cods, tunas, and salmons), crustaceans (like crabs, shrimps, and lobsters), and mollusks (like scallops, squids, and snails) (Sicherer et al., 2004). Roheim (2008) emphasized that the supply chain of seafood can involve a great number of intermediaries operating between the fishermen and the consumers. Most seafood is traded globally, particularly those high-value seafood such as tunas and lobsters.

A unique feature in the seafood supply chain is that any live seafood needs water to stay alive throughout the supply chain. The maintenance of good quality water is therefore crucial. European Union is by far the largest single market for imported fishes and fish products (Fernández-Tajes et al., 2011). To ensure the reliability of seafood and fish products,

traceability of these products is highly emphasized and has become a fundamental prerequisite in EU (Luten et al., 2003). Important traceability data like the seafood's origin, processing history, distribution, and state (i.e. location) are required to be recorded.

2. FMCG Food

FMCG (fast moving consumer goods) are products that are relatively inexpensive and are frequently purchased and consumed (Miremadi and Faghanie, 2012). FMCG consist of different types of products bought daily by consumers, such as soaps, cleaners, tobacco products, cosmetics, personal care, and edible oils (Cocks, 2000; Bansal and Sharma, 2012). One type of FMCG is food. Chocolates, biscuits, and drinks are all examples of FMCG food. FMCG industry is characterized by low operating cost, low per capita consumption, and well-established distribution channels (Kavitha, 2012). Producers of FMCG food will pay more effort in building their brand names and creating better packaging. FMCG food is very common in China because of the rapid development of its economy and the increasing living standard of the mainland Chinese.

VERTICAL INTEGRATION IN FOOD SUPPLY CHAIN

Vertical integration is a very common practice in food supply chain industry. Vertical integration is the co-operation between parties at different levels of the supply chain (Caputo and Mininno, 1996). There are two types of vertical integration, namely forward integration and backward integration. Different parties throughout the supply chain will be benefited from vertical integration. For example, if a food supplier links up with its downstream partners (i.e. distributors and restaurants), it can control the food quantity and prices to meet demand changes instantly. In contrast, if a supermarket links up with its upstream partners (i.e. food suppliers), it can ensure a stable supply of quality food and reduce costs.

QUALITY MANAGEMENT MEASURES IN FOOD SUPPLY CHAIN

A number of food contamination incidents were recorded in the last two decades (Bernard et al., 1999; Durham, 2005; Bai et al., 2006; Ingelfinger, 2008; Iwamoto et al., 2010). For instance, vegetables with excessive pesticide residues, mad cow disease, and seafood with norovirus. Some people even died in these incidents. As a result, people and firms start to pay more attention to the quality and safety of food.

Different measures and tools have been used to enhance the quality and safety of food worldwide. Three popular quality measurement measures adopted in food supply chain are described below.

1. Traceability and RFID

Traceability refers to the ability to follow and trace food, food producing animals, or food producing materials through all the production and distribution stages (Folinas et al., 2006). Traceability becomes an important requirement in supply chain management (Wang and Li, 2006). A good food traceability system will collect and record all important information to ensure that the quality of food products is in "real-time" (Wilson and Clarke, 1998). It can provide a greater assurance of food quality to different parties. Producers or farmers can also identify any food problem quickly according to those useful hints.

With the increasing importance of food tracing, a number of technologies have been utilized in tracing food. The most popular one is Radio Frequency Identification (RFID). RFID was first introduced in 1940s. RFID allows wireless identification of the nature and location of a physical object. Nowadays, it serves as a medium for several tasks, including managing supply chains, tracking livestock and products, preventing counterfeiting, and other security issues (Rieback et al., 2006). Together with the barcode and internet system, RFID can bring lots of benefits to manufacturers and retailers. RFID creates opportunities for more efficient and effective traceability system design (Kelepouris et al., 2007).

Modern RFID tags are about the size of a grain of rice and contain built-in microchip, antenna and memory. In terms of communication, the passive RFID tags communicate using RFID readers' power while the active RFID tags communicate using battery power (Rieback et al., 2006). In 1970s, the American first introduced the RFID tracking scheme in cows. Since then, RFID-tagged animals and vegetables have become very common worldwide.

As for FMCG, chocolate is a common food tracked by RFID. With the effective of "The Bioterrorism Act of 2002" in the USA, food producers have to maintain their raw materials and finished goods in good and safe condition. Bloomer Chocolate, the largest cocoa-bean producer in North America, has utilized the RFID system together with its original Warehouse Management System (WMS) for tracking and tracing raw materials and chocolates. As a result, the company can ensure that each shipment of raw materials arriving the manufacturing plans were in good condition and the visibility of inventory. The rest of the supply chain process (i.e. distribution and storage) can also be monitored until the chocolates reach the end users. The overall effectiveness of the firm has been improved thereby (O'Connor, 2006).

2. Hazard Analysis & Critical Control Point (HACCP)

HACCP is a science-based monitor system, which enables the production of quality and safe food through identification of potential hazards in the production establishment and critical processing points and establishment of methods for monitoring how well the process control is working (Hulebak and Schlosser, 2002). It is a famous measurement tool used worldwide. HACCP involves seven principles, namely (i) conduct a hazard analysis, (ii) identify the critical control points (CCPs), (iii) establish critical limits to be met for preventive measures of CCPS, (iv) establish monitoring procedures and requirements for CCPs, (v) establish corrective actions, (vi) establish procedures for recordkeeping of HACCP plan, and (vii) establish procedures for verifying the proper functioning of HACCP system. The popularity of HACCP has led to the development of ISO 22000 which is an international standard ensuring the integrity and safety of food supply chain (Valder, 2009). ISO 22000 specifies the requirements for a food management system that consists of four elements to ensure quality and safety of food through the supply chain, including interactive communication, prerequisite programs, system management, and HACCP principles.

Most of the vegetables are monitored by HACCP system nowadays. According to a research conducted in Shanghai of China in 2008, it was found that HACCP is an effective tool in ensuring food quality and safety. From their study, the researchers found that most vegetable enterprises in China had a wide range of vegetable products, whereas, various types of vegetables required different processing methods and temperature settings throughout the

transportation process. Based on these, the researchers conducted a HACCP study on one selected vegetable enterprise. They provided a basket of methods to the enterprise. As a result of the methods, it was found that the percentage of perished vegetables of the enterprise dropped by 7% while the commercial rate of agricultural products of the enterprise rose by 10%. The study proved that HACCP can improve the quality of vegetable products substantially (Xie et al., 2008).

3. Key Performance Indicators (KPI)

KPI is a measurement tool for evaluating the performance of a company. KPI is a quantitative management indicator measured by setting, sampling, measuring, and analyzing key parameter of the input and output ports of the company's internal process (Luo et al., 2012). The strategic goal of the company can be translated to operational long-term target with KPI. Its final goal is to provide a guideline and standard for the department heads of the company, rectifying their directions and maintaining high-quality management for the company.

In food supply chain industry, KPI is commonly used in evaluating and improving the distribution procedure of food (Liu, 2009a). Two main problems in the distribution of food are the utilization of trucks and the traveling time. After analyzing the KPI, recommendations can be given to distributors, including delivery routes, numbers of shipments, and vehicle loadings. Besides, for frozen food, KPI can help improve the linkage between suppliers, distributors, and retailers. KPI is a tool that allows companies to view each supply chain member's performance comprehensively and make sure that all the distribution and logistics steps are normal.

THE CURRENT FOOD QUALITY MANAGEMENT MEASURES IN HONG KONG

Comparing with other Asian countries or cities, Hong Kong is one of the few places with comprehensive policy in managing and measuring food quality. In Hong Kong, the Food and Environmental Hygiene Department (FEHD) of HKSAR is responsible for the quarantine of food products. Its affiliate, Center for Food Safety, assumes full responsibility for inspecting the quality of food (both local food and foreign food) on sale in Hong Kong. The FEHD also conducts laboratory tests on food samples regularly and oversees the application of international tracking and measurement tools, such as HACCP and RFID, in Hong Kong. The FEHD strives to ensure that all food sold in Hong Kong are of high quality and safe for the consumption by Hong Kong citizens (HKSAR Government, 2012).

To have a better understanding of how Hong Kong firms manage their food supply chain using different quality management measures, three case studies will be discussed.

1. Case Study 1 – McDonald's Hong Kong

McDonald's Corporation is one of the leading fast-food chains in the world. McDonald's Hong Kong opened its first restaurant in Hong Kong in January 1975 at Paterson Street, Causeway Bay (McDonald's Hong Kong, 2014). There are more than 210 McDonald's restaurants in Hong Kong currently with over 15,000 staff. The company pays great attention to food quality. McDonald's owns 3 regional Food Studio and Quality Centre. One of these centres is located in Hong Kong. These centres are responsible for developing new food products and monitoring quality of food products for McDonald's (Liu, 2009b).

In logistics, HAVI Logistics provides the distribution services for McDonald's Corporation and McDonald's Hong Kong. HAVI Logistics, established in 1974 at Chicago, is a multi-functional global logistics service provider (HAVI Logistics (Taiwan) Ltd., 2014). It strives to provide high-quality logistics, food processing, packaging, and distribution services to its customers. HAVI Logistics has built a close relationship with McDonald's for a long time. It has established a good monitoring system for the storage and transportation of frozen food for McDonald's.

McDonald's successfully practices the "From farm to table" concept. Chicken is one of the main food of McDonald's restaurants. HACCP is well applied in the supply chain of chicken in McDonald's. Chicken will undergo HACCP assessments at different stages. Their origins, types, forages, or other relevant information will be recorded in the computer system for tracking. Apart from chicken, McDonald's also uses HACCP in maintaining the quality and safety of other frozen food.

2. Case Study 2 – Tao Heung Group

Tao Heung Group, so-called Tao Heung, is a leading restaurant chain in Hong Kong. The group has more than 120 restaurants under 15 different brand names in Hong Kong and Southern China (Tao Heung Holdings Ltd., 2011b). Tao Heung is among the few restaurant chains that have their own centralized food processing and logistics centres. Tao Heung has two food processing and logistics centres, one located in Dongguan, China and one located in Taipo, Hong Kong (Tao Heung Holdings Ltd., 2011a). These two centres are multi-functional food supply chain hubs equipped with mass production lines, food testing and preparation facilities, packaging facilities, frozen warehouses, and cold-storage vehicles.

Due to inflation, the cost of raw materials rose substantially over the last few years. The issue of how to maintain profit without a big upward adjustment on menu prices has become a big challenge for all restaurant chains in Hong Kong. To deal with it, Tao Heung chooses to pursue "vertical integration" by cooperating with its raw material suppliers (upstream parties) like poultry farms. As a result, Tao Heung is able to influence and control the price, the production volume and schedule, and the quality of its raw materials. Moreover, its centralized food processing and logistics centres can combine the food production process and food testing process together, eliminating unnecessary steps and reducing the possibility of food contamination. The overall efficiency of the food supply chain of Tao Heung is enhanced thereby.

3. Case Study 3 – Wellcome

Wellcome has been serving Hong Kong citizens for more than 60 years. It is the longest established and largest supermarket chain in Hong Kong (Wellcome, 2013). There are about 6,000 to 7,000 products available in each Wellcome supermarket, including fresh food and other FMCG. Wellcome is the first supermarket chain to use "Electronic Data Interchange (EDI)". All products sold in Wellcome supermarkets are equipped with GS1 barcodes that carry information about the products for easy stocktaking and tracing.

In addition, Wellcome has adopted "ezTRADE" platform in its supermarkets. "ezTRADE" is an e-commerce platform that allows the transmission of commercial documents using EDI messaging format to partnering companies along the supply chain (GS1 Hong Kong Limited,

2014b). “ezTRADE” helps Wellcome shorten its order turnaround time, allowing Wellcome to deliver quick and better service to its customers (GS1 Hong Kong Limited, 2014a).

Wellcome sells many fresh food, such as vegetables, fruits, seafood, and poultries. All the fresh food is monitored using some international quality control systems, like HACCP and EureGAP. In 1998, Wellcome opened its Wellcome Fresh Food Centre. The Centre enables Wellcome to conduct laboratory tests on fresh food sold in its supermarkets regularly. All of these systematic measures have helped Wellcome win the confidence of Hong Kong citizens. Wellcome received the “Hong Kong Proud Brand Award” for three consecutive years (2008 – 2010) in recognition of its commitment to providing high-quality food and household items to Hong Kong citizens.

CONCLUSION

More and more people are now concerned with the quality of food. It is important for food companies to trace the food and monitor the quality of food throughout their supply chains. Vertical integration among members of the food supply chain is a good way to enhance traceability and quality control of food. Besides, a number of quality management measures are nowadays available to food companies. RFID allows an efficient tracing of a food product, HACCP system enables the production of a safe food product, and KPI improves the distribution procedure of a food product along the food supply chain.

Experiences from the case studies of three Hong Kong food companies show that these quality management measures are promising tools for maintaining food quality and improving the food supply chains of the food companies. If food manufacturers and food retailers can adopt those measures appropriately, the efficiency of their food supply chains can be optimized, the quality of their food or food products can be enhanced, the confidence of customers towards their food or food products can be built, and the overall performance of the companies can be improved.

One limitation of this study is that it only focuses on qualitative research. Empirical research, i.e. survey with a large sample size, can be conducted in future so that the findings obtained can be generalized to all food companies. Despite its limitation, the study is sound for practitioners in food industry and contributes to the development of quality management strategies for food companies. The findings can also serve as foundation for building framework for efficient food supply chain management in future studies.

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PRICE-SETTING NEWSVENDOR MODELS FOR INNOVATIVE PRODUCTS AND ITS EXTENSION TO THE TWO-ECHELON SUPPLY CHAIN

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ABSTRACT

In this paper, price-setting newsvendor problems for innovative products are analyzed. Because the product is new, no relevant historical data is available for statistical demand analysis. Instead of using the probability distribution, the possibility distribution is utilized to characterize the uncertainty of the demand. We consider innovative products whose life cycles are expected to be shorter than the procurement lead times. Determining optimal order quantities and optimal retail prices of such products is a typical one-shot decision problem for a retailer. Therefore, a price-setting newsvendor model for innovative products is proposed based on the one-shot decision theory (OSDT). With the OSDT, optimal order quantity and selling price are obtained simultaneously. As an extension, a two-echelon supply chain with one manufacturer and one retailer is studied. The proposed models are scenario-based decision models which provided a fundamental alternative to analyze issues of supply chain management for innovative products.

Keywords: Price-setting newsvendor model, supply chain, one-shot decision theory, scenario-based decision model, innovative product

1. INTRODUCTION

As a well-known inventory management problem, the newsvendor problem has the following characteristics. Prior to the season, the retailer must decide the quantity of the goods to purchase. The procurement lead-time tends to be quite long relative to the selling season so that often there is not enough opportunity to replenish inventory once the season has begun. Excess stock can only be salvaged at a loss once the season is over (Khouja, 1999).

In the standard newsvendor problem, the demand or market parameters are often taken to be exogenous. Recently, the price-setting newsvendor problem has been extensively researched and it could be applied to a much broader scope (Petruzzi and Dada, 1999; Xu et al., 2011). Most of models for the price-setting newsvendor problem and the two-echelon supply chain problem are developed within the probabilistic framework (Cachon, 2003; Petruzzi and Dada, 2010). Some researches point out some limits of probabilistic models (Khouja, 1999; Ryu and Yucesan, 2010).

In this research, we consider the price-setting newsvendor problem for the innovative product which has been defined by Fisher (1997). Although the functional product are normally considered to be higher price sensitivities than the innovative ones (Fisher, 1997), there are instances that innovative products are also aimed at price-sensitive customers (Bloom, 2003). According to the idea of Fisher, the products basically belong to either primarily functional category or primarily innovative one. Functional products satisfy basic needs and have stable, predictable demand and long life cycles whereas innovative products have higher profit margins, intrinsically unpredictable demand and short life cycles. In addition, for such innovative products, the procurement lead-time is usually longer than the selling season so that often there is only one opportunity to order goods before the season. For example, Sport Obermeyer, a major supplier of fashion skiwear, ships its products in September, but has to commit itself to products well before February. However, the retailer season is only a few months long. Hence, for the retailer of innovative products, how to determine the optimal order amount can be regarded as a one-shot decision problem, which are typical for situations where a decision is made only once under uncertainty.

In one-shot decision problems, there is one and only one chance for only one state of nature (scenario) occurring. Guo (2011) initially proposed the one-shot decision theory for dealing with such one-shot decision problems. The one-shot decision theory provides a scenario-based choice but not the lottery-based choices in the existing decision theories. As the applications, a newsvendor problem is analyzed (Guo and Ma, 2014). Recently, the research (Guo, 2014) clarified the fundamental differences between the one-shot decision theory and other decision theories under uncertainty and pointed out the instinct problems in other decision theories to show that the one-shot decision theory is necessary to solve one-shot decision problems and manifested the relationship between the one-shot decision theory and the probabilistic decision methods. Guo and Li (2014) proposed multistage one-shot decision making approaches and analyzed the optimal stopping problem.

In this paper, we extend the standard newsvendor problem to the price-setting newsvendor problem for the innovative products where the partly known information of the innovative products is presented by the possibility distributions. The optimal order quantity and the selling price are obtained simultaneously. Different from the existing models which are lottery-based (probability-distribution-based), the proposed model is scenario-based. As an extension, we consider the two-echelon supply chain models. That is the manufacturer chooses his/her wholesale price, after observing the wholesale price, the retailer decide his/her retail price and order quantity.

The reminder of the paper is organized as follows. In Section 2, a price-setting newsvendor model for innovative products is developed based on the one-shot decision theory and some results of analysis of the proposed price-setting newsvendor model are given. In section 3, as an extension, the two-echelon supply-chain model is analyzed. Some summary of concluding remarks and directions for future study are provided in Section 4.

2. THE PRICE-SETTING NEWSVENDOR MODELS WITH THE ONE-SHOT DECISION THEORY

Consider a retailer who sells an innovative product. The retailer orders q units before the season at the unit wholesale price W. We use the following linear inverse demand function (Mills, 1959):

$$x = b - aR, \tag{1}$$

where $x>0$ is the market demand, R is the retail price. $b>0$ is the x-intercept of (1) representing the limit demand of the innovative products when the retail price approaches to zero and $a > 0$ is the slope of (1) showing the demand decrease when the retail price increasing by one unit.

Any excess units can be salvaged at unit salvage price S_o with $W > S_o$. If shortage, there's a unit opportunity cost S_u for the retailer. The profit function for retailer is

$$r(x,q) = \begin{cases} (R-W)x - (W-S_o)(q-x); & x < q \\ (R-W)q - S_u(x-q); & x \geq q \end{cases}. \tag{2}$$

The decision parameters for the retailer are retail price and order quantity. Assume that the plausible information of the demand is characterised by the parameter b in (1). In this case, the retailer does not know the certain value of b but know its possibility distribution, i.e. $\pi_b(b)$.

Definition 1. The possibility distribution of b is defined by the following function

$$\pi_b : [b_l, b_u] \to [0,1], \tag{3}$$

$\pi_b(b)$ satisfies $\exists b_c \in (b_l, b_u)$, $\pi_b(b_c) = 1$, $\pi_b(b_l) = 0$ and $\pi_b(b_u) = 0$, $\pi_b(b)$ increases within $b \in [b_l, b_c]$ and decreases within $b \in [b_c, b_u]$.

b_l and b_u are the lower and upper bounds of b, respectively; b_c is the most possible amount of b. The smaller the possibility degree b is, the more surprising the occurrence of b is. It should be noted that $\pi_b(b_l) = 0$ and $\pi_b(b_u) = 0$ mean that if b_l or b_u happens it will be most surprising. However, they do not mean that b_l and b_u are impossible. The plausible

information of the demand x is related with retail price R and it can be represented by a possibility distribution $\pi(R,x)$, satisfies

$$\pi(R,x)=\pi_b(x+aR)=\pi_b(b), \tag{4}$$

where $x\in[b_l-aR,b_u-aR]$. Since the demand should be larger than zero, a reasonable $R\in[W,\frac{b_l}{a}]$. b_c-aR is the most possible amount of demand. The smaller the possibility degree of demand x, the more surprising is the occurrence of that demand x. The highest profit of retailer is

$$r_u=(R-W)(b_u-aR). \tag{5}$$

That is, the retailer orders the most $q=b_u-aR$ and the demand is the largest b_u-aR. The lowest profit is

$$r_l=((b_l-aR)R+(b_u-b_l)S_o-(b_u-aR)W)\wedge((b_l-aR)(R-W)-(b_u-b_l)S_u),$$

which is determined by the minimum of two cases, one is that the retailer orders the most but the demand is the lowest: $(b_l-aR)R+(b_u-b_l)S_o-(b_u-aR)W$, the other is that the retailer orders the lowest but the demand is the highest: $(b_l-aR)(R-W)-(b_u-b_l)S_u$. We assume $W\geq S_o+S_u$, which leads to

$$r_l=(b_l-aR)R+(b_u-b_l)S_o-(b_u-aR)W. \tag{6}$$

Definition 2. The satisfaction function of the retailer is the following continuous strictly increasing function of profit r,

$$u:[r_l,r_u]\to[0,1], \tag{7}$$

where $u(r_l)=0, u(r_u)=1$.

(7) gives a general form of satisfaction function of retialer where the satisfaction of the lowest profit is 0 and the satisfaction of the highest profit is 1. The satisfaction function is written as $u(R,x,q)$ in this section.

Since the life cycle of the innovative product is generally shorter than the procurement lead-time, the retailer has only one chance to determine the retailer price as well as the order

quantity and one and only demand will come up. It is reasonable that the retailer needs to contemplate which demand ought to be taken into account before ordering products. Under a retail price, the retailer chooses one demand (focus point) amongst all possible ones while considering the possibility degree to which the demand will appear in the future and the satisfaction level the demand can bring about for an order quantity. We consider the active focus point as follows.

Active focus point for an order quantity: For a fixed retail price *R*, the active focus point of the order quantity q, denoted as $x_o^*(R,q)$, is

$$x_o^*(R,q) = \arg\max_{x\in[b_l-aR,b_u-aR]} \min[\pi(R,x),u(R,x,q)]. \tag{8}$$

$x_o^*(R,q)$ is a demand that has a higher possibility degree and a higher satisfaction level for an order quantity q.

It follows from (8) that $x = x_o^*(R,q)$ maximizes $g(R,x,q) = \min[\pi(R,x),u(R,x,q)]$. Since $\min[\pi(R,x),u(R,x,q)]$ represents the lower bound of the vector $[\pi(R,x),u(R,x,q)]$, increasing $\min[\pi(R,x),u(R,x,q)]$ will increase the possibility degree and the satisfaction level simultaneously. Therefore, $\arg\max_{x\in[b_l-aR,b_u-aR]} \min[\pi(R,x),u(R,x,q)]$ represents the demand that has the higher possibility degree and the higher satisfaction level.

For easily understanding (8), let us have a look at Fig. 1. For a fixed retail price *R*, there are four possible demands x_1, x_2, x_3 and x_4 with a possibility distribution $\pi(R,x)$. For an order quantity *q* whose $[\pi(R,x),u(R,x,q)]$ are $[0.1,0.6]$, $[0.3,0.2]$, $[1.0,0.3]$ and $[0.6,0.8]$ represented by *A*, *B*, *C* and *D*, respectively. $\min[\pi(R,x),u(R,x,q)]$ transfers *A*, *B*, *C* and *D* into A', B', C' and D', which are $[0.1,0.1]$, $[0.2,0.2]$, $[0.3,0.3]$ and $[0.6,0.6]$, respectively. $\max_x \min[\pi(R,x),u(R,x,q)]$, that is, $\max([0.1,0.1],[0.2,0.2],[0.3,0.3],[0.6,0.6]) = [0.6,0.6]$ corresponds to D'. $\arg\max_x \min[\pi(R,x),u(R,x,q)]$ chooses x_4. It follows from Fig.1 that x_4 is a state of nature with a higher possibility degree and a higher satisfaction level.

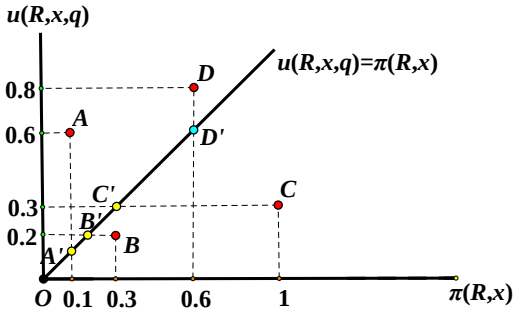

Figure 1 - The explanation of the formula (8).

In the newsvendor problem, the retailer contemplates that the focus points are the most appropriate scenarios (demand) for him/her and chooses one order quantity which can bring about the best consequence (highest profit) once the scenario (demand) comes true. For a fixed retail price *R*, for one order quantity, more than one demand might exist as focus points. We denote the sets of active focus points of an order quantity q as $X_o(q,R)$. For a fixed retail price *R*, the optimal active order quantity is

$$q_o(R) = \arg\max_{q\in[b_l-aR,b_u-aR]} \max_{x_o^*(q,R)\in X_o(q,R)} r(R,x_o^*(q,R),q), \tag{9}$$

It should be noted that under a retail price *R*, the optimal orders are obtained only based on the profits of focus points. In (9) the possibility degree does not exist any longer. Consider the retailers' pricing strategies and ordering strategies together, we have the optimal retail price and optimal orders as lists.

$$R_o^* = \arg\max_{R\in[W,\frac{b_l}{a}]} r(R,x_o^*(R,q_o(R)),q_o(R)), \tag{10}$$

$$q_o^* = q_o(R_o^*). \tag{11}$$

R_o^* and q_o^* are called optimal active retail price and optimal active order quantity, respectively. The retailers who obtain the optimal retail price and the optimal order quantity based on the active focus point are called active retailers. For simplicity, we use $r_o^*(R)$ instead of $r(R,x_o^*(R,q_o(R)),q_o(R))$ in the following. For a fixed retail price *R*, $r_o^*(R)$ is called active profit, its corresponding satisfaction level is $u_o^*(R)$.

For easily understanding how to decide the order quantity with OSDT, a numerical example is given below. For simplicity, suppose the retail price *R* is fixed.

Example 1.

For a new design fashion sportswear, the unit wholesale price W, the unit revenue R, the unit salvage price S_o and the unit opportunity cost S_u are set, for example, as 7, 10, 1, 4 (thousand JPY), respectively. By (2), the profit of the store is

$$r(x,q)=\begin{cases}9x-6q, x<q\\ 7q-4x, x\geq q\end{cases}. \tag{12}$$

For the illustrative purpose, we consider the case of discrete demand. The set of the demand is $D=\{350,450,550,650,750\}$. Suppose their possibility degrees are 0.22, 0.35, 1.00, 0.73, and 0.29, respectively (shown in Table I). The set of order quantities is $D=\{350,450,550,650,750\}$.

Table I. Possibility Degrees of Demand

Demands	350	450	550	650	750
Possibility Degrees	0.22	0.35	1.00	0.73	0.29

Using (12), we calculate the profits (thousand JPY) (see Table II). For the sake of simplicity, we assume that the satisfaction function is $u(r)=(r+1350)/3600$, which is a linear function with $u(-1350)=0$ and $u(2250)=1$. The obtained satisfaction levels are listed in Table III.

Table II. Profits Obtained for Each Order Quantity

		Demands				
		350	450	550	650	750
Orders	350	1050	650	250	-150	-550
	450	450	1350	950	550	150
	550	-150	750	1650	1250	850
	650	-170	150	1050	1950	1550
	750	-1350	-450	450	1350	2250

Table III. Satisfaction levels Obtained for Order Quantities

		Demands				
		350	450	550	650	750
Orders	350	0.67	0.56	0.44	0.33	0.22
	450	0.50	0.75	0.64	0.53	0.42
	550	0.33	0.58	0.83	0.72	0.61

	650	0.17	0.42	0.67	0.92	0.81
	750	0.00	0.25	0.50	0.75	1.00

Let us explain the obtained results for order quantity 450 in detail. The ordered pair of the possibility degree and the satisfaction level at demand 550, i.e. [1.00, 0.64] is not dominated by the ones at the other demands, which means that demand 550 can bring the higher satisfaction with the higher possibility for the order quantity 450. Thus demand 550 is regarded as the active focus point of order quantity 450. Likewise, we can obtain the active focus points for the other order quantities. The active focus points are listed in Table IV and the satisfaction levels provided by each order quantity for active focus points are listed in Table V. By (9), the optimal active order quantity is 650.

Table IV. Active Focus Points of Order Quantities

	Order Quantities				
	350	450	550	650	750
Active focus point	550	550	550	650	650

Table V. Satisfaction Level for Active Focus Points

	Order Quantities				
	350	450	550	650	750
Satisfaction level for active focus point	0.44	0.64	0.83	0.92	0.75

Suppose the plausible demand information is characterized by a continuous possibility distribution $\pi(R, x)$ shown in (4). The optimal active order quantity and retail price can be obtained by the following theorems.

Theorem 1. For a fixed retail price *R*, the active order $q_o(R)$ is the solution of the following equation:

$$u(R, x, x) = \pi(R, x), \quad x \in [b_c - aR, b_u - aR]. \tag{13}$$

The active focus point of $q_o(R)$, i.e. $x_o^*(q_o(R), R)$ is $q_o(R)$.

Proof. In Guo and Ma (2014).

Theorem 1 indicates that for a fixed retail price, the focus point (selected demand) of the active retailer's optimal order quantity is the optimal order quantity itself. It means that under the fixed retail price, the active retailer has confidence that he/she can sell all the products that he/she has optimally ordered.

Lemma 2. If $\forall x \in [b_c - aR, b_u - aR]$, $\pi(R,x)$ and $u(R,x,x)$ are of class C^1, and $\pi_x(R,x) - u_x(R,x,x) \neq 0$, then $q_o(R)$ is a continuously differentiable function, and

$$q_o'(R) = \frac{\partial u(R,x,x)/\partial R - \partial \pi(R,x)/\partial R}{\partial \pi(R,x)/\partial x - \partial u(R,x,x)/\partial x}. \tag{14}$$

Proof. By Theorem 1 and the implicit function theorem, the proof is trivial. □

Theorem 3. The solution set of the following equation is denoted as $\Re_o$.

$$[q_o(R) + q_o'(R)(R-W)](b_c - aR) = 0. \tag{15}$$

Then the optimal active retail price is $R_o^* = \arg\max_{R \in \Re_o} r_o^*(R)$.

Proof. By Theorem 1, we know the active profit is

$$r_o^*(R) = r(R, q_o(R), q_o(R)) = (R-W)q_o(R), \tag{16}$$

which is differential. Then the proof is trivial. □

3. TWO-ECHELON SUPPLY CHAIN MODELS

A manufacturer produces a kind of innovative product and sells it to a retailer. The retailer faces a price-setting newsvendor problem as described in the above section. For simplicity, the manufacturer's production cost is assumed to be zero. The manufacturer acts as a Stackelberg leader, offering the wholesale price *W*. With conjecturing the retailer's order quantity *q*, the manufacturer charges an optimal wholesale price, which maximize his/her profit $f(W,q)$.

$$f(W,q) = Wq. \tag{17}$$

After observing *W*, the retailer decides the optimal retail price and optimal order quantity, which maximizes his/her own satisfaction level, and then the market demand is realized. The satisfaction function of retailer follows from the Definition 2, is written as $u(W,R,x,q)$. For the sake of simplification, with considering (5), (6) and (7), we set

$$u(W,R,x,q) = \frac{r(W,R,x,q) - r_l}{r_u - r_l}. \tag{18}$$

3.1 Lower Level Problem: the Retailer's Model

After observing the wholesale price W offered by the manufacturer, the retailer's chooses the optimal retail price and optimal orders to maximize his/her profit. As the demand x is

governed by the possibility distribution $\pi(R,x)$, based on the above analysis, the active retailer's decision-making procedure within the one-shot decision framework is described as follows:

Step 1: After observing the wholesale price W, determine the active focus point for each order quantity q for a given retail price R:

$$x_o^*(W,R,q) = \arg\max_x \min[\pi(R,x), u(W,R,x,q)]. \tag{19}$$

Step 2: Obtain the optimal order quantities $q_o(W,R)$:

$$q_o(W,R) = \arg\max_q \max_{x_o^*(W,R,q)\in X_o(W,R,q)} r(W,R,x_o^*(W,R,q),q), \tag{20}$$

where $X_o(q,R,W)$ is the set of active focus points $x_o^*(q,R,W)$.

Step 3: We have the optimal retail prices and optimal orders as lists.

$$R_o(W) = \arg\max_R r(W,R,x_o^*(W,R,q_o(W,R)),q_o(W,R)), \quad q_o(W) = q_o(W,R_o(W)); \tag{21}$$

3.2 Upper Level Problem: the Manufacturer's Model

The retailers' optimal response of order quantities for wholesale price *W*, i.e. $q_o(W)$ is obtained in the lower level problem. With consideration of (17), the manufacturer's payoff functions are as follows:

$$f(W,q_o(W)) = Wq_o(W). \tag{22}$$

4. CONCLUSION

With the one-shot decision theory, this paper examines the price-setting newsvendor models for the innovative product. The optimal order quantity and the selling price are obtained simultaneously. As an extension, a two-echelon supply chain model is studied. Due to the shorter lifecycle than the procurement lead-time, determine the order quantity and retail price is a typical one-shot decision problem. Instead of using the subjective expected utility theory (SEU), we utilize the one-shot decision theory (OSDT) to analyze the price-setting newsvendor problems. The proposed models are scenario-based which is fundamentally different from other models with SEU which are lottery-based.

The proposed models provide managerial insights into the active retailer's behavior and the behavior of manufacturer when he/she is facing the active retailer. The research on price-setting newsvendor problems for innovative products with OSDT is at an early stage. In this paper, the uncertainty of the demand is price dependent and modeled in an additive fashion; further research should consider the multiplicative fashion. Moreover, as a direct extension of this study, supply chain coordination problems for innovative products will be studied.

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CORPORATE SOCIAL RESPONSIBILITY (CSR): STRATEGIC IMPLEMENTATION AND ONLINE DISCLOSURE OF THE MINING INDUSTRY

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ABSTRACT
Implementing Corporate Social Responsibility (CSR) initiatives as part of a company's core strategies and operations helps in establishing a long-term profit orientation instead of short-term profit maximisation. Furthermore, responding to key stakeholder preferences complements effective communication strategies and will translate into positive corporate reputation. As key stakeholders expect relevant and transparent CSR disclosure, proactive communication helps to significantly stabilise trust building which is essential for the longevity of a successful company-stakeholder relationship. In the mining industry, significant environmental degradation is a global problem. We suggest that a well-developed communication policy will help to improve the completeness, transparency, accuracy and credibility of voluntary, non-financial reporting.

Keywords: Mining, Strategic CSR, CSR communication

INTRODUCTION

Responding to stakeholder preferences and implementing CSR initiatives as a company core strategy will arguably translate into positive corporate impact (Peloza, 2006). Companies which implement their CSR initiatives on a strategic basis will achieve excellent bottom line results (Michelon, Boesso & Kumar, 2013) and gain long-term competitive advantage (Porter & Kramer, 2006). Communicating CSR-related information effectively is a major expectation of some stakeholder groups. In Argentina, stakeholders adjacent to mining sites argue that inadequate communication, such as complicated access to information, as well as deficits in its completeness, transparency and accuracy, are major reasons for rejecting the mining industry and distrusting their notional CSR engagement (Mutti et al., 2012). A reliable communication method is supposed to balance any conflict between stakeholder groups, such as governments, non-government organisations (NGOs), local communities, or trade unions, and mining companies. Over time, the level of communicating CSR initiatives to different stakeholder groups has slowly achieved a higher standard in some countries. However, there is still room for improvement in terms of relevance, transparency and maturity of reporting practices (Perez & Sanchez, 2009).

In Australia, neither businesses nor the broader community appear to show deep interest in CSR as a factor in business activities. Instead, there is a relative silence in respect of CSR and

CSR-related reporting. Arguably, media reports about mining issues tend to focus on protest activities. Stakeholder groups seem to confine themselves to protests about specific problems, rather than taking a broader view of the concepts involved in CSR.

This paper surveys strategic management and CSR as a management tool, followed by an overview of CSR in the mining industry, stakeholders' (e.g. investors, employees, local communities) expectations and perceptions about CSR activities, and corporate CSR communication strategies.

STRATEGIC MANAGEMENT

A business strategy seeks to create a unique and valuable competitive position, where the chosen set of operational activities is different from those of competitors. Successful strategies depend on the tailored fit among a chosen set of activities, which will then contribute to profitability and sustainability. A fundamental issue of developing a winning strategy is to make the decision about which group of stakeholders to target and in which way to focus that strategy. Therefore, implementing strategies requires persistent management discipline and a straightforward internal communication to employees, to guide them in their day-to-day operations. Consistency in implementing a strategy helps to communicate to internal and external stakeholders, such as employees, customers and shareholders (Porter, 1996). A productive organisational environment allows for the required employee behaviour and understanding to support successful corporate strategies and operations (Markides, 2004).

The essence of corporate strategy is to either perform activities differently, or conduct different activities compared to competitors, rather than undertake the same activities, but merely better (Porter, 1996). A distinctive strategic position ensures a competitive advantage. However, as no attractive strategy remains the same forever, flexibility is important to respond to aggressive rivals' imitations. It is essential to develop new strategic positions over time (Markides, 2004). Moreover, a strategy needs to be distinguished from operational effectiveness. While strategy is about combining activities, operational effectiveness seeks to achieve excellence in individual operations or functions. Both managerial approaches seek to achieve exceptional corporate performance as a primary business goal, but they are differently maintained (Porter, 1996).

Furthermore, strategy is associated with competitive positioning. In order to achieve competitive advantage, a strategy has to “deliver a unique mix of value” (Porter, 1996, p. 64). In addition, trade-offs are an important component of strategy, because they avoid copying successful strategies from competitors. Trade-offs, especially in terms of positioning, are pervasive and ensure a long-term competitive advantage (Porter, 1996). Furthermore, fit among functional policies is important. Fit is a central part of competitive advantage and the exclusiveness of a competitive position can be increased by a fit of activities specific to the strategy. However, Porter also suggests that some fit among other activities can apply to many organisations and, as such can be seen as generic (Porter, 1996). Markides (2004) also suggests that a company's individual set of activities has to be a market requirement, the chosen activities must fit and be in balance with each other and consequently, will form an interrelated system (Markides, 2004).

In summary, strategy is a core competence of general management, as it defines and communicates the firm's unique competitive position, determines trade-offs and maintains an important fit among business operations (Porter, 1996).

CSR as a strategic management tool

According to Porter and Kramer (2006), CSR approaches "are so fragmented and so disconnected from business and strategy as to obscure many of the greatest opportunities for companies to benefit society" (p. 4). Many companies invest in social issues as a short-term strategy to fight loss of reputation. Consequently, they engage in CSR activities in a "haphazard, reflexive response to short-term challenges" (Werbel & Wortman, 2000, p. 125). Yet many companies neglect to consider the economic element of CSR initiatives and assess them as 'dead cost-factors' (Murray & Montanari, 1986). In order to gain long-term competitive advantage, Porter and Kramer (2006) suggest focusing on the interdependence of corporate financial goals and CSR activities, and as a result, implementing CSR initiatives in the company's strategies and operations. Furthermore, responding to stakeholder preferences and implementing CSR initiatives accordingly as a company core strategy will translate into positive corporate impact (Peloza, 2006). According to Michelon, Boesso and Kumar (2013) companies which implement their CSR initiatives on a strategic basis achieve excellent bottom line results.

Strategic CSR

Any type of strategic CSR is defined as an integral part of a company's core strategies to obtain competitive advantage by differentiation (Porter & Kramer, 2006). Therefore, CSR is not primarily classified as a cost driver but seen as a long-term investment (Heugens & Dentchev, 2007; McWilliams, Siegel & Wright, 2006). Baron (2001) suggests that companies which voluntarily engage in CSR will be rewarded through increasing demand. Thus a corporation which invests in CSR will enhance both societal and corporate benefits. Accordingly, CSR contributes to the company's competitive advantage by following a strategy of profit maximisation which is partly self-interested (Baron, 2001). Baron defines strategic CSR as "redistribution to appeal to a stakeholder group for the purpose of increasing demand for its products or reducing its costs" (Baron, 2001, p. 12). Apart from the societal benefit, this type of CSR is characterised by increasing corporate effectiveness (increasing demand for its products), or efficiency (reducing its costs) (Meyer & Wassmann, 2011).

Strategic CSR seeks to implement social responsibility such that not only society, and particularly relevant stakeholders, but also the organisation, will benefit from specific CSR initiatives (Baron, 2001; Lantos, 2001; Porter & Kramer, 2008). Consequently, CSR activities are strategic if they generate not only societal benefits but also corporate advantages (a win-win situation) (Meyer & Wassmann, 2011). Strategic CSR seeks to overcome the trade-off between profit maximisation and social responsibility by linking societal benefit with economic incentives (Handelman & Arnold, 1999; Kraft, 1991; Meyer & Wassmann, 2011). A company can conduct CSR reactively or proactively. Reactively means a tactical behaviour, when a company implements specific CSR activities only after a corporate misbehaviour or after stakeholder pressure. Whereas reactive CSR responds to specific problems, strategic CSR seeks proactively to find opportunities for social corporate engagement, which refers to the company's value chain as well as the competitive environment (Meyer & Wassmann, 2011; Porter & Kramer, 2008; Wagner, Lutz & Weitz, 2009).

Vaaland, Heide and Grønhaug (2008) define strategic CSR as follows: “Corporate social responsibility is management of stakeholder concern for responsible and irresponsible acts related to environmental, ethical and social phenomena in a way that creates corporate benefit” (p. 931). Compared with the generic CSR definition, this approach explicitly highlights that corporate responsibility toward specific stakeholder groups in terms of economical, environmental and social aspects will be implemented at its best, if specific CSR initiatives include an additional profit for the organisation (Meyer & Wassmann, 2011). Strategic CSR is no zero-sum game but represents a corporate motivation to generate additional societal wealth through profit incentives (Lantos, 2001). In addition, strategic CSR seeks to achieve long-term profit orientation instead of short-term profit maximisation (Meyer & Wassmann, 2011).

Strategic implementation of CSR

In order to provide both social benefit and economic advantages for the organisation, the scope and content of CSR initiatives must be implemented as an integral part of the company's core strategies (Porter & Kramer, 2008). Against this background, Porter and Kramer (2008) suggest a management framework for CSR implementation based on two different procedures. The first step seeks to identify existing value activities, which have already had a positive effect on the socio-ecological environment of the company or are subject to appropriate modifications. This procedure is based on an inside-out perspective. The second step requires an analysis of the competitive surroundings, indicating how the company may benefit from proactively influencing its environment. This procedure is based on an outside-in perspective. (Porter & Kramer, 2008). The double-sided approach is required for implementing CSR, in order to position appropriate CSR activities in both the corporate core strategies and the environment, where both the company and the society benefit from a high level of strategic CSR implementation (Porter & Kramer, 2008).

CSR IN THE MINING INDUSTRY

It is the nature of the mining industry to exhibit a relatively temporary activity “although some mines might have a lifespan of close to 40 years” (Cronjé & Chenga, 2009, p. 413), beginning with exploring, developing and operating the mine until closing down and rehabilitating the site. (Heath, 2009). In general, mining has a bad reputation in terms of social responsibility over this life span (Lambert, 2001; Sandbroke & Mehta, 2002).

Environmental impacts

Significant environmental degradation is a concern, and this is usually irreversible (Cowell et al., 1999; Mutti et al., 2012). In addition, environmental degradation may include disastrous industrial accidents. Environmental impacts affecting the air, water and soil (Vintró et al., 2012) are the most important concerns included in the CSR policies of mining companies (Heath, 2009). Apart from environmental issues, the mining industry is also well known for its harmful social impacts, encompassing health and safety concerns, violations of humans rights and impact on the livelihood of local, often Indigenous, communities (Mutti et al., 2012).

Balancing environmental issues with the goal of profitability has been a challenge within the entire mining industry for numerous years. In Australia, the mining sector, more than in any other industry, is associated with ignoring the business case for CSR and maintaining an

emphasis on profitability, rather than considering the moral or social aspects associated with CSR (Trebeck, 2008). There is a clear emphasis among mining managers on the financial bottom line, rather than investing in environmental and social initiatives (Altman & Martin, 2009).

Social impacts

Social concerns are much more than problems with local communities: they encompass also governance and regulations, developer perspectives, internal governance, and labour relations and industry culture. As continuing new drivers for the social part of CSR engagement emerge, such as the industry's self-regulation, the minerals industry in Australia began discussing the idea of "developing formal accredited qualifications for practitioners in the community relations sector" (Solomon, Katz & Lovel, 2008, p. 147).

In response to "dismal human living conditions" (Lange & Kolstad, 2012, p. 134), which organisations often meet in proposed mining areas, mining companies usually begin with an approved set of CSR activities which "include building schools and health facilities, providing infrastructure like roads, wells and water-pipes, sanitary facilities, access to electricity and a number of other initiatives" (Lange & Kolstad, 2012 p. 134). In developing countries, costs for investing in sustainable development in terms of health and safety issues, education and basic infrastructure are being carried by the mining firm itself, whereas in developed countries, "these costs are shared with different contributors" (Vintró et al., 2012, p. 120).

However, some specialists and scholars blame companies for fulfilling corporate objectives, rather than engaging in genuine community involvement, which can be harmful rather than supportive (Lange & Kolstad, 2012). Vintró et al. (2012) suggest that mining companies tend to engage more in environmental issues rather than social concerns. Mining firms are well advised to analyse local communities in terms of interests and power in order to maintain a differentiated stakeholder approach and to obtain beneficial community development (Esteves 2008; Lange & Kolstad 2012). As more management systems are implemented to handle sustainability concerns, systematisation of business procedures will improve strategic CSR management (Vintró et al., 2012). The mining industry, with its comprehensive fields of corporate responsibilities, such as environmental and social concerns, is in the unique position of pioneering CSR in the context of sustainable development (Heath 2009; Hilson 2011).

Sustainable development

However, social CSR activities were not included until after 'sustainable development' was introduced as a concept in 1987. The Brundtland Report (1987) defines the paradigm of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987; Heath, 2009).

Canada, which "contributed an estimated 34% of the world's total exploration budget" (Fitzpatrick, Fonseca & McAllister, 2011, p. 376), is also the pioneer in terms of creating international sustainability initiatives. In 1993, the Mining Association of Canada (MAC) created the 'Whitehorse Mining Initiative' (WMI) which, as an industry-led initiative,

outlined voluntary environmental regulations. Its core outcome, the Leadership Council Accord, set up a policy framework for "dealing with issues related to mining in Canada in a cooperative and collaborative manner" (WMI, 1994). The WMI aimed at an approach to mining in Canada in accordance with sustainability. Subsequently, multi-stakeholder consultative initiatives were undertaken in order to find solutions for concerns about contentious questions of how to exploit the land. The WMI acted as a blueprint for similar approaches to stakeholders in Brazil and South Africa (Fitzpatrick, Fonseca & McAllister, 2011).

In 2004, MAC shifted from the ambitious and holistic approach of WMI to their initiative 'Towards Sustainable Mining' (TSM) which focuses on four specific areas in terms of performance indicators and principles guidelines. Energy efficiency and reduction of CO_2 emissions, external outreach, crisis and tailings management came to the fore. Furthermore, concerns related to Indigenous people and biodiversity conservations were addressed. TSM now includes monitoring, verification and reporting. However, even after many other initiatives dealing with sustainability have been launched in the mineral sector since the beginning of the 21st century, mining and sustainability are still incompatible bedfellows in the mind of numerous academics and practitioners (Cowell et al., 1999; Fitzpatrick, Fonseca & McAllister, 2011; Heath, 2009; Lambert, 2001; Sandbroke & Mehta, 2002; Vintró et al., 2012; Young & Septoff, 2002), although some academics describe the positive impact of CSR initiatives (Walker & Howard 2002; Wheeler et al. 2002).

Mining companies in developing countries, such as Tanzania, which engage in community development as part of their CSR activities, most likely face unfavourable results if they disregard the often complex distribution of power within local communities. Instead of improving development prospects by conducting conducive corporate community involvement activities, a firm might fail totally and abet dysfunctional political behaviour at the local level by unintentionally "adding to the power of unaccountable local elites" (Lange & Kolstad, 2012, p.135). As a result, distrustfulness between members of the local community may have a significant impact on the development of the entire community (Lange & Kolstad, 2012). Only in the last decade, a new paradigm in addition to 'sustainable development' has emerged, namely 'social licence to operate' (SLO).

Social licence to operate

Increasingly, local communities have become a very important group of stakeholders as governance actors. The previous distribution of conventional CSR activities is no longer sufficient to protect mining companies from opposing stakeholder groups, as the latter demand a "greater share of benefits and increased involvement in decision-making" (Prno & Slocombe, 2012, p. 354). Local communities seek progressively to negotiate private benefit agreements with mining companies to achieve a tailored set of company CSR activities.

In return, local communities give the licence to operate and abandon opposition to mining development (Prno & Slocombe, 2012). This approach to social responsibility is pragmatic, as it indicates exactly those social demands which matter for local stakeholders and enables the company to address them. In addition, SLO allows for constructive dialogue with governments, community members and activists, which makes it a favoured approach for

permission-dependent industries such as mining and extracting industries (Porter & Kramer, 2006).

However, there is no unique definition of what a social licence to operate should encompass, as it is understood to be not materially available (ie. not registered) compared to regulatory licences for mining affairs. Instead of engaging in long-term development by means of CSR activities, mining companies tend to use SLO to minimise stakeholders' resistance for short-term profitability purposes.(Owen & Kemp, 2013; Porter & Kramer, 2006). The mining industry takes SLO as a label to demonstrate its efforts to meet stakeholder expectations. There is evidence that companies' expectations of what is essential and preferable in terms of sustainable development differ significantly from those of stakeholders. Therefore, by way of SLO, an 'expectation gap' emerges because companies presume to have approval for their requirements, whereas the demands of their stakeholders may be notably different (Owen & Kemp, 2013).

Although the Mining Association of Canada recommends appropriate and proven sets of CSR activities based on the paradigm of sustainable development, which is evidence of a broad awareness of social, cultural and environmental needs, this advanced understanding of CSR is not necessarily accepted among mining companies. Instead, Canadian mining companies operating in Mexico negotiate private benefit agreements with local communities adjacent to their proposed mining site, in order to ensure a supportive corporate-community relationship embedded in a social contract. Instead of targeting potential stakeholders and applying non-specific CSR activities to the community, the companies respond to assessments of needs established by the local community and align these to the mine's economic success (Weaver, 2012). The social licence to operate seems to become an effective model, which works through various social, political, and economic contexts (Prno & Slocombe, 2012).

Social licence to operate used as a strategic tool by highly influential stakeholders compels mining companies to respond to stakeholders' demands. The fear of failing to enhance their reputation, losing employees' retention and motivation, failing to improve stable market conditions for suppliers and consumers, as well as demands from institutional investors, are the strongest drivers for adopting comprehensive CSR activities (O'Faircheallaigh, 2013; Trebeck, 2008).

However, Australian mining managers see SLO as a real and important aspect which must be considered in planning initiatives, although SLO results are very difficult to verify. SLO as a management instrument to respond to stakeholders' expectations about resource development is difficult to achieve, but easy to lose. Regarding SLO, local communities are stakeholders with top priority. In addition, the concept of SLO may expand the scope of contractual partners, encompassing important complementary stakeholder groups. As a result, various SLOs with different stakeholder groups may exist at the same time. Mining managers closely associate SLO with other concepts of corporate duties, namely sustainable development and corporate social responsibility (Lacey, Parsons & Moffat, 2012). They classify SLO either as a supplement nestled between the other concepts or as a less important element in the hierarchical order of CSR concepts. It can be distinguished from CSR by its significantly local characteristics, rather than the bureaucratic and procedural elements of

CSR. Finally, mining managers consider SLO as a dialogue-driven instrument to maintain future freedom to operate a mine (Lacey, Parsons & Moffat, 2012).

Over the last 30 years, 75% of mining closures were premature and in times of global economic instability the number of unplanned closures almost doubled (Laurence, 2011). In times of global economic crises, the risk of unplanned mine closure becomes an important issue for mining companies and affects reliable CSR behaviour. Particularly in Australia, remote residential mining communities, due to their significant dependence on mining companies, rely on guaranteed certainty in terms of community development, employment, and participation in decision-making and wealth through giving a social licence to operate. Therefore, an unplanned premature mine closure, which has not been negotiated as part of SLO, leaves these communities with massive social, economic, and environmental problems. In order to remain responsible, Browne, Stehlik and Buckley (2011) suggest that mining companies provide for the risk of sudden mine closure, as part of their CSR strategies. Indigenous and First Nation people are the preferential beneficiaries of SLOs and ILUAs (Indigenous Land Usage Agreements), the preferred term in Australia.

Stakeholders' perceptions

In many countries there are prevalent perceptions among various stakeholder groups, that CSR activities of mining companies are only 'window dressing' and have no real intention of providing local communities with long-term benefits. They either experience CSR as a lip service or perceive it as a manipulative tool, which enables mining companies to achieve their business goals, rather than maintaining community involvement on an ethical level. Thus there is a significant difference between stakeholders' CSR expectations and what they think mining companies conduct. It is imperative for a company to tailor its CSR communication to the specific needs of different stakeholder groups (Du, Bhattacharya & Sen, 2010). The products of the extracting industry, such as minerals and noble metal, are essential for the mining industry's economic results. Most often these products are found in sensitive environments. (Heath, 2009; Kepore & Imbun, 2011). However, complex and adverse environmental circumstances in these areas often challenge even the best intentions of companies' CSR activities in terms of environmentally and socially friendly extraction(Heath, 2009).

CSR COMMUNICATION

There is an "increasing prominence of CSR for a wide range of stakeholders, from consumers and employees to legislators and investors" (Dawkins & Lewis, 2003). In addition, other researchers enlarge the main stakeholder groups by adding the local community and the environment (Lepoutre & Heene, 2006; Wulfson, 2001). Even a single person can have various stakes in a company, e.g. as a customer, a prospective employee or investor (Neville & Menguc, 2006). Furthermore, these different audiences vary in terms of their expectations of business and information needs. Thus they may respond differently to the various communication channels of CSR.

However, the primary target addressees are analysts, investors and the business press. Nevertheless, there is public interest in receiving reliable information as to companies' responsibilities (Bowd, Bowd & Harris, 2006). Research has suggested that companies communicate information about their CSR initiatives "in line with what their key stakeholders

expect" (Sweeney & Coughlan, 2008). Social responsibility disclosure refers to the disclosure of information about organisations' interaction with stakeholders (Branco & Rodrigues, 2006). Messages about corporate ethical and socially responsible activities are likely to suggest strong and often positive reactions among stakeholders. Research has established that, the more companies expose their ethical and social objectives, the more likely they are to attract critical stakeholder attention (Ashford & Gibbs 1990, in Morsing & Schultz, 2006).

Drivers of disclosure

The most effective driver to non-financial corporate reporting in the mining industry is criticism from civil society organisations (Perez & Sanchez, 2009), as well as external pressure, risk and reputation management, moral matters and support of better investor relation and corporate performance (Fonseca, 2010; Spence & Gray, 2007). Since the 1990s (Perez & Sanchez, 2009), the mining industry was among the first businesses to communicate environmental issues (Jenkins & Yakovleva, 2006), due to increasing societal pressure. Mining companies were also among the first to introduce stand-alone Environmental Reports (Fonseca, 2010; Mutti et al., 2012). The industry is now moving towards a leadership role of communicating social and environmental information (Jenkins & Yakovleva, 2006).

Thus sustainability reports have evolved as an important tool for mining companies to demonstrate their commitment to a triple bottom line, appropriate CSR initiatives and local community relations (Jenkins & Yakovleva, 2006). In addition, O'Connor and Gronewold (2012) found that global companies in the petroleum industry use environmental sustainability reports to emphasise their competitive advantage (Vintró et al., 2012), as well as their commitment to CSR. Specific methods of communicating CSR-related information are used, dependent on CSR activities conducted, the company's position within the industry, and particularly intra-industry regulations and pressures. As such, sustainable communication is significantly influenced by industry values, norms, and corporate idiosyncrasies (O'Connor & Gronewold, 2012). However, sustainability reports, instead of minimising clashes, can have a paradoxical effect if community concerns are not properly communicated in the report (Murguía & Böhling, 2013).

Particularly within the mining sector, mineral associations such as the Mining Association of Canada (MAC), the Mineral Council of Australia (MCA) and the International Council on Mining and Metal (ICMM) are insisting their members disclose sustainability reports according to their specific frameworks, guidelines and indicators. On the other hand, the Global Reporting Initiative (GRI) provides principles for voluntary sustainability reporting in their Mining and Metals Sector Supplement (MMSS) (Fonseca, 2010; Murguía & Böhling, 2013). In Australia, companies tend to report on sustainability, because they seek to disclose information about possible impacts according to the firm's performance and different strategies to stakeholders other than shareholders. Furthermore, they report information about financial performance and how well they deal with non-financial and financial risks (Parliament of Australia, 2010).

Types of disclosure

There are different types of corporate disclosure communicating information about the social and environmental issues of mining companies. Less detailed information, which is qualitative in nature rather than quantitative, can be found in mandatory reports, such as

Financial Reports and Annual Reports. However, because these types of disclosure are required by legislation and published by all companies, the information is spread widely (Jenkins & Yakovleva, 2006).

In contrast, stand-alone Environmental Reports usually encompass information about the mining company's "environmental policy, their principal problems, their performance and information on the environmental consequences of the companies' activities" (Jenkins & Yakovleva, 2006, p. 273). By communicating environmental issues via a stand-alone report, the company shows its commitment to a wide range of stakeholders and its attitude towards environmental management strategies. Apart from environmental topics, contemporary stand-alone Sustainability Reports cover areas such as health and safety, employee, and community matters (Jenkins & Yakovleva, 2006). It has been found that companies in the mining industry use different approaches to communicate their non-financial information, most likely influenced by stakeholder demands for specific information, company resources and advisors with expertise in sustainability reporting (Perez & Sanchez, 2009).

Media of disclosure

Over time, a notable variety of media, such as *Mining Australia, ECOS Magazine Australia, The Environmentalist, The Green Lifestyle Magazine* or *Landscope*, has come into use to disclose social and environmental information. Besides advertisements and articles, booklets and leaflets, specific product labelling and press releases, a company's website has become a favoured communication medium (Jenkins & Yakovleva, 2006; O'Connor & Gronewold, 2012). The Web enables companies to communicate all types of reports and information (Annual Report, Financial Report, Site-specific Reports, Sustainability Reports) in a constantly updated version, which makes it an attractive tool for companies and stakeholders alike. However, there is also the risk of negative stakeholder comments if companies perform and report inadequately (Jenkins & Yakovleva, 2006).

The highly interactive nature of the Web has led to its proactive use to engage influential stakeholders and foster public consultation to shape policy (Esrock & Leichty, 1998). This has precipitated an increase in stakeholders' interest regarding online communication of companies' CSR initiatives. Thus, in order to remain competitive, it is essential that companies use the Web, as it is one of the most cost-effective means of communication in today's world for corporate purposes (Lakatos, Gazdac & Dan, 2011). With the advent of the Web and the opportunities offered by online communication, a very low cost mass communication solution is available with permanent access and updating options, that make it even more flexible and applicable than standard print media (Dincer & Dincer, 2010).

Successful firms use the Internet and their websites to communicate their CSR initiatives. Relationships with internal and external stakeholders are fostered by publishing ethical statements as well as specific CSR activities in terms of environmental policies (Snider, Hill & Martin, 2003). The use of websites for communicating CSR initiatives is rising among organisations in response to changing local, national and global societal expectations concerning business practices (Isenmann, 2006). For most organisations, the corporate web site now represents an instant and full-blown information hub. It is an ideal channel through which corporate messages that outline, improve or maintain the company's corporate identity and reputation are communicated (Rolland & O'Keefe Bazzoni, 2009). Nevertheless,

although the World Wide Web has emerged as a required medium for corporate communication purposes, its use may be limited to specific content (Moreno & Capriotti, 2009).

Comprehensiveness, credibility and assurance

A lack of credibility is the most important point of critique related to voluntary social and environmental disclosure. Unlike Annual and Financial Reports, which have to be audited before disclosure, there are no obligatory rules for Sustainability Reports in terms of form, structure and content. As a result, social and environmental information is not yet standardised and therefore hard to measure and quantify unless audited by third party verification (Emel, Makene & Wangari, 2012; Jenkins & Yakovleva, 2006; Perez & Sanchez, 2009). Verifications could also mean audits, where external stakeholders participate in the reporting process about community development (such as government inspections), the local community and rigorous accounting standards (Emel, Makene & Wangari, 2012). The largest global mining companies adhere to GRI standards or follow national industry reporting guidelines (Perez & Sanchez, 2009). However, companies tend to select information they want to communicate, which makes it difficult to compare data either between reports of different years, or even between companies within the same industry (Jenkins & Yakovleva, 2006).

The International Council on Mining and Metal (ICMM) launched an assurance procedure based on standards such as the International Standard on Assurance Engagements (ISAE 3000), AccountAbility Assurance Standards (AA1000AS) and G3/G4 GRI guidelines (including 10 reporting principles). Although a few companies now report assured information on sustainability, credibility in the assurance procedure is still a matter of concern among stakeholders, because the assurors seem to be directed by management. Presently, it is unclear as to whether the ICMM Assurance Procedure might encourage mining companies to report beyond GRI guidelines (Fonseca, 2010).

Expectations of CSR disclosure

In order to build good relationships with the communities located near a mining area, Cronjé and Chenga (2009) recommend establishing a strategically organised communication department. This department should encourage stakeholders to participate in communication about the mine's corporate social initiatives and also maintain interaction with the government, communities and activist groups, in order to avoid difficulties during acculturation processes (e.g. overcoming apartheid in South Africa) and building power relationships (e.g. unequally distributed power of communities, governments and mining companies) (Cronjé & Chenga, 2009).

CONCLUSION

In order to comply with a modern and effective CSR concept, it seems to be inevitable to site CSR strategically within a company's core strategies. Apart from anticipated positive effects on corporate profitability, reputation and competitive advantage, effective CSR communication strategies, as part of strategic CSR, will have a positive impact on key stakeholders' expectations and demands in terms of environmental and social corporate initiatives. Using contemporary communication channels, such as the World Wide Web, to

disclose appropriate CSR initiatives in accordance with related economic success and social benefits, is essential.

Due to the poor reputation of the mining industry in terms of balancing economic, environmental and social interests, mining companies need an effective communication strategy in order to avoid resistance of environmentalists and other key stakeholder groups. Over time, the social licence to operate as part of a strategically implemented CSR has become a promising instrument to respond individually to affected key stakeholders. SLO allows a specific response to key stakeholders' demands, rather than conducting CSR activities on an unspecific, more general level.

Communicating environmental and social CSR initiatives as well as disclosing corresponding bottom line results with regard to economic and societal impact, allows for a dialogue between mining companies and specific stakeholder groups. If CSR-related information is communicated honestly, comprehensively and proactively, key stakeholders are most likely to avoid resistance and instead, support a company. However, assurance of CSR-related disclosure will help to achieve a high standard of transparency and credibility. Otherwise, CSR, and predominantly CSR in the mining industry, will most likely remain being seen as lip service and window dressing.

The Australian mining industry in particular has a good opportunity to increase its credibility in terms of conducting corporate social responsibility, since appreciating and implementing strategic CSR concepts will improve the scope and quality of online communication strategies. In Australia, the Minerals Council of Australia (MCA) anticipated the need of 70,000 additional mining employees by 2015, which implies challenging social, recruitment and business opportunities for the Australian mining industry (Altman and Martin 2009). Against this background, it becomes an increasing challenge for Australian mining companies to expand their CSR activities to broader social dimensions (Solomon, Katz & Lovel, 2008).

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The Impact of Trust-Building Mechanisms and Trust Transference on Online Group Buying

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ABSTRACT
While many other Internet business applications have fallen by the wayside, the online group buying continues to be a highly popular avenue for web-based trade. However, lots of new online group buying sites have emerged, thereby intensifying competition among these websites since the Internet makes it relatively easy to switch from one website to another that provides the same products or services. Likewise, understanding the determinants influencing consumer's group buying intention and related behaviors will be vital for maintaining the closed relationships with existing customers and thus facilitating new relationship with potential ones. Based on the perspectives of trust building mechanisms proposed and trust transference, the primary objectives of this research are twofold: (1) to investigate determinants of trust in online group buying website and trust in initiator and their influences on users' participation intention in online group buying and (2) to explore the effect of trust transference from online group buying website to group buying initiator. The proposed model is tested on real-world data collected from group buying consumers of several well-known marketplaces. Results show that both trust in website and trust in initiator could positively increase buyers' intention to participate group buying. Moreover, as expected, the effect of trust transference (from online group buying website to initiator) is significant. Moreover, Our findings also show that structural assurance and situational normality have significant effects on consumer's trust in online group buying website, and both disposition to trust and user endorsement have significant effects on consumer's trust in initiator. Implications for practitioners and researchers are also addressed in this study.

Keywords: Online Group Buying, E-Commerce, Online Trust, Trust-Building Mechanism, Trust Transference

INTRODUCTION

With the advent of e-commerce and social marketing tools, the trend of online group buying has been increasingly important and becomes a huge market in the world, and it still continues to grow in size. In China, there are over 1500 online group buying websites have been commenced and the total revenue created from such market is projected to reach RMB$ 980 million (US$ 147.6 million). In Taiwan, the group buying revenue increased from NT$13 million in 2008 to NT$ 400 million at the end of 2012, however, such number is still increasing continuously (Money Link, 2013). Consequently, lots of new online group buying sites have emerged, thereby intensifying competition among these websites since the Internet makes it relatively easy to switch from one website to another that provides the same products or services. Administrators for these websites have to provide needed value for their customers in order to remain competitive in maintaining active member participation, attracting new members, or even receiving more advertising support. Likewise, understanding the determinants influencing consumer's group buying intention and related behaviors will be vital for maintaining the closed relationships with existing customers and thus facilitating new relationship with potential ones.

Online group buying can be best described as a social or collective buying behavior. When enough buyers participate in the group buying process, buyers can purchase their interested products with significant volume discounting because of demand aggregation (Cheng and Huang, 2013). Group buying can be initiated by buyers (customer-initiated), sellers (merchants-initiated) or others (third-party-initiated). This study focused on the context of "customer-initiated online group buying" since it is the most popular group buying form, and this type of group buying can benefit consumers from their collective bargaining opportunity for negotiating prices with sellers (Ku, 2013).

Initiator will be the key person when initiating a customer-initiated online group buying. The initiator negotiates the amount and discounted price from sellers and then recruit enough participants for goods or service purchase. Therefore, higher feelings of trustworthiness toward the group buying website and the initiator could positively strengthen customer's intention to join group buying since higher degree of trust formation could reduce consumer's concerns about possible uncertainties or potential opportunistic behaviors, and increase buyers' expectation and commitment toward their sellers, thereby raising higher chance for further transaction in near future (Kim et al., 2008; Pavlou, 2003). Despite the importance of trust in online group buying context, the exploration on the determinants affecting consumer's trust toward online group buying website and initiator are still limited. Besides, Studies pertaining how trust in online group buying website and trust in the initiator are related are also scant.

The primary objectives of this research are twofold: (1) to investigate determinants of trust toward online group buying website and trust toward initiator and their influences on users' participation intention in online group buying and (2) to explore the effect of trust transference from online group buying website to group buying initiator. Based on the perspectives of trust building mechanisms proposed by Zucker (1986) and trust transference proposed by Stewart (2003), we hope to provide insights to online group buying vendors and assist them in designing better strategies to engender consumers' initial trust and more holistic view on consumer's online trust formation mechanisms for scholars and practitioners.

THEORETICAL BACKGROUND AND HYPOTHESES

We develop our research model by identifying key constructs and hypotheses, as illustrated in Figure 1. We assert several hypotheses: (1) brand image, structural assurance and situational normality will affect user's trust in online group buying website, (2) user endorsement toward initiator will influence user's trust in online group buying initiator, (3) both trust in online group buying website and trust in initiator affect user's intention to participate online group buying, and (4) trust in online group buying website is posited to influence user's trust perception in initiator, the trust transference effect. The following section elaborates on these relationships and explains the theoretical underpinning of these hypotheses.

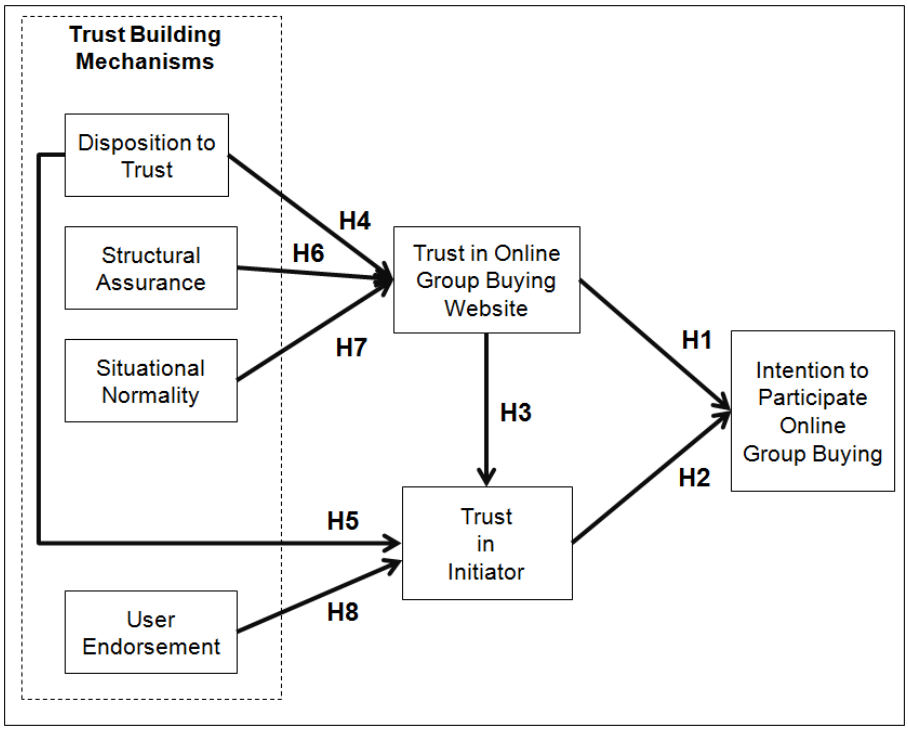

Figure 1 – Research Model

Conceptualizing Trust

Trust, as a social phenomenon, has been acknowledged in several science disciplines such as sociology, psychology, economics, marketing, management, organizational behavior, and most recently, e-commerce (Kim et al., 2004). An examination of trust-related literature reveals that in spite of significant interest in researching trust issues, there is no universally accepted scholarly definition of trust. For example, trusting behavior is seen in psychology as a personal trait, a personal tendency to trust others, or an expectancy held by an individual or a group that the word, promise, verbal or written statement of another individual or group can be relied upon (e.g., Rotter (1980)). Sociologists see trust as a social structure or a characteristic of the institutional environment (Zucker, 1986). In the economic field, trust is defined as an economic-choice mechanism or a state of mind, an expectation held by one trading partner about another, that the other behaves or responds in a predictable and mutually acceptable manner (Lewicki and Bunker, 1995). Synthesizing disciplinary perspectives, this study follows the definitions proposed by Mayer et al. (1995) and Rousseau et al. (1998) and

defines trust as "the willingness of a party (trustor) to be vulnerable to the actions of another party (trustee) based on the expectation that the other (trustee) will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party (trustee)".

Trust reflects an aspect of predictability – that is, it's expectancy. Trust exists in an uncertain and risky environment; if it did not, it would do so trivially (Bhattacharya et al., 1998). Through this perspective, trust could lead to a set of behavioral expectations among transactors, allowing them to manage the uncertainty or risk associated with their interactions so that they could jointly optimize the gains that would result from cooperative behavior (Jones and George, 2003). Since trust is essentially a value proposition that consumers might hold about the vendor and the related transactions, it can be developed and established in a relationship. Accordingly, it should come as no surprise that under these circumstances, trust is not only critical for the success of e-commerce, but it also has a substantial effect on business relationships in general (Gefen, 2000).

In online group buying context for this study, consumers can spend higher cognitive thinking for website evaluation and shape trust in online group buying websites, and subsequent transaction intention toward e-vendor website. Morevoer, consumers can also shape transaction intention toward online group buying website through trust in initiator, since initiator is deemed to be a trustworthy source for online group buying website, and initiator can be treated as important type of opinion leader and be a critical node or hub among a certain social network (Valente, 1995). From the viewpoint of consumers, online group buying initiators are then the important opinion leaders and reliable information sources for online group buying evaluations. Hence, we hypothesize the following:

Hypothesis 1: *Consumer's trust in online group buying website has a positive effect on his (or her) intention to participate online group buying.*

Hypothesis 2: *Consumer's trust in online group buying initiator has a positive effect on his (or her) intention to participate online group buying.*

The Effect of Trust Transference

Trust transference is a process by which consumers' trust in an unknown target is influenced by trust in associated targets (Uzzi, 1996). Trust may be transferred from different kinds of sources. For example, trust may be transferred from a third person, a place, or the context of an encounter. It relies on the unknown target being perceived as related to the source of the transferred trust. Such perceptions are based on the similarity, proximity, and common fate of the entities (Stewart, 2003). According to Stewart (2003), if the tie between two websites (e.g. consumers' "expectation on unity and consistency" of two sites) is high, then consumers form an initial impression from the first site they visit. This impression operates as a filter, causing consumers to interpret information from the second site consistently with the impressions they have already formed. For example, Zaheer et al. (1998) found a strong correlation between trust in an organization and trust in an individual within that organization.

In the online group buying context, a trusted online group buying website can also be expected to take steps to reduce buyer risk because it reduces transaction uncertainty by instituting regulations that restrict the ability of a seller (or a initiator) to engage in opportunistic behavior and provides guidelines of what constitutes acceptable transaction behavior (Pavlou and Gefen, 2004). Moreover, online group buying consumers who trust the intermediary (e.g., online group buying website) should also trust the initiators because of

their perceived association with the online group buying website and the trust enforcement mechanisms such as guarantee, feedback system, or other structures [44]. For example, several online group buying websites denote the reputation quality and experience scores for augmenting buyers' confidences toward initiators. Consequently, following the trust-transference logic (Stewart, 2003), we argue that consumer's trust in online group buying website is expected to increase the likelihood of consumer's trust in online group buying initiator. It means that trust could be transferred from online group buying website to individual initator. Hence we hypothesize that:

Hypothesis 3: *A consumer's trust in online group buying website will positively increase his (or her) trust in online group buying initiator.*

Mechanisms of Trust-Building

Zucker (1986) conceptualized that the central modes of trust production are characteristic-based trust, institutional-based trust, and process-based trust. *Characteristic-based trust* is related to a person and based on ethnicity or background. *Institutional-based trust* is tied to formal societal structures depending on firm-specific or individual attributes and on intermediary attributes. *Process-based trust* is tied to expected or past exchange, e.g. vendor's reputation or endorsement. Among the trust antecedents that identified in the above, we posit disposition to trust as characteristic-based trust, structural assurance and situational normality as institution-based trust, and user endorsement as process-based antecedents to two focal research constructs: trust in online group buying website and trust in initiator.

Characteristic-Based Trust: Disposition to Trust

Disposition to trust comes primarily from trait psychology, and it is defined as the extent to which an individual is willing to depend on others across a broad spectrum of situations (McKnight and Chervany, 2001-2002). Individuals first have their own upbringing and cultural issues which mold their persona and their overall disposition to trust (Tan and Sutherland, 2004). Such tendency is not based upon experience with or knowledge of a specific trusted part, but is the result of ongoing lifelong experience and socialization (Gefen, 2000; McKnight et al., 1998).

For instance, empirical studies show that American individuals have a higher general disposition to trust strangers (e.g., Yamagishi and Yamagishi, 1994). When people enter a new relationship, i.e., before they have time to form an assessment of whether they can trust the other person or organization, this disposition to trust could be looked upon as the necessary foundation in the formation of trust. As Gefen (2000) pointed out, disposition to trust is most effective in the initiation phases of a relationship when parties are still mostly unfamiliar with each other and before extensive ongoing relationships provide a necessary background for the formation of other trust-building beliefs, such as integrity, benevolence, and ability (McKnight et al., 1998). The more customers are disposed to trust the other party (i.e., the online auction website and the seller), the less amount of risk they are likely to perceive (Gefen, 2000; McKnight et al., 1998).

Since disposition to trust is cross-situational and cross-personal (McKnight and Chervany, 2001-2002), empirical evidences also show that disposition to trust is a predictor of trust in an e-commerce context (e.g., Chang and Cheung, 2005; Gefen, 2000]). Accordingly, this study proposes that disposition to trust should influence people's trust in the online group buying website and the group buying intiator. Therefore, it is hypothesized that:

Hypothesis 4: *The stronger a buyer's disposition to trust, the more he will trust an online group buying website.*

Hypothesis 5: *The stronger a buyer's disposition to trust, the more he will trust the online group buying initiator.*

Institution-Based Trust: Structural Assurance and Situational Normality

Consistent with Zucker's argument, Lane and Bachmann (1996) also contend that trust-based buyer-seller relations rarely evolve spontaneously at the individual level, but are highly dependent on the existence of stable institutions. Therefore, institution-based trust means that one believes the necessary impersonal structures, such as the existence of third-party structures, are in place to enable one to act in anticipation of a successful future endeavor (McKnight et al., 1998). Institutions build trust either directly through adoption of professional standards or codes of ethics, or indirectly through the observance or administration of laws and regulations (Zucker, 1986).

McKnight et al. (1998) integrate various sources of institution-based trust and identify two dimensions namely, structural assurance and situational normality. *Structural assurance* means one believes that success is likely because guarantees, contracts, regulations, promises, legal recourse, processes, or procedures are in place that assures success. It serves as guarantees and constructs provided by the institution that deter opportunistic behavior and thus, allows for more successful transactions (McKnight et al., 1998). For example, Pennington et al. (2003) examine structural assurances that lead to system-based trust. They empirically show that guarantees can lead to increased system trust and increased perceived vendor trust, which in turn leads to an increase in the purchase intent of the buyer. *Situational normality* relates to the belief that "everything seems in proper order" based on superficial cognitive cues (Lewis and Weigert, 1985, p.974). McKnight et al. (1998, p.478) propose that a person entering a bank seeks reassurance from "the workers' professional appearance, the prosperous and secure physical setting, and the friendly, yet safe, money handling procedures".

For today's online e-commerce context such as online group buying, McKnight et al. (2002) define institutional-based trust as an individual's perception of how safe and secure is the online environment such as the Internet (termed structural assurance,) and how trustworthy is the online vendor (termed situational normality). Moreover, situational normality can be easily projected in virtual settings through well-designed customer interfaces, and it may involve a properly ordered setting that appears likely to facilitate a successful interaction. As such, we argue that people who perceive higher structural assurance and situational normality would believe the Internet environment and online group buying website vendors are appropriate and favorable for doing personal business in general. As such, institutional structures (institution-based trust) could positively generate a higher trust attitude toward vendors (e.g. online group buying). Therefore, it is hypothesized that:

Hypothesis 6: The perceived effectiveness of structural assurance will positively increase buyer's trust in online group website.

Hypothesis 8: The perceived effectiveness of situational normality will positively increase buyer's trust in online group website.

Process-Based Trust: User Endorsement

For today's online group buying context, satisfied user's endorsement can also become an effective way to reinforce the formation of trust (Lim et al., 2006). User endorsement

involves displaying positive testimonials from one or more satisfied customers on the Web site of a store or a specified person. As the concept of "unit group" indicated by McKnight et al. (1998), people who share common characteristics tend to perceive each other in a positive light and, hence, are more likely to trust each other. Besides, according to theory of reasoned action (TRA), along with the effect of individual's attitude on intention, the concept of subjective norms, such as social influence or word-of-mouth recommendations from peers, are also influential means of affecting one's attitude and behavior (Fishbein and Ajzen, 1975).

In this research, when potential group buying shoppers see several evidences of higher user endorsement toward an online group buying initiator such as higher visitor numbers, higher volume of positive word-of-mouth, sharing or interactions, these potential shoppers or users may thus transfer those evidences into their perceptions of trustworthy proofs, and these process-based trust proofs could therefore generate their higher degree of trust in online group buying initiator. This is especially essential for today's e-commerce since source credence generated through trustworthy sources can enhance buyer's confidence and trust for the expertise toward initiator. Thus, the following hypothesis is developed:

Hypothesis 8: User endorsement has a positive effect on user's trust in online group buying initiator.

METHODOLOGY AND RESEARCH DESIGN

Sample and Data Collection

In order to test our hypotheses, data was collected by using online survey questionnaire sent to users of several well-known online group buying websites in Taiwan, including ihergo (http://www.ihergo.com), PTT (http://www.ptt.cc), Groupon Taiwan (http://www.groupon.com.tw) and so on. We developed an online version survey and posted its URL on the above websites for about two months. The online survey yielded 229 completed questionnaires. Since 6 questionnaires were invalid, we obtained 223 valid responses. About 18.2% of the respondents were male and 81.8% were female. A majority (80.3%) of the subjects was between the ages of 21 and 40 and had at least a Bachelor's degree. They were also frequent and experienced members of the communities. Around 46.36% of the participants participated online group buying for 6 or greater times per month, and 66.4% of the respondents reported that their group buying amount is between NT$201 to NT$800 (US$ 6.5 to US$30).

Measurement Development / Operationalization of Constructs

The measures were drawn from previous studies whenever possible and were reworded to relate specifically to the context of the study. Moreover, the questionnaire items were reviewed by several information management and marketing scholars for clarity, and these items were modified following a pretest of the survey instrument with a certain number of real-case respondent samples. All items were seven-point, Likert-type scales anchored at "strongly disagree" (1), "strongly agree" (7), and "neither agree nor disagree" (4).

The disposition to trust scales are adapted from Gefen (2000). The institution-based trust items are based on McKnight et al. (2002). As for the user endorsement construct, we adopt it from Lim et al. (2006). For the trust in online group buying website construct, we adopt it from Gefen et al. (2003). And the trust in initiator scales are adapted from Gefen (2000). Finally, intention to participate online group buying was adapted from Zeithaml (1988).

DATA ANALYSIS AND RESULTS

Convergent and Discriminant Validity

We conducted the data analysis in two parts: scale validation and hypothesis testing. First, scale validation proceeded in two steps, namely convergent and discriminant validity analyses. Convergent validity was evaluated using three criteria proposed by Fornell and Larcker (1981): (1) all item factor loadings (alpha) should be significant and exceed 0.5, (2) composite reliabilities (CRs) for each construct should exceed 0.8, and (3) average variance extracted (AVE) for each construct should exceed 0.5 (in other words, the square root of AVE should exceed 0.71). In addition, internal consistency reliability is generally considered a necessary but not sufficient condition for convergent validity. Hence, Cronbach's alpha, which should be larger than 0.7, was also computed for each construct (Nunnally, 1978). Standardized confirmatory factor analysis (CFA) loadings for all scale items in the CFA model are significant at $p < 0.001$ and exceed the minimum loading criterion of 0.5. Besides, as illustrated in Table 1, the AVE of each construct exceeds 0.5, and CRs and Cronbach's alpha for all factors exceed the required minimum of 0.8 and 0.7 respectively. Hence, all three conditions for convergent validity are met.

Table 1 – Reliability, Correlation Coefficients and AVE Results

Variable	Mean	S.D.	Cronbach's Alpha	C.R.	AVE	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. SA	3.97	1.57	0.9	0.93	0.76	**0.87**						
2. SN	4.75	1.29	0.94	0.94	0.61	0.55	**0.78**					
3. T_WEB	5.40	1.32	0.85	0.91	0.78	0.14	0.40	**0.88**				
4. DISPOS	4.78	1.45	0.86	0.9	0.66	0.39	0.56	0.23	**0.81**			
5. T_INITIATOR	5.21	1.09	0.94	0.96	0.89	0.37	0.54	0.21	0.35	**0.94**		
6. INTENTION	5.07	1.21	0.72	0.85	0.61	0.31	0.58	0.29	0.31	0.74	**0.78**	
7. ENDORSE	4.64	1.37	0.9	0.92	0.62	0.45	0.56	0.29	0.26	0.51	0.54	**0.79**

Notes:
1. The main diagonal shows the square root of the AVE (Average Variance Extracted).
2. Significant at $p < 0.01$ level is shown in bold.
3. **C.R.** for Composite Reliability, **DISPOS** for Disposition to Trust, **SN** for Situational Normality, **SA** for Structural Assurance, **T_WEB** for Trust in Online Group Buying Website, **T_INITIATOR** for Trust in Online Group Buying Initiator, **ENDORSE** for User Endorsement, and **INTENTION** for intention to participate online group buying.

Meanwhile, discriminant validity is the degree to which measures of two constructs are empirically distinct. Discriminant validity is shown when the square root of each construct's AVE is larger than its correlations with other constructs (Chin et al., 2003). From the data presented in Table 1, we can see that the highest correlation between any pair of constructs in the CFA model was 0.74, and this figure is lower than the lowest square root of AVE among all of the constructs, which was 0.78. Hence, the discriminant validity criterion was also met for our data sample.

Hypothesis Testing

We use partial least square (PLS) to test the main effects specified in hypotheses H1 through H8, and the analyzed results as presented in Figure 2. PLS is a component-based structural equation modeling technique that enables the examination of measurement and structural models simultaneously and working with relatively small samples (Chin et al., 2003), which is the case in our study.

First, we predicted whether Trust in Online Group Buying Website (H1) and Trust in Initiator (H2) would be positively related to consumer's Intention to Participate Online Group

Buying. Consistent with our expectation, the analysis result showed that both Trust in Online Group Buying Website (beta = 0.143, p<0.05) and Trust in Initiator (beta = 0.713, p<0.001) have strong and significant effects on user's Intention to Participate Online Group Buying, thereby demonstrating support for H1 and H2 respectively. Second, we predicted whether Trust in Online Group Buying Website (H3) would be positively related to Trust in Initiator. Results show that Trust in Online Group Buying Website (H3) is significantly related to Trust in Initiator (beta = 0.128, p<0.05), rendering support for H3 and the effect of trust transference.

Third, both Structural Assurance (H6) (beta = 0.107, p<0.05) and Situational Normality (H7) (beta = 0.447, p<0.001) have significant and positive effects on users' Trust in Online Group Buying Website. However, Disposition to Trust (H4) has no any significant effect on users' Trust in Online Group Buying Website, and thus H4 is not supported. Lastly, both Disposition to Trust (H5) (beta = 0.233, p<0.001) and User Endorsement (H8) (beta = 0.437, p<0.001) have significant and positive effects on users' Trust in Initiator, providing support for Hypotheses H5 and H8. We will discuss these findings in detail in the next section.

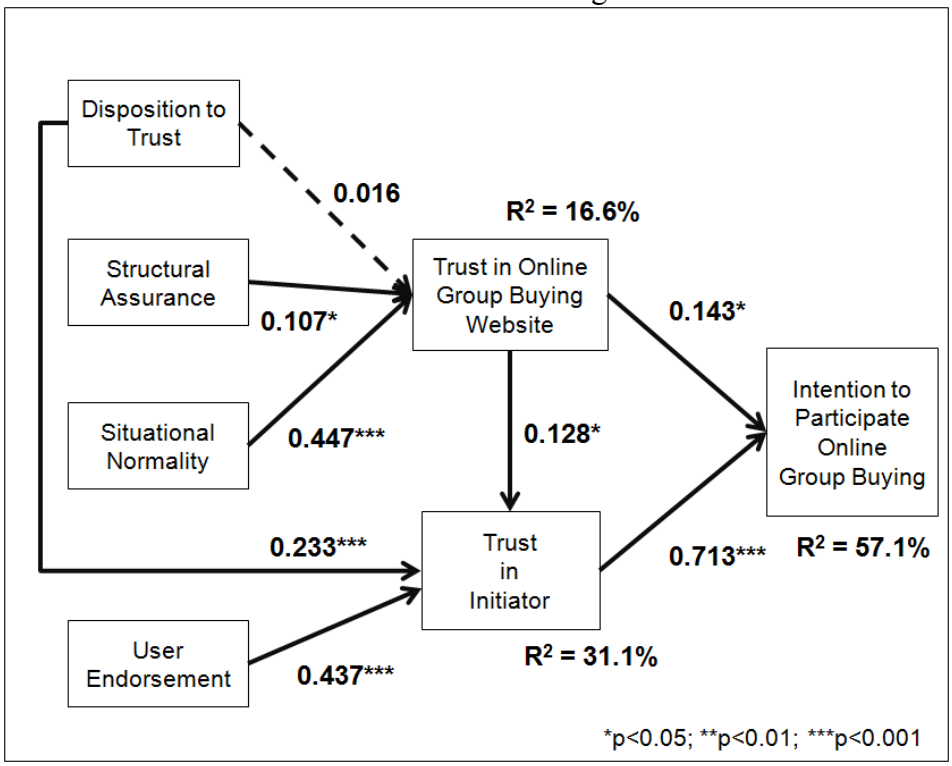

Figure 2 –Hypotheses Testing Results

IMPLICATIONS AND CONCLUSIONS

This study sheds some light on this issue by showing the effects of trust building mechanisms and trust transference under the online group buying context. And the results of this study impart substantial new insights that can help both academics and e-commerce practitioners in enhancing their understanding of the trust formation process.

First, it can be enlightened that users generate their intentions to participate online group buying not only through trust in online group buying website, but they also enhance their intentions through trust in online group buying initiator. Morevoer, the effect of trust in online group buying initiator is greater than the one of trust in online group buying website. These

two kinds of trust jointly explain 22.8 percent of the variance in user's intention to participate online group buying. Furthermore, the trust transference effect (from website to initiator) is apparent and significant, thereby being consistent with Stewart's proposition regarding the positive influence of trust transference on trusting intention and provides empirical evidence for the context of online group buying websites for service or product transaction. Likewise, our study suggests that online group buying website can not only increase several trustworthy sources for initiators (e.g., initiator's performance, service quality, rankings and so on), but online group buying website can also enhance consumer's trust and confidence toward itself, since trust transference effect is clearly significant from online group buying website to initiators, as indicated in this study.

Second, we argued that disposition to trust and institution-based trust (including structural assurance and situational normality) are hypothesized to influence consumer's trust in online group buying websites. The results show these three factors jointly explain 16.6 percent of the variance of trust in online group buying website and that structural assurance and situational normality positively increase trust in online group buying websites. However, it seems that disposition to trust have no effect for facilitating trust in online group buying websites. In other words, the institution-based trust building mechanism such as situational normality and structural assurance are more effective than personality traits to form domain-specific states (trust in online group buying website) when consumers make transactions under the online group buying context. Organizational studies also indicate that overall personality traits (e.g., disposition to trust) are less predictive of specific behaviors than domain-specific states, because of their inability to distinguish between situational differences (Lewicki et al., 1998). Hence, disposition to trust may not adequately explain why an individual buyer who is relatively trusting in personal life may demonstrate less trust toward online auction websites. As such, this study suggests that increasing higher degree of secure situational normality (e.g., website layout and browsing security, smoothness and so on) and structural assurance (e.g, guarantee or escrow services) mechanisms can efficiently strengthen consumer's trust in online group buying website, and thus increasing his (or her) intention to participate online group buying.

Lastly, Disposition to trust and user endorsement are hypothesized to have an influence on determining the trust in initiator. As expected, the result shows that these two factors are found to positively increase trust in initiator, and these two factors, accompanying with trust in online group buying website, jointly explain 31.1 percent of the variance of trust in initiator. According to McKnight et al.'s (1998) initial trust model and Gefen's (2000) empirical findings, trust is significantly affected by people's socialized disposition to trust, and our study supports such premise again. Hence, users with higher disposition to trust will form higher trust toward their online group buying initiators. Moreover, we also found that user endorsement has greater influence on trust in initiators than the one comes from disposition to trust. User endorsement served as a process-based trust evidence for strengthening consumer's trust in initiator, and related evidences (e.g., positive word of mouth or assessments) are cumulated and transformed into process-based trustworthy sources for generating consumer's trust in initiators. Likewise, those qualified and endorsed contents thus then strengthen consumer's confidence and trust toward online group buying initiators.

We acknowledge that a number of research limitations exist in our research which should be overcome in the future. First, this study used real-world online group buying users. Although this was strength of the study, a non-probability based sample may still not allow for drawing more general conclusions across different populations. Second, the respondents of

the current study are mostly drawn from trustworthy and well-known online group buying websites. Even though we believe that the study has provided some valuable insights, generalizability of its findings might still be limited to online group buying websites that are, indeed, trustworthy. Thus, as Gefen et al. (2003) indicated, examining the relationships and the relative importance of the study constructs across sites that vary in their trustworthiness would be a fruitful direction for future research.

While most prior studies focused on trust building for generic e-commerce contexts and partial aspects of trust building antecedents, our understanding of how trust is built and evolves over time has been limited. To give a more holistic picture, we draw on McKnight et al.'s (1998) framework in studying the effects of trust building mechanisms and trust transference in the online group buying marketplace. Our study also offers an important practical contribution toward the proliferation of online group buying by providing guidelines on how group buying vendors should address their trust problems differently for themselves and group buying initiators, so as to induce new and repeat group buying transactions and to encourage group buying users' loyalty.

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AN EXPLORATORY STUDY ON THE FACTORS AFFECTING ONLINE BENEVOLENT COMMENT

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ABSTRACT
Information Technology (IT) has influenced the overall living of people and promoted South Korea into an IT powerhouse. However, with the growth of IT, the influence not only from a positive aspect but from a negative is becoming intense. Especially, considering cyberbullying, a systematic abuse of power which takes place by means of information and communication technologies (ICTs), the damage level is being expanded and thus it is being raised as a social problem. To tackle this problem, the research uncovers the factors that have an influence on 'Benevolent Comment', a subset of online prosocial behavior offering a favorable and a positive comment toward others in the Internet forums. By using a qualitative approach of the 57 interviews, seven driving factors (self-presentation/image enhancement, pleasure/feeling worthwhile/satisfaction, social contribution, companionship/emotional support, reputation, monetary reward, and reciprocity) and two inhibiting factors affecting benevolent comment (social anxiety and time/effort) were discovered as the factors affecting online benevolent comment. The research has its theoretical contribution to analyzing benevolent comment as online prosocial behavior and suggesting driving/inhibiting factors influencing an act of posting a benevolent comment online. The study has its practical implication for developing a campaign/program for shaping a positive online culture.

Keywords: Cyberbullying, Online Prosocial Behavior, Benevolent Comment

Ⅰ. INTRODUCTION

South Korea has entered into the information age where most of people use the Internet with the help of the rapid growth and advance of Information Technology (IT) taken place after 2000s. Specifically, after the year of 2009, when the development of Smartphone and wireless Internet was carried out in full scale, it turned out that over 77% of people above age 3 use wire-wireless Internet more than once a month (Statistics Korea, 2012). Also, in 2010, the domestic Internet penetration rate reached 96.8%, recording the highest figure among OECD member nations (OECD, 2011).

Currently, there is a trend that both the growth and the side effect of IT are increasing. The side effect of IT is largely classified into cyber aggression and cyber crime, followed by cyber addiction or the exposure of personal information, and so forth. Being distinguished from a broader concept of cyber aggression that presumes a one off act, there exists cyberbullying, which includes two specific criteria of repetition and imbalance of power (Slonje et al., 2013). Unlike aggression, bullying happens due to the malicious intent of a perpetrator to hurt a weaker party and thus involves the feature of the power imbalance in essence (Kwan and Skoric, 2013). Based on these features, cyberbullying is defined as a systematic abuse of

power which happens by means of information and communication technologies (ICTs) (Slonje et al., 2013).

Cyberbullying has brought about a vast amount of damage throughout the globe until recently. In New Zealand, a third of students aged 12-19 said that they had experienced cyberbullying, 53.7% of which considered it distressing (Fenaughty and Harré, 2013). In Singapore, among Facebook users aged 13-17, 59.4% of them underwent at least one type of bullying and 28.5% suffered from the victimization experience of receiving nasty comments on Facebook (Kwan and Skoric, 2013). In the US state of Florida, a 12-year-old girl named Rebecca Sedwick committed suicide after being suffered from cyberbullying. It turned out that about 15 girls including the two perpetrators – a 14-year-old girl and a 12-year-old girl – arrested had bullied her for months through online message boards and texts.[1] In South Korea, posting nasty comments online is at an extremely serious level. According to the research on the situation of posting nasty comments online and the damage triggered by it, 23.9% of the Internet users have posted nasty comments and 54.4% have suffered from those comments (Korea Internet & Security Agency, 2012).

With these side effects of cyberspace being intensified at home and abroad, the necessity of studying diverse sectors is rising in order to solve those matters. However, the studies progressed so far focus on offering a conceptual definition for or categorizing forms of cyberbullying or nasty comments, and looking into the current situation regarding them (Abu-Nimeh et al., 2011; Aoyama and Talbert, 2010; Kwan and Skoric, 2013). This research goes beyond understanding the problematic phenomenon of the side effects of cyberspace and makes an attempt to approach the phenomenon from a perspective of improving it. Therefore, this study aims to analyze the factors that facilitate or inhibit posting 'Benevolent Comment' in the online context to alleviate the side effects of cyberspace. This study has its theoretical implication since it is the first study regarding online 'Benevolent Comment.' In addition, from a practical viewpoint, this study aims to provide help in developing an ethical program or a campaign for users and coming up with a guideline for managing and operating an online community in shaping a positive online culture.

Ⅱ. CONCEPTUAL BACKGROUND

Cyberbullying and online benevolent comment

The phenomenon of cyberbullying can be comprehended referring to an incident occurred back in the 1960s. In 1964, in a residential area in New York, a woman in her 20s named Katherine Genovese was killed by a robber.[2] While being attacked, she shouted out for help. However, all of the 38 apartment residents living nearby who heard her voice and witnessed the scene did not help her in person or report to the police while the crime was being lasted for about 35 minutes. Later it has been said that the psychological phenomenon the witnesses showed can be defined as 'Genovese Syndrome' or 'Bystander Effect.' With this case occurred, reflective thinking was permeated into the society and the necessity of helping and providing an altruistic behavior for others was raised.

In the same vein, when cyberbullying happens, a number of users can witness the scene. However, many times, people merely look on the cybervictims suffering from cyberbullying, and this is in line with Genovese Syndrome. In 2007, a South Korean female singer killed herself by severely suffering from nasty comments. This aroused the shared reflection among

[1] http://www.theguardian.com/world/2013/oct/15/florida-cyberbullying-rebecca-sedwick-two-girls-arrested
[2] http://www2.southeastern.edu/Academics/Faculty/scraig/gansberg.html

the Internet users, and a movement called 'Sunfull Movement' took place in order to vitalize 'Sunfull', which indicates 'good comments' used as an antonym of nasty comments, a new word combining the Chinese character 'Sun' standing for 'Good' with the Korean word 'Full' for 'Reply.'[3] The Sunfull Movement is a campaign that encourages the Internet users to use good words and actions in an online environment to counter cyberbullying. Established in 2007, the headquarters of the Sunfull Movement, based on the record at this time, Jan 2014, have secured about over 109,000 in gathering signatures for enhancing the perception of posting 'Sunfull' among the Internet users and the amount of 'Sunfull' has reached over 5.13 million through the headquarters.[4] This movement not only offers a voluntary service but an organized form of a tutoring program for posting a benevolent comment by assigning the tutors to elementary, middle and high schools nationwide. Besides, its scale is becoming more and more expanded with the help of strategic alliances among universities, government agencies, companies, and celebrities.

This study, instead of the rather ambiguous term 'Sunfull', uses the concept 'Benevolent Comment.' Here, 'Benevolent Comment' is a form of prosocial behavior, differentiating from anti-social behavior exposed by means of posting nasty comments and non-social behavior represented by refusing to take part in online communication or looking on nasty comments (Bar-Tal, 1976; Barton, 1986).

Online prosocial behavior

The concept of prosocial behavior means an individual's social responsiveness for benefiting others (Barton, 1986) and it involves a series of behaviors that can bring about positive outcomes for society (Bar-Tal, 1976), including sympathy, charity, donating, exchange, kindness, altruism, sharing, helping, and so on. Extended from this concept, online prosocial behavior is an idea that has applied offline prosocial behavior in an online context and it can be defined as a voluntary behavior intended to benefit others, including an individual and a group (Bar-Tal, 1976; Mussen and Eisenberg, 1977).

Sproull, et al. (2005) classified subsets of online prosocial behavior as follows. First, an activity of a monetary contribution through an online charity or donating unused computer resources of a personal computer for analyzing massive data can be suggested as a form of online prosocial behavior. Another form can be sharing software and code for developing open source software (Osterloh and Rota, 2007) or sharing one's capacity and talent through providing free mentoring services and sharing learning materials for students who need help through an online learning community. In addition, Kim et al. (2013) found the motivation factors for online prosocial behavior by examining the act of producing and sharing the subtitles of American dramas, and Bock et al. (2005) and Kankanhalli et al. (2005) studied about online knowledge sharing behavior. Moreover, donating time and effort into organizing and operating a voluntary online discussion group and giving emotional support by sharing information within a group can be referred to as another form of online prosocial behavior. Table 1 shows the previous studies on online prosocial behavior. Most of them are about the activity of sharing material resources, knowledge, capacity, etc.

[3] http://news.mk.co.kr/newsRead.php?year=2011&no=377850
[4] http://www.sunfull.or.kr

Table 1 – Overview of the Studies on Online Prosocial Behavior

Researcher	OPB type	Research objective	Findings
Kim et al. (2013)	The activity of making the subtitles for American dramas	To examine the motivation for making the subtitles for American dramas via FGI toward subtitle makers and literature review	It turned out that a subtitle maker's intrinsic motivation factors such as self-satisfaction, engagement, pleasure, responsibility, empathy are more important.
Yew (2011)	Online music sharing (ccMixter)	To analyze prosocial sharing activity via Social Performance Framework and design a system facilitating prosocial sharing activity	Through social network analysis, it turned out that a core group of members is responsible for much of the sharing and the remixing activity in ccMixter and through qualitative research, it is shown that 24 members of the group are motivated to contribute and share due to the impact of the norms created socially transparent by the website.
Osterloh and Rota (2007)	Open source software (OSS) development	To analyze open source software as a collective invention model	The study found the benefit factors as the motivators for contributing to OSS (e.g. Benefits from extended functionality, reputation, enjoyment, and prosocial motives), social dilemma, etc.
Wasko and Faraj (2000)	Knowledge sharing in electronic communities of practice	To analyze why the users participate in an online professional community and help others	The results showed that the intrinsic motivation such as the users' feeling pleasure in participating itself, helping others, and feeling satisfaction is vital.

Note: Online Prosocial Behavior (OPB)

Hence, this study attempts to newly suggest a concept, posting a benevolent comment, as a subtype of online prosocial behavior. Besides, 'Benevolent Comment' as a form of online prosocial behavior is defined as an act of voluntarily providing information or emotional support such as encouragement, compliment, consolation, and so forth via posts or comments to benefit or help an individual or a group within an online community (Bar-Tal, 1976; Mussen and Eisenberg, 1977; Sproull et al., 2005).

Ⅲ. EXPLORATORY STUDY

Research method

We establish an act of posting a benevolent comment on the Internet forums as a subtype of online prosocial behavior and attempt to analyze the factors promoting or inhibiting it. A qualitative approach is on the basis of a phenomenological or an interpretive approach, and provides a situational understanding by grasping the relationship of various aspects with an elaborate description of a phenomenon (Hwang et al., 2004). Also, a qualitative research has its strength in the fact that it can offer a detailed and a rich understanding and suggest a new outcome that has not yet been discovered. Thus, this research, an exploratory study regarding

online comment which belongs to a novel context of research, uses an interview methodology to promote an understanding about a phenomenon first, and analyze newly discovered factors. The interview procedure was constructed in four steps in sequence: set up a plan to interview (Planning), find and recruit interviewees (Recruiting), conduct the interview with recording and observing it (Moderating), and analyze the interview result (Analysis).

First of all, the interview consisted of open-ended questionnaires for exploring the driving and inhibiting factors for posting a benevolent comment on the Internet forums. The interview respondents were 60 in total, consisting of those who use the Internet forums and are aged from above 13 to below 60. Among them, 3 responses carelessly answered were excluded and accordingly 57 responses were used for analysis. The gender distribution of the responses shows 45.6% of male and 54.4% of female. The age distribution reveals that 6 are between 14 and 19 (10.5%), 22 are between 20 and 29 (38.6%), 18 are between 30 and 39 (31.6%), 6 are between 40 and 49 (10.5%), and 5 are 50 and older (8.7%); thus, the respondents from the 20s to 30s occupy the largest percentage. The occupation is composed of as follows: 21 for a student (36.8%), 16 for an office job (28.1%), 13 for a specialized job (22.8%), 4 for a housewife (7.0%), 3 for other types of occupation (5.3%).

For the purpose of getting various opinions of the interview respondents, the interview was carried out in a comfortable atmosphere. Besides, since gathering short answers by asking yes/no questions or direct questions was not what this study had intended to, we utilized an in-depth interview. Finally, we analyzed the collected interview data in three stages and attempted to guarantee the validity of the coding results in the course of analysis. The first stage of analysis was taking content analysis that the researcher categorizes a series of types based on the keywords extracted from each of the responses. Next, peer review that two other researchers examine the content of the interview and the result of categorizing keywords was held. Lastly, the researcher, with the reflection of the previous stage of peer review, drew and interpreted the final result of the analysis.

Data analysis and results

The coding results summing up the kind of driving and inhibiting factors that the interviewees have experienced by posting a benevolent comment on the Internet forums are described in Table 2. The most preferred answer chosen by 41 respondents was that they can express their thoughts and ideas with a benevolent comment, and thus enhance their image in an online community. The responses illustrating this factor are as follows: '*I can reveal the situations highly related to me or the topics that I am interested in by posting a benevolent comment on Daum Agora (one of the Internet forums in South Korea)*' (27 years old, a graduate student); '*The term 'Angel Commenter' is used for calling those who post benevolent comments on others' posts during inactive times*' (26 years old, a college student).

Next, 34 respondents replied that they feel psychological driving factors including pleasure, feeling worthwhile, satisfaction, and so forth through a benevolent comment. The responses regarding this factor are suggested as follows: '*I feel worthwhile because my comment may cheer someone up*' (18 years old, a high school student); '*I think that it is pleasant for each other to post a benevolent comment in brief like 'It was very helpful for me' and 'Thank you for your information' when seeing a good quality of information, rather than just passing by*' (49 years old, a housewife).

Moreover, social driving factors involved in a socio-psychological aspect were discovered. Especially, 17 respondents answered that purifying the negative parts of the Internet forums and contributing to others in an online community are possible through a benevolent comment.

The responses regarding this factor are as follows: '*I believe that a benevolent comment can actualize society's good and set an overall atmosphere that others are willing to positively sympathize with*' (32 years old, an office worker); '*When people give a compliment to those who have done good things in the Internet forums, there will appear another group of people who also do good things and take more care of the surrounding people. Those who have posted a benevolent comment will live more earnestly by receiving a compliment and those who have read the kind of warm comments will also live more diligently with their hearts being moved by those comments*' (18 years old, a high school student).

The other 16 people replied that emotional support, a sense of belonging, companionship, and so forth can be conveyed to them via a benevolent comment. The responses related to this factor are represented as follows: '*I believe that the comments suggesting logical evidence or accurate information can gain sympathy from others*' (31 years old, an office worker); '*When I post a comment that can cheer up and console someone who has posted about a negative event, I feel close to and sympathy toward him/her*' (35 years old, a graduate student).

Lastly, external driving factors like reputation, monetary reward, and reciprocity attracted only a few respondents. The responses further elaborating this factor are: '*I can gain points by posting a benevolent comment*' (27 years old, an office worker); '*I can earn money by taking part in part-time jobs for posting a good comment for an enterprise*' (23 years old, a college student).

When it comes to the inhibiting factors, the coding results show that only 3 people among the total respondents replied that time and effort are involved in those factors. This indirectly infers the fact that the amount of time or effort needed when posting online comments is not as much as the users actually recognize. This study could newly find social anxiety as another key inhibiting factor of posting comments except for time and effort. Social anxiety is the users' socio-psychological inhibiting factor not used often in the context of online community. The responses depicting this factor are suggested as follows: '*I do not want to be in trouble by posting a comment because I can be uselessly blamed and, if it get worse, my personal information can be disclosed*' (29 years old, an office worker); '*Even though I want to keep others from posting a nasty comment on someone who has already given a huge amount of nasty comments, I just cannot do it since I can also be the target of being blamed*' (18 years old, a high school student).

Table 2 – Coding Results

Category	Factor	Response example	N
Driving category	Self-presentation /Image enhancement	I can reveal myself by presenting my thoughts through a benevolent comment.	41
		I feel like I have become a kind or a righteous person when posting a benevolent comment.	
	Pleasure /Feeling worthwhile /Satisfaction	I feel the pleasure of helping others by posting a benevolent comment.	34
		I feel that I have done something good and feel worthwhile when posting a benevolent comment.	
		I feel pleasure and satisfaction by actualizing altruism per se by posting a benevolent comment.	
	Social contribution	An atmosphere of the Internet forums with many nasty comments can be purified by benevolent comments.	17
		I feel as if I am contributing by sharing my information via a benevolent comment.	

	Companionship /Emotional support	I can feel like I belong to an online community where I write a benevolent comment.	16
		I can form sympathy and companionship through a benevolent comment.	
		I can feel the emotional support from a benevolent comment.	
	Reputation	I can gain reputation in an online community by means of posting a benevolent comment.	6
	Monetary reward	I can accumulate points or mileage by posting a benevolent comment.	4
		I can earn money by working part-time posting a benevolent comment.	
	Reciprocity	When facing problematic situations like receiving nasty comments or cyberbullying, others' benevolent comments can help me.	2
		When I need information, others will leave it for me.	
Inhibiting category	Social anxiety	Nasty comments like 'You are pretending to be nice', 'Don't be pretentious', 'You look like a part-timer', etc are posted below my comment.	36
		I am being blocked by reactions like 'Just stand still', 'Who the heck are you', etc.	
		I cannot show the real me since my real name is shown.	
		I feel uncomfortable since I do not really mean it.	
		I feel especially reluctant to post comments on the posts dealing with politically sensitive issues.	
	Time/Effort	I need much time to write a comment.	3
		I feel tiresome to log in and write a comment.	

Ⅳ. DISCUSSION AND IMPLICATIONS

Discussion of findings

This study has discovered the driving and inhibiting factors of posting a benevolent comment online, especially on the Internet forums. First, the largest number of the respondents regarded self-presentation or image enhancement as the driving factor of online benevolent comment. Posting a benevolent comment allows them to represent their own thoughts and ideas, leading to revealing their own selves. Besides, they can improve their image by becoming an 'Angel Commenter' who posts a benevolent comment on others' posts during inactive times. Second, 34 of the respondents answered that they feel pleasure, worthwhile, satisfaction when posting a benevolent comment online, and this works as the significant driving factor of performing online prosocial behavior such as posting a benevolent comment. Third, social contribution ranked as the next crucial factor of online benevolent comment. The coding results showed that purifying the Internet forums filled with a number of nasty comments and fulfilling one's altruistic behavior were regarded as functions of posting a benevolent comment that satisfy the driving factor of social contribution. Fourth, the driving factor of forming companionship or feeling emotional support was subsequently revealed with the difference of only one person when compared to the number of the respondents supported the third factor. The remnants of the driving factors that affect online benevolent comment consisted of gaining a reputation, earning money, and being reciprocal. When it comes to the inhibiting factors, which hamper

the interviewees from posting a benevolent comment, social anxiety was considered the key factor that discourages them from posting the kind of comments. Other commenters in the Internet forums criticize those who post a benevolent comment since they think that they are pretending to be nice; thus, people trying to post a benevolent comment online are somewhat hesitant to perform the kind of online prosocial behavior and afraid of the possibility of becoming a victim of a witch-hunt. Comparatively, the amount of time or effort consumed when posting a benevolent comment online was regarded less significant when compared to social anxiety.

Limitations and future research direction

While this study employed an exploratory study based on the interview in understanding and extracting the factors affecting an act of posting an online benevolent comment, there are some limitations which need to be considered. First, an examination through a quantitative method like survey needs to be conducted to enhance the objectivity of the factors that this study has found. This research has drawn each factor on the basis of the responses of the 57 interviewees; hence it has its limitation for generalizing the results on the whole. Therefore, the future studies may further go through an additional verification with a measurement tool that secures reliability and validity. Second, this research has unveiled seven driving factors and only two inhibiting factors which affect an act of posting a benevolent comment online; thus the future studies are expected to further discover other possible factors, the inhibiting factors in particular to promote a balanced analysis on the factors affecting online benevolent comment, and develop the research model based on them. Finally, since an exploratory study was utilized in this research, the future studies need to develop the findings of this research by applying a theoretical basis such as social exchange theory which discusses the benefit and cost factors and suggests that those factors will give impact to the real behavior and intention of an actor (Kankanhalli et al., 2005, Molm, 1997).

Implications for research and practice

This study suggests several implications for research. First, as the first to study about online benevolent comment, this study has attempted to newly define 'Benevolent Comment' and examine the influence factor through the concept of online prosocial behavior as a solution for cyberbullying, which goes beyond the previous studies only looking into the phenomenon and cause of the matter (Abu-Nimeh et al., 2011; Aoyama and Talbert, 2010; Kwan and Skoric, 2013). Second, through the 57 interviews, this study has found a set of the factors facilitating or suppressing an act of posting a benevolent comment. This exploratory study will be a good foundation for the future studies that attempt to develop the conceptual framework regarding what drives and inhibits an act of posting an online benevolent comment. Lastly, by means of a qualitative approach, this study has newly found the driving and inhibiting factors affecting posting an online benevolent comment, such as social contribution and social anxiety, which have been undiscovered. When utilizing an empirical research, these factors will help extract new and diverse relationships between variables.

This study also renders several practical implications for promoting a benevolent comment in the Internet forums. First, this study meets the social situation of this time that the side effects caused by online anti-social behavior such as nasty comments and cyberbullying are being intensified and the necessity of a self-purified behavior is being requested. In particular, there has been an attempt driven by the headquarters of the Sunfull Movement to solve the side effects produced in cyberspace. But the discussion on its influence and direction for the

development lacks. Thus, we expect that, with this study, the study of the education program or campaign for the Internet users to form a mature online culture will become more extensive. Second, it is possible to prepare specific strategies in order to manage comments online and policies for promoting a benevolent comment on the basis of this study implying that not only an individual driving factor (e.g. Feeling pleasure, worthwhile, and satisfaction) but also an organizational driving factor (e.g. A desire for social contribution) motivates the users' act of posting a benevolent comment in the Internet forums. To enhance pleasure, increasing one's satisfaction and engagement by making him/her accomplish a sort of mission through posting a benevolent comment seems vital. On the other hand, to enhance social contribution through posting a benevolent comment, it is necessary to visually show how one's activity of posting comments contributes to the overall community by measuring and revealing the benevolent comment index within the Internet forums. Lastly, this study shows an important managerial implication regarding the domestic online setting that has entered into so-called 'post online real-name policy' that presumes complete anonymity after abolishing restrictive identification system. The underlying context of the study, the Internet forums, is where one can restrictedly reveal oneself through a nickname. Thus, the driving factors including social contribution and pleasure which suggest that it is possible to fulfil online prosocial behavior only by the self-perception of the users, without revealing oneself and getting approvals or responses from others, are noticeable in the upcoming era of 'post online real-name policy.' Therefore, in the era of 'post online real-name policy,' rather than implementing compulsory real-name system, and censoring and controlling the posts, enhancing the users' perception needs to be preceded to manage the changed online setting.

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Effect of Purchasing Size Variability on Inventory Performance: Do More Customers Buy Less or Do Fewer Customers Buy More?

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ABSTRACT
Retail sales are affected by two factors: the arrival rate of shoppers and the purchase size of each shopper. By providing an inventory model that can distinguish the effect of the variability of customers' arrivals on inventory cost from that of the purchase size per customer, we propose how management can adequately deal with purchasing size variability and thereby improve retail efficiency according to the firm's managerial goal, with a focus on either average total sales or average sales per customer. When a business focuses on average total sales, we show that a homogeneous purchasing size is preferable; in other words, the purchase size per shopping occasion should be controlled to be as close to the average level as possible. However, when a business focuses on maintaining average total sales at a certain level, we show that large or small shopping size per customer may be preferable for retailers. This study also addresses the relationship between the retail decision to sell either more to fewer customers or less to more customers and customers' shopping behavior. Based on the analytical results, we present managerial implications regarding marketing, such as package designs and volume discounts.

Keywords: Retailing, Purchasing size per customer, Uncertainty reduction

1. INTRODUCTION

Operations management studies explicitly or implicitly assume that each customer makes a single purchase on each occasion. In other words, the number of customers who buy products at a store is usually considered the same as the number of the products sold. However, this always-buy-one assumption often does not hold in a real shopping environment. For example, in a supermarket, the number of soft drink bottles that each customer buys differs depending on factors such as family size, how much he/she likes the soft drink, and the impact of price

discounts or promotions. At a gas station, the amount of gasoline that a driver pumps into his/her car varies according to the size of the automobile and the amount of gasoline remaining in the tank. Furthermore, real retail businesses aim to expand both the frequency of customers' store visits and the purchase size per customer to earn more profits. For example, Komeri, one of the largest DIY stores in Japan, increased both the frequency of store visits and spending per customer per shopping occasion by offering "Komeri Card," a credit-card-based loyalty program for loyal customers (Nikkei MJ, April 11, 2014). Moreover, major convenience store chains in Japan now focus on over-the-counter sales of premium coffee, and this new service of coffee sales has resulted in an increase in customers' visiting frequency and the average amount of shopping per customer (Nikkei MJ, May 5, 2014). Thus, in addition to the uncertainty of customer arrivals, the variation in the number of products that a shopper purchases on each shopping occasion generates uncertainty that can negatively affect inventory performance.

Managing variability is a key challenge for operations researchers and practitioners, because any type of variability that a firm encounters (e.g., level of demand, unstable processing time, inconsistent quality level) can cause unfavorable outcomes (Hopp, 2008). Various tools such as strategic partnerships, information sharing, and risk mitigation strategies, have been applied to improve supply chain performance (Simchi-Levi et al., 2008). This study considers how variability in both purchase size on each shopping occasion and the number of arrivals of shoppers influences inventory cost. We first consider how the variability of purchasing size per customer and random arrivals of customers affect a retailer's performance when the sales size is kept at a certain level. In particular, we evaluate the impact of variability on a firm's profit when maintaining a certain level of revenue. Note that this performance measure comes from the lean philosophy in which smaller waste is better to achieve the same output. We also consider how, in order to reduce the negative effects of variability, a firm can make adequate managerial decisions, such as in-store volume discount promotions, effective advertising, package size and design, and optimal safety stock, as well as the choice of whether to sell more to fewer customers or less to more customers.

This study relates to several academic areas. Marketing researchers have thrown new light on product package size. For example, Granger and Billson (1972) investigated how consumers make a decision about package size when they consider information on the price-per-unit of a product. Wansink (1996) empirically studied the effect of package size on usage volume per usage occasion. Jain (2012) discussed the conditions under which a firm that produces products that customers tend to over-consume (e.g., soft drink, cookies) can enhance both consumer and social welfare by offering small packages. In contrast, few attempts have thus far been made to investigate the variability of a customer's purchasing size

from the operations management viewpoint. Gerstner and Hess (1987) analyzed why manufacturers decide to vary package size and price when consumers' consumption rate, storage rate, and transaction costs are heterogeneous. Koenigsberg et al. (2010) investigated package size and pricing decisions for perishable products.

Previous research has suggested that a beta distribution is applied in empirical studies of economics and business, owing to the flexible shape of its density function. For instance, Stewart's (1979) market research study modeled the behavior of brand loyal consumers using a beta distribution. A statistics study by McDonald and Xu (1995) discussed the flexibility of the beta distribution family and its versatile applicability in empirical research.

This study distinguishes the effect on inventory decisions of the variability of purchasing size from that of customer arrivals using two random variables, one for normally distributed arrivals and the other following a beta distribution that represents the variation in purchasing size per shopping occasion. In fact, marketing researchers have studied customer's shopping frequency and shopping basket size, but their research was conducted from a marketing perspective, mainly from the viewpoints of promotion and pricing (e.g., Krishna et al. (1991), Bell and Lattin (1998), Scarpi (2012)). In contrast, we analyze the impact of the variability of customer arrivals and purchase size on business performance from operational perspectives such as efficiency, specifically how a firm can gain a certain level of output using the minimum possible amount of recourses. This relatively simple inventory model gives us useful insights and implications for operational and marketing decisions. To the best of our knowledge, this study is the first to investigate the effect of purchase size variability in addition to customers' arrival variability on store performance from an inventory management perspective and to propose adequate marketing policies for retailers to improve their performance.

The remainder of this paper is organized as follows. In section 2, we briefly present the model and key assumptions. Section 3 analyzes the model to discover how a firm minimizes purchasing size variability when keeping the average purchase size per customer as a goal. Section 4 asks the same question in relation to a situation in which a firm aims to maintain average sales at a certain level; it then discusses the managerial implications. Section 5 concludes this paper.

2. MODEL

Our model contains two random variables, X and Y, to capture the effect of uncertain customer arrivals on the store and variability in customers' purchasing size on each shopping occasion. X represents the arrival of customers following a normal distribution, with mean μ, variance σ^2, and coefficient of variation $k = \sigma/\mu$. Y follows a beta distribution of

parameters α and β, assuming that the purchase size is distributed within a given interval of the product amount. We assume that these two random variables are independent, and that the range of Y is standardized as between 0 and 1. A beta distribution is employed because of its flexibility. A beta distribution is flexible enough to form a variety of shapes according to the values of the parameters α and β, and this flexibility can capture various types of customer behaviors and market situations regarding purchasing size on each shopping occasion (see McDonald and Xu, 1995).

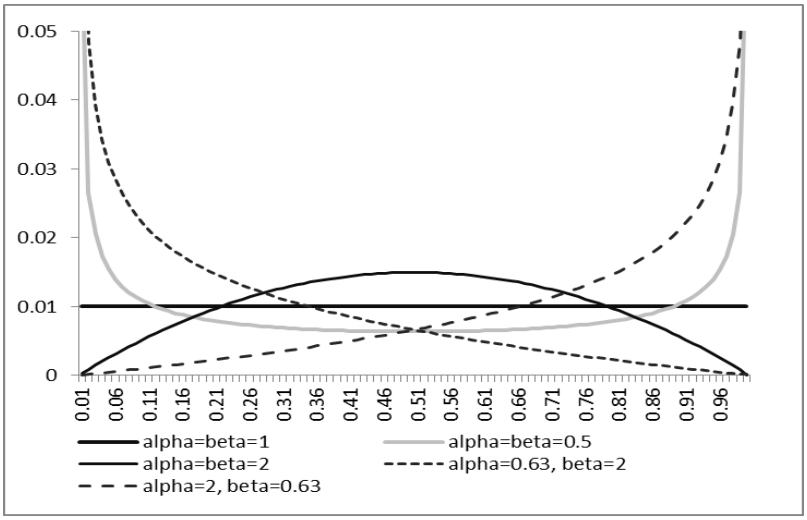

Figure 1 – Plot of the five different beta probability density functions

For example, Figure 1 shows the shapes of the five different probability density functions (pdf) of a beta distribution. In Figure 1, the three beta distributions of $\alpha = \beta = 0.5, 1.0, \text{and } 2.0$ share the same mean of 0.5, but their variances differ, being 0.125, 0.0083, and 0.050, respectively. Furthermore, unbalanced values of α and β generate a skewed distribution. The three density curves of $(\alpha, \beta) = (0.63, 2.00)$, $(1.00, 1.00)$, and $(2.00, 0.63)$ in Figure 1 share the same variance of 0.05, but their shapes and mean values are quite different.

The product of the two random variables, X and Y, can capture the joint effect of customer arrival variability and purchase size variability on demand uncertainty. Following Bohrnstedt and Goldberger (1969), the mean and variance of the product of the two independent random variables are determined as follows.

Lemma 1: Means and variances

$E(X) = \mu \;\; and \;\; V(X) = \sigma^2.$

$$E(Y) = \frac{\alpha}{\alpha+\beta} \text{ and } V(Y) = \frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}.$$

$$E(XY) = \mu\frac{\alpha}{\alpha+\beta}. \tag{1}$$

$$\begin{aligned} V(XY) &= E(X)^2\mathrm{V}(Y) + E(Y)^2\mathrm{V}(X) + V(X)V(Y) \\ &= \mu^2\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)} + \left(\frac{\alpha}{\alpha+\beta}\right)^2\sigma^2 + \sigma^2\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)} \\ &= \mu^2\frac{\alpha}{\alpha+\beta}\left\{\frac{\beta}{(\alpha+\beta)(\alpha+\beta+1)} + k^2\frac{\alpha}{\alpha+\beta} + k^2\frac{\beta}{(\alpha+\beta)(\alpha+\beta+1)}\right\}. \end{aligned} \tag{2}$$

Proof. For Eq. (2), see Bohrnstedt and Goldberger (1969).

As a performance measure, we assume the following profit function:

$$\Pi = r\mathrm{E}(XY) - c\sqrt{\mathrm{V}(XY)}. \tag{3}$$

Here, *r* and *c* represent a given unit revenue and a given inventory cost factor, respectively. In Equation (3), the revenue is calculated by the unit revenue multiplied by the expected total sales and the inventory cost is proportional to the standard deviation of the total amount of sales. The rationale behind this cost term is that safety stock as an inventory method coping with uncertain demand is usually formulated as a function of the square root of the demand variance (Sobel, 2007; Zipkin, 2000; Section 6.5.2). Furthermore, the square root in Equation (3) can reflect economies of scale with respect to demand size. In fact, mass operations tend to be cost-effective.

The additional rationale behind using Equation (3) as a performance measure comes from lean philosophy and efficiency: the goal of the lean philosophy can be considered as waste elimination, and inventory is a typical example of waste in a production system (Schroder 2008, Chapter 6). Furthermore, efficiency, which is defined as "the degree to which a process generates outputs with the minimal consumption of inputs" (Collier and Evans, 2006, p.82), is among the most important operational goals. Hence, from these operational perspectives of lean and efficiency, we evaluate the impact of the cost term of Equation (3) on a firm's profit when it earns a given level of revenue (i.e.,$r\mathrm{E}(XY)$). In fact, Equation (3) is often used as a representation of the system performance in the conceptual discussion of operations management. For example, Hopp (2008, p. 104) uses the profit function "Profit = Unit Profit × Throughput – Unit holding cost × Work-in-process," which is equivalent to the concept of our performance measure.

In the following sections, we evaluate the performance by minimizing the demand variability $V(XY)$ when the sales size represented by $E(XY)$ is set at a certain level. In

other words, our analysis focuses on efficiency: how management can reduce the inventory cost by maintaining a certain level of revenue.

3. EFFECT OF PURCHASING SIZE VARIABILITY WHEN THE PURCHASE SIZE PER CUSTOMER IS FIXED

In this section, we calculate the demand variance by assuming that the mean purchase size per customer is fixed at a certain value. Note that retailers often pay attention to a customer's basket size, that is, how much each customer buys on each shopping occasion. In the real retail environment, attractive in-store displays and promotions, cross-selling, and loyalty programs are common approaches to increase sales per customer. Furthermore, in a mature market, it is difficult to increase the number of customers, and therefore retailers tend to aim to increase the sales size per customer. We model a situation in which a retailer wants to raise efficiency by maintaining sales per customer at a certain level. Proposition 1 shows the demand variance when the firm keeps its average purchase size at a certain level R_0.

Proposition 1

(a) When the mean purchasing size on a shopping occasion is fixed as a constant R_0 (*set* $R_0 = \frac{\alpha}{\alpha+\beta} \in (0,1)$), *the variance of the total amount of sales is determined as*

$$V(XY) = \mu^2 R_0^2 \left\{(1+k^2)\frac{R_0(1-R_0)}{\alpha+R_0} + k^2 R_0\right\}. \quad (4)$$

(b) $V(XY)$ *decreases in* α *and* β.

Proof. (a) When $E(Y) = \frac{\alpha}{\alpha+\beta}$ is fixed as a constant R_0, $\beta = \frac{\alpha}{R_0} - \alpha$. (5)

Then, (2) can be rewritten as

$$V(XY) = \mu^2 R_0 \left\{(1+k^2)\frac{1}{\alpha+\frac{\alpha}{R_0}-\alpha}\frac{\frac{\alpha}{R_0}-\alpha}{\alpha+\frac{\alpha}{R_0}-\alpha+1} + k^2 R_0\right\} = \mu^2 R_0^2 \left\{(1+k^2)\frac{R_0(1-R_0)}{\alpha+R_0} + k^2 R_0\right\}.$$

(b) From Equation (4), it is obvious that $V(XY)$ decreases in α but increases in μ and k. Equation (5) shows that if α increases, β increases. Thus, $V(XY)$ decreases in β. Q.E.D.

We know from Proposition 1 how management can improve performance by maintaining a certain level of sales per customer. Figure 2 shows the decrease in $V(XY)$ in α when arbitrarily setting parameters as $\mu = 2$, $k = 1$, and $R_0 = 0.5$. Because the variance decreases in α and β, raising these parameters will result in a smaller inventory cost.

Note that for a beta distribution, when both α and β are large enough to be more than 1, the shape of the distribution will be unimodal (e.g., the inverted U-shaped curve of $\alpha = \beta = 2$

in Figure 1), whereas the distribution becomes U-shaped when both α and β are small enough to be less than 1 (e.g., the curve of $\alpha = \beta = 0.5$ in Figure 1).

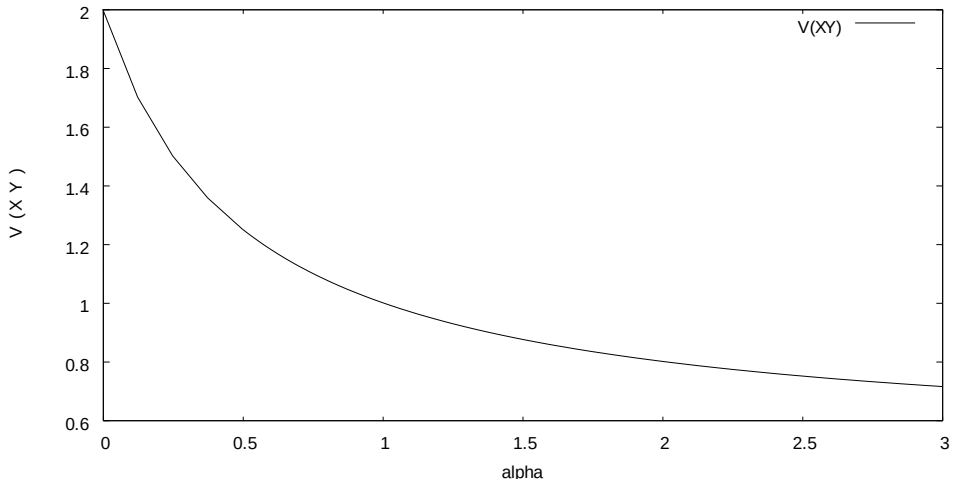

Figure 2 – Plot of V(XY) with respect to alpha

Hence, Proposition 1 implies that the sales per customer should be standardized as much as possible if the firm intends to keep the purchase size per customer at a certain level. For example, the package size of the product may be designed to be near the average purchase size of the product. In broad terms, our suggestion is that a retailer might offer only a medium-sized package and eliminate small- and large-sized packages or stop volume discount promotions, such as "buy one, get one free."

4. EFFECT OF PURCHASING SIZE VARIABILITY WHEN AVERAGE TOTAL SALES ARE FIXED

4.1 Variance when average total sales are fixed

In this section, we assume that a firm intends to minimize the demand variance (and correspondingly, the inventory cost) by maintaining a certain level of total sales. Toward this end, we define the expected sales as exogenously fixed at a certain constant (i.e., $R_1 \equiv E(XY) = \frac{\mu\alpha}{\alpha+\beta}$, where R_1 is a given constant). Proposition 2 indicates how sales variability behaves when the expected sales are fixed as R_1.

Proposition 2

When the mean of the total sales is fixed as a constant R_1 $(R_1 = \frac{\mu\alpha}{\alpha+\beta} \in (0, \infty))$*, the variance*

of the total sales is determined as

$$V(XY) = R_1^2\left\{(1+k^2)\frac{\mu-R_1}{\mu\alpha+R_1} + k^2\right\}. \quad (6)$$

Proof. (a) $R_1 = \frac{\mu\alpha}{\alpha+\beta}$ can be rewritten as $\beta = \left(\frac{\mu}{R_1} - 1\right)\alpha$. Then, by substituting $\beta = \left(\frac{\mu}{R_1} - 1\right)\alpha$ into (2), we obtain $V(XY) = R_1^2\left\{(1+k^2)\frac{\mu-R_1}{\mu\alpha+R_1} + k^2\right\}$. Q.E.D.

We know from Equation (6) that the values of α, β, and μ are not uniquely determined for the given k and R_1. To demonstrate the behavior of the distribution of sales size in a readily understandable way, we arbitrarily apply the following additional constraints to Equation (6):

Case-a: β is constant,

Case-b: β is the same as α,

Case-c: β is proportional to α, and

Case-d: β is a certain distance apart from α.

Note that $E_i(XY)$ and $V_i(XY)$ represent the mean and variance of random variable XY of case-i for $i \in \{a, b, c, d\}$. Corollary 1 shows the behavior of $V(XY)$ at the given sales level $E(XY) = R_1$, when the values of α, β, and μ are constrained by Case-a through Case-d as shown above.

Corollary 1

When maintaining the sales level at the given level $R_1 = E(XY) = \frac{\mu\alpha}{\alpha+\beta}$, $V_i(XY)$ *changes with respect to* α *and* β *as follows:*

(Case-a) If β *is assumed constant, that is* $\beta = b > 0$ *and b is a given constant value,*

$V_a(XY) = R_1^2\left\{(1+k^2)\frac{b}{\alpha(\alpha+b+1)} + k^2\right\}$. *Then,* $V_a(XY)$ *decreases in* α*, increases in* μ*, and is independent of* β*.*

(Case-b) If β *is assumed the same as* α *(i.e.,*$\beta = \alpha$*),* $V_b(XY) = R_1^2\left\{(1+k^2)\frac{1}{2\alpha+1} + k^2\right\}$.

Then $V_b(XY)$ *decreases in* α *and* β *but is independent of* μ*.*

(Case-c) If β *is assumed proportional to* α *(i.e.,*$\beta = \tau\alpha$ *and* $\tau > 0$*),* $V_c(XY) = R_1^2\left\{(1+k^2)\frac{1}{(1+\tau)\alpha+\tau} + k^2\right\}$. *Then,* $V_c(XY)$ *decreases in* α*,* β*, and* τ *but is independent of* μ*.*

(Case-d) If β *is assumed to be a certain distance apart from* α *(i.e.,*$\beta = \gamma + \alpha$ *and* $\gamma > 0$*),*

$V_d(XY) = R_1^2\left\{(1+k^2)\frac{\alpha}{(2\alpha+\gamma)\alpha+\alpha+\gamma}+k^2\right\}$. Then, $V_d(XY)$ increases in α and μ if $0 < \alpha < \sqrt{\gamma/2}$ but decreases in α and μ if $\sqrt{\gamma/2} < \alpha$. Furthermore, $(XY|R_1, \beta = \gamma + \alpha)$ increases in β if $0 < \beta < \gamma + \sqrt{\gamma/2}$ but decreases in β if $\gamma + \sqrt{\gamma/2} < \beta$.

Proof. From (6), it is enough to consider the behavior of $\frac{\mu - R_1}{\mu\alpha + R_1}$.

(Case-a) Since $R_1 = \frac{\mu\alpha}{\alpha+b}$, then $\mu = R_1\frac{\alpha+b}{\alpha}$. Thus, $\frac{\mu-R_1}{\mu\alpha+R_1} = \frac{b}{\alpha(\alpha+b+1)}$. (7)

(Case-b) Since $R_1 = \frac{\mu\alpha}{\alpha+\alpha}$, then $\mu = 2R_1$. Thus, $\frac{\mu-R_1}{\mu\alpha+R_1} = \frac{1}{2\alpha+1}$. (8)

(Case-c) Since $R_1 = \frac{\mu\tau\alpha}{\alpha+\tau\alpha}$, then $\mu = R_1\frac{1+\tau}{\tau}$. Thus, $\frac{\mu-R_1}{\mu\alpha+R_1} = \frac{1}{(1+\tau)\alpha+\tau}$. (9)

(Case-d) Since $R_1 = \frac{\mu(\gamma+\alpha)}{\alpha+(\gamma+\alpha)}$, then $\mu = R_1\frac{2\alpha+\gamma}{\alpha+\gamma}$. Thus, $\frac{\mu-R_1}{\mu\alpha+R_1} = \frac{\alpha}{(2\alpha+\gamma)\alpha+\alpha+\gamma}$. (10)

Then, $V_i(XY)$ is determined by Equations (7)–(10). Furthermore, Case-a through Case-c readily demonstrate the sensitivity with respect to α, β, and μ. For Case-d, $\frac{\partial}{\partial\alpha}V(XY) = \frac{1}{\{(2\alpha+\gamma)\alpha+\alpha+\gamma\}^2}\{-2\alpha^2+\gamma\}$. Thus, if $-2\alpha^2+\gamma > 0$, $V(XY)$ increases in α. Otherwise, $V(XY)$ decreases in α. Q.E.D.

The next subsection discusses how the purchasing size variability behaves differently according to the aforementioned two goals, namely, maintaining average total sales and maintaining average sales per customer.

4.2 Comparison between two managerial goals

Interestingly, when the average purchase size per customer is fixed at a certain point (i.e., Proposition 1) or when the average sales size is kept at a given level (i.e., Corollary 1), the demand variance decreases in α and β. However, Case-d is an exception, as there is a possibility that the demand variability increases in α and β. It is safe to say that, in general, a greater value of α and/or β is better in the context of our investigation.

The numerical examples give some clues as to how a manager should control the purchasing size to minimize inventory risk when, as Corollary 1 implies, increasing α and/or β is preferable from an efficiency perspective. Figure 3 shows a numerical example of Corollary 1 - Case-a, in which the value of β is fixed at $b = 1.5$. Figure 3 shows four pdfs of the beta distribution, in which the parameters are set as $(\alpha, \beta) = (0.5, 1.5)$, $(1.0, 1.5)$,

$(2.0, 1.5)$, and $(3.0, 1.5)$. From Figure 3, we know that as α increases, the probability of purchasing a large amount increases (i.e., the pdf curve tends to shift toward the right). Thus, one suggestion for Case-a is that a manager should promote a large purchase size via marketing policies in order to improve efficiency.

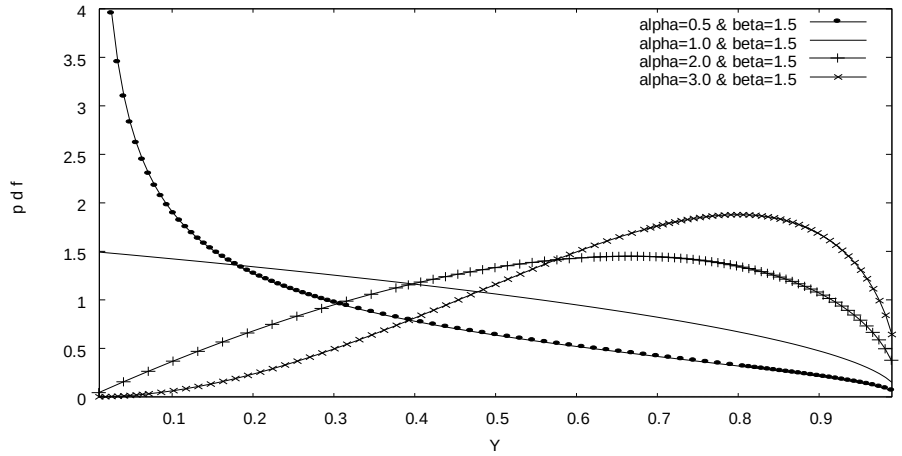

Figure 3 – Beta pdfs of Case-a (β is fixed at 1.5).

Figure 4 shows Corollary 1 - Case-b, in which the distribution of the purchase size variability is symmetric. Figure 4 shows four pdfs of the beta distribution in which the parameters are set as $(\alpha, \beta) = (0.5,0.5)$, $(1.0, 1.0)$, $(2.0, 2.0)$, and $(3.0, 3.0)$. From Figure 4, we know that a manager should increase the value of α and β as much as possible to improve the inventory performance, as a result of which the distribution of the purchase amount will be unimodal and strongly inverted U-shaped. This implies that for Case-b, offering only medium-sized packages and eliminating extra-small and extra-large packages could be necessary for efficiency.

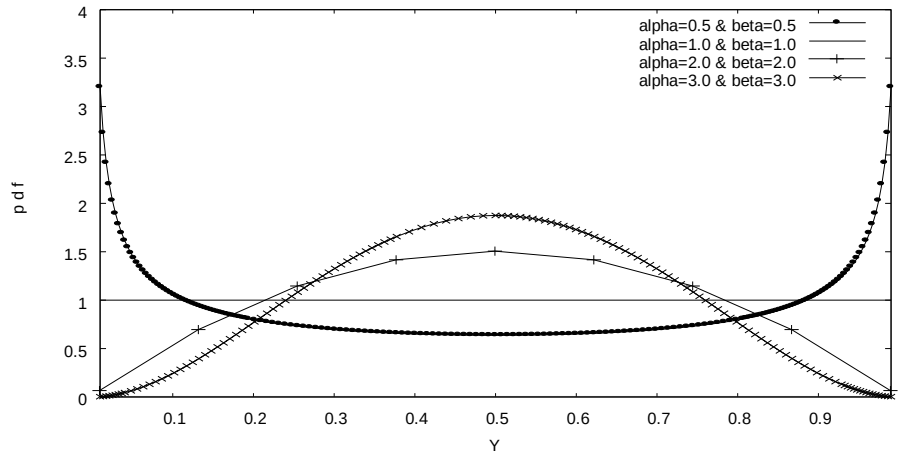

Figure 4 – Beta pdfs of Case-b ($\alpha = \beta$).

Corollary 1 - Case-c is another case in which the values of α, τ, and β should be as large as possible to improve performance by keeping the sales level high. Figure 5 shows four pdf curves of the beta distribution - the pdfs of $(\alpha, \beta) = (1,0.5)$, $(0.75,0.375)$, $(0.5, 0.25)$, and $(0.25, 0.125)$ - when we change the value of α while maintaining $\tau = 0.5$. In Figure 5, as α increases, the curve shifts toward the right (i.e., the probability in the region representing larger purchasing size increases). This implies that it is reasonable for retailers to motivate customers to buy more.

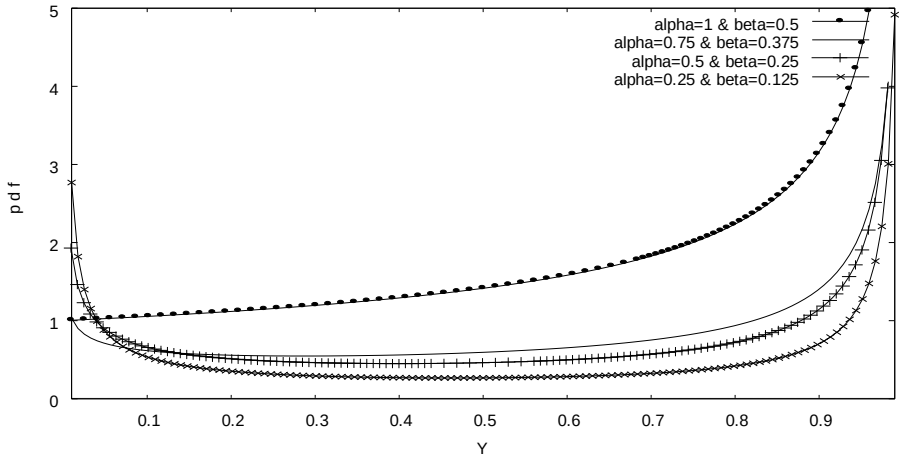

Figure 5 – Beta pdfs of Case-c (case of $\beta = \tau\alpha$ and $\tau = 0.5$).

We know from Corollary 1 - Case-d that the inventory cost is maximized at the threshold value $\alpha = \sqrt{\gamma/2}$. Thus, a reasonable policy for Case-d is that a manager should set the value of α as close to zero as possible or as much as possible. As a numerical example of Corollary 1 - Case-d, Figure 6 shows four pdf curves of the beta distribution of $(\alpha, \beta) = (0.21,1.21)$,

$(0.71,1.71)$, $(1.21, 2.21)$, and $(1.71,2.71)$, in which γ is set as 1.00. Note that $\alpha = 0.71$ is approximately the threshold value that maximizes the value of $V(XY)$ with respect to α when $\gamma = 1.00$.

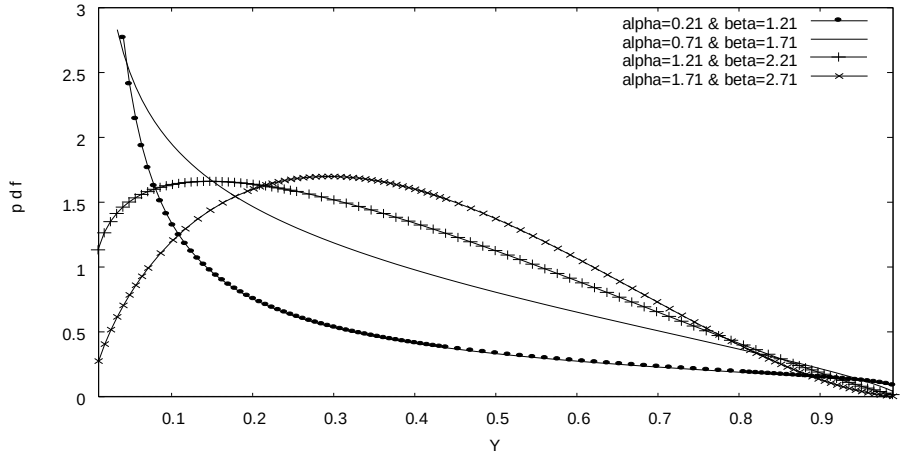

Figure 6 – Beta pdfs of Case-d ($\beta = \alpha + \gamma$ and $\gamma = 1.00$).

In Figure 6, the curve of $(\alpha, \beta) = (1.71,2.71)$ is inverted U-shaped, representing the homogeneous purchase size situation, whereas that of $(\alpha, \beta) = (0.21,1.21)$ is a decreasing function in α, demonstrating a situation in which the majority of purchasers buy a small amount. From Figure 6, we know that in Case-d, a reasonable policy on purchasing size per customer is to sell small- or medium-sized purchases according to the direction in which a manager decides to move the value of α.

4.3 Do more customers buy less or do fewer customers buy more?

We consider an often-discussed managerial concern of retailers: which is preferable, many customers making small purchases or a few customers making large purchases? First, in the case where the mean purchasing size on a shopping occasion is fixed as a constant R_0, we obtain from Proposition 1 the following relationship between α and μ:

$$\mu = \left[R_0\left\{(1+k^2)\frac{R_0(1-R_0)}{\alpha+R_0} + k^2 R_0\right\}\right]^{-0.5}. \quad (11)$$

From (11), it is obvious that μ increases in α. Note that the parameters α and μ represent customers' shopping behavior. We may then examine this via a numerical example. Figure 7 shows how μ increases with α for a given variance level. Note that Figure 7 sets k as 1 and R_0 as 0.4, 0.5, 0.6, and 0.7. Because the high α generates a concave distribution of purchasing size per customer, Figure 6 implies that the greater the number of customers that

go shopping, the more profitable is a homogeneous purchasing size per customer.

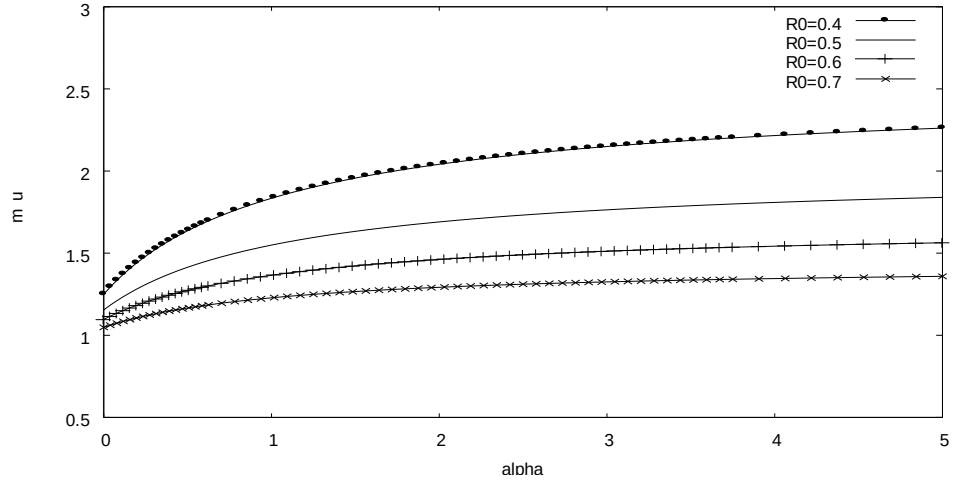

Figure 7 – Relationship between μ and α in Proposition 1.

Next, the average number of customers μ and the average purchasing size per shopping α and β interact, as the assumption of Proposition 2, $R_1 = \mu\alpha/(\alpha+\beta)$, shows. We discuss this relationship numerically using the four specific cases of Corollary 1. Figure 8 shows how μ changes with respect to α in Case-a through Case-d. The parameters in Figure 8 are arbitrarily set as $R_1 = 2,\ \tau = 0.8$, and $b = 1$.

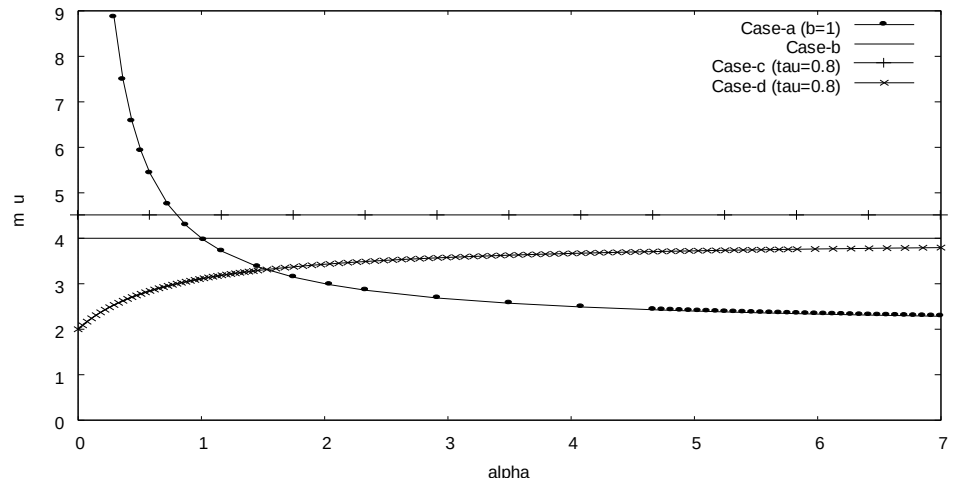

Figure 8 – Relationship between μ and α in Corollary 1.

Numerical examples of Figure 8 provide us an interesting observation. For example, in Case-a (i.e., when β is fixed at constant b), μ decreases in α. This implies a trade-off between the

arrival rate of customers and the purchasing size of each shopping event. In other words, a retailer should choose either a large number of small sales or a small number of large sales to maintain a certain level of total sales or revenue. Customers' arrivals are independent of customers' shopping size in Case-b and Case-c. Finally, Case-d shows an outcome in which μ increases in α and correspondingly in β. In Case-d, increasing α and β leads to larger μ, but μ does not diverge to infinity and instead converges to a certain value.

5. CONCLUDING REMARKS

Retail sales are affected by two factors: the arrival rate of shoppers and the purchase size of each shopper. By providing an inventory model that can distinguish the effect of the variability of customers' arrivals on inventory cost from that of the purchase size per customer, we propose how management can adequately deal with purchasing size variability and thereby improve retail efficiency according to the firm's managerial goal, with a focus on either the average total sales or the average sales per customer. When a business focuses on the average total sales, we show that a homogeneous purchasing size is preferable; in other words, the purchase size per shopping occasion should be controlled to be as close to the average level as possible. However, when a business focuses on maintaining average total sales at a certain level, we show that large or small shopping size per customer may be preferable. This study also addresses the relationship between the retail decision to sell either more to fewer customers or less to more customers and customers' shopping behavior. Based on the analytical results, we present managerial implications regarding marketing, such as package designs and volume discounts.

In a real business, demand is mainly influenced by the number of customers, the variability of the purchase size of each shopper, or both. For example, it is not uncommon in fast food restaurants for one person in a party of customers to buy meals for all the group members. Thus, data on customers' arrivals are required to reduce congestion at parking lots, manage tables, and staff cash registers. In contrast, an accurate assessment of the demand for buns, burgers, and drinks depends on the variability of the purchase size of each shopper, as well as the number of shoppers. More generally, Bell et al. (1998) demonstrated that the customer's shopping cost, comprising the fixed cost (e.g., distance) and the variable cost (e.g., quantity), determines where to shop. Therefore, our model, which distinguishes the customers' purchase size from their arrivals, is a tool for describing customers' shopping behavior and thereby assisting the making of specific decisions, for example, accurate item-by-item inventory control for a restaurant chain.

This study has certain limitations. First, as part of our analytical research, we set up several assumptions for the sake of simplicity and tractability. By relaxing some assumptions, we

might make our analysis closer to real retail situations. For example, we assumed no relationship between customer arrivals and purchasing size per customer. However, it could be the case that frequent customers are usually heavy users of a certain product. Considering the correlation between the two random variables would be an interesting extension of the present study. Second, we developed a descriptive model. If this model were to contain control variables representing the marketing mix, our analysis would be of more practical assistance to retailers. Third, we arbitrarily determine parameter values as is often done in analytical research. If an adequate empirical data set were offered to estimate the parameters, it could enhance the plausibility of model analysis.

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A CASE STUDY ON THE CLOUD COMPUTING SERVICES IN KOREA

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ABSTRACT
As the cloud computing is located in the center of Information Communication Technology (ICT) eco-system around the world, it has been playing an important role as an IT strategy for the global competitiveness of companies and nations. However, after the government release its plans to lead the world public cloud market in 2009, despite the efforts of companies and relevant ministries, public cloud computing market in Korea has not been working very successfully for four years. It is quite slow in its development. This study aims to identify inhibiting and promoting factors for the successful cloud computing services. For this purpose, we adopt a case study based on a company in Korea. We then analyzed causalities of the extracted factors based on the use of Causal Loop Diagram, presented several key issues, and proposed alternatives for booming cloud computing market. Therefore, this study is considered to support more various practical implications than previous studies that arranged issues and alternatives one-dimensionally. We also can provide a guideline to the government and enterprises which are planning to start cloud computing business, and also expected to revitalize the domestic public cloud computing market.

Keywords: Cloud Computing, Causal Loop Diagram, System Dynamics

INTRODUCTION
Information Communication Technology (ICT) eco-system which is defined as CPND (Content, Platform, Network, and Device) has rapidly been changing human life since the emergence of the internet that started as ARPANET in the late 1960s. In the circumstance, the cloud computing technology with the concept of virtualization is located in the center of the ICT eco-system as a key to evolving and developing the ICT industry further (Chang 2009; Kim et al. 2009).

Clouding computing is based on the concept that users borrow as many internet resources as they want and then pay as much as they use. The point that it can reduce costs in terms of resource use drew people's great attention in the wake of the global economic crisis triggered by the US subprime mortgage crisis in 2007 (Susarla & Whinston 2009). With the change of the global IT industry environment, the Korean government also announced 'Cloud Computing Activation All-out Plan in Korea' to develop the cloud computing industry in December 2009, and ambitiously took its first step to early activate the domestic cloud computing market and lead the world market by setting up the goal of '10% market-share in the global cloud computing industry in 2014.' Despite the government's goal and

determination, the domestic cloud computing market faces a very low actual-introduction-rate (%) of cloud computing because of the government's remaining regulations, people's strong desire for possessing information, their lack of understanding cloud computing, and their poor competence for could computing, though the attention on cloud computing is high. Therefore, it has been suggested that it is necessary to immediately seek alternatives to activate cloud computing

Cloud computing service has long been performed in the advanced countries such as the US and European nations. A lot of foreign firms announced that the introduction of clouding computing brought about an improvement in productivity and a reduction in cost (Paleologo 2004; Rochwerger et al. 2009; Marston et al. 2011). Unlike such clouding computing overseas, the domestic clouding computing is in an early stage. So it is necessary to make a lot of studies and efforts to find alternatives to activate cloud computing.

Domestically cloud computing has been studied in a wide range of research subjects, varying from overall research ones, including a clear definition of cloud computing and the trends and outlooks of domestic and foreign markets, to detailed research ones, such as a suggestion of a plan to effectively establish cloud computing, a suggestion of a policy on cloud computing, and an analysis of influential factors on the intention of introducing cloud computing service. Although such research has actively been conducted from the time of introducing clouding computing in Korea up to now, many studies of cloud computing still focus on unclear definitions or concepts of cloud computing, or the market trends and outlooks of cloud computing. Case studies of the best practices in Korea or quantitative analyses of actual achievements have not been performed.

Therefore, this study aims to examine the issues for the success of cloud computing services from the service provider's perspective. We consider the success in terms of two factors: (1) the number of users and (2) the sales revenue. To achieve the research objective, we extract the inhibiting and promoting factors to activate the domestic cloud computing market through a case analysis based exploratory study, analyze cases through interviews with experts at a cloud computing provider, and look into relevant issues through the analysis of the collected data by system thinking approach (system dynamics). Also, it tries to diagrammatize the analyzed results with the use of Causal Loop Diagram (CLD), an analysis tool of system dynamics; to use the causalities of the extracted factors to derive the main issues arising in activating the cloud computing market; and finally to propose high-levelled alternatives for booming cloud computing market.

CONCEPTUAL BACKGROUND: CLOUD COMPUTING

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction (Peter & Timothy 2011).

IT resources can be categorized into three types: software, platform, and infrastructure. Cloud computing service can be different depending on the types of IT resources that users borrow. To put it simply, if software is borrowed, the service is called 'SaaS (Software as a Service)'; if platform is borrowed, it is called 'PaaS Platform as a Service)'; if infrastructure is borrowed, it is called 'IaaS (Infrastructure as a Service)' (Weiss 2007).

The ecosystem of the cloud computing industry can largely be classified into developer, service provider, device manufacturer, and end user. A developer supplies contents, applications, platforms, and IT infrastructure to service providers. A service provider receives

IT resources from an infrastructure provider to make and operate a diversity of cloud computing services. A device manufacturer produces devices like Smartphones which will be used for cloud computing.

Cloud computing market in the world is expected to grow 27.4% per annum and will be over $55 billion by 2014 (IDC 2010). In particular, the business applications are expected to increase in the annual average of 86% so domestic companies need careful analysis and careful observation point.

The current cloud world market is mostly dominated by the U.S. companies. Especially when applied to server virtualization, the top five's market share stand at about 96 percent. U.S. companies, such as Google and IBM, are expanding investment in cloud computing. And HP and BMC are strengthening their own capacity through M&A (IDC 2013).

Table 1 – Platform-based major operators and market share (IDC 2010)

Category	**Technology**		**No. 1**	**No. 2**	**No. 3**	**No. 4**	**No. 5**
SaaS	Software on Demand	Company	Salesforce.com	Cisco	Citrix systems	Intruit	MS
		Share	11.8	7.6	3.7	3.1	2.9
	Mobile Application	Company	Google	Apple	Symbian	RIM	Others
		Share	55	39	3	1	2
PaaS	Application Deployment Software	Company	IBM	Oracle	Swift	Sterling	TIBCO
		Share	31.9	16.1	4.5	4.4	2.9
IaaS	Server Virtualization	Company	VMware	IBM	HP	Parallels	Citrix
		Share	79	10.9	3.3	2	0.8

Cloud computing market in Korea is expected to grow 47.6% per annum and will be over $460 million by 2014 (IDC 2010). However, foreign companies are taking the main area of the software market. Domestic company is non-existent in markets of system, network management software, and storage soft. Moreover, market share of the top five foreign companies is over 50 percent.

In the period since almost 100 domestic companies took the plunge into software business, only 10 percent of them are successfully deployed on a commercial scale and many of them are still in early phase. So domestic companies could hardly access to domestic markets because of cutthroat competition among domestic and against global companies.

Table 2 – Platform-based major operators and market share (IDC 2010)

Category	**Technology**		**No. 1**	**No. 2**	**No. 3**	**No. 4**	**No. 5**
PaaS	Application Deployment Software	Company	Oracle	IBM	MS	Tmax	SAP
		Share	25.9	14.8	8.1	4.8	2.4
IaaS	Storage Software	Company	EMC	Symantec	HDS	HP	IBM
		Share	19.3	8.3	6.8	2.6	2.4
	System/Network Management Software	Company	HP	IBM	BMC	nKia	Brainzsquare
		Share	16.3	14.8	9.8	8.4	7.6

In recent years, although some companies are securing the competitiveness with specialization, even the domestic market is difficult to enter because of U.S. companies.

Therefore, if domestic companies cannot secure competitiveness, the anticipated rapid growth of the domestic cloud computing market is not meant, but will rather lead to strengthening the market power of foreign companies.

RESEARCH METHODOLOGY

Case Study Method

This study selects a cloud computing service provider, ABC, in Korea for the case study which uses cloud computing after its introduction and leads the domestic cloud computing market. Since its introduction of cloud computing in 2009, the company has taken the lead in helping users raise their awareness of cloud computing services and activating the domestic public cloud computing market.

For the case study, data collection was performed in two steps. In the first step, the company's product data on its website, its PR materials, seminar documents, and literatures related to the case studies of the company were collected as the first data. In the second step, based on the first data, the interviews in the cloud computing service supplier of the company were used as the second data.

The interview mainly focused on the question as to 'what are the influential factors on activation of cloud computing service usage?' To investigate the influential factors on activation, the interview was aimed at analyzing as to why the company introduced cloud computing, why it performed the cloud computing business, what processes were unfolded, and consequently, how the current state of its cloud computing business is. Of the 29 interviewees selected by ABC, 25 (86%) were men, and 4 (14%) women. Their jobs varied.

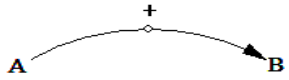
System Dynamics with Causal Loop Diagram (CLD)

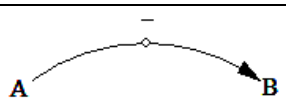
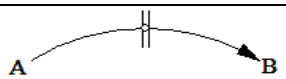
System Dynamics is a system analysis and design methodology created by Jay W. Forrester in 1961. It is used to look into a complex system wholly and structurally and thereby analyze the influence of a variety of relevant factors and solve problems. In the system dynamics methodology, it is possible to simulate diverse policies and strategies and assume nonlinear changes. For the reason, the methodology is used as a frame of reference for the phenomena occurring in complicated causal relations (John 2000)

Therefore, this study tried to analyze and define the current state of cloud computing in the system dynamics methodology; extract the inhibiting and promoting factors of activation from an interview-based case study; analyze the causal relations of the extracted factors; and make suggestions for cloud computing activation.

A Causal Loop Diagram (CLD), a key to the system dynamics approach, is used to diagrammatize the interactions of potential causes and make feedback loops (John 2001). The diagram is made up of three elements. First, an arrow represents the causal relation of variables. The starting point of an arrow means a cause variable, and its end point means an effect variable. A sign represents a direction of the causal relation (+/-), '+' sign means that two factors change in the same direction, and '–' sign means that two factors change in a different direction. '=' sign means Time Delay.

Table 3 – Causal Loop Diagram Types

Types of causal link	Description
	The diagram on the left means that when all conditions are equal, **an increase (decrease) in** variable A leads into **an increase (decrease) in** variable B.

	The diagram on the left means that when all conditions are equal, **an increase (decrease)** in variable A leads into a **decrease (increase)** in variable B.
	There is delay between the cause (A) and the effect (B) so that it takes a lot of time.

When such causal links create one close loop, it is called a feedback loop. A feedback loop is defined as a reinforcing loop and a balancing loop. In a reinforcing loop, when a variable changes, the effect returns to the variable so that the variation is reinforced. In a balancing loop, when a variable changes, the effect returns to the variable in an opposite direction so that each balance is in balance. When a feedback loop has the causal links, all of which are denoted with '+', or have an even number of the causal links denoted with '-', the loop is a reinforcing loop. When a feedback loop has an uneven number of the causal links denoted with '-', the loop is a balancing loop.

As a qualitative model, the causal loop diagram is used to analyze the interaction and effect of various phenomena through system analysis and qualitative simulation.

CASE STUDY: ABC CASE IN KOREA

Background and process of the introduction of cloud computing

The backgrounds of the company ABC's cloud computing business are presented as follows: first the company ABC aims at immediately responding to the changes of the management environment caused by the rapidly changing ICT ecosystem; secondly the company tries to reduce its IT operating cost effectiveness; and thirdly it intends to increase its corporate revenue by innovating its IT operating process and business model.

In the backgrounds, as shown in Figure 1, the company ABC prepared for introducing cloud computing in 2009, performed planning and development to release personal cloud computing products in 2010, and advanced in the cloud computing market on a full scale by launching cloud server service in the early 2011. In the beginning, the company had yet to make a big success because of some issues, including information leakage and concern about the system stability. However, in 2012 the company exerted its most efforts to advance the quality of cloud computing services and ended up stabilizing cloud computing by acquiring various certificates (KT 2012). Thanks to such efforts, the company ABC is equipped with the business environment of the cloud computing service with high performance as of 2014. The company expects to achieve visual achievements in the business area.

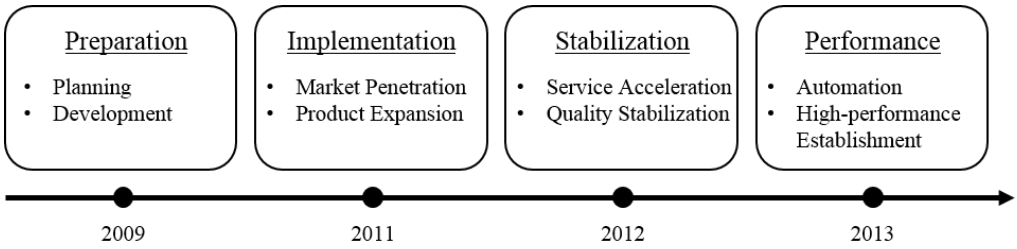


Figure 1 – Company ABC's cloud computing business progress

Efforts and achievements

The company ABC reached up its level to Amazon's, the world's best cloud computing service provider, in terms of system performance, network quality, SLA level, security and

price. In November 2011, the company was approved by Cloud Harmony specializing in the test of cloud computing performance (KT 2012).

In addition, to enhance the quality of cloud computing service, the company implemented center & system replication designs in Cheonan, Mokdoing, and Gimhae CDCs, and established cloud operating governance system with its experience of the establishment and operation of its private cloud system. In July 2012, the company received 'the 1st cloud service provider' certificate from Korea Communications Commission. To meet clients' needs, the company expanded and advanced products. Now it is equipped with the Korea's largest product line-up. Compared to domestic and foreign competitors, the company has the best competitiveness in terms of product price.

By making such ceaseless efforts, the company ABC provides cloud services for many different industries, such as entertainment, press media, and finance. As a result, many domestic firms are using the company ABC's cloud products to achieve cost saving and work efficiency.

ANALYSIS RESULTS

In this study, as shown in *Figure 2*, 'Used amount of cloud computing services for enterprise' war regarded as a reference model, based on 'The present and future of cloud computing and market strategy' in light of the study mentioning that the growth conditions of cloud computing is the spread of corporate demand (KIPA 2008). And the inhibiting and promoting factors of the activation of the domestic cloud computing market were extracted with the exploratory study of expert interview and actual case studies of the company ABC that is leading the domestic cloud computing market. And causalities of the extracted factors were analyzed with system dynamics research methodology to derive main issues, and then present several key issues and propose alternatives for booming cloud computing market.

Reference Model

Company ABC's corporate client of cloud computing products were 80 companies in March 2011 when cloud server products launched, 1600 compaies at the end of 2012, and more than 4000 companies in Auguest 2013 (KT 2012).

However, according to expert interview results, the current ABC company's corporate client (used amount) remained still insufficient level by comparison with CAPEX(capital expenditures) and OPEX(operational expenses) on the cloud computing business. There has been also rarely large-scale corporate client like congloeramates and public organizations and many obstacles such as system failure and information disclosure concerns in the domestic cloud computing market (Subashini & Kavitha 2011; Paquette & Wilson 2010; Pearson 2009). Therefore, the situation scarcely warrants that company ABC made their cloud computing business successfully settled in the market.

Company ABC now wishes a continuous growth in the number of corporate clients and activating cloud computing business enables by securing large-scale corporate client. Ultimately, what they want is to reach the break-even point through the activation of the market. However, the company is concerned with the market failing to overcome the various obstacles mentioned above.

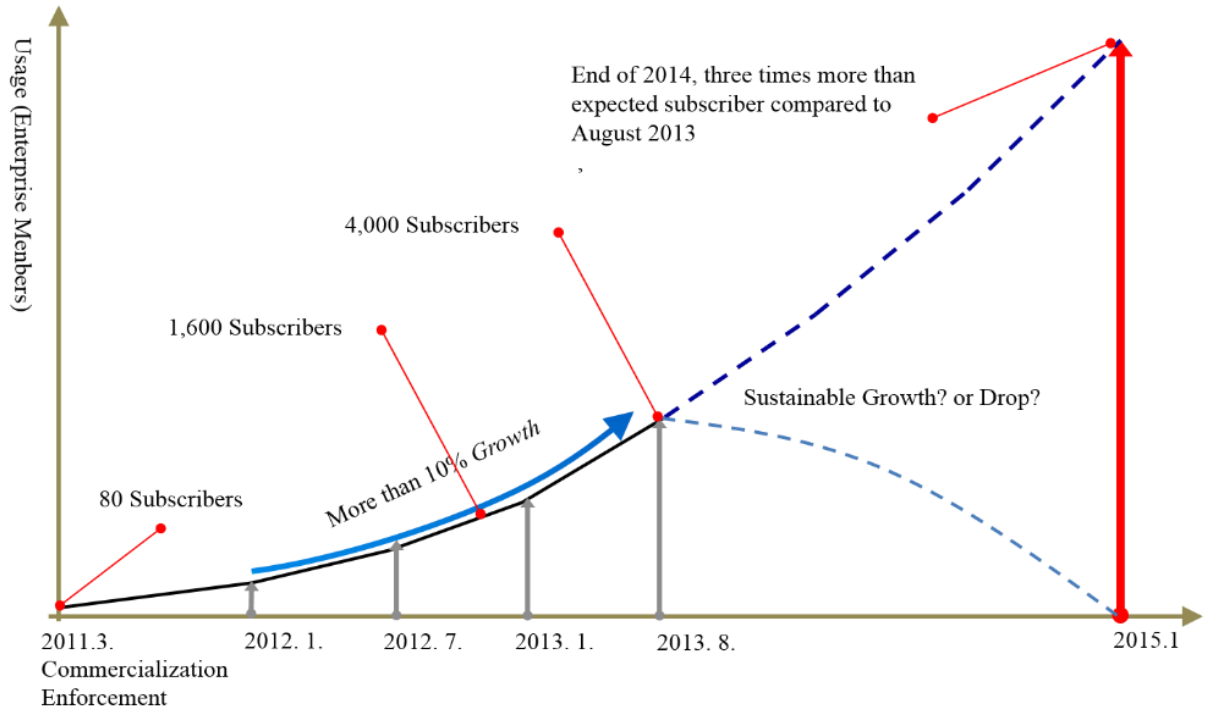


Figure 2 – Company ABC's reference model

Most of domestic companies promoting cloud computing business lie in the similar situations like company ABC. Moreover, in recent years the global leaders in cloud computing, such as Microsoft and Amazon, are beginning to threaten the domestic market.

This study extracts the factors to activate the domestic cloud computing market through a case analysis, analyze cases through interviews with experts at a cloud computing provider, and look into relevant issues through the analysis of the collected data by system thinking approach (system dynamics). Also, it tries to diagrammatize the analyzed results with the use of Causal Loop Diagram (CLD); to use the causalities of the extracted factors to derive the main issues arising in activating the cloud computing market; and finally to propose high-levelled alternatives for booming cloud computing market.

Analysis framework of causal loop diagrams

The influential factors of cloud computing are defined as the promoting factors and the inhibiting factors. The promoting factors mean the positive effect generated by a sense of fear for survival in the changing ICT environment and by the profits gained by cloud computing business. The inhibiting factors are a firms' fear and resistance in the circumstance of cloud computing introduction and activation, the cloud business department's lowering morale and productivity, and obstacles to cloud computing introduction. The effect of inhibiting factors causes the management and employees to preferring conventional work processes, leading into a reduction in a cloud computing use rate.

The analysis result consists of four promoting loops and five inhibiting loops. Based on the result, the main issues were extracted and the final alternative causal loop diagram (CLD) was proposed. Regarding the CLD analyzed by the systems thinking approach, the result from the analysis of promoting and inhibiting loops from a provider's point of view was applied to extract main issues and propose alternatives and the final CLD.

Causal loop diagram of the promoting factors of activation

In regard to cloud computing, an expert at the company ABC mentioned "The development of cloud computing technology leads into a rapid change in the ICT environment. As a result, relevant firms quickly respond to the changing management environment and make an investment to defeat other competitors. Such an investment results in an improvement in the quality of cloud computing service and a rise in a supply of service products which increases sales".

Such a process creates a basic loop for activating the cloud computing market, in which the increasing sales trigger an investment again into the development of cloud computing technology and end up improving the quality [R1].

According to the interview result, a cloud computing provider should first reinforce a virtuous circular loop in which the provider makes an investment into improvements of system stability and information security to gain client' trust and thus increase the number of users and a supply [R2]; secondly the provider should create a loop of promoting the activation of the virtuous circle, in which the provider continues to develop the extensibility and accessibility of IT resources to improve the efficiency of cloud computing and thereby achieve client satisfaction to increase a supply[R3]; and thirdly, when the above virtuous circular loop works well, it is possible to create a virtuous circulation based reinforcing loop of activating the cloud computing market, in which a large increase in a supply causes a fall in cloud service use price and thereby helps increase further user satisfaction, the number of users and a supply and finally achieve economies of scale [R4].

Causal loop diagram of the inhibiting factors of activation

An expert interviewee said, "A rise in users of cloud computing brings about 'Cannibalization' which affects the sales of existing IT products, and therefore it is hard to actively promote cloud computing products in TV and media press."[B1] Also, he mentioned "Thanks to the resistance of the organization related to conventional business in the cloud computing provider, it is possible to delay the launch of cloud computing products."[B2]

Such a process creates a basic loop of inhibiting (balancing) activation, in which a rise in a supply fails.

An expert referred to the failure case of DuPonts and said, "As global competitors with better technology enter into the domestic market, clients' preference to global firms' products rise, and the value of domestic firms' products falls. For the reason, to keep up with the global competitors' quality service, domestic firms excessively try to introduce the cloud computing service far apart from their core competence and end up facing failure." Such a process creates a vicious circular loop of inhibiting activation of cloud computing [B3].

According to cloud quality enhancement regulations of the government organization, a cloud computing provider increases its investment to multiply systems and comply with standards, and consequently meets resistance of other groups than cloud computing related departments and delay the launch of cloud computing products. That is a reinforcing loop of inhibiting activation of cloud computing [B4]. In addition, as an investment in cloud computing facilities and the operation cost continue to remain high, the resistance of conventional groups causes a fall in the morale of cloud related departments, which results in lowering productivity and ends up inhibiting a rise in a supply. That is a vicious circle loop of inhibiting activation of cloud computing [B5].

Summary of analysis results

Based on the interviews with experts at the cloud computing provider ABC, a case study was conducted to activate the domestic public cloud computing market. The interview data were examined by literature review and the case study of the company ABC. After that, a causal loop diagram was used to analyze issues and alternatives for the promoting and inhibiting factors to activate the cloud computing market.

To sum up, the issues arising in activating the cloud computing market are a sense of crisis over the management environment being rapidly changed by the development of the ICT industry, the stability and efficiency of cloud computing services, and an increase in clients. To address the issues, it is necessary to enhance the efficiency of IT operation which is created by the switch to cloud computing and to alleviate relevant firms' concerns about the quality of the service. In fact, it takes much time until service providers earn client' trust and satisfaction. Therefore, the providers need to make efforts to shorten the time. An alternative to that is to make a successful case like successful joining of large-size corporate client (e.g., public organizations) in cloud computing services and thereby to promote the service.

The issues arising in inhibiting the cloud computing market can be summarized as the cannibalization effect according to which the sales of conventional IT products fall with the increasing use of cloud computing service; domestic firms' premature launch of cloud computing products regardless of their core competence in the circumstance where global competitors with better technology enter into the domestic cloud computing market; the government organization's regulations to minimize system failure or information leakage; resistance of other groups than cloud computing related departments in providers; failure of launching products because of obstacles for cloud computing service; and lowering morale of the executives and staff in cloud business division and falling productivity. As an alternative to address the issues, it is necessary to specify the cloud computing market, position strategic products, and make customized target advertisements to respond to the cannibalization effect. In addition, it is urgent to develop and launch cloud computing products which reflect a provider's distinct value on the basis of its core competence. Also, it is necessary for the government to come up with reasonable regulations and support policy in the participation of the firms demanding and providing the service. To stir up the morale of the executives and employees in cloud computing departments and mitigate resistance of other groups than cloud computing related departments, it is necessary to operate a cloud computing promotion center and constantly manage the changes of the cloud computing environment.

As shown in *Figure 3*, a causal loop diagram of integrating the promoting loops and inhibiting loops extracted above is proposed. The alternatives for the issues drawn are displayed in the boxes.

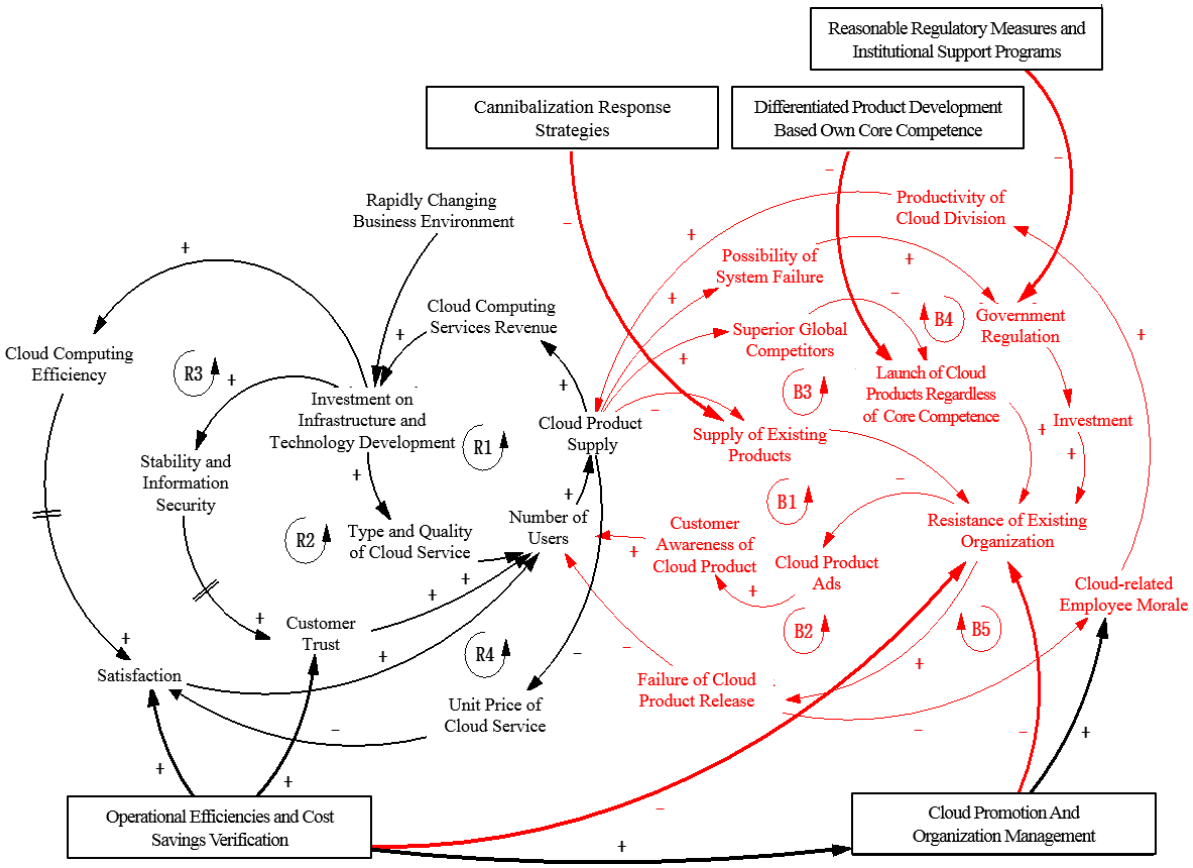


Figure 3 – Final causal loop diagram

DISCUSSION AND IMPLICATIONS

Core causal loop diagram

In the core loop of the positive circular structure of the activation of the cloud computing market, enhancing cloud operation efficiency and activating the cloud computing based application industry, including smart work and big data contribute to achieving client satisfaction which increases a use rate of cloud computing. In the core loop of the negative circular structure, the negative factors-relevant firms' insistence on conventional IT application methods on account of their concern about quality, cannibalization effect, the government regulations, the launch of products irrelevant to core competence, and entailing resistance of other groups than cloud computing related departments, and lowering morale and productivity of cloud computing departments-cause a fall in a use rate of cloud computing. Such structures can be drawn in the core CLD of promoting and inhibiting the activation of the cloud computing market.

Suggestions for activation

From the case analysis, we have identified four issues affecting the business success of cloud computing services in the Korean context. Based on the identified issues, this study offers three suggestions for facilitating the success of the Korean cloud computing business. Suggestions for activating the cloud computing market can consist of two types: reinforcing the positive circular structure of the above core CLD and weakening the negative circular structure.

First, in the positive circular structure, as a plan for shortening the time of improving client's trust and satisfaction, it is necessary for cloud computing providers to make operational efficiencies and cost savings verification. For this issue, it is necessary to make their efforts to find success cases for securement of large-scale corporate client or for others.' Secondly, they need to try to vitalize cloud-based appliance industry such as smart work and big data through government's institutional support and related research activity. They also need to enhance cloud computing efficiency through improving data processing performance in cloud system and access quality for accessibility of IT resource. Lastly, it is necessary to intensify stability of cloud systems. The alternatives could be redundant cloud data center for data loss prevention and disaster recovery and redundant equipment and transmission for preventing service disruptions.

It is also necessary to come up with a plan for addressing such issues in the negative circular structure. First, cloud computing providers need to establish the strategies of responding to cannibalization. It can be useful to develop strategic product positioning through cloud market segmentation and targeted advertising aimed to client segmentation. Secondly, they need to develop the differentiated cloud product based own core competence. It is an applicable way to create a synergy effect with the core capabilities of another company for the issue. They also need to reinforce information security for the prevention of information leakage. It is useful ways to configure physical and logical private network, designate of the data storage location, develop the enhanced technology to prevent unauthorized removal, and establish strict information security policy. Finally, they need to make constant efforts to manage organizational changes and develop consensus at an organizational level.

Additionally, the government organizations need to prepare reasonable regulatory measures and institutional support programs. It is possible ways to establish a special law for the activation of the cloud services and practical support through participation of cloud user and supply company for regulatory policy.

Limitations and the future research direction

Although it has been four years since the full-scale introduction of cloud computing in Korea, the domestic public cloud computing market has yet to be activated. Therefore, this exploratory study was conducted. But, it has limitations as follows:

First, although this study analyzed the promoting factors to activate the cloud computing market by investigating the case of the company ABC, it didn't verify and prove the actual effectiveness of the introduction of cloud computing because of the poor activation of the domestic cloud computing market. Secondly, to secure the representative nature of a case, this study chose a company leading the domestic cloud computing market. However, by focusing on a specific company, it didn't look into various influential factors appearing in other firms or other industrial areas. Thirdly, this study chose an exploratory study model based on interviews, so that it had a limited number of samples and might reflect this researcher's subjective opinion in interpreting the interviews with experts. Fourthly, after having interviews with experts, this researcher developed causal loop diagrams and examined them together with some interviewees. In other words, this study failed to perform and update constant examinations together with all interviewees. Therefore, there is somewhat a lack of completeness.

In the future study, it will be necessary to investigate the quantitative effect of cloud computing since the introduction of public cloud computing in Korea and investment in the service, and to analyze various cases. Additionally, it is required to develop the causal loop

diagram proposed in this study, to make a more detailed and elaborate model, and perform other empirical studies.

Implications for research and practice

The purpose of this study was to analyze the issues related to the activation of the domestic public cloud computing market and propose alternatives through case study based interviews with experts and systems thinking approach. Therefore, this study suggested the following implications:

First, this study tried to investigate the effect of the introduction of cloud computing and the inhibiting and promoting factors of activation of the cloud computing market, which were suggested in previous studies, to analyze the causal relations between the factors, and to propose a causal loop diagram showing the overall relations. Therefore, it is meaningful in the point that it helps generally understand something related to cloud computing activation. Secondly, this study used systems thinking approach to extract the issues and alternatives for cloud computing activation and therefore made a contribution to securing different points of view in terms of the diversity of study. Thirdly, whereas the previous studies mainly focused on the users' service use as a plan for activating cloud computing, this study looked into the difficulties and obstacles that service providers have in running the service. Therefore, this study is expected to provide more diversified scientific implications. Fourthly, this study analyzed an actual case of a cloud computing business by conducting interviews with experts at a cloud computing provider in the dimension of the lessons learned, and found issues and alternatives. Therefore, it is expected to provide scientific lessons.

In this study, we extracted the influential factors on the activation of the domestic cloud computing market with the exploratory study of expert interview and an actual case study of the company ABC that is leading the domestic cloud computing market. Then, in terms of positive and negative influences, we analyzed causality of the extracted factors, by the system dynamics methodology to derive main issues, present several key issues and propose alternatives for booming cloud computing market. Therefore, it is considered that this study will be able to provide more diversified and practical implications than previous studies which enumerated issues and alternatives one-dimensionally.

Furthermore, this study analyzed the causal relationship between the promoting factors and the inhibiting factors from a cloud computing provider's point of view, and made integration and summary. Therefore, it is expected that this study will serve as guidelines for the firms which will perform a cloud computing business, for the firms or public organizations which will introduce cloud computing services, and for the government organizations which will establish and draw up relevant policies.

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Subordinates' Machiavellianism Self-efficacy and Impression management tactics effect on Organizational Citizenship Behavior：Supervisor Perspective

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ABSTRACT

Most studies of impression management focus on the behaviors from subordinate to superiors. However, the tactics of impression management manipulated between colleagues are ignored. To clarify the difference of personality and effect of organization civic behavior, the study introduces the concept of tactic of impression management. The analysis result can explain the development of organization citizenship behavior. Based on the questionnaires collected, it is from different industries of managers and employees which allocated two sources to collect samples to avoid common method variance. There are total 297 questionnaires. The valid rate of recovery reaches 96.1%. The data is analyzed through relevant analysis and structural equation to testify study and submits the hypothesis. The result shows that the variant personality between colleagues will indeed influence individual adopted the tactic of impression management. The tactics of supplication and intimidation are intermediate variables of Machiavellianism and organization citizenship behavior respectively. However, the general self-efficacy and specific self-efficacy will influence organization civic behavior without intermediate effect of impression management.

Keywords：Machiavellianism, Impression Management, Organization Citizenship Behavior

INTRODUCTION

According to sociologist Goffman "Dramaturgical approach", it is the first statement for impression management. Goffman think the impression management is the common behavior in the social interaction which is to reveal the personal characterization. The impression management was brought up by social scholar in 1980's. The individuals manipulate self-image through social interaction intentionally or accidentally. The scholar Wayne and Kacmar (1995) consider the impression management help further for the study of achievement and promotion. The employee will use the tactic to ingratiate high management to get better impression, furthermore, it brings the better outcome of performance evaluation and salary and promotion plan.

The recent studies show that impression management includes ingratiation, exemplification, intimidation, self-promotion and supplication. Those behaviors are the common tactics which are used to supervisor. It is to achieve the goal of contentment or satisfaction. Those are the research field of impression management. From the personal point of view, it can promote self-image and get attention like supervisor, colleagues and subordinates by means of manipulation of impression management. That's to reach the goal of promotion, transfer and working smoothly. Thus, it will be learned that impression management can exist in workplace. Therefore, based on the theses of impression management, it can be diversity of development. Furthermore, impression management of tactics almost happens between supervisor and subordinate. However, it is limited studies between colleagues.

From the superiors' point of view, the studies discuss the variant personality between inferiors. Is it going to influence the organization citizenship behavior by manipulating the tactics of impression management? The studies are used to fill in the gap shown in the past. Besides, the studies testify the mediate effect in personality and organization citizenship behavior through structural equation model (SEM).

LITERATURE AND HYPOTHESE

Impression Management；IM

Impression management is the course of events, which can affect the image how people think about you. The sociologist and psychologist have studied this topic for over 40 years. It can't avoid to show up oneself in the front of people while you are in social communication. You will try to apply specific skills to direct or manipulate response from others to maintain self-image. When you try to manipulate the response from others, you will be manipulated and become the audience by others at the same time. Therefore, everyone is actor and audience noted by Leary& Kowalski in 1990. The scholar Schlenker in 1980 defined the impression management that it intends to manipulate self-image through social interaction. He leaded in the definition of impression management which indicated the mental development of performer. He suggested that people intend to manipulate the thoughts. They belonged to the field of impression of management. This research is to develop scales quoted by Bolino & Turnley in 1999 based on Jones & Pittman in 1982. The following classification of impression management is based on Jones & Pittman in 1982. Please have the introduction as below.

Jones' writings in initial stage proposed one type of tactic of impression management－ingratiation. He think this behavior used improper way to raise the attraction to others. He classified ingratiation four types respectively. The first type is complimentary other-enhancement. This behavior is usually flattering someone. This tactic usually brings to succeed because the target audiences can't resist compliments. Sometimes it can indirection. That is to say something good about target audience to third party, and then from third party told to target audience. The reliable fact is built through the process.

The second type is conformity in opinion, judgment and behavior. These kinds of behavior show much more similarities between actors and audiences. This assumption is based on that people usually like to get along with whom have the same values. This behavior model is likely from the same opinion to imitation.

The difference between them is not easy to show up and maintain compared the verbality especially when actors are not conformity with audiences. However, another feasible tactic is to force audiences to accept their opinion. But it is not wise to comply with their thoughts every time and try to share with your thinking, then you won't be considered to flatter someone.

The third type is self-presentation. He intends to show up himself. It can focus on strong points of himself or excellence of target audience. The practical tactics is like modest and honest or do him a favor. Besides, it is importance to leverage the position between individuals and target audience. If the target audience has much higher level, then individuals should focus on the modest side. On the contrary, the individuals should think about what positive values can be brought.

The fourth type is rendering favors. The studies at the age of Jones is not clear if individuals give petty favor based on the obligation of mutual beneficial, then it suggested that he render favors. However, if the answer is positive, then it will succeed without any reward.

The tactic of self-promotion by Jones & Pittman in 1982 is to reflect the capability and achievement of individuals , then make target audience think they are most competitive. Ellis, West, Ryan & DeShon (2001) think that self-promotion can divide into three kinds of categories which are entitlements, enhancement and overcoming obstacles. The studies recommended that applicant will use self-promotion to give interviewer great impression. The entitlements represent that applicant try to emphasize a positive of event and maximize the relationship of it. The enhancement will let someone think he is better than others besides the positive aspects. The last one overcoming obstacles will be focused by applicant especially when applicant is toward the goal. The problems encountered and how he will resolve it and bring successful eventually. The above tactics include in self-promotion. The main purpose is to show up the certain image to meet the expectation

of individuals whatever is positive or negative characterization.

This kind of tactic - exemplification may include performing the behavior of honesty or integrity and it usually can get immediate outcome. Therefore, the individuals may arrive at company easier and lunch break less than one hour and working efficiently. They build up the model of exemplification in colleagues. On the other hand, the studies by Jones & Pittman in 1982 defined the tactic of exemplification is to sacrifice himself for public welfare or exceeding his work responsibility to have target audience notice his contribution.

The tactic of supplication is not only to pass an image of helpless but also to rely on people. The purpose behind is to attract the morality of social responsibility, furthermore, to get help or benefit from someone. The definition by Jones & Pittman in 1982 is to let target audience know the weak point or disadvantage of oneself, then to get support. However, the studies by Tedeschi & Linskold in 1976 indicated that the tactic works when it won't cost much effort.

It will give people an impression something like dangerous, powerful and influential by performing initiation. The actor created the dangerous impression by dominating the social interaction. These kinds of behavior of impression management usually happen in higher management team. The main purpose is to demand obedience from his inferiors.

The impression management belongs to a common phenomenon in workplace for over forty years studying. It has been discussed in different situations like job interview (Steven & Kristof, 1995), evaluation of performance (Wayne & Ferris, 1990 ;Wayne & Kacmar, 1991；Wayne & Liden, 1995）, leadership（Wayne & Green, 1993）, career plan（Feldman & Klich, 1991）,feedback seeking（Ashford & Northcraft, 1992）, the discussion of impression management process（Bozeman & Kacmar,1997）,strategic management（Resenfeld, Giacalone, & Riordan, 1995）, the relationship between leader and inferiors（Liden & Mitchell, 1989；Wayne & Ferris, 1990). The main discussion of this study is to examine the message from inferior to leader while inferior is taking the tactic of impression management. Whether the right message is passing to leader and show a positive image in the mind of leader, it also meets the expectation of inferiors.

Machiavellianism with IM relationship

The studies made by Mudrack, Mason & Stepamski (1990) that found the characterization with high score of Machiavellian is cool, arrogant, argued and doubt. It will take wicked measures if needs to get better outcome. Machiavellian believes that human nature is selfish. Once he owns the power, then he will win the world. The high marks of Machiavellian will show his honest, generous and sympathy and so on. In fact, it is not true that he is kind. Their kindly behavior is to gain and protect their power. On the contrary, the low marks of Machiavellian will consider others needs and feeling, even under negotiation. They will treat them fair as much as possible.

The relationship between Machiavellianism and impression management was positive relevant which was inferred by Christie & Geis in 1970. Furthermore, Ickes, Reidhead & Patterson in 1986 indicated that high marks of Machiavellian people tend to take tactic of impression management extensively. If it's advantageous for him, even take mean measures like begging or intimidating without acceptance by general people. However, he will be cautious to use them. (Researched by Turnley & Bolino, 2001). It shows that high marks of Machiavellian people will be more aggressive than low marks ones while they perform the impression management.

The study here is using the scales which were developed by Christie & Geis in 1970. Even though the word - Machiavellianism indicates depreciation, there is no evidence shown that high index of Machiavellian are much more malicious, cruel or revengeful. In fact, people with index of Machiavellian appear cool syndrome and selfish ones without any faithfulness and friendliness. Besides, they won't show any emotions to people or sensitive affairs under in hard-pressed.

Hypothesis 1a：The relationship between index of Machiavellianism and positively impression management

Hypothesis 1b：The relationship between index of Machiavellianism and negatively impression management

Self-efficacy；GSE、SSE

The concept of self-efficacy was brought up by Bandura in1977. He considered that the sense of self-efficacy is a kind of expectation himself. The decision will be made by personal expectation how many efforts will be going to make and how long it will be lasted when encounter the difficulties. He also mentioned that the scores of self-efficacy can be an indicator of capability. When people with high marks of self-efficacy, it can be inferred that people can be quick problem solver. On the contrary, it will be the other way round. Now that the self-efficacy will influence the degree of facing difficulties and making efforts, it even influences personal endurance to resolve problems. Then, what is the difference between high marks of self-efficacy and low marks one? The high self-efficacy person tends to devote himself to relevant affairs and distinguish it clearly and work it out when he encountered problems. During the problem solving, they will proceed with much more experiments and gain value experiences to enhance their capabilities. On the contrary, The low self-efficacy person tends to evade the problems and give up easily (Bandura & Schunk, 1981)。Bandura et al. in 1977 that a person with well experience of personal mastery doesn't only show in specific situation but also appear in other behavior. Whatever it works or destiny or results from capabilities, it will influence the judgment of self-efficacy and become an important indicator. Therefore, Sherer & Madduex in1982 suggested that individuals will summarize the generalized expectations from successful and failed experiences to influence the experience of personal mastery which is so called general self-efficacy(**GSE**).

The theory of self-efficacy in Bandura indicated that specific self-efficacy(**SSE**) is to recognize himself owned capability, then helps to resolve any kind of situation. In the starting phase, it will affect the choice in behavior through recognizing himself owned capability. If individual regards something beyond his capability under certain circumstances, he will bring about fear or avoid this menace situation happened. On the contrary, they show self-confident and certainty and to conquer difficulties. When he was blocked by other people or facing dilemmas, he could be possibly adopt the fierce measures to deal with the social interaction so as to achieve the goal eventually.

In general speaking, self-efficacy is alternated, it contains much differences in various person, timing, task. Furthermore, the importance of self-efficacy influences our motivation and behavior in any time. The coverage includes the following reasons are: 1.The self-efficacy influences the choice of individual. 2. The individual decide to spend how much effort on tasks through the help of self-efficacy. 3. The degree of insistency is influenced by self-efficacy when individual encountered problem. 4. The self-efficacy influences the thinking model. 5. The self-efficacy influences the individual response of emotion. Therefore, it is reasonable to infer the following assumptions:

Hypothesis 2：GSE with high or low marks is showing negative relevant with the behavior of supplication. It's to say, the more GSE he/she is, the more he/she will use the tactic of supplication.

Hypothesis 3：SSE is showing positive relevant with the behavior of intimidation. Namely the SSE with Higher index, he/she will tend to use the tactic of intimidation.

Organization Citizenship Behavior；OCB

The scholar Katz was hoping to find the behavior which is the most helpful for the functioning and performance in organization in early forty years ago. He thought that there are three basic behaviors which are mostly important for survivals in organization. If there are lacks of three elements, the organization will become fragile. First of all, People must be induced to enter and remain within the system. Secondly, they must carry out specific role requirements in a dependable fashion. Finally, there must be innovative and spontaneous activity that goes beyond role prescriptions. However, the spontaneous activity is beyond role descriptions, it was called supra-role behavior in early stage. That is used to distinguish the in- role behavior described in working instructions or other official documents in organization. Until 1983, Bateman & Organ

thought that the suitable name is not available for it at that time, he entitled the spontaneous activity and pro-social behavior “Citizenship Behavior”.

The research studied by Smith, Organ, & Near in 1983 that citizenship behavior is essential part of social interaction. It provided the flexibility beyond regulations which work requires. Besides, it is interdependent existed in potential condition through cooperation in organization. Because citizenship behavior is beyond the requirement of supra-role, it is not easy to mandate and manage through inspiration. Therefore, this kind of behavior is unpredictable and immeasurable. It could be possibly received more than contributed to others, even it could be outcome sacrificed by certain part of himself. The studies made by Organ in 1988 who was focus on behavior in organization and addressed officially the name of citizenship behavior. The definition of citizenship behavior is a kind of working behavior which hasn't material reward directly to employee. It is decided freely. It is nothing to do with payment system in official organization. In general speaking, it is to promote organization efficiently. The studies suggested by Posdakoff, MacKenzie, Paine & Bachrach in1997 that it was observed various kinds of citizenship behavior around 30 types.

There are various kinds of aspects recommended by different scholars. In fact, many concepts are overlapping like altruism (Organ, 1988) , courtesy, cheerleading, peacekeeping, sportsmanship, civic virtue and conscientiousness. The studies concluded by Podsakoff & MacKenzie in 1994, it will be difficult to distinguish all various aspects totally. The leader will conclude altruism, courtesy, cheerleading, and peacekeeping as the same aspects which are so called helping behavior. Therefore, the studies continue to use measures of civic behavior in organization according to recommendation by Podsakoff, P. M., Ahearne, M., & MacKenzie, S. B. in 1997 who summarized in three aspects: 1. Helping Behavior 2. Sportsmanship 3. Civic Virtue.

The relationship between OCB and IM

Bolino in 1999 said that it is similar between various tactics of impression management and organization civic behavior. For example, it may be civic behavior by helping leader, on the other hand, it may be one tactic of impression management. The scholar Schnake in 1991 suggested that behavior of impression management belongs to organization citizenship behavior unless the motivation revealed. Similarly, it mistakes organization citizenship behavior for impression management. The studies observed by Wayne & Green in1993 that it was positive relevant index(r =0.49) between the impression management and organization citizenship behavior. Therefore, the evidence showed that the two concepts were connected.

Taking for further example, the ingratiation in impression management, they trust in them, the individual are willing to help other people and obey others. The measures provided by Wayne & Ferris in 1990 included the identical opinion, doing an favor in private and undertaking task and so on especially to leader. Besides, the studies built by Kumar & Beyerlein in 1991, the measures of ingratiatory behaviors in organization settings, those can be used to measure the degree in listening to other question, dealing with trifling things, helping others voluntarily and showing up unselfish. Those behaviors in definition are overlapping with help others, sportsmanship and civic virtue in organization behavior. And inferiors showed his achievement and capability to audiences by manipulating one of tactics of impression management – promotion themselves. That is to make audience impression that he is the most competitive. At this moment, they will perform their professional aspect in front of audience like undertaking special task voluntarily or helping others something as he is doing his job. On the other hand, he will submit proposal about company strategy to ingratiate higher management team. It is the opportunity to show up their expertise and capability. Then, leaders and colleagues will know they are important in organization. Those concepts were included in the aspects of helping behavior and sportsmanship etc. in organization.

At the same time, Bolino in 1999 also indicated that individuals will take part of measures of impression management to achieve the purpose of intimidation. For example, if individuals know the colleague can't stay, they will stay or claim to stay here at least. They will devote himself to work compared to other colleagues.

The inferiors will use the tactic of intimidation between colleagues. The motivation behind will not be correspondence with the spirit of organization civic behavior.

The last part I would like to mention, the studies suggested by some scholars in recent years that it is not sure about inferiors when they volunteered for it or asked for no reward. For example, the research shown by Rioux & Penner in 2001 that inferiors act organization civic behavior because it can fit their specific requirement and inspire them how it is important. One of reasons is impression management in order to keep their own positive image and gain rewards. Therefore, it is reasonable to infer the following assumption.

Hypothesis 4a：The relevant factors between the tactic of positively IM and OCB

Hypothesis 4b：The relevant factors between the tactic of negatively IM and OCB

Summarized Hypothesis1 to Hypothesis4, the research framework as below:

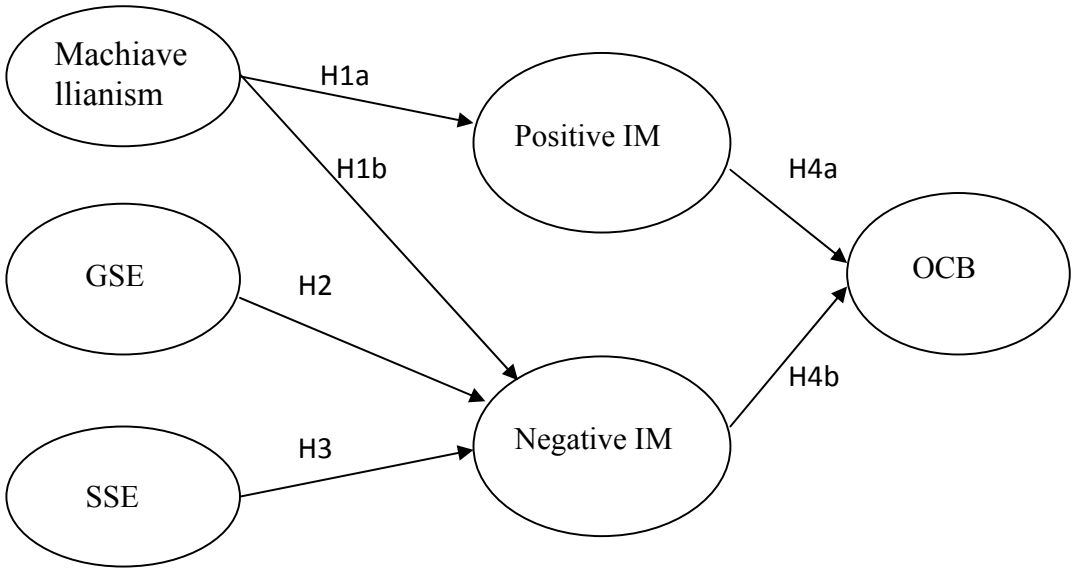


Figure 1. Research Framework.

METHODS

Sample and Procedures

The content of study will be focus on the tactics of impression management which were possibly undertaken by subordinate. Furthermore, it is to discuss the cognition of superiors regarding the tactics of impression management by subordinate. Therefore, the prerequisite is to select the direct subordinate relationship between superiors and subordinates. Secondly, the number of superiors is restricted to two to four. Under the resource limited point of view, medium size of numbers will be better choice. Besides, the superiors and subordinates will know each other in certain level. The degree of interaction and relationship will be value for reference. The questionnaires were mainly set out by random sampling. The almost questionnaires were sent to superiors by mail. And only few questionnaires were sent by email. And inform the superiors in advance if the self-evaluation of subordinates were passed to his subordinates by random selected. The self-evaluation of subordinates is to measure the difference between personality and tactics

adopted of impression management. If the subordinates were selected to fill out self-evaluation, the direct subordinators will need to fill out the questionnaire of subordinate evaluated by superior. In the superior aspect, the content of subordinates evaluated by superiors is to measure the opinion of superiors if the direct subordinate is undertaking organization civic behavior. The purpose is to understand the cognition of superior how his subordinates work performance. Every superior can fill out 4 copies of superior questionnaires at most. The studies sent out 297 copies of questionnaires of subordinate evaluated by superior and 297 copies of questionnaires of self-evaluation. There are total 204 copies received. After reviewing ones, 8 copies were invalid questionnaires. The effective samples are 196 pairs eventually. Furthermore, the superior matches subordinate varied from one to four among these pairs. Therefore, the final effective questionnaires are 196 pairs of valid samples which are derived from 92 superiors and 196 subordinate. The ratio of effective questionnaires is 96.1%.

Table 1. Sample characteristics n=196.

		Superiors		Inferiors	
		Frequency	Effective Percentage	Frequency	Effective Percentage
Gender	male	81	89.0%	117	60.6%
	female	10	10.9%	76	39.4%
Age	Above 50 years old	4	4.4%	1	0.5%
	40~49 years old	16	17.6%	12	6.1%
	30~39 years old	62	68.1%	93	47.4%
	Under 29 years old	9	9.9%	83	42.3%
Seniority	Under 5 years	41	46.1%	156	79.6%
	6~10 years	37	41.6%	21	10.7%
	11~15 years	5	5.6%	11	5.6%
	16~20 years	5	5.6%	3	1.5%
	Above 21 years	1	1.1%	1	0.5%
Education	Senior high school	1	1.1%	2	1.0%
	colleague	6	6.9%	29	15.1%
	University	42	48.3%	107	55.7%
	Graduate school	38	43.7%	54	28.1%

To gender, the ratio of superiors for male reaches 86.1%, and for female is only 13.9%. This is because the sample is based on high tech industry. The ratio of inferiors for male reaches 60.6%, and for female is only 39.4%. At the age group, the age of superiors is distributed at 35-39 years old. And the age of inferiors is distributed at 30-34 years old. For the seniority group in company, the superiors are distributed between under 5 years and 6~10 years. And inferiors are distributed under 5 years. For education, the most people in superior level are university and graduate school takes second place. The few people are senior high school. The educational background in subordinator is the same as superiors. The details show in the table 1.

Measure

It is to perform the inner reliable analysis for the variables (Machiavellianism, GSE, SSE, the tactics of IM, OCB) and other dimension. The method of reliable analysis was taken by Cronbach's α value. The scholar Devellis(1991) and Nunnally(1978) think that the α value is the minimum acceptable level which is greater than 0.7. Furthermore, the studies Bryman & Cramer (1997) think that the α value is greater than 0.8, then it represents the measures with high reliability. The purpose of validity analysis is to reach the predicted result effectively. Therefore, the confirmatory factory analysis is performed to observe the variables testing before analysis, then to understand and observe variables is significant effect for potential variables of hypotheses.

Machiavellianism

The scales to measure the degree of Machiavellianism were built by Christie and Geis in 1970. There were total 20 items. The coefficient of Cronbach's is 0.76 here. From the aspect of the suitable index of model, $\chi 2$ =614.38（df=170，p<0.001. It reveals the improper fit between data and model. The possible reason may result from the effect of sample size to change the meaning of statistics. Therefore, the scholars think that the referable value ($\chi 2$/df) is suitable to judge the fit of model if it is less than 5 (Wheaton, Muthen, Alwin, & Summer,1977). The studies here showed that $\chi 2$/df =3.6. It reveals that the fit between data and model is staying in the acceptable range. And other proper indicators of model, TLI = .76、CFI=.65、RMSEA=.105 It reveals that stability of measured model and data match is fine.

Self-Efficacy

The scales of degree of self-efficacy were derived from Sherer & Maddux（1982）. There are total 23 questions. The former 17 questions test GSE. The latter questions test SSE. The Cronbach's coefficient of GSE is 0.86. And the Cronbach's coefficient of SSE is 0.71. The three indicators were compressed by process in GSE. The first stage is to check the coefficient of standardized regression derived from former 17 questions. By taking the largest one adds the smallest one, then it divided by two, then infers the 9 indicators of second stage. Eventually, they have been compressed into three pointers by repeating the same process. For the aspect of proper indicator in the model, the $\chi 2$= 119.4（df=71，p<0.001）, it reveals that it doesn't fit well between data and model. The reference value for $\chi 2$/df = 1.68, it shows that it is in the acceptable range between data and model. And the other proper indicator in the model like TLI = .94, CFI =.95, RMSEA= .07, they show that measured model is quite stable and fit for data.

Impression Management

The studies refer to the scales built by Bolino & Turnley in1999 年. According to the five tactics developed by impression management, the measures are total 22 questions. They are measurable skills for subjects used impression management. As for the ingratiation part, the Cronbach's coefficient is 0.83. As for the self-promotion part, the Cronbach's coefficient is 0.78. As for exemplification part, the Cronbach's coefficient is 0.75. As for supplication part, the Cronbach's coefficient is 0.88. As for intimidation part, the Cronbach's coefficient is 0.86. The aspect of proper indicator in model, $\chi 2$ = 200.9（df=122，p<0.001). It reveals that it doesn't fit well between data and model. But the reference value $\chi 2$/df = 1.65, it shows that it is in the acceptable range between data and model. Reference value for $\chi 2$/df =1.68, it shows that it is in the acceptable range between data and model. And the other proper indicator in the model like TLI =.96, CFI =.91, TLI =.94, RMSEA=.06, SRMR= .6, they show that measured model is quite stable and fit for data.

Organization Citizenship Behavior

The study adopts the measures which three dimension(helping behavior, sportsmanship and civic virtue) are derived from the scholars Podsakoff, Ahearne & MacKenzie（1997）based on Organ's recommendations in 1988 and 1990 and the evidences developed by Podsakoff & MacKenzie（1994）and Podsakoff et al.（1990). In study, as for the helping behavior part, the Cronbatch's coefficient is 0.95; as for the sportsmanship part, the Cronbatch's coefficient is 0.88; as for the civic virtue part, the Cronbatch's coefficient is 0.96. Before proceeded with the measurement of model, helping behaviors among organization civic behaviors were reduced to 4 indicators from 7 items. As for the verification results of factor analysis based on organization civic behaviors, all coefficients of standardized regression have been testified and reach significant meaning. It shows that they are rather highly related between questions and factors. Secondly, the relevant coefficients values are 0.49 to 0.92 between all factors. It shows that they are quite well related between all factors. As for the aspect of proper indicator, the value $\chi 2$ =52.4（df=30，p<0.01）and reference value $\chi 2$/df =1.747. It shows that it is in the acceptable range between data and model. And the other proper indicator in the model like CFI= .98, GFI =.95, TLI =.97 RMSEA=.06, SRMR = .5, they show that measured model is quite stable and fit for data.

Table-2. Means, standard deviations and correlations n=196.

	Variables	Means	SD.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	Machiavellianism	2.55	.52	-.08	---													
2.	GSE	3.67	.43	.26***	-.49***	---												
3.	SSE	3.41	.56	.58***	-.19**	.48***	---											
4.	IM- Ingratiation	3.05	.61	.15**	.31***	-.09	.09	---										
5.	IM- Self-Promotion	2.68	.66	.20**	.24***	.04	.14**	.41***	---									
6.	IM- Exemplification	2.17	.66	.16**	.24***	-.18**	-.02	.31***	.42***	---								
7.	IM- Supplication	2.31	.66	.05	.28***	-.25**	-.03	.41***	.31***	.59***	---							
8.	IM- Intimidation	2.08	.70	.06	.26***	-.13*	-.06	.20**	.31***	.44***	.35***	---						
9.	OCB-Helping Behavior	3.71	.51	.11	-.11	.11	.21**	-.03	.06	-.01	-.03	-.01	---					
10.	OCB-Civic Virtue	3.44	.61	.15**	-.15**	.25***	.19**	-.03	.07	-.03	-.13*	.01	.68***	---				
11.	OCB-Sportsmanship	3.76	.69	.05	-.14**	.27***	.15*	-.08	-.06	-.07	-.13*	-.19**	.45***	.34***	---			
12.	Subordinate Gender	---	---	-.11	-.15**	-.12*	-.19**	-.12	-.17**	-.16**	-.13*	-.21**	-.13*	-.17**	-.07	---		
13.	Subordinate Age	34.19	13.49	.01	-.02	-.05	.04	.00	-.12*	-.09	-.09	.00	-.09	-.07	-.03	.02	---	
14.	Subordinate seniority	45.56	46.80	-.20**	-.06	.00	-.07	-.10	-.17**	-.14*	-.24***	-.10	.02	.04	-.05	.14*	.38***	---
15.	Subordinate education	---	---	.26***	-.21**	.24***	.27***	-.02	.11	.03	.04	.08	.07	.12*	.13*	-.24***	-.038	-.31***

*P<.05 ; **P<.01; ***P<.001

RESULT

Table 2 presents descriptive statistics and zero-order correlations among the variables. As Table 2 shows, the following analysis outcome is a statistic description. As for the variables of different personality, all variables are significantly related except self-monitoring and Machiavellianism. But they show different degrees and orientations. As for the variables of impression management, the five dimensions which are ingratiation, self-promotion, exemplification, supplication and intimidation show significant positive related. The three dimensions in organization civic behavior which are helping behavior, civic virtue and sportsmanship show significant positive related. The self-monitoring in individual personality variance and the three dimensions of impression management which are ingratiation, self-promotion and exemplification showed significantly positive relevance. The individual difference of Machiavellianism and five dimensions of impression management show significantly positive relevance. The specific self-efficacy in individual personality differences and self-promotion in impression management show significantly positive relevance.

The application of structural equation modeling is very widely. It can use to deal with complicated multivariate data, Because the parameter assessment is through calculation of related coefficient or, covariance matrix the variables can be independent items or dependent items at the same time and then go on parameters assessment. To distinguish the regression intermediary effect, it requires to proceed with regression analysis individually (Bollen, 1989). Before proceeding with structural model, it should testify measured model (Byrne, 2001).The study is using by individual difference, impression management and civic behavior to testify factor analysis as measured model. To exams impression management if it belongs to the mediation individual difference and organization civic behavior. Besides, application of structural equation modeling is to calculate variables standardized regression coefficient . The indicator of suitable model is important reference indicator to testify hypotheses or model. Summarized studies by Hu & Bentler (1998) , it is for data and suitable model in accordance with TLI（or NNFI）greater than 0.95（Bentler & Bonett, 1980) , CFI close to 1 (Bentler, 1990),RMSEA less than 0.06（Hu & Bentler）, SRMR less than 0.08（Bentler, 1995）.

DISCUSSION

First of all, summarized all verifications between variables of linear model , please refer to the figure2 corrected model of rout analysis. It is to check all variables if they are direct effect. All structural model in proper indicator, $\chi 2$ =1175.41（df=773，$p<0.01$）, reference data value $\chi 2/df$ is 1.521. They reveal that the proper fit between data and model is acceptable range. And other suitable indicators, CFI = .90、GFI = .79、TLI = .89、RMSEA = .05、SRMR= .08. It appears that the studies are rather stable and fit between data is quite well.

Hypothesis 1a, predicted the index of Machiavellianism and positive impression management is positive relevant. That is to say that the higher index of Machiavellianism, individual tends to use variant tactics of impression management. The statistics show that the index of Machiavellianism reveals positive relevance to the tactics of positive impression management. Therefore, Hypothesis 1a was supported.

Hypothesis 1b, predicted the index of Machiavellianism and negative impression management is positive relevant. The statistics show that the index of Machiavellianism reveals positive relevance to the tactics of negative impression management. Therefore, Hypothesis 1a was supported.

Hypothesis 2 reveals that individual with general self-efficacy and supplication in the tactics of impression management is positive relevance. That is to say that individual with high degree of general self-efficacy tends to use the tactic of supplication. However, the statistics show that the individual with the degree of general self-efficacy and supplication tactic of impression management is not positive relevance（Un-standardized Coefficients is equal to -0.091，p value doesn't reach the significant level.）. It infers that subordinates with the degree of general self-efficacy will certainly use the tactic of supplication. Hypothesis 2 was not supported.

Hypothesis 3 thinks that the individual with specific self-efficacy and the negative impression management is positive relevance. That's to say that the individual with high degree of specific self-efficacy tends to use the tactic of intimidation. The statistics show that the individual with high degree of specific self-efficacy and the tactic of negative impression management is not significant relevance（Un-standardized Coefficients is equal to 0.028, p value doesn't reach the significant level). It can't be inferred that the subordinates with high degree of specific self-efficacy will use the tactic of intimidation. Hypothesis 3 was not supported.

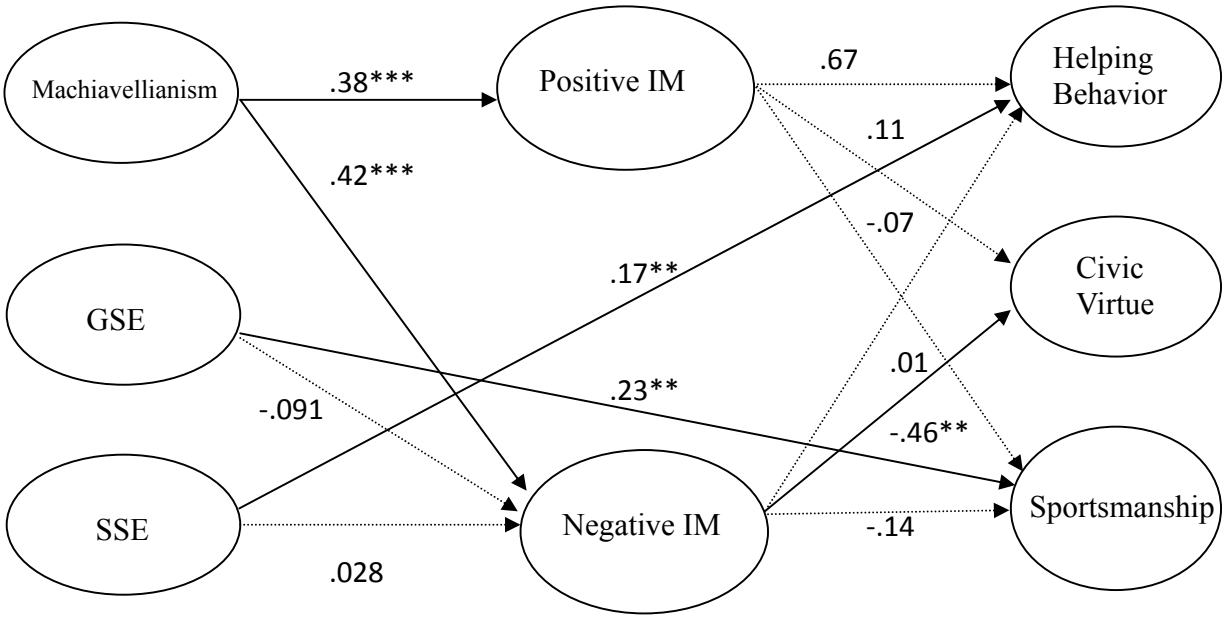
Hypothesis 4a thinks that the subordinates adopts the tactics of positive impression management, then the superiors think that subordinates is doing the organization civic behavior of helping behavior, civic virtue, sportsmanship. The study statistics shows that the dimension of helping behavior in organization civic behavior（Un-standardized Coefficients is equal to 0.67, p value doesn't reach the significant level), civic virtue（Un-standardized Coefficients is equal to 0.11，p value doesn't reach the significant level）and sportsmanship（Un-standardized Coefficients is equal to -0.07，p value doesn't reach the significant level）. Hypothesis is not significantly positive relevance.

Hypothesis 4b If superiors adopt the tactic of supplication and intimidation, they aren't regarded as the organization civic behavior of helping behavior, civic virtue and sportsmanship. The study reveals that the tactic of supplication will be significantly negative relevance for the dimension of civic virtue in organization civic behavior（Un-standardized Coefficients is equal to- 0.46, p value is less than 0.01). Therefore, Hypothesis 4b was partially supported.

The evidence in mediate effect of impression management

Among the structure of studies, the role of impression management is mediate variable. It tries to testify the variable of personality if it will influence the recognition of superiors for inferiors' performance through inter-mediate effect of impression management. From the verification of linear model (figure2 modification path diagram), it's observed that the variant personality of Machiavellianism will certainly influence the recognition of superiors to the subordinate' behaviors like helping behavior, civic virtue and sportsmanship respectively by tactics of impression management.

In the studies, hopefully, the verification through inter-mediate effect of impression management will demonstrate the impression about superiors who think about the organization citizenship behavior adopted by inferiors. However, it is beyond the expectation of previous hypotheses which is in the general self-efficacy and specific self-efficacy among variant individuals. It directly influences the impression of superiors about the individual adopted organization citizenship behavior without the impression management of inter-mediate effect. For more detailed explanations, the statistics show that the personality with general self-efficacy is significantly positive effect for dimension of sportsmanship in organization citizenship behavior. And the personality with specific self-efficacy is significantly positive effect for dimension of helping behavior in organization citizenship behavior.



Notes: *p < 0.05; **p < 0.01; ***p < 0.001

Figure 2. Modification path diagram

CONCLUSION

Implications and suggestions for management practice

The inferiors with high index of Machiavellianism will adjust or control their verbal or behaviors according to the emotional expression of related people under certain circumstances. But their organization civic behaviors won't be considered good for organization from the leader's point of view. On the other hand, the inferiors with high index of Machiavellianism will show sternly cool and seldom express any emotions about people or sensitive questions. In dealing with social communication, they tend to set up a criterion to check if there is any value. The outcomes of this study are correspondence with assumptions. The inferiors with

high index of Machiavellianism will do well for themselves. They certainly will use tactics of impression management widely. However, it's unfortunate, their behavior won't influence the cognition of supervisor if they perform organization civic behaviors.

However, if those tactics of impression management won't influence the relationship and atmosphere in office, even result in tense situation. It is recommended that the supervisors consider to tolerate the behaviors by manipulating the impression management. They may possibly bring about advantage or convenience accidentally. They can even inspire the aspiration and the motivation of there work and the intense loyalty to their supervisor. Therefore, the supervisor may firstly consider the harm or acceptability in organization when he decides to support the behaviors of impression management in organization. But the most important thing is to recognize the personality of inferiors. If supervisor become acquainted with inferiors, it will be helpful for supervisors to predict the possible tactic of impression management taken and distinguish the motivation behind. It is used to develop the unique relationship between superior and inferior. Thus, we can stay focus and achieve goals successfully and won't waste much time to get credits.

The outcome of this study for workers would be rather disappointed. No matter how workers make great efforts to please the leader, the superior won't show his appreciation. Even it will have adverse effect after undertaking the tactics of supplication and intimidation. The superiors think that workers violate the organization civic behavior. On the other hand, if the cognition of superiors doesn’t be influenced by impression management, it reflects that workers won't spend much time to deal with the self-image. Even the workers should do their best. The superiors will appreciate the efforts done by them. If workers put emphasis on specific image of themselves, it will bring about adverse effect.

Limitations and suggestions for future research

The sample size is focus on high technical industry this time. Besides, the almost gender is male no matter who the superiors or inferiors are. Therefore, we regret that there can’t go deep into discussion about the inner thoughts of female. Furthermore, the valid samples almost come from the same company due to personal reason if it may distort the fact. The conclusion may be possibly misled by only one enterprise culture. There may be under discussion.

Besides, there are many factors influenced the tactics of impression management like culture in organization, the classification of tasks, the power of actors and audiences, position, capability, attraction and so on. The above factors haven't been included in the studies. It's only focus on the partial personalities of actors analyzed.

This study adopts Machiavelli’s measures which was developed by former researcher in the past and repeated testing many times. But it hasn't shown better reliable. The personality

won't be easily measured accurately. Although the social expectation measures have been added in the questionnaires, it still can't avoid the unreliable outcome. Besides, it adopts the way of self-evaluation of personality which belongs to subjective measurement. We may adopt evaluation by others in the future, hope to be more objective to understand the personality.

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AN OPTIMAL SUBSIDY STRATEGY OF MANUFACTURER BY CONSIDERING DISTRIBUTOR PROVIDING REPAIRED SERVICE

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ABSTRACT

Green supply chain (GrSC) has been receiving significant attentions and concerns in recent years. As remanufacturers needs more supply of used products, the economic incentive is required to attract customers to return their used products. This study investigates the optimal subsidy and pricing policy of a manufacturer in the green supply chain, suggesting that the flow of returned items is variable, and is affected by the amount of subsidy provided by the manufacturer. Moreover, this study considers a distributor who sells the usable products, purchased from the manufacturer, and repaired products, produced by the distributor, to the customers at the same time. A two-stage game model is proposed to derive the optimal pricing policy of the manufacturer, considering the interaction between a manufacturer and a distributor within the context of price competition. A sensitivity analysis is conducted to discuss how manufacturer's and distributor's profit will be influenced by consumer valuation, return rate and the ratio of new product cost to remanufactured product cost. According to the results, the subsidy mechanism not only enhance the profit of the manufacturer, but also the profit of overall supply chain. Finally, this study suggest that the manufacturer should consider the demand side, production cost, and the impact of subsidy policy in order to set up appropriate subsidy policy and pricing policy.

Keywords: Green Supply Chain, Reverse Logistics, Game theory, Return rate

I. INTRODUCTION

In recent years, excessive consumption of resources, waste, and environmental pollution problems have become a more serious concern within the context of economic growth. To promote the ideal of sustainable development, many countries have begun to encourage environmental protection and the saving of resources. In addition, environmental awareness has also gradually risen. All of these trends have made the green supply chain garner significant attention from consumers, industries, and governments. In 2007, Dell announced the plan that they will become the greenest technology firm, including the establishment of recycling processes and the introduction of more environmentally friendly computer products. Panasonic in the United States promote the recovery process through the sponsorship of thousands of recovery station. Toshiba collaborate with Best Buy to recycle used products. In Apple's recycling program, the user can check the residual value of their electronic products on the Apple's website, and return the product to Apple. After estimating the residual value of the product, Apple will inform the user. If the user satisfies it, the recovery amount of the product will be delivered to the user through the Apple Gift Card. ASUS has also organized activities to encourage recycling activities in 2008, As long as consumers return the discarded

electronic products to the ASUS repaired station, they can obtain the coupons for ASUS notebook.

From the cases above, recycling channel and the design of recycling mechanism are important activities in green supply chain. In the reverse logistics, the recycling firms often provide financial incentives to encourage consumers to return used products. (Guide & Wassenhove, 2001) Thus, the recycling quantities will increase as the given of financial incentives. Most previous studies assume that the recycling rate is fixed (Min & Ko, 2008), which is different from practice. Thus, this study takes variable recycling rate into consideration, and assumes recycling quantities as the function of the subsidy amount. The manufacturer subsidizes per used product that consumers return to the distributor and hopes this mechanism could enhance the overall market recycling quantities; thus, increase manufacturer's profit.

Previous studies regarding green supply chain tend to focus on remanufactured products and new products. Consideration of practical operation, many distributors collect used products from the consumers and sell repaired products after repairing them. The examples include mobile phone, tire, and air conditioner industry and so on. Thus, this study takes repaired products into the scope of remanufacturing activity in the green supply chain. We assume that the distributor wholesales remanufactured products and repaired products at the same time. In addition, this study investigates the function of green supply chain characters and market products. As a result, this study builds a two-stage game model that considers the interaction between a manufacturer and a distributor within the context of Bertrand duopoly and price competition to arrive at the optimal subsidy and pricing policy. In addition, we also investigate how the design of subsidy mechanism influences the manufacturer's and distributor's profit.

The rest of the paper is organized as follows. Section 2 reviews the relevant literature; the model building and solution are presented in section 3; sensitivity analysis is presented in section 4; and, finally, we conclude the paper in section 5.

II. LITERATURE REVIEW

In the past, there have been many papers discussing the concept of green supply chain. Fleischman et al. (1997) proposed the definition of reverse logistics, which refers to the activities or processes that can make products re-sellable. Fleischman et al. (2000) proposed the network system of product recovery which was then compared with the traditional logistic system. In addition, they also addressed relative activities of forward and reverse supply chains. Sarkis (2003) addressed the important factors that should be considered when business implement green supply chain. Furthermore, he also explained the elements of green supply chain one by one to assist business to assess green supply chain decisions. Savaskan et al (2004) investigated what are the best reverse channels for the manufacturer. The result showed that retail channel would be the most efficient way to undertake product recovery when considering decentralized channels. Moreover, they also found that simple coordination mechanisms can be designed such that collection effort of the retailer and supply chain profits are attained at the same level as in a centrally coordinated system. Neto et al. (2008) reviewed the main activities influencing the environment and costs in logistic network. Next, they developed a framework for optimizing the design of logistic networks based on the multi-

objective programming. Finally, they used the European pulp and paper industry to illustrate their methodology and findings.

In addition, pricing and recycling mechanism are important issues in the green supply chain. Thierry et al. (1995) investigated the management of recycling mechanism in the context of closed supply chain. Jayaraman et al. (1999) proposed a recoverable manufacturing system, including recycling, remanufactured process, and disposal. Savaskan & Van Wassenhove (2006) investigated the relationship between pricing of forward logistics and reverse channel choices within the realm of competitive retail markets. The results showed that retailer collecting systems would be a preferred option when the competitive degree of a given product has a strong impact on its price. Atasu et al. (2008) provided an alternative approach that considers demand-related issues, such as green market size and consumer valuations for remanufactured products. The results showed that remanufacturing activities are influenced by competition, cost, and product life cycles. Chen & Sheu (2009) proposed a model to find the optimal green supply chain pricing policy under the restriction of environment rule. Finally, Zhou & Li (2011) proposed that pricing issues are related with economic optimization in the supply chain strategy. In their model, company should consider the recycling cost and value of product, parts and package, analyze and evaluate the various schemes, thus gaining the maximal recycling value with minimum cost. The difference between previous paper and our paper is that we take variable recycling rate into consideration which has not been used in previous researches. In addition, previous paper studied subsidy policy standing on the government's perspective; however, many practices show that there are many manufacturers give consumers recycling incentives. Thus, this study is conducted from the manufacturer's point of view and it is desirable to find the optimal subsidy policy.

III. MODEL BUILDING AND SOLUTION

In this section, we develop our proposed model. We begin by introducing our assumptions and our framework. Next, according to the framework developed, we formulate the two-stage game model to determine the optimal subsidy and pricing policy. Finally, we address the procedure used to obtain the solution of our model.

3.1 The assumptions of the models

First, we assume that the industry structure is duopoly. One firm (manufacturer) produces usable product, including new products and remanufactured products, and the other (distributor) only produces repaired products. The competition between usable product and repaired product is Bertrand price competition and customers have different valuations for these two products. The valuation of the repaired product is lower than the valuation of the usable product. We assume that the return rate of the used products varies with the manufacturer's subsidy. In addition to the base recovery quantities, the manufacturer can enhance the recovery quantities that consumers return to the distributor by subsidizing consumers. In addition, when the recyclables that the manufacturer buy from the distributor cannot meet the demand, the manufacturer will produce new products with raw materials

The usable products are made by the manufacturer, including new products and remanufactured products. The materials of the remanufactured product are the used products that the distributor collected from the customers. The materials of the new products are raw materials. The cost of new products is higher than the cost of the remanufactured products. This study assumes that there is no difference between the new product and the

remanufactured product. However, the quality of usable products is better than the quality of repaired products. The distributor repairs the used products collected from customers and sells them to the market. The valuation of repaired products is lower compared to the valuation of usable products.

The manufacturer will determine the purchase price of collected products and purchase them from the distributor. In addition, the manufacturer also determines the wholesale price of usable products which are sold to the distributor. The distributor provides usable products come from the manufacturer and repaired products to the customers. In addition, the distributor has to decide the price of usable products and repaired products. The distributor also plays the role of collecting used products from customers. The distributor has two options for these collected products. The distributor can repaired them and sell them to the customers. Otherwise, the distributor can sell them to the manufacturer. Finally, we do not consider the collection cost and the remanufacturing cost is lower than the manufacturing cost of a new product. The operating process of the supply chain is shown in Figure 1.

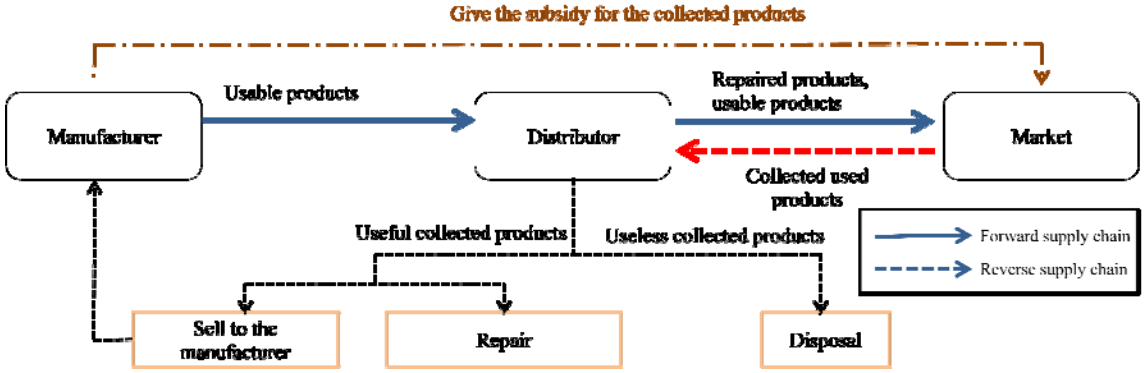


Figure 1 The operating process of the supply chain

3.2 Model Framework

This study builds a two-stage game model with regard to the interactions between a manufacturer and a distributor. We assume that these entities make decisions based on precise and accurate information. The decision process and the order of the members in the supply chain are shown in Figure 2. At stage 1, the manufacturer determines the optimal price to maximize profit, including wholesale price and purchase price of collected products. At the same time, the manufacturer determines the subsidy payment for the market. At stage 2, the distributor determines the price of usable products and repaired products based on the pricing policy of the manufacturer.

This study use backward induction to solve this two-stage game model. First, we solve the optimal price for each product by maximizing the profit of distributor at stage 2. Next, we substitute the optimal price of stage 2 into the profit function of the manufacturer to determine the optimal pricing and subsidy policy at stage 1.

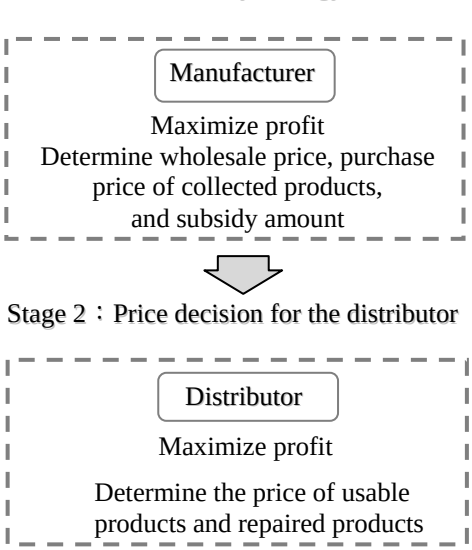


Figure 2 Model framework

3.3 The two-stage game model

First, notations are defined. Second, we construct a demand function based on Atasu et al. (2008). Next, the profit functions of the manufacturer and the distributor are developed.

Notations for two-stage game model

Basic symbol

Π_M : Profit of manufacturer

Π_D : Profit of distributor

θ: The valuation of a usable product for customers, which is uniformly distributed on [0, 1]

Input parameters

γ : The valuation ratio of a repaired product to a usable product for customers. For example, if the reservation price of a new product for consumers is θ, then, the reservation price of a repaired product is $\gamma \cdot \theta$

α：The base recycling quantity

β：Subsidy impact factor for recycling quantities

Q：Market size

C_n : The unit manufacturing cost of a new product

C_r : The unit manufacturing cost of a usable product

C_p : The unit repaired cost for the distributor

Decision variables

1. Decision variable for the manufacturer

w：The wholesale price of usable products that the manufacturer produces

p_b : The purchase price of collected products that the manufacturer purchase from the distributor

S_m：The subsidy amount for each collected product.

2. Decision variable for the distributor

p_r : The price of usable products that the distributor sells to the market

p_p : The price of repaired products that the distributor sells to the market

3. Derive decision variable

q_c : The number of recyclables that the distributor collects from the market
q_r : The number of usable products that the distributor orders from the manufacturer
q_p : The number of repaired products
q_b : The number of collected products that the distributor sells to the manufacturer
q_n : The number of new products made from raw material

Demand function

The demand function in our research is extended from Atasu et al. (2008). For consumers, when the valuation of a usable product (θ) is greater than or equal to p_r, consumers will purchase a usable product; when the valuation of a repaired product ($\gamma \cdot \theta$) is greater than or equal to p_p, consumers will purchase a repaired product. When the two conditions are satisfied at the same time, consumers will select the product with the larger consumer surplus. For example, when $\theta - p_r > \gamma \cdot \theta - p_p$, that is, $\theta > (p_r - p_p)/(1-\gamma)$, consumers will purchase a usable product. Because θ is uniformly distributed on [0, 1], the probability of $\theta > (p_r - p_p)/(1-\gamma)$ is 1-$(p_r - p_p)/(1-\gamma)$. As a result, the demand of a useable product (q_r) is $Q \cdot (1 - \frac{P_r - P_p}{1-\gamma})$. When the valuation of the repaired product is greater than 0 and $\theta - p_r < \gamma \cdot \theta - p_p$ (that is $\frac{P_p}{\gamma} < \theta < \frac{P_r - P_p}{1-\gamma}$)), the consumer will buy the repaired product. The probability of this situation is $\frac{P_r - P_p}{1-\gamma} - \frac{P_p}{\gamma} = \frac{\gamma P_r - P_p}{\gamma(1-\gamma)}$. Thus, the demand of the repaired product (q_p) is $Q \cdot \frac{\gamma P_r - P_p}{\gamma(1-r)}$.

Profit function for a manufacturer and a distributor

1. Profit function for a distributor

The revenue of the distributor includes selling repaired products and usable products to the market and collected products to the manufacturer. At the same time, there is a repaired cost. Finally, this study does not consider recycling cost. The profit function for the distributor is shown in equations (1)

$$\Pi_D = q_r \cdot (p_r - w) + q_p \cdot (p_p - C_p) + p_b \cdot q_b \quad (1)$$

2. Profit function for a manufacturer

The manufacturer produces usable products, including new products and remanufactured products. When collected products are not enough to meet the demand of usable products, the manufacturer will produce new products with new raw materials to meet unsatisfied demand. The manufacturer faces a higher unit cost of a new product and a lower unit cost of a remanufactured product and we assume that there is no difference in quality between these two products. The only difference is the production cost. In order to enhance the recycling quantities to increase its profit, the manufacturer subsidize each collected product for customers. Thus, the profit of the manufacturer is the revenue that sells usable products to the distributor minus the cost that subsidizes customers, purchases the collected products, and produces usable products. The profit function for the manufacturer is shown in equation (2)

$$\Pi_M = w \cdot q_r - p_b \cdot q_b - q_b \cdot C_r - q_c \cdot S_m - q_n \cdot C_n \quad (2)$$

3.4 Model Solution

As mentioned above, this study uses backward induction to solve this two-stage game model. First, we solve the optimal price for the distributor at stage 2. Next, we obtain the optimal price and subsidy strategy at stage 1, given the prices derived from the distributor.

The pricing policy for the distributor

First, we take the demand of the useable product ($Q \cdot (1 - \frac{P_r - P_p}{1-\gamma})$), the demand of the repaired product ($Q \cdot \frac{rP_r - P_p}{r(1-r)}$), and collected products that buy from the distributor ($q_b = q_c - q_p$) into profit function of the distributor. Then, we can obtain equation (3).

$$\Pi_D = p_b \left(q_c - \frac{Q(P_p - P_r \cdot r)}{r(r-1)}\right) - Q\left(\frac{P_p - P_r}{r-1} - 1\right)(p_r - w) - \frac{Q(C_p - P_p)(P_p - P_r \cdot r)}{r(r-1)} \quad (3)$$

Next, we take the first order differential of p_r and p_p for equation (3), and we can obtain the optimal price for the usable product and the repaired product after solving simultaneous equations, which are shown in equations (4) and (5).

$$p_p{}^* = \frac{C_p + p_b + r}{2} \quad (4)$$

$$p_r{}^* = \frac{w+1}{2} \quad (5)$$

However, the industry structure of our model is duopoly, that is, q_r and $q_p \geq 0$. We can obtain the required conditions which are shown in equations (6) and (7).

$$\gamma \leq 1 - p_r + p_p \quad (6)$$

$$\gamma \geq \frac{p_p}{p_r} \quad (7)$$

Next, substituting equation (4) and (5) into q_r and q_p gives equations (8) and (9).

$$q_r = \frac{Q}{2} - \frac{Q(C_p + p_b - w)}{2(r-1)} \quad (8)$$

$$q_p = \frac{Q[\frac{C_p + P_b + r}{2} - r\left(\frac{w+1}{2}\right)]}{r(r-1)} \quad (9)$$

The pricing policy for the manufacturer

First, this study refers to Xiang et al. (2008) and Konstantaras et al. (2011) In addition to the base recycling quantity, the recycling quantity impacted by the subsidy policy ($\beta \geq 0$). Thus, the function of recycling quantity is shown as equation (10). The distributor will give priority to the use of collected products to meet the demand of repaired products. The rest of collected products (q_b) are sold to the manufacturer. The relationship is shown in equation (11). When q_b cannot meet the demand of the usable products, the manufacturer will produce new products to meet the unsatisfied demand. The relationship is shown in equation (12)

$$q_c = \alpha + \beta \cdot S_m \quad (10)$$

$$q_b = q_c - q_p = (\alpha + \beta \cdot S_m) - q_p \quad (11)$$

$$q_n = q_r - q_b \tag{12}$$

Next, we substitute equations (8) and (9) into equation (11) and equation (12) gives equations (13) and (14).

$$q_b = \alpha + \beta \cdot S_m - \frac{Q[\frac{C_p+P_b+r}{2} - r(\frac{w+1}{2})]}{r(r-1)} \tag{13}$$

$$q_n = \frac{Q}{2} - \frac{Q(C_p+p_b-w)}{2(r-1)} - \alpha - \beta \cdot S_m + \frac{Q[\frac{C_p+P_b+r}{2} - r(\frac{w+1}{2})]}{r(r-1)} \tag{14}$$

Finally, we substitute equations (8), (10), (13) and (14) into the equation (2) and we can obtain equation (15), that is, the profit function of the manufacturer.

$$\Pi_M = Q\left[\frac{wr(w-2P_b-C_p-C_r+r-1)+(C_r+P_b)(C_p+P_b)+C_n(P_b+C_p-r)(r-1)}{2r(r-1)}\right] + (C_n - C_r - P_b - S_m)(\alpha + \beta \cdot S_m) \tag{15}$$

After obtaining the Hessian matrix of the manufacturer's profit function, we find that whether the function is convex or concave is determined by different parameter settings. In addition, we need to consider the constraint of price and quantity. Therefore, there is no closed form of the optimal decision for the manufacturer. The mathematical model for the manufacturer's profit is as follows.

Max Π_M =

$$\frac{wr(w-2P_b-C_p-C_r+r-1)+(C_r+P_b)(C_p+P_b)+C_n(P_b+C_p-r)(r-1)}{2r(r-1)} + (C_n - C_r - P_b - S_m)(\alpha + \beta \cdot S_m)$$

St.

$w - S_m - P_b \geq 0$
$\alpha + \beta \cdot S_m \leq 1$
$q_c \leq q_r + q_p$
$0 \leq q_r \leq 1$
$0 \leq q_p \leq 1$
$0 \leq q_b \leq 1$
$0 \leq q_n$

$where \quad w \geq 0, S_m \geq 0, P_b \geq 0$

IV. SENSITIVITY ANALYSIS

In this section, a sensitivity analysis is performed to understand how different parameters influence the profit of the manufacturer and distributor.

4.1 Parameter setting

This study refers to relative study (Atasu. Et al, 2008) to set the value of input parameters. We assume that $c_n = 0.5$, $c_r = 0.3$, $c_p = 0.4$, $\alpha = 0.05$, β=0.7, and $\gamma = 0.6$. Next, we try to

find the optimal subsidy policy at different base recycling quantity (α), Recycling rate geared by the subsidy policy (β), and the ratio of new product cost to remanufactured cost (c_n/c_r). Finally, we also analyze how these parameters affect manufacturer's profit, distributor's profit, subsidy mechanism and pricing strategy.

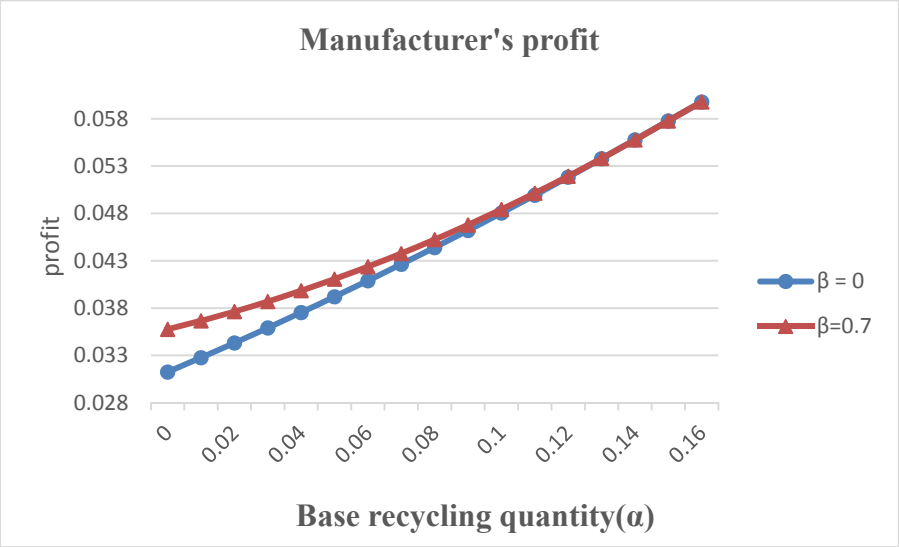
4.2 Impact of subsidy mechanism

Here, we discuss whether subsidy mechanism (β) affect manufacturer's profit and distributor's profit. We discussion two situation which is no subsidy mechanism ($\beta = 0$) and subsidy mechanism exists ($\beta = 0.7$).The results in Figure 3 and 4 indicate some findings.

(1) The subsidy mechanism can effectively increase the manufacturer's profit and distributor's profit when the base recycling quantity less than one specified value.

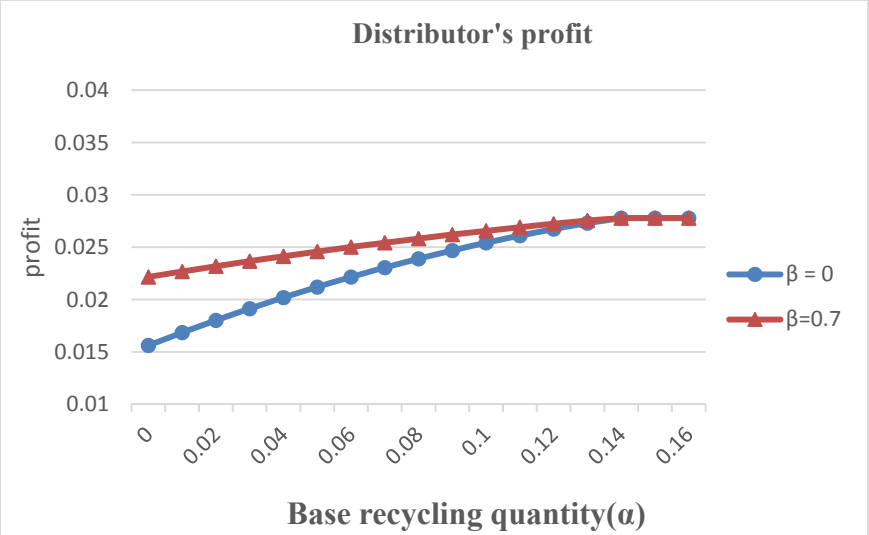
(2) The effect of subsidy mechanism is decreasing as the base quantity increase.

The reason is that when the base recycling quantity reaches a certain value, the recycling amount is enough to satisfy the demand for usable and repaired products; thus, with or without subsidy mechanism has no effect on manufacturer's and distributor's profit.



$[\alpha = 0 \sim 0.16 , \gamma = 0.6 , C_n = 0.5 , C_p = 0.4 , C_r = 0.3]$

Figure 3 The manufacturer's profit with subsidy policy and without subsidy policy at different base quantity



$[\alpha = 0{\sim}0.16\,, \gamma = 0.6\,, C_n = 0.5\,, C_p = 0.4\,, C_r = 0.3\,]$

Figure 4 The distributor's profit with subsidy policy and without subsidy policy at different base quantity

4.3 Impact of subsidy impact factor (β)

Next, we investigate the relationship between subsidy impact factor and the decision of manufacturer and distributor. The results are shown in Figure 5 and 6. As β increases, the manufacturer will increase the subsidy amount to boost the collected products in order to decrease the purchase price of collected products that the manufacturer purchases from the distributor. The decrease of purchase price and increase of collected products increase the manufacturer's profit. In addition, β has positive effect for the distributor's profit. The reason is that the manufacturer chooses decreasing the wholesale price to increase demand which also increase the profit of the distributor who sells usable products. When the subsidy impact factor is too small, the impact of subsidy amount for collected products is low. The subsidy mechanism cannot increase effectively the collected products, thus, the manufacturer will choose not to subsidize the market.

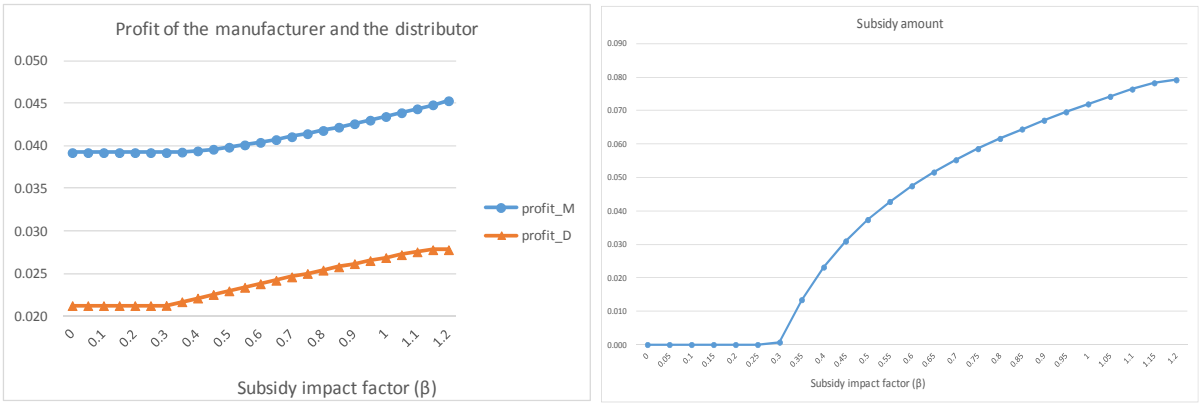


Figure 5 The relationship among the subsidy impact factor, the profit of manufacturer and distributor, and the subsidy amount

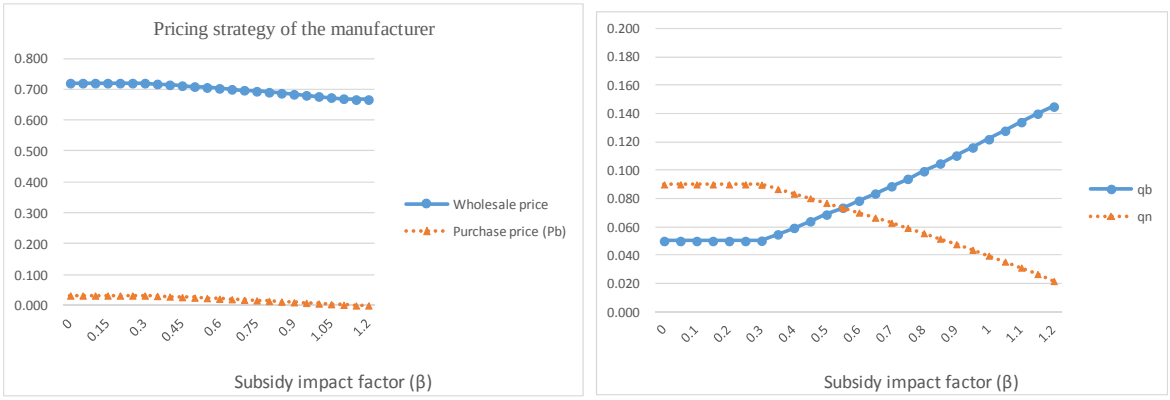


Figure 6 The relationship among the subsidy impact factor, pricing strategy of the manufacturer, the number of collected products, and the number of new products

4.4 Impact of valuation for a repaired product (γ)

Next, we want to understand how different valuation for a repaired product affects the manufacturer profit, distributor's profit, and their decision. The results in Figure 7 and 8 indicate some findings.

As the valuation for a repaired product increases, the manufacturer's profit decrease and the distributor's profit increase as well. As the acceptance of repaired products is high, the willingness of the distributor that sells collected products to the manufacturer is low. Therefore, the manufacturer needs to increase the purchase price to buy the collected products from the distributor. It increases the product cost of usable products and decreases the profit. Due to lower demand and higher buyback price, the manufacturer is not willing to use subsidy to enhance the recycling quantities. The manufacturer will use more new products to meet the demand of usable products and increased production costs are reflected in the wholesale price; thus, the whole price increases as the valuation increases.

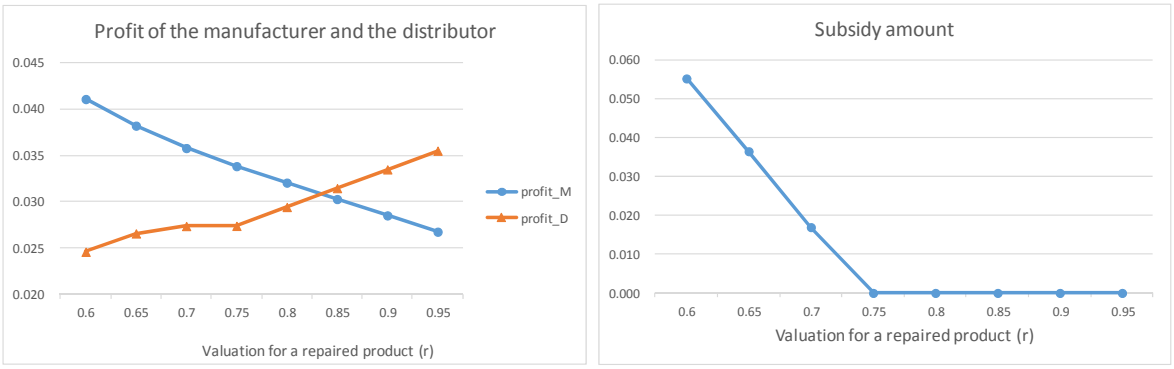


Figure 7 The relationship among the valuation for a repaired product, the profit of manufacturer and distributor, and the subsidy amount

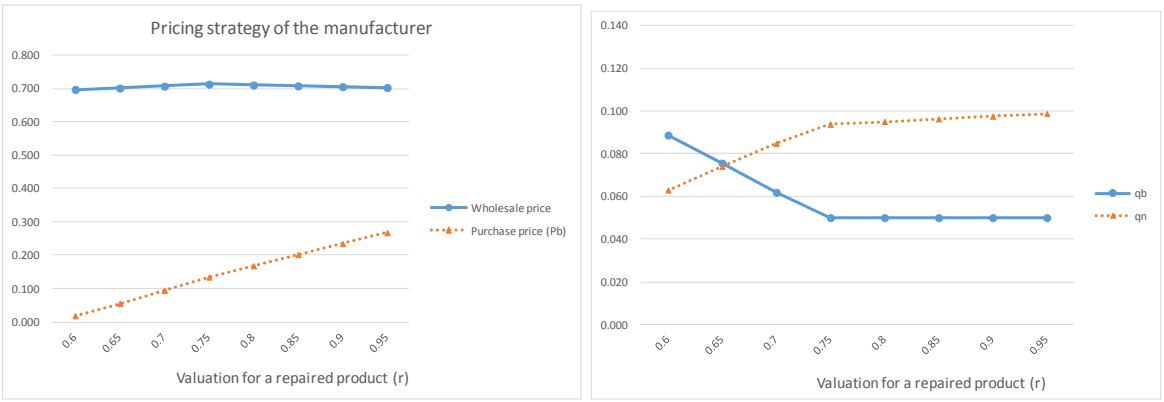


Figure 8 The relationship among the valuation for a repaired product, pricing strategy of the manufacturer, the number of collected products, and the number of new products

4.5 Impact of the ratio of new product cost to remanufactured cost (c_n/c_r)

This section will analyze how different ratio of new product cost to remanufactured costs influence the profit of manufacturer and distributor and their decision. The results in Figure 9 and 10 indicate some findings.

As the cost of new products increases, the profit of manufacturer decreases as well. At the same time, the manufacturer will increase the wholesale price to respond to the higher cost and it decreases the profit of distributor. With the higher ratio of new product cost to remanufacturer cost, the manufacturer will buy more collected products to produce remanufactured products to satisfy the demand. Thus, the subsidy amount also increases. When ratio is too large (>0.65), the manufacturer do not produce new products. Therefore, the impact of increasing new product cost on pricing strategy and subsidy strategy of the manufacturer is very low.

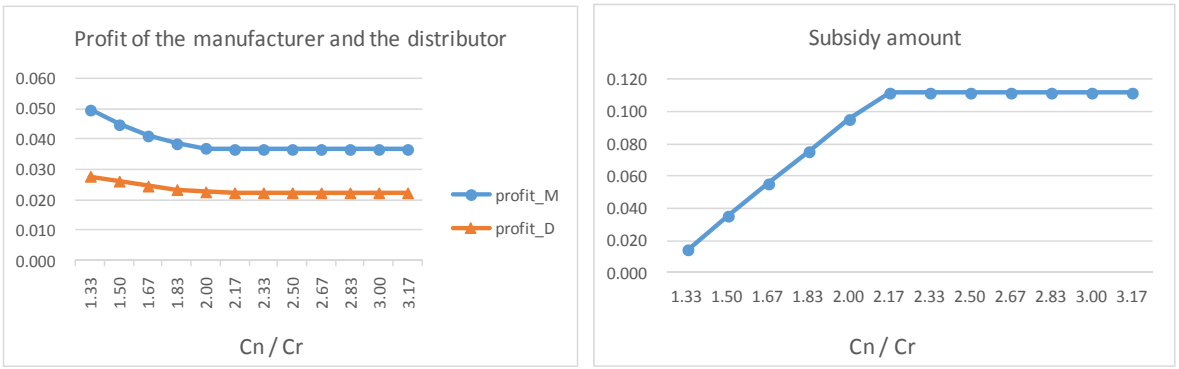


Figure 9 The relationship among the ratio of new product cost to remanufactured cost, the profit of manufacturer and distributor, and the subsidy amount

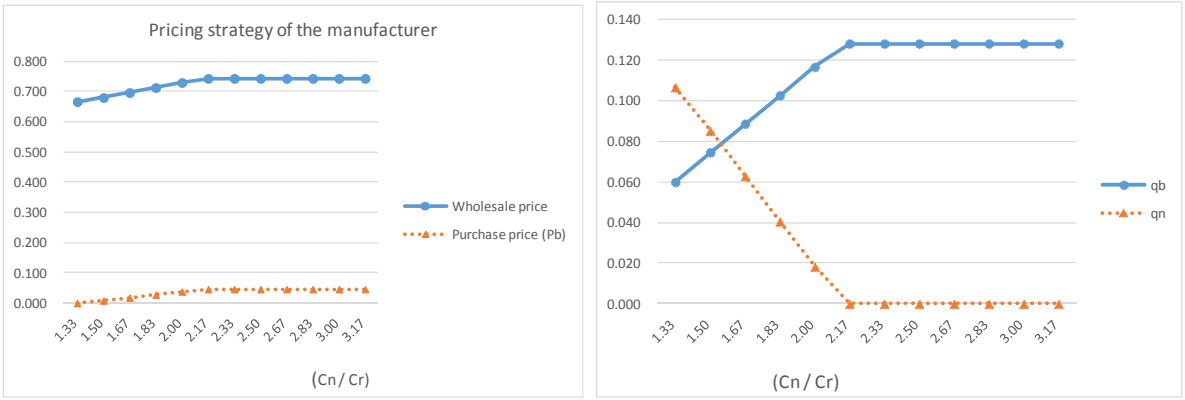


Figure 10 The relationship among the ratio of new product cost to remanufactured cost, pricing strategy of the manufacturer, the number of collected products, and the number of new products

V. CONCLUSIONS

As the concept of green supply chains has receiving significant attention from consumers, industries, and governments in recent years, this study attempts to understand how the manufacturer determines pricing policy and subsidy policy to maximize its profit within a duopoly industry structure. As a result, this study establishes a two-stage game model. First, the distributor determines the optimal price of usable products and repaired products. Next, we substitute the pricing policy of the distributor into the manufacturer's profit function to obtain the optimal pricing policy and subsidy policy by maximizing manufacturer's profit. In addition, a sensitivity analysis is proposed.

Finally, according to the results, we draw the following conclusions. (1) The design of subsidy mechanism can effectively enhance the manufacturer' s profit and the distributor' s profit. However, the effect of subsidy mechanism is decreasing as the base recycling quantity increases. (2) The manufacturer should consider the size of subsidy impact factor when setting subsidy policy. (3) As the valuation for a repaired product increases, the manufacturer's profit decreases as well. (4) When the cost of new product is relatively high, the manufacturer should increase the subsidy amount to increase the collected products.

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APPLYING IPGA MODEL TO EXPLORE THE CRITICAL FACTOR FOR IMPROVING SERVICE QUALITY OF MOTEL INDUSTRY

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ABSTRACT

The motel industry is a highly competitive industry with high resource investment requirements and high customer and innovation demands. Therefore, finding out the critical factors for improving service quality has become an important issue. The purpose of this study is to apply the Importance-Performance & Gap Analysis (IPGA) in order to determine the critical service quality factors, and to develop their improvement strategy. This study selected the customers of 10 famous Motels in Taipei City as the subjects, and 362 valid questionnaires were returned. The IPGA result showed there are 14 items located in the second quadrant (Concentrate here), which were the service quality items most in demand for urgent improvement of Motels industry. The improvement priorities of 14 items were fully

discussed in the context. In particular, priority should be given to making improvements in the areas of bathrooms and empathy. Finally, the study expects that the IPGA results maybe used as a reference for improvingthe service quality of Motel industry, then to enhance consumer intention to Motel and enterprise competitiveness in the Motel competitive market.

Keywords: Motel, service quality, Importance-Performance & Gap Analysis (IPGA)

INTRODUCTION

Service quality is an important factor for maintaining a competitive advantage in the hospitality industry(Cheng, Chen, Hsu, and Hu, 2012)。For the hospitality industry, service quality is the critical factor affecting customer satisfaction and repurchase intention (Anderson, Fomell and Lenmanr, 1994; Jen and Hu, 2003; Kim, Ng, and Kim, 2009). In order to attract consumers, motel operators in Taiwan put more emphasis on atmosphere, a unique design style and novel equipment to win consumer recognition (Wu and Chen, 2012). Comfort and privacy are the service quality attributes that consumers feel are most important(Chang, Ryan, Tsai, and Wen, 2012). Therefore, in the competitive motel industry, service quality has become a key factor for motel operators to create competitive advantage and maintain sustainable operations.

Service quality was defined as the overall difference between a customer's expectations and perceptions of the service experience (Parasurman et al., 1985).The definition of service quality gap is an important guideline for scholars in the investigation of service quality-related issues. Based on the resource-based view (RBV), a competitive advantage of the firm is the result of optimal resource allocation and combination (Wernerfelt, 1984).If, under limited resources, motels can properly determine the service quality attributes that most urgently require improvements, they can effectively develop improvement plans to fully exert the effectiveness of invested resources. Lin et al. (2009) developed a set of resource reorganizing analysis models that integrated the traditional IPA model and service quality gap analysis through function conversion, which is Importance-Performance & Gap Analysis (IPGA). The IPGA model converted the axes of the traditional IPA matrix into relative importance (RI) and relative performance (RP). In addition to reflecting service quality gap, IPGA can assist enterprises to develop strategies meeting customers' needs. Some scholars have used the IPGA model to investigate the service quality and food quality of hospitality industries (Tsai and Lin, 2010; Cheng, Lin, Liu, Hu, and Lin, 2011; Cheng, Chen, Hsu, and Hu, 2012).

Many studies have investigated issues concerning the service quality of motels (Tsai and Yeh, 2012；Chang et al., 2012；Wu and Chen, 2012).Most focus on the influence of service quality on customer satisfaction, relationship marketing, and customer loyalty, as well as the consumption characteristics of different consumers; while very few studies have specifically probed into the improvement of motel service quality. The main reasons include: (1) failure to take into account the concept of service quality gap; (2) failure to take into account the resources invested; and (3) failure to objectively identify the critical service quality attributes of competitiveness. The above problems have led to a significant research gap in the assessment of motel service quality and the development of improvement strategies. Fortunately, IPGA can solve the said problems. Therefore, this study intended to use IPGA to investigate the critical factors for improving the service quality of motels and to develop strategies for service quality improvement. It is hoped that the research results can be provided as reference for motel operators to improve customer satisfaction and repurchase intention.

LITERATURE REVIEW

Service quality of Motel

In the early, the studies on service quality originate from the customer satisfaction theory previously proposed in the Europe and the U.S. (Fisk, Brown, and Bitner, 1993; Chent, Tynan, and Money, 1999). For service quality development, Parasuraman et al. (1985) processed in-depth interviews focusing on banks, credit card companies, securities brokerages and product maintenance companies, and proposed five gaps that exist in the service process. The five gaps are: Gap 1, the listening gap; Gap 2, the service designs and standards gap; Gap 3, the service performance gap; Gap 4, the communication gap; and Gap 5, the customer gap (Tsai and Lin, 2010). Those five gaps are the factors that the service industry cannot satisfy regarding customer demand or expectation. If the industry wants to satisfy customer demand, then the difference of these five gaps must be reduced. In these five gaps, the first four gaps are the most major obstacles for the service industry to provide service quality. Gap 5 (i.e. service quality gap) is formed from the difference between customer perceived service quality and expected service quality, and is the function of the previous four gaps. A negative gap of service quality indicates that the received service is less than the customers' expectations. On the contrary, a positive gap indicates that customers perceived that the delivered service exceeded their expectations. Thus, Parasuraman et al. (1985) referred the fifth gap (Gap 5) to define service quality. Service quality was defined as the overall difference between a customer's expectations and perceptions of the service experience (Parasurman et al., 1985).

In other word, service quality can be assessed by comparing the expectations of customers with their perceptions of the delivered service. At the same time, Parasuraman et al. (1985) proposed determinants of perceived service quality, which include tangibles, reliability, responsiveness, communication, credibility, security, competence, courtesy, understanding/knowing the customer, and access, etc. dimensions, and there are 97 items. Parasuraman et al. (1988) processed in-depth interviews on banks, credit card companies, product maintenance companies and long-distance all companies, and focused on their customers for empirical study. Through factor analysis, the 10 dimensions from 1985 were extracted to five dimensions, tangible, reliability, responsiveness, assurance, and empathy, and 22 items, and are named the SERVQUAL scale.

Knutson et al. (1990) referred to the service quality SERVQUAL scale, to propose the "LODGSERV" scale, which is used to specially measure the service quality of lodgings and hotels.LODGSERVscale proposed five dimensions, including tangible, reliability, responsiveness, assurance and empathy, and 26 items. Currently, there are a few scholars who have applied or revised the LODGSERV scale to explore hotel service quality.Wilkin, Merrilees and Herington (2007) re-defined the dimensions of hotel service quality to include the seven major dimensions of fashion & comfort, staff quality, personalization, guestroom quality, rapid service, additional services, and F&B quality, with a total of 30 items. However, the service attributes of motels are different from those of general hotels or resorts, and it is therefore difficult to directly use the SERVQUAL sale or LODGSERV scale to assess motel service quality. Tsai (2012) referred to the hotel service quality scale developed by Wilkin et al. (2007) while taking into account the characteristics of motel service quality to develop a motel service quality scale which included five major dimensions – architectural appearance, guestrooms, bathrooms, staff, and empathy, with a total of 26 items. Consequently, in order to ensure the validity of empirical studies on service quality of motels, this study referred to the model service quality scale developed by Tsai (2012) as the basis to develop the research questionnaire.

IPGA model

The IPA model was originally proposed by the study of Martilla and James (1977) to analyze product attributes of the motorcycle industry. The basic concept of IPA is to understand the perceived quality characteristic importance and actual perceived performance standard (satisfaction) of the respondents through a marketing survey, and then construct a two dimensional matrix of importance and performance standards, and divide quality characteristics into four types according to importance and the performance standard to facilitate companies to apply a corresponding market strategy according to the classification

of the quality characteristics. Lin et al. (2009) developed (Importance-Performance & Gap Analysis, IPGA) by integrating the traditional (Importance-Performance Analysis, IPA) model with a resource reallocation analysis model for gap analysis, and based on function conversion. IPGA converts the axes of traditional IPA matrix into relative importance (RI) and relative performance (RP). The vertical axis of the amended matrix is relative importance of the evaluated attributes, while the horizontal axis is the relative performance of the evaluated attributes. The resource allocation strategies, as denoted by the various quadrants of the IPGA model, are as shown in Figure 1 (Lin et al., 2009).

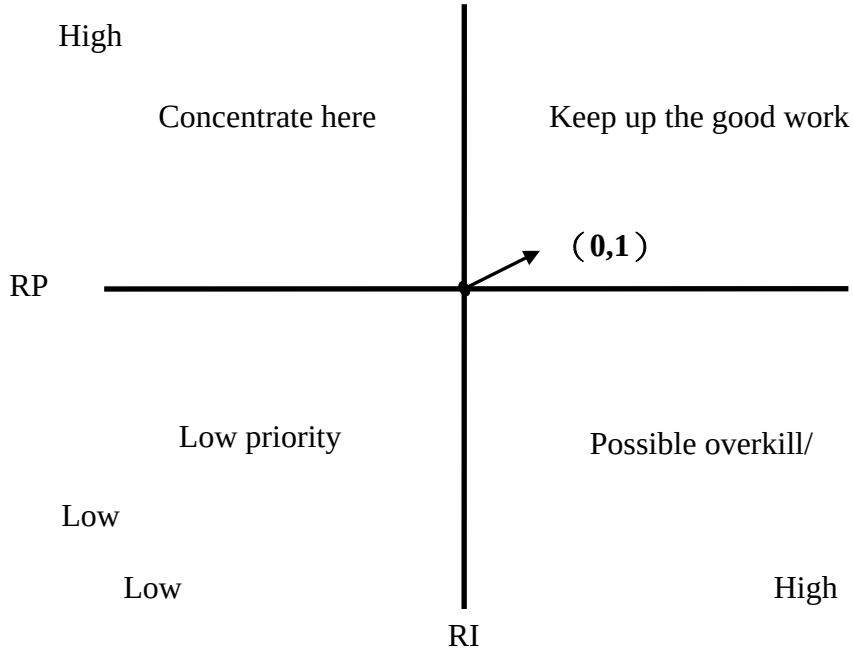

Figure 1-IPGA model

- **Quadrant I**is the quadrant consisting of high relative performance and high relative importance, and is located in the upper right area of the two-dimensional matrix. It is necessary to "keep up the good work" of the factors in this area.
- **Quadrant II** is the quadrant consisting of low relative performance and high relative importance, and is located in the upper left area of the two-dimensional matrix. It is necessary to "concentrate here" on the factors in this area. Moreover, the larger the distance between the factors and the coordinate center (0,1), the more urgent to make improvements.
- **Quadrant III** is the quadrant consisting of low relative performance and low relative

importance, and is located in the lower left area of the two-dimensional matrix. The factors in this area are of "low priority."

- **Quadrant IV** is the quadrant consisting of high relative performance and low relative importance, and is located in the lower right area of the two-dimensional matrix. The factors in this area are of "possible overkill." Moreover, the larger the distance between the factors and the coordinate center (0,1), the higher the level of resource transfer.

The analysis process of the IPGA model includes the following 6 steps (Lin et al., 2009; Tsai and Lin, 2010; Cheng et al., 2012):

Step 1: Collect information on customers' perceived degree of importance and performance (i.e. satisfaction) of Motel service quality attributes.

Step 2: Calculate the mean of importance ($\overline{I_{.j}}$) and performance ($\overline{P_{.j}}$) perceived for each attribute, as well as the average importance ($\overline{I}$) and average performance ($\overline{P}$) of all the items.

Step 3: Use paired t-test to understand whether there is a positive gap (i.e. performance significantly larger than importance) or a negative gap (i.e. performance significantly smaller than importance), or there is no gap (i.e. performance equals to importance) between customers' expectation and actual perception of various attributes.

Step 4: Calculate the relative importance (RI) and relative performance (RP) of various service quality attributes, respectively. The formula of relative importance (RI) is $\overline{I_j} / \overline{I}$. In addition, relative performance (RP) combines the concept of gap analysis model. The average performance of various attributes, as evaluated by respondents, is converted into perceived performance. In other words, after paired t-test is applied to perform gap analysis on the importance and performance of evaluated attributes, the formula was used to convert the values to obtain the RP values of various service quality attributes (as shown in Table 1).

Table 1-Relative performance (RP) calculation regulation table

Factor j's gap analysis result	Paired samples t-test	Factor j's RP value
$\overline{P_j} > \overline{I_j}$	Significant ($p \le 0.05$)	$\overline{P_j} / \overline{P}$
$\overline{P_j} < \overline{I_j}$	Significant ($p \le 0.05$)	$-(\overline{P_j} / \overline{P})^{-1}$

$\overline{P_j} > \overline{I_j}$ or $\overline{P_j} < \overline{I_j}$	Not significant (p>0.05)	0

Note: The average performance of Assessment factor j is $\overline{P_j}$, the importance is $\overline{I_j}$, and the average performance of all assessment factor is $\overline{P}$

Step 5: Draw the IPGA strategy matrix (as shown in Figure 1), where relative importance (RI) and relative performance (RP) are used as vertical axis and horizontal axis, respectively. The intersecting point of the horizontal and vertical axes is (0, 1).

Step6: Determine the priority of resource allocation for service quality attributes requiring improvement in quadrant II (concentrate here), namely, the larger the distance, the higher the priority for improvement. The formula is follow as equation (1):

$$D_q(j) = \sqrt{[RP_j / \max_{r \in q}(|RP_{.r}|]^2 + [(RI_{.j} - 1) / \max_{r \in q}(|RI_{.r} - 1|)]^2} \quad \text{.....(1)}$$

METHODOLOGY

Analytical framework

Firstly, this study referred to Tsai(2012) the motel service quality scale developed by Tsai (2012) to develop the questionnaire content, and surveyedquestionnaires on customers' perceived degree of importance and satisfaction of Motel service quality attributes. Secondly, this study analyzed the service quality attributes of each quadrant through IPGA. In this way, this study may identifythe critical factors for improving the service quality of motels and then to develop strategies for service quality improvement (as shown in Figure 2).

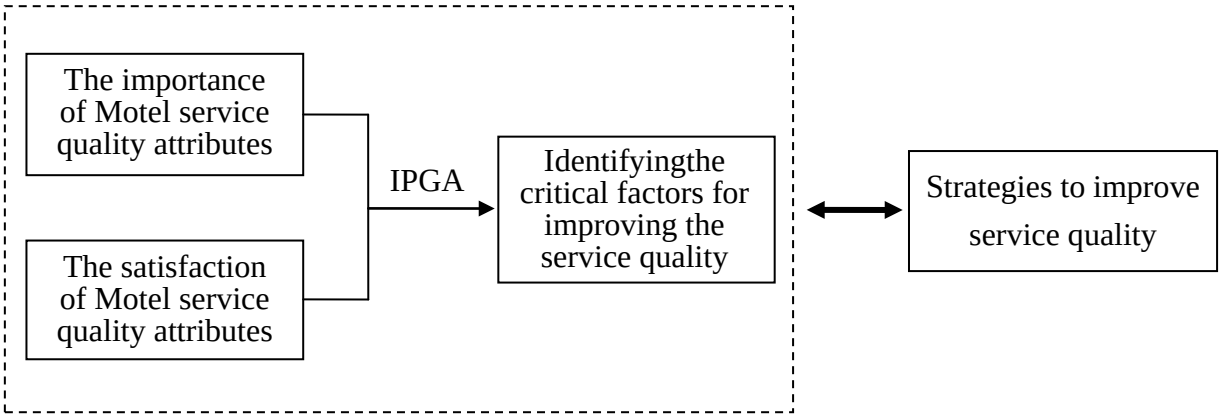

Figure 2-Analytical framework

Measurement

This study mainly referred to the motel service quality scale developed by Tsai (2012) to develop the questionnaire content. The questionnaire content included five dimensions: architectural appearance, guestrooms, bathrooms, staff, and empathy, with a total of 26 items. It is used to investigate the importance and performance (i.e. satisfaction) of customers on motel service quality, and a Likert 7-point scale is applied for the measurement. The test subjects complete the questionnaire with a secret ballot. Before the official questionnaires are issued, the reliability analysis (Cronbach's α value) of 50 pre-test questionnaires are processed, and the result shows that, except for building exterior (one item), the reliability values of all dimensionsin the study questionnaire are over 0.7, which shows that the questionnaire content has internal consistency.

Questionnaires collection

The study selected the customers of 10 famous Motels in Taipei City as the study object.The study questionnaires were issued from October 1 to October 31, 2013, with 400 questionnaires being issued. After the calculation, we collected 40 valid questionnaires for each Motel. The Motel's industries help us to collect questionnaires. After deducting the invalid questionnaires (incomplete questionnaires), there are 362 effective recycled questionnaires, with an effective recycle rate of 90.5%.Among the 362 valid questionnaires, in gender, there are more female customers (55.8%);in age, 21-30 year-olds accounted for more (43.6%); in education, having a university or college education accounted for more (56.6%); in marital status, being unmarried accounted for more (71.5%); in monthly income, earning NT$20,000~ NT$40,000 accounted for more (46.4%);in occupation, the service industry (35.2%) accounted for more; in average visited frequency in Motel within 3 the past the year, twice or less (58.6%) accounted for more.

Data analysis methods

This study first processed the descriptive statistical analysis of the effective questionnaires. Second, this study assessed the properties of measurement scales for convergent validity and discriminant validity, and constructed composite reliability by confirmatory factor analysis (CFA) using maximum likelihood to estimate parameters. Third, the allocated quadrant of Motel service quality attributes, with the two-dimensional matrix constructed by RI and RP through IPGA analysis, was examined to understand the strategy meaning of service quality attributes and to determine the critical service quality attributes of the Motel in Taipei City.

MAIN SUBJECT MATTER

Reliability and validity analysis

In accordance with accepted practice, this study assessed the properties of the scale for convergent validity, discriminant validity, and composite reliability (CR) (i.e. construct reliability). The measurement scale of this study provided a good overall fit with the data (GFI =0.92, AGFI=0.86, CFI=0.95, NFI=0.94, NNFI=0.95, IFI=0.95, $\chi^2 / d.f$ =2.92, RMR=0.041, and RMSEA=0.055). Composite reliability (CR) for all dimensions of the scale were more than 0.7, respectively. This study again confirmed all dimensions of the scale with a high degree of internal consistency. In addition, the average variance extracted (AVE) for all dimensions were more than 0.5, respectively, all exceeding the benchmark of 0.50 for convergent validity (Fornell and Larcker, 1981).

Discriminant validity was established if the AVE is larger than the squared multiple correlation (SMC) coefficients between factors (Fornell and Larcker, 1981). Our results demonstrated that the AVE for all dimensionswere more than SMC coefficients. This result indicated sufficient discriminant validity for all dimensions of the scale in this study.

IPGA analysis

This study used IPGA analysis to quantify the importance and performance of various service quality attributes of the Motel.The coordinate axes of a traditional IPA matrix were converted into relative importance (RI) and relative performance (RP) to develop the IPGA strategy matrix (Lin et al., 2009). After analysis of motel service quality through IPGA (as shown in Table 2), there are 14 items located in the second quadrant (Concentrate here), including6 items (Guestroom 3, Guestroom 4, Guestroom 7, Guestroom 8, Guestroom 9 and Guestroom 12) in the Guestroom dimension,4 items (Bathroom 1, Bathroom 2, Bathroom 3 and Bathroom 4) in the Bathroom dimension,1 item (Staff 3) in the Staff dimension, and 3 items (Empathy 1, Empathy 2 and Empathy 3)in the Empathy dimension.Based on the said results and findings, all of the items for the dimensions of bathrooms and empathy were located in the second quadrant (Concentrate here), suggesting that among the five dimensions of motel service quality, these two dimensions required the most urgent improvements.

In addition, there are 11 items located in the third quadrant (Low priority), including1 item (Architectural appearance 1) in the Architectural appearance dimension,6 items (Guestroom 1, Guestroom 2, Guestroom 5, Guestroom 6, Guestroom 10 and Guestroom11) in the Guestroom dimension, and 4 items(Staff 1, Staff 2, Staff 4 and Staff 6) in the Staff dimension. Finally, only1 item (Staff 5)in the Staff dimension is located on the boundary of

the second quadrant and the third quadrant.

Moreover, in quadrant II, the larger the value of $D_q(j)$, the higher the priority for improvement (Lin et al., 2009). This study further focuses on the 14 items of the second quadrant (Concentrate here)to calculate the distance between various items and the coordinate center (0,1), and the order of the value of $D_q(j)$ from the largest to smallest wasEmpathy 1, Guestroom 7, Guestroom 3, Guestroom 4, Empathy 2 , Guestroom 9, Bathroom 2, Guestroom 12, Guestroom 8, Bathroom 3, Empathy 3, Staff 3, Bathroom 4, and Bathroom 1.The aforementioned order could be provided as reference for the priority improvements to be made to service quality of the Motel industry.The aforementioned order could be provided as reference for the priority improvements to be made to service quality of the Motels in Taipei City.

Table 2-IPGA analysis of the items of Motel service quality scales.

Dimensions	Items	RI	RP	Quadrant	$D_q(j)$	Rank
Architectural appearance	1.The appearance is fashionable and novel.	0.932	-1.027	III	-	
Guestroom	1.There are diversified facilities in the guestroom.	0.950	-1.031	III	-	
	2.There are explicit signs for the use of facilities in the guestroom.	0.993	-1.004	III	-	
	3.The guestroom is well soundproofed.	1.053	-0.993	II	1.180	3
	4.There is no noise in the guestroom, and the sleep quality is good.	1.043	-0.983	II	1.107	4
	5.The guestroom decorations follow a certain theme.	0.927	-1.016	III	-	
	6.The guestroom style is attractive.	0.964	-1.016	III	-	
	7.The sheets, bed sheets, and pillow cases in the guestroom are neat and tidy.	1.071	-0.975	II	1.306	2
	8.There is a clear sign indicating the direction of escape from the guestroom.	1.027	-0.998	II	1.041	9
	9.The water quality in the guestroom is good.	1.035	-0.992	II	1.072	6
	10.Sufficient snacks and F&B are provided in the guestroom.	0.915	-1.044	III	-	
	11.The quality of the complementary food and	0.944	-1.047	III	-	

	beverages in the guestroom is good.					
	12.The sheets and pillows in the guestroom are comfortable.	1.035	-0.981	II	1.065	8
Bathroom	1.The lighting in the bathroom is good.	1.002	-0.986	II	0.977	13
	2.The ventilation in the bathroom is good.	1.036	-0.981	II	1.067	7
	3.The quality of the toiletries provided in the bathroom is high.	1.027	-0.996	II	1.041	9
	4.The quality of the towels provided in the bathroom is high.	1.014	-0.989	II	0.993	12
Staff	1.The service personnel can actively provide services.	0.975	-1.014	III	-	
	2.The service personnel can provide rapid services.	0.997	-1.003	III	-	
	3.The service personnel can provide accurate services.	1.001	-1.010	II	1.000	11
	4.The service personnel have sufficient knowledge to answer questions.	0.988	-1.012	III	-	
	5.The service personnel will not ignore my responses because they are too busy.	1.000	-0.996	Boundary (II & III)	-	
	6.The service personnel provide accurate time reminders.	0.930	-0.993	III	-	
Empathy	1.The motel attaches importance to personal privacy.	1.081	-0.939	II	1.365	1
	2.The motel gives priority to customer interests.	1.038	-0.991	II	1.085	5
	3.The motel understands customers' personal needs.	1.025	-0.996	II	1.034	10

CONCLUSIONS

To effectively understand the improvement strategies of Motel service quality in Taipei City, this study used IPGA model to seekurgent improvement factors,and then input the most effective service quality key factors. The IPGA results provide such information as reference for managers of the Motels in Taipei City to develop service quality improvement strategies, as well as to determine the priority of resource allocation, thus,enabling service quality improvements for the Motels to achieve the maximum effect.

Among the 26 items of service quality, further IPGA analysis showed that a total of 14 items were located in the area of "Concentrate here," including 6 items ("The guestroom is well soundproofed", "There is no noise in the guestroom, and the sleep quality is good", "The

sheets, bed sheets, and pillow cases in the guestroom are neat and tidy", "There is a clear sign indicating the direction of escape from the guestroom", "The water quality in the guestroom is good" and "The sheets and pillows in the guestroom are comfortable") in the Guestroom dimension, 4 items ("The lighting in the bathroom is good", "The ventilation in the bathroom is good", "The quality of the toiletries provided in the bathroom is high" and "The quality of the towels provided in the bathroom is high") in the Bathroom dimension, 1 item ("The service personnel can provide accurate services") in the Staff dimension, and 3 items ("The motel attaches importance to personal privacy", "The motel gives priority to customer interests", "The motel understands customers' personal needs") in the Empathy dimension. Based on the said results and findings, all of the items for the dimensions of bathrooms and empathy were located in the second quadrant (Concentrate here), suggesting that among the five dimensions of motel service quality, these two dimensions required the most urgent improvements.

The dimension of empathy was found to particularly require improvement. Customers staying in motels usually give top priority to the protection of privacy. Therefore, how to give priority to customer interests, attach importance to individual needs, and concurrently protect customers' privacy are important issues faced by motel operators. This study suggested that operators invest more resources in training to reduce customers' concerns over privacy. For example, operators may set up car plate and ID card identification systems to reduce the amount of contact between customers and service personnel. They may also develop customized service procedures for customers with different attributes or for different holidays (e.g. birthdays, Valentine's Day, Christmas, and New Year's Eve) to meet customers' special needs, as well as enable them to experience affection, novelty, and privilege during their stay.

The importance that consumers attach to bathroom environments and facilities in motels is different from that attached to general hotels, which is reflected by the bathroom space ratio in the amount of guestroom space and the bathroom utilization rate. This study suggested that operators use a semi-open space design and introduce a large number of green plants to improve ventilation and lighting. In addition, if operators can cooperate with famous brands to develop innovative and unique toiletries, the quality and image of motels can be improved and female customers' satisfaction and loyalty can be significantly enhanced.

In conclusion, this study suggested that motel operators in Taiwan endeavor to improve the environment and facilities of bathrooms, invest resources to protect customers' privacy, and develop customized service procedures for customers with different attributes or those celebrating different holidays in order to meet their special needs, as well as to enable them to experience affection, novelty, and privilege during their stay.

According to the IPGA results, this study further suggested that managers of Motels should give priority to the improvement of the 14 items mentioned above. The priority, from the highest to the lowest, was“The motel attaches importance to personal privacy (Empathy 1)”, “The sheets, bed sheets, and pillow cases in the guestroom are neat and tidy (Guestroom 7)”, “The guestroom is well soundproofed (Guestroom 3)” , “There is no noise in the guestroom, and the sleep quality is good (Guestroom 4)”, “The motel gives priority to customer interests (Empathy 2)” , “The water quality in the guestroom is good (Guestroom 9)”, “The ventilation in the bathroom is good (Bathroom 2)”, “The sheets and pillows in the guestroom are comfortable (Guestroom 12)”, “There is a clear sign indicating the direction of escape from the guestroom (Guestroom 8)”, “The quality of the toiletries provided in the bathroom is high (Bathroom 3)”, “The motel understands customers’ personal needs (Empathy 3)”, “The service personnel can provide accurate services (Staff 3)”, “The quality of the towels provided in the bathroom is high (Bathroom 4)”, and “The lighting in the bathroom is good (Bathroom 1)”. The aforementioned order could be provided as reference for the priority improvements to be made to service quality of the Motel industry. The aforementioned order could be provided as reference for the priority improvements to be made to service quality of the Motels in Taipei City.

Moreover, a total of 11 items were in the area of Low priority, including 1 item (“The appearance is fashionable and novel”) in the Architectural appearance dimension, 6 items (“There are diversified facilities in the guestroom”, “There are explicit signs for the use of facilities in the guestroom”, “The guestroom decorations follow a certain theme”, “The guestroom style is attractive”, “Sufficient snacks and F&B are provided in the guestroom”, and “The quality of the complementary food and beverages in the guestroom is good”) in the Guestroom dimension, and 4 items (“The service personnel can actively provide services”, “The service personnel can provide rapid services”, “The service personnel have sufficient knowledge to answer questions”, and “The service personnel provide accurate time reminders”) in the Staff dimension. Finally, only 1 item (“The service personnel will not ignore my responses because they are too busy”)in the Staff dimension is located on the boundary of the second quadrant and the third quadrant.This study suggested that managers of the Motel in Taipei City should not excessively invest resources in the quality items located in the area of “Low priority” and the boundary between “Concentrate here and Low priority”.

Finally, worthy of note, in the research results of IPGA, none of the service quality dimensions of Motel industry was located in the area of “Keep up the good work”, this result is consistent with the IPGA result of service quality in other areas of the hospitalityindustry (Cheng et al., 2011; Cheng et al., 2012). The investigation showed that, although the

importance of some of the quality dimensions was higher than the average importance, there was no positive gap (i.e. satisfaction—importance were both>0) in the dimensions of Motel service quality. Consequently, service quality of Motels industry must be continuously improved to increase customers' satisfaction to a degree higher than importance, in order to develop substantial competitive advantage of service quality of Motel industry.

Due to cost and time factors, the main research limitations of this study were that only customers of 10famous Motelsin Taipei City were selected as the subjects, and the opinions from customers in other areas could not be reflected. Therefore, future researchers are advised to expand the research scope to Motel customers in different areas, or even use other methodologies (e.g. Neural networks), to investigate service quality improvement strategies for Motels industry from different perspectives in order to effectively analyze factors affecting the service quality of Motels.Finally, this study may understand the difference of Motel service quality with different customercharacteristics (such as age, education, visiting frequency) by one-way analysis of variance in order to develop different strategies to improve motel service quality.

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A CLOUD COMPUTING TECHNOLOGY FORESIGHT STUDY WITH SCENARIO PLANNING APPROACH

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ABSTRACT
While the importance and value of cloud computing are gradually being realized worldwide, cloud computing related technologies and the priority of adopting these technologies have so far not been clearly recognized. To fill this gap, this paper focuses on the technology planning strategy of organizations that have an interest in developing or adopting cloud computing related technologies.
Based on the scenario analysis approach, a technology planning strategy is proposed. In this analysis, thirty cloud computing related technologies are classified into six strategic clusters, and the importance and risk factors of these clusters are then evaluated under two possible scenarios. The main research findings include the discovery that most cloud user device technologies are rated high to medium in importance and high risk in two different scenarios, and that scenario changes will have less impact on mobile cloud application technologies. These results provide a reference for organizations and vendors interested in incorporating emerging cloud computing related technologies.

Keywords: cloud computing, scenario analysis, technology foresight, strategy

INTRODUCTION
Frequent reports of global economic instability and catastrophic changes, energy and raw material price fluctuations, and increased labor costs led to the formation of inevitable operating costs for enterprises and affected the corporate decisions of information technology investments (Jain and Bhardwaj, 2010). Meanwhile, cloud computing, having experienced the test of the market in its sprouting stage, gradually became an important operation for IT users. With this development trend, companies from different fields gained entry into the cloud market. The cloud computing industry adopts system integration, data center, server, and the mobile device industry as its core and continues to combine external business resources and break new ground in the cloud computing market.
The cloud computing industry can be considered to be technologies and services that enable the user to access IT resources and services over the network (Mell and Grance, 2011). The cloud computing concept has had a major impact on the products, services and business models of the IT software and hardware industries. Cloud computing has therefore become the emerging concept and technology that has drawn the most attention from the IT software

and hardware industries in the wake of the global financial crisis. The broad scope of the industry, as well as the fact that it spans both the enterprise and consumer markets, has led to much discussion on its future business potential as well.

Presently, major IT firms worldwide are exploring possible business opportunities in the cloud computing generated market. However, what is the scope of cloud computing technologies? And what are the possible outlooks in terms of the importance as well as the risks of these technologies? These key questions need to be answered before one can have confidence in the accuracy of technology strategy planning. To assist IT vendors moving forward in the emerging cloud computing market, this research aims to explore possible planning strategies for adopting or developing cloud computing related technologies. To achieve this objective, a systematic approach of scenario analysis followed by technology strategy planning is conducted.

LITERATURE REVIEW

Evolution of cloud computing technologies

Cloud computing is an innovative technology that is continuing to be developed due to this trend (Kshetri, 2011). Cloud technology not only offers ordinary users greater convenience and flexibility, but also allows businesses to integrate their basic IT infrastructure, introduce different types of services and increase their computing capacity (Iyer and Henderson, 2010). Innovative cloud computing technologies will also play an increasingly important role (Lin and Chen, 2012) in enterprises (Sultan and van de Bunt-Kokhuis, 2012).

Cloud services

The concept of cloud services (Katzan, 2009) has gained in popularity with the development of innovative web services on the Internet (Armbrust et al., 2010). Businesses have gradually migrated their computing resources from their own server rooms to service providers. Internet users are now actively creating and sharing content instead of just passively browsing, and thanks to the popularity of mobile devices, it is now easier than ever to share and access information. Users have therefore been encouraged to move their data from personal computers to the data centers of cloud service providers (Vouk, 2008). To provide a more reliable and responsive service, service providers must upgrade their computing capacity and storage space as well as develop all new service architecture in order to meet user requirements (Buyya et al., 2008).

Cloud infrastructure and data center

Data center equipment consists mainly of servers, storage equipment and network communications equipment (Foster et al., 2008). The nature of the application software running on the server may also influence the development of the server product. If cloud services continue to be taken up by businesses or consumers then applications such as web browsers, e-mail clients, collaboration software and virtual desktops that are the most likely to be placed in data centers should see rapid growth (Helland, 2013). On the other hand, cloud computing means that data centers may also adopt servers that can be quickly deployed to expand or reduce resources as required (Basu et al., 2012). Container server or appliance server are therefore another potential avenue of development.

Virtualization software and system management software have always been a key area of development of large system software vendors (Sotomayor et al., 2008). The push for interoperable cloud technology standards however means that virtualization software and

management software based on an open software platform standard may be worth developing (Smajda, 2011).

Cloud user devices

In 2011, the smart-phone and tablet PC industries began making programs combining cloud services and terminal devices, such as the iCloud developed by Apple. Through the mechanism of cloud computing, collaborative applications focusing on the content, and with a cloud multi-machine development direction, future users will be able to easily experience cloud services with just a mobile terminal device and a wireless network. This is also the industry direction of major smart-phone and media tablet vendors (Holzer and Ondrus, 2011). For example, iOS 5 released by Apple in 2011 comes with iCloud service built-in. Once the user stores their data with this service it is synchronized to all other Apple products they own including iPhones, iPads, iPods and even iWatch in the future. Important data can therefore be accessed seamlessly from any device.

Mobile Cloud Applications

With the popularity of mobile application software Apps in the mobile phone and media tablet market, there will be more and more cloud applications linked to the mobile application software marketplace (Bouwman et al., 2013). Accompanying this wave of interest, more software development industries will launch innovative applications with Apps to link cloud services and create new opportunities for the terminal device operators. The communications equipment industry promotes cloud computing-related services by linking to cloud services through IoT(Internet of Things) (Atzori et al., 2010) and context sensing applications.

As mobile application software ("App") (Serrano et al., 2013) on mobile phones and tablets become more popular, more cloud applications will be linked to the app market. This trend will see more software developers release innovative applications that link apps to cloud services, creating new opportunities for terminal device vendors. Communications equipment vendors can themselves develop cloud-related innovative services by linking Internet of Things and context-sensing apps to cloud services.

Cloud data security

Cloud data security technology has two dimensions. One dimension is the adoption of IT security technology, products or services by businesses to improve the security of cloud services. This is known as "Security for the Cloud" (Kalloniatis et al., 2013). The other dimension is the use of cloud computing by IT security vendors to strengthen, expand or transform their existing IT security technologies and services. This is known as "Security as a Service". Examples include the collection of real-time virus data, updating virus definitions through the cloud, using cloud data centers for correlation analysis, reducing the load on terminal computers and blocking malicious attacks before they can enter the corporate network. The goal is real-time protection. The improved cloud IT security technology and service can also help protect businesses from the IT security risks associated with the adoption of cloud architecture (Subashin and Kavitha, 2011).

Cloud development and deployment tools

Changing user lifestyle and work habits means that mobile devices must strive to provide users with cloud service access on different devices at different times and locations while ensuring that information is synchronized across all mobile devices (Garrison et al., 2012).

The development and deployment tools of cloud computing related services spurred by the increasing maturity of user interface and networking technology now offers a solution (Zhang et al, 2013).

RESEARCH METHOD

Scenario Analysis

Scenario Analysis (SRI, 1996) has been used in various domains for analyzing and forecasting trends in the development of technology. Many versions and variations of the SRI scenario analysis methods have been proposed (Mietzner & Reger, 2005). The technology portfolio planning process (Yu, 2006) is a systematic procedure used to assist in the strategic decision necessary to find the cluster set of resource allocations among available technologies that best fits the goal of an organization. Scenario planning is a key technique used by futurists to develop future models in order to facilitate this process and to develop strategic action plans and policies, as well as create a vision for the future (Erdogan et al., 2009).

The major steps of the technology strategy planning process are as follows (Bishop et al., 2007).

1. Identify decision criteria, which are the motivational forces for the resource allocation decision.
2. Propose possible future scenarios by exploring combinations of significant impact variables.
3. Compose a set of technology alternatives and classify them into clusters.
4. Generate a set of technology assessment indicators from mutually exclusive dimensions.
5. Find the best plan for a technology portfolio.

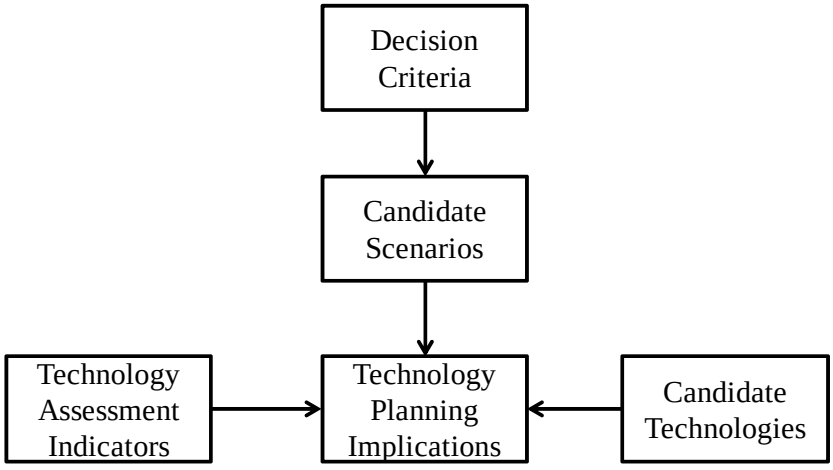

Figure 1 – Research Framework of a Technology Foresight study

Expert Panel

To conduct the technology foresight study, an expert panel was formed with eleven domain experts selected from both the IT industry and the academic world. This expert panel consisted of the following members:

1. Three consultant managers of publicly listed IT services firms.
2. Four CEO and VP level executives of independent software vendors.
3. Two R&D managers of publicly listed IT device manufacturers.
4. Two project managers of publicly listed telecom operators.

A facilitator led the expert panel discussion sessions by following the steps in Figure 1 above. Activities in these sessions included open discussions, anonymous voting, as well as the administration of surveys.

RESULTS

Decision Criteria

To identify decision making criteria, expert panel discussions were conducted concerning decision making factors from the social, political, economic and techno-logical perspectives. Possible decision factors were discussed, such as the market outlook for a technology, as well as the competence of the industry to acquire this technology. The final set of indicators is summarized in Table 1.

Table 1 – Major decision factors

Decision factors	Issues
Social factors	1. Availability of cloud services for quality of life improvement for general public
Technological factors	1. Entrance barrier level of cloud computing technology 2. R&D strength of the local industry
Economic factors	1. Strategic benefit of the enterprises adopting cloud technologies 2. New business opportunity for the local industry
Political factors	1. Strength of cloud computing industry promoting policies of government

Candidate Scenarios

There are many different scenario alternatives which organizations may select for cloud computing technology trends. Impact variables which are most likely to affect the scenario development were identified by the expert panel. Through evaluations from different combinations of these variables, final choices of scenarios were then determined. After the Expert Panel discussions, the scenarios were labeled and elaborated upon. The results are illustrated in Table 2.

Table 2 – Candidate Scenarios

Scenario Code	Global IT Spending Outlook	Cloud Technology Breakthrough	Vendor Competition Level	Final Scenario Choice and Naming
000	High	High	High	Big Demand
100	Low	High	High	
010	High	Low	High	Slow Progress
110	Low	Low	High	
001	High	High	Low	
101	Low	High	Low	
011	High	Low	Low	
111	Low	Low	Low	

A detailed description of the scenarios is as follows.

Scenario 000: Big Demand

In the Big Demand scenario, the foreseen global economic situation is strong, and the worldwide IT spending outlook is in good shape. At the same time, with the progress of continuous research in both industry and academia, the development of cloud computing technology is experiencing a major breakthrough.

Scenario 010: Slow Progress
In the Slow Progress scenario, the foreseen global economical situation is strong, and the worldwide IT spending outlook is in good shape. However, the progress of academic and industrial cloud computing technology research and development is slow. As a result, potential users may relocate their resources to other areas with more promising technologies.

Candidate Technologies
To assess the possible cloud computing Analytics technologies for the proposed scenarios, another technology expert panel of ten members was formed. This panel differed from the previous panel. The purpose of a different expert panel was to assure independence between technology planning activities. Cloud computing technology data were collected by interviewing these panel members, as well as from secondary data which included vendor propositions and research literature. The final list of the most promising cloud computing Analytics technologies is exhibited in the following table.

Table 3 – Candidate Cloud computing Technology

Cluster	Technology
Cloud Service (CS)	CS1: IaaS (Infrastructure as a Service) CS2: PaaS (Platform as a Service) CS3: SaaS (Software as a Service) CS4: DSaaS (Data Storage as a Service) CS5: BPaaS (Business Process as a Service)
Cloud Infrastructure and Data Center (CI)	CI1: Server Virtualization CI2: Storage Virtualization CI3: VDI (Virtual Desktop Infrastructure) CI4: SDN (Software Defined Network) CI5: SDDC (Software Defined Data Center)
Cloud User Device (CU)	CU1: Smartphone CU2: Tablet CU3: Wearable Device CU4: Thin Client CU5: E-Reader
Mobile Cloud Application (CA)	CA1: Mobile Social Media CA2: M-Commerce CA3: Location Based Application CA4: Cloud Analytics CA5: Search and Explore Application
Cloud Data Security (CD)	CD1: BYOD (Bring Your Own Device) solution CD2: MDM (Mobile Device Management) CD3: Security as a Service CD4: Security for cloud CD5: Mobile Data Protection
Cloud Development and	CT1: Mobile App IDE (Integrated Dev Environment)

Cluster	Technology
Deployment Tool (CT)	CT2: Middleware for Cloud Deployment CT3: Enterprise App Store CT4: RIA (Rich Internet Applications) CT5: HTML5
Total items	30

Technology Assessment Indicators

The expert panel on technology then applied the scenario analysis approach to assess the candidate cloud computing technologies of the six major clusters in two dimensions: importance and risk. These two dimensions are quantified by selected indicators summarized in Table 4.

Table 4 – Technology Assessment Indicators

Dimensions	Indicators	Low Level	Medium Level	High Level
Importance	Compound annual growth rate of global market size for the next 5 years	< 10%	10%~20%	> 20%
	Global user adoption ratio	< 10%	10%~60%	> 60%
Risk	Compound annual growth rate of local production value for the next 5 years	> 10%	10%~5%	< 5%
	Local R&D over revenue proportion	> 9%	9%~3%	< 3%

Technology Planning Implications

Based on the importance indicators and risk indicators in Table 4, the expert panel assessed the cloud computing technologies compiled in Table 3 with respect to the four scenarios. The assessment results are exhibited in figures 2-3 and discussed as follows.

Technology Planning Implications for Scenario 000: Big Demand

For the Big Demand scenario, the assessment outcome is depicted in Figure 2. In this scenario, the mobile cloud application (CA) technologies would be of high importance and low or medium risk in general. This is mainly because the mobile cloud application technologies, based on the development of social media, mobile commerce and location based service, are relatively popular on mobile devices and have a large base of users worldwide. Also note the tablet and wearable device technologies are positioned in both high importance and high risk. Though these technologies are viewed as the big opportunity for the IT industry, these technologies are also new and highly competitive to most enterprises, and the adoption of them is considered highly risky.

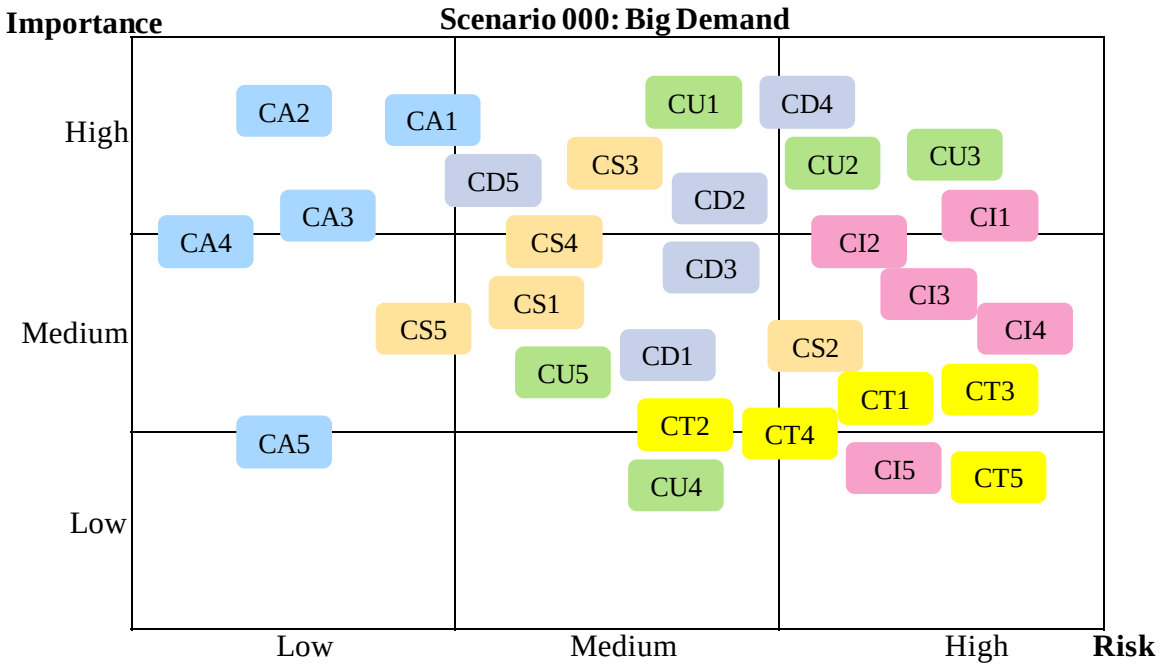

Figure 2 – Technology assessment for Scenario 000: Big Demand

Technology Planning Implications for Scenario 010: Slow Progress

For the Slow Progress scenario, the assessment outcome is depicted in Figure 3. In this scenario, the risk of most technologies would increase in general compared with the Big Demand scenario. The cloud service (CS) technologies, based on the development of web service and on-demand model, would have decreased importance. In general, the cloud data security (CD) technology would also have lower importance, due to the slow advancement of cloud technology development.

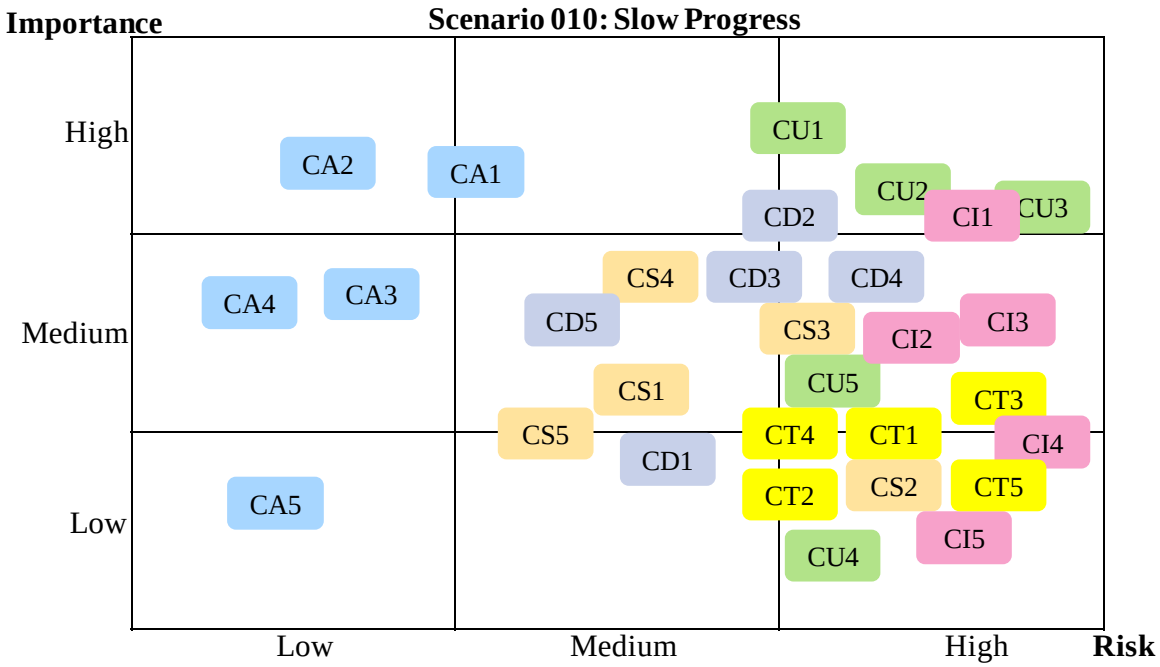

Figure 3 – Technology assessment for Scenario 010: Slow Progress

CONCLUSION

In this study, a systematic approach geared towards deriving foresight towards possible cloud computing technology developments over the next five years was conducted. Highlights of the research findings are summarized in Table 5. Based on these results, the strategic thinking of an organization toward developing or adopting cloud computing technologies for competitive advantages can be initiated. For example, these findings suggest that mobile cloud application (CA) technologies should have a higher priority for organizations in the pursuit of new market opportunities.

Table 5 – Results and Implications

Cloud Computing Technology Cluster	Result	Implication
Cloud Service (CS)	Cloud service technologies are of medium importance and medium risk. The importance rating will have obvious decline in Slow Progress scenario.	If the progress of technology development is slow, users will tend to stick with the traditional on-premise IT solutions, and be cautious about adopting these technologies.
Cloud Infrastructure and Data Center (CI)	Most cloud infrastructure and data center (CI) technologies are rated low to medium importance and high risk in both scenarios.	These technologies are mainly dominated by global major IT vendors. It is considered highly risky for the local industry to compete with major plays for the market opportunity.
Cloud User Device	These technologies are rated medium to high risk in	Smart-phones and tablets are currently the two most popular

Cloud Computing Technology Cluster	Result	Implication
(CU)	general. Smart-phone, tablet and wearable device technologies are of high importance in both scenarios.	mobile user devices with ongoing market opportunity. Wearable devices are viewed as the next big thing in IT industry. However, the high competitiveness of the market is also highly risky.
Mobile Cloud Application (CA)	These technologies are rated low risk in general. Mobile social media and mobile commerce are rated high importance in both scenarios.	Integrating cloud service, mobile app, location based service and social media, these technologies represent application software of a new era. Innovative applications are evolving with opportunities.
Cloud Data Security (CD)	These technologies are of medium to high importance and medium to high risk. The importance ratings drop significantly in the Slow Progress scenario.	The demand of these technologies depends on the adoption scale of cloud service and mobile cloud application. The global major IT vendors also play dominant role in security technology development.
Cloud Development and Deployment Tool (CT)	These technologies are rated medium to low importance and high risk in general.	Users of these technologies are mostly software developers. The high risk reflects the monopoly power of global major vendors in these technologies.

On the other hand, vendors interested in exploring the market opportunities of cloud computing technologies can use the analysis framework and outcome of this research as a reference for their strategy planning, thereby avoiding many unnecessary trial and error marketing efforts. In particular, with a clear picture of the cloud computing technologies scenario analysis, vendors can better position themselves for the most suitable market sector in terms of importance and risk.

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GLOBAL SUPPLY CHAIN COORDINATION

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ABSTRACT
This paper addresses the horizontal coordination of production and distribution decisions between plants located in different countries to serve multiple international markets in a changing economic and political environment. Horizontal coordination gives the multinational firm the flexibility to shift production between plants within its global manufacturing network to take advantage of future changes in production and/or transportation costs, trade regulations, exchange rates, competitive moves, or government policies. In reaction to and in anticipation of such changes, the question is to determine how to adjust the production and distribution activities of the different plants in the network to maximize the global after-tax profit for the multinational firm. Proposed in this paper is a horizontal coordination model that integrates the multi-period production and distribution decisions of the various plants for simultaneous optimization. This model considers multiple products at each plant and incorporates production, inventory and transportation costs as well as governmental regulations such as taxes, export incentives, tariffs, and import quotas.

Keywords: Supply Chain Coordination, Global Production and Distribution Planning, Optimization

INTRODUCTION

In response to intensified competition in the rapidly changing global marketplace, multinational companies operating multi-facility international production networks are faced with the challenge of continuously updating their production and distribution strategies to maximize their global after-tax profit. The multi-facility global production structure gives the multinational firm the flexibility to shift production between plants to take advantage of future changes in production and/or transportation costs, trade regulations, exchange rates, competitive moves, or government policies. Kogut and Kulatilaka (1994) show, for example, how the option of switching production between two plants produces extra value for the multinational firm when exchange rates vary.

An important question that arises in formulating profit-maximizing production and distribution strategies is how decision-making at the different plants should be coordinated so that the operating policies are optimal for the multinational firm as a whole. This is important because without coordination value-adding decisions at one plant may not produce the expected results at the multinational firm level due to inefficiencies at another plant in the global production network.

Coordination of production planning among multiple plants is not a new topic. Much research has been carried out on vertical coordination where a large vertically integrated firm

may have a hierarchy of production plants making parts, components, and semi-finished products for assembly into final products. Production decisions at these plants must be coordinated in such a way to meet the material requirements of the final assembly schedule at downstream plants. In this regard, many currently proposed approaches are based on the development of design-planning models (Cardoso et al., 2013, Kopanos et al., 2011 and Laínez et al., 2009), while others focused on the integration of midterm decision making levels using integrated planning-scheduling models (Guillén-Gosálbez et al., 2006, Kopanos et al., 2012 and Sung and Maravelias, 2007) and/or production-distribution planning models (Cóccola et al., 2013 and Erengüç et al., 1999). By contrast, there is smaller amount of work devoted to horizontal coordination between plants located in different countries to take advantage of the diversity in international markets. In their review of the models for management of global supply chains, Cohen and Mallik (1997) points out to significant gaps in the literature in understanding how firms should achieve the required coordination to respond to changes in market conditions and competitive environments. They organize the analytical models of the literature into two broad categories: network flow and option valuation. Network flow models deal with network configuration and long-term utilization of the firm's global supply chain, whereas option valuation models focus on switching production or sourcing in response to uncertain events in markets.

Network flow models may in turn be organized into two types of problems, namely the plant location problem and the supply chain coordination problem. Plant location problems have traditionally attracted the attention of a number of researchers. The interested reader is referred to Brandeau and Chiu (1989) for an extensive survey of the work done in this area. While much research has been focused on classic plant location problems, little analytical work exists on international plant location problems. Location of international plants can be viewed as an extension of the classic plants location problems. In the classic plant location problem, plants and customers are all considered to be located in the same country, wherein international plant location problems, plants are located in different countries with varied economic environments, but can serve customers within the host country as well as other countries. Proposed approaches for this problem include break-even analysis (Jucker, 1977), quadratic programming (Hodder and Jucker 1985, Hodder and Dincer 1986), mixed integer programming (Haug 1985, Cohen and Lee 1989, Cohen et al. 1989), and heuristics (Haug 1992). The primary goal of these models is to determine in which countries to locate manufacturing facilities and when to do so over a given planning horizon such that either total costs are minimized or total after-tax profits are maximized.

Supply chain coordination problems are concerned with the management of production and distribution activities throughout the global supply chain. The idea is to lower production and distribution costs through the allocation of value-adding activities to facilities, transfer pricing between plants operating in different tax jurisdictions, and international cash flow management. Analytical modeling in this field is relatively new and has yet to be structured into a well-defined and comprehensive framework. Consequently, a wide variety of supply chain coordination scenarios have been considered in the literature. Cohen and Lee (1988) introduced stochastic models and heuristic solution methodologies to integrate material, production, and distribution decisions in supply chains. Next, Cohen and Lee (1989) introduced a deterministic model for a global manufacturing and distribution to show how a company should structure its worldwide plants under varying conditions, from country to

country, of demand, supply, and cost structures. Their model is defined to include value markups, local offset requirements as well as costs, enabling estimation of before-tax and after-tax profitability, including exchange rate effects. However their model does not capture multi-period effect directly, suggesting rather that sequential runs of the model handle these. Lee and Billington (1995) describe a worldwide inventory network model to determine the optimal inventory levels in different locations of the Hewlett-Packard global supply chain. Arntzen et al. (1995) describe a supply chain coordination model used at Digital Equipment Corporation. This is one of the most comprehensive coordination models. Formulated as a mixed integer program, this model determines site locations, capacity decisions, manufacturing technology at the facilities, product mix, shipping modes, and production quantities that minimizes a weighted combination of production and transportation costs in the company's global supply chain network. The solution of this large-scale mathematical model (20,000 variables and 6000 constraints) was reportedly derived using a special-purpose solution methodology. Rosenfield (1996) develops a number of deterministic and stochastic models to determine the number of plants and production levels in a global environment for a firm in order to minimize production and distribution costs for geographically dispersed markets. Goetschalckx, Vidal, and Dogan (2002) show the potential savings generated by the integration of the design of strategic global supply chain networks with the determination of tactical production–distribution allocations and transfer prices, which combines strategic planning and tactical planning in global supply chain networks.

Global supply chain coordination decisions are influenced by strategic, technological, macroeconomic, political, infrastructure, competitive, and operational factors. For example, prior to 1997 Toyota had plants located worldwide in each market that it served, with each plant only capable of serving its local market. When the Asian economy went into recession in the late 1990's some local plants were shut down or refitted to serve other markets that had excess demand (Chopra and Meindl, 2004). Toyota's plants have now the flexibility to serve markets other than the local ones, and with this flexibility comes the challenge of which ones to open or close in the face of the changing market conditions. The supply chain must not only routinely deliver products on time, but it must be able to respond with flexibility to changes in markets, suppliers, and cost structures.

This paper belongs to the network flow category discussed above. We formulate the multi-plant coordination problem as a multi-period mixed integer optimization program. The model's optimum solution specifies how the different plants in the global supply chain network should adjust their product mixes, production outputs, and distribution schedules in anticipation of changes in demand; production, inventory, and transportation costs; and corporate taxes, import duties, export quotas, and export incentives; in such a way to maximize the global after-tax profit for the firm over a given multi-period planning horizon. The main contribution of the paper is to determine through a comprehensive and integrative model an optimal multi-plant coordination policy that provides unambiguous answers to such important and complex questions as: (1) is it profitable to serve customers in this country with this product? (2) In which plant, in which country, and in what quantity should a product be manufactured? (3) Which plants should be open for production and which plants should be closed in every time period of the planning horizon? (4) Which plants should service which country's product demand, and in what quantity? (5) How much inventory of which products should be stored at which plant? And finally, (6) what is the most economical way to comply

with governmental regulations on taxes, export quotas, import duties, and local content requirements?

In the next section, we describe in detail the multi-plant coordination problem we are considering and present a formulation of this problem.

AN INTEGRATED MULTI-PLANT COORDINATION MODEL

In the problem we consider, that several products are produced over time at several plants located in different countries. Each plant has a specific cost structure, and can serve customers within the same country as well as other countries. The demand for each product at each country in every time period in the planning horizon is known. With known plant capacities, selling prices of products in the various countries, transportation costs from the various production facilities to the various market countries, production and inventory costs of the various plants, and export incentives import duties and quotas of the various countries, the question is to decide the set of plants to operate, the product mix at each plant, and the quantities that plants ship to each country in each time period; in such a way to maximize the global after-tax profit for the firm. Next, we define the notation used, and provide a formulation of the mathematical model.

Notation

Primary Sets and indices

$P =$ Set of products, $p \in P$;

$C =$ Set of countries, $c, r \in C$;

$F =$ Set of production facilities, $f \in F$;

$T =$ Set of time periods in the planning horizon, $t \in T$.

Induced Sets

$P_c =$ Set of products marketed in country *c*, $P_c \subseteq P$;

$P_f =$ Set of products that can be produced at facility *f*, $P_f \subseteq P$;

$C_p =$ Set of countries where product *p* is marketed, $C_p \subseteq C$;

$F_p =$ Set of facilities capable of producing product *p*, $F_p \subseteq F$;

$F_c =$ Set of production facilities located in country *c*, $F_c \subseteq F$;

$F_r =$ Set of production facilities located in country *r*, $F_r \subseteq F$.

Cost Data

$C_{pft} =$ Fixed cost of producing product *p* at facility *f* in period *t*,

F_{ft} = Fixed cost of operating facility *f* during period *t*,

L_{ft} = Fixed cost of keeping facility *f* closed throughout period *t*,

T_{pfct} = Transportation cost of one unit of product *p* from facility *f* to country *c* in period *t*,

V_{pft} = Variable production cost of one unit of product *p* at facility *f* in period *t*,

H_{pft} = Cost of holding one unit of product *p* in inventory at facility *f* throughout period *t*,

R_{pct} = Sale price of one unit of product *p* in country *c* during period *t*,

G_{pfct} = Transfer price of one unit of product *p* from facility *f* to country *c*, $(f \notin F_c)$, in period *t*,

M_{prct} = Import duty fee of one unit of product *p* into country *c* from country *r* during period *t*,

E_{pft} = Monetary incentive given by the host country of facility *f* for exporting one unit of product *p* to other countries in period *t*,

TX_{ct} = Corporate tax rate (as a coefficient between 0 and 1) in country *c* at period *t*,

A_{ct} = After tax profit retention rate in country *c* at period *t*,
$= 1 - TX_{ct}$.

Supply/Demand Data

D_{pct} = Demand for product *p* (in units) in country *c* at period *t*,

S_{pft} = Production capacity of product *p* (in units) at facility *f* in period *t*,

N_{pcrt} = Quota on the number of units of product *p* that can be exported from country *c* to country *r* in period *t*.

Decision Variables

X_{pfct} = Units of product *p* produced at facility *f* and sold in country *c* in period *t*,

Y_{pft} = Units of product *p* produced at facility *f* in period *t*,

I_{pft} = Units of product *p* held in inventory at facility *f* at the end of period *t*,

$$Z_{pft} = \begin{cases} 1, \text{ if product } p \text{ is produced in facility } f \text{ during period } t; \\ 0, \text{ otherwise.} \end{cases}$$

$$Q_{ft} = \begin{cases} 1, \text{if facility } f \text{ is open for production in period } t; \\ 0, \text{otherwise.} \end{cases}$$

Model Description and Formulation

The verbal formulation of the multi-plant coordination model is given next.

Maximize: Total multi-period after tax profit =

Sales revenue plus export incentives revenue minus fixed operating cost of open facilities minus fixed cost of closed facilities minus fixed product manufacturing costs minus variable product manufacturing cost minus inventory holding cost minus purchase cost of imported products minus transportation cost minus import duty.

Subject to:

Global demand target
Product conservation flow
Export quota
Production capacity
Logical constraints linking products to facilities

$$\text{Max} \sum_{t\in T}[\sum_{c\in C} A_{ct}[\sum_{p\in P}[\sum_{f\in F_c}[R_{pct}X_{pfct} - C_{pft}Z_{pft} - V_{pft}Y_{pft} - H_{pft}I_{pft} - F_{ft}Q_{ft} - L_{ft}(1-Q_{ft}) + \sum_{(r\neq c)\in C_p}(G_{pfrt} + E_{pft})X_{pfrt}] + \sum_{f\notin F_c}(R_{pct} - G_{pfct} - T_{pfct})X_{pfct} - \sum_{(r\neq c)\in C}\sum_{f\in F_r} M_{prct}X_{pfct}]]] \quad (1)$$

Subject to:

$$\sum_{f\in F_p} X_{pfct} \le D_{pct}, \qquad p\in P, c\in C_p, t\in T; \quad (2)$$

$$Y_{pft} + I_{pf,t-1} = \sum_{c\in C_p} X_{pfct} + I_{pft}, \qquad p\in P,\ f\in F_p, t\in T; \quad (3)$$

$$\sum_{f\in F_c} X_{pfrt} \le N_{pcrt}, \qquad p\in P, c\in C, (r\neq c)\in C, t\in T; \quad (4)$$

$$Y_{pft} \le S_{pft}Z_{pft}, \qquad p\in P,\ f\in F_p, t\in T; \quad (5)$$

$$Z_{pft} \le Q_{ft}, \qquad p\in P,\ f\in F_p, t\in T; \quad (6)$$

$$Z_{pft}, Q_{ft}, U_{ft} = \{0,1\}, \qquad p\in P,\ f\in F, t\in T; \quad (7)$$

$$X_{pfct}, Y_{pft} \ge 0, \qquad p\in P,\ f\in F_p, c\in C_p, t\in T. \quad (8)$$

Constraint set (2) imposes bounds on the maximum quantity of product *p* that can be sold in country *c* at time period *t*. Observe that in order to allow for the possibility of not serving unprofitable markets this constraint does not require fulfilling an entire market's demand. Constraint (3) imposes product flow conservation among production, inventory, and sale

variables at each production facility in every time period. Inventory may be carried to provide better customer service or to satisfy forecasted demand that exceed production capacities in future time periods. Constraint (4) imposes quotas on the quantity of product *p* that can be exported from country *c* to any other country *r* at time period *t*. In order to provide protection for local production, some countries may apply quotas on selected imports. Constraint set (5) imposes the production capacity of product *p* at facility *f* in period *t*. Constraint set (6) states the condition that product *p* may be produced at facility *f* in period *t* only if that facility is open for production during that time period. Constraints (7) and (8) respectively ensure integrality and nonnegativity on the decision variables.

The objective function maximizes the multi-period global after-tax profit of the multinational firm. For a given period *t* the global after-tax profit is the result of adding all countries' pretax profits multiplied by their respective after-tax profit retention rates.
The pretax profit derived from country *c* at time period *t* may be expressed as follows:

Revenue from products produced and sold locally: $\sum_{p\in P}\sum_{f\in F_c} R_{pct}X_{pfct}$,

plus revenue from imported products sold locally: $\sum_{p\in P}\sum_{f\notin F_c} R_{pct}X_{pfct}$,

plus revenue from locally made products exported to other countries: $\sum_{p\in P}\sum_{(r\neq c)\in C_p}\sum_{f\in F_c} G_{pfrt}X_{pfrt}$,

plus revenue from product export incentives: $\sum_{p\in P}\sum_{(r\neq c)\in C_p}\sum_{f\in F_c} E_{pft}X_{pfrt}$,

minus fixed production cost of products manufactured locally: $\sum_{p\in P}\sum_{f\in F_c} C_{pft}Z_{pft}$,

minus variable production cost of products manufactured locally: $\sum_{p\in P}\sum_{f\in F_c} V_{pct}Y_{pft}$,

minus inventory holding cost at the local facilities: $\sum_{p\in P}\sum_{f\in F_c} H_{pft}I_{pft}$,

minus fixed operating cost of local facilities: $\sum_{f\in F_c} F_{ft}Q_{ft}$,

minus fixed closing cost of local facilities: $\sum_{f\in F_c} L_{ft}(1-Q_{ft})$,

minus purchase cost of imported products: $\sum_{p\in P}\sum_{f\notin F_c} G_{pfct}X_{pfct}$,

minus transportation cost of imported products: $\sum_{p\in P}\sum_{f\notin F_c} T_{pfct}X_{pfct}$,

minus duty fee of imported products: $\sum_{p\in P}\sum_{(r\neq c)\in C}\sum_{f\in F_r} M_{prct}X_{pfct}$.

Rearranging the above terms yields the following pretax profit function for country *c* at time period *t*:

$$\sum_{p\in P}[\sum_{f\in F_c}[R_{pct}X_{pfct}-C_{pft}Z_{pft}-V_{pft}Y_{pft}-H_{pft}I_{pft}-F_{ft}Q_{ft}-L_{ft}(1-Q_{ft})+$$

$$\sum_{(r\neq c)\in C_p}(G_{pfrt}+E_{pft})X_{pfrt}]+\sum_{f\notin F_c}(R_{pct}-G_{pfct}-T_{pfct})X_{pfct}-\sum_{(r\neq c)\in C}\sum_{f\in F_r}M_{prct}X_{pfct}]$$

Next, we multiply the above expression by the after-tax profit retention rate, A_{ct}, and sum it over all periods in set *T*, and countries in set *C* yielding the multi-period after-tax global profit maximization objective function of the mixed integer-programming model:

$$\text{Max}\sum_{t\in T}[\sum_{c\in C}A_{ct}[\sum_{p\in P}[\sum_{f\in F_c}[R_{pct}X_{pfct}-C_{pft}Z_{pft}-V_{pft}Y_{pft}-H_{pft}I_{pft}-F_{ft}Q_{ft}-L_{ft}(1-Q_{ft})+$$

$$\sum_{(r\neq c)\in C_p}(G_{pfrt}+E_{pft})X_{pfrt}]+\sum_{f\notin F_c}(R_{pct}-G_{pfct}-T_{pfct})X_{pfct}-\sum_{(r\neq c)\in C}\sum_{f\in F_r}M_{pcrt}X_{pfct}]]]$$

Optional Constraints

A number of optional constraints may be added to the above formulation to capture particular characteristics of the international production-distribution environment. These constraints may be applied uniformly across all production facilities and time periods or selectively to specific ones.

Value-Based Offset Trade Restriction

The countries considered in the global coordination environment might impose import limitations. For example the host country of market *c* may require that market value (i.e. sales price) of all imported products cannot be greater than a percentage φ_{ct} of the market value of all products manufactured by the multinational company in country *c*. The objective is to enforce a value-based offset trade restriction, requiring that the local value produced in country *c* be at least equal to some minimum fraction of the value of imported products sold there. This restriction may be expressed mathematically as follows:

$$\sum_{f\notin F_c}\sum_{p\in P_c}R_{pct}X_{pfct}\leq\sum_{f\in F_c}\sum_{p\in P_c}\varphi_{ct}R_{pct}Y_{pft}, \qquad c\in C, t\in T. \qquad (9)$$

Aggregate Capacity Constraint

This constraint states that any open facility *f* in period *t* must produce an aggregate output ranging between $\underline{B}_{ft}$ and $\overline{B}_{ft}$ units.

$$\underline{B}_{ft}Q_{ft}\leq\sum_{p\in P_f}Y_{pft}\leq\overline{B}_{ft}Q_{ft}, \qquad f\in F, t\in T; \qquad (10)$$

Shipping Capacity Constraint

This constraint sets the maximum number of units of all products that can be shipped from country *c* to country *r* in period *t* as ϖ_{crt}. This constraint may be expressed as follows:

$$\sum_{p\in P}\sum_{f\in F_c}X_{pfrt}\leq\varpi_{crt}, \qquad c\in C,(r\neq c)\in C, t\in T; \qquad (11)$$

Number of Open facilities

This constraint restricts the total worldwide number of facilities producing product *p* in period *t*, to at least $\underline{F}_{pt}$ but no more than $\overline{F}_{pt}$ facilities.

$$\underline{F}_{pt} \le \sum_{f \in F_p} Z_{pft} \le \overline{F}_{pt}, \qquad p \in P, t \in T; \qquad (12)$$

This constraint restricts the total number of open facilities in period *t* to a minimum of $\underline{M}_t$, and a maximum of $\overline{M}_t$ plants. Often, limiting the number of open facilities in a given period helps the organization streamline its supply chain.

$$\underline{M}_t \le \sum_{f \in F} Q_{ft} \le \overline{M}_t, \qquad t \in T. \qquad (13)$$

This constraint restricts the total number of open facilities in country *c* during period *t* to a number between $\underline{F}_{ct}$, and $\overline{F}_{ct}$. This constraint may be expressed as follows:

$$\underline{F}_{ct} \le \sum_{f \in F_c} Q_{ft} \le \overline{F}_{ct}, \qquad c \in C, t \in T. \qquad (14)$$

Inventory Constraint

This constraint requires that the ending inventory of product *p* at facility *f* must be no less than $\underline{I}_{pft}$ units and no more than $\overline{I}_{pft}$ units. This constraint may be expressed as follows:

$$\underline{I}_{pft} \le I_{pft} \le \overline{I}_{pft}, \qquad p \in P,\ f \in F_p, t \in T. \qquad (15)$$

Similarly, the storage space at facility *f* may be such that the imposition of an upper bound $\overline{\overline{I}}_{ft}$ on the total amount of inventory held at that facility at the end of period *t* might be necessary. This constraint is expressed as follows:

$$\sum_{p \in P_f} I_{pft} \le \overline{\overline{I}}_{ft}, \qquad f \in F, t \in T. \qquad (16)$$

CONCLUSION

This paper introduced a mixed integer programming model to support multi-plant coordination decisions in a global manufacturing and distribution network. The model helps a multinational company, correctly balance production and distribution decision between plants in anticipation of changes in demand; production, inventory, and transportation costs; and corporate taxes, import duties, export quotas, and export incentives; in such a way to maximize the global after-tax profit for the firm over a given multi-period planning horizon. The proposed model is comprehensive and supports decisions on the number of plants to open or close, their location in the world, the types of products and corresponding quantities each facility produces, the markets or countries each facility serves as well as the quantities shipped from each plant to each market. The next stage of this research effort is to conduct a computational experiment to test this model and report the results in a later paper.

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The Effects of Abusive Supervision on Organizational Citizenship Behavior: The Moderating Role of Future Orientation

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ABSTRACT

In this study, we examined the effects of abusive supervision on organizational citizenship behavior. Beyond this, we also investigated the moderating role of future orientation. Data was collected from 650 pairs of managers and subordinates, of which 584 pairs returned with valid data. The probability of total effective retrieval is 89.84%. Results of moderating effects did show that future orientation moderates positively the relationship between abusive supervision and organizational citizenship behavior. Based on our findings, some limitations, implications, and directions for future research are discussed as well.

Keywords: uncertainty management theory, abusive supervision, future orientation

INTRODUCTION

Research on traditional leadership focuses on effective and positive leadership behaviors, through positive encouragement and substantive incentives to stimulate subordinates to produce positive behavior change and performance benefits, such as transforming leadership (Burns, 1978), transactional leadership (Bass, 1985) and ethical leadership (Treviño, 2000, 2003). However, over the past 20 years, scholars have begun to pay attention to the impact of negative leadership behavior on employees and the organization. (e.g., Ashforth, 1987, 1994, 1997; Bies, 1999; Tepper, 2000; Duffy, Ganster, & Pagon, 2002). According to Tepper (2007), negative leadership concepts include petty tyranny (Ashforth, 1987, 1994, 1997)、workplace victimization (Aquino, 2000)、workplace bullying (Hoel & Cooper, 2001)、supervisor aggression (Schat, Desmarais, & Kelloway, 2006)、supervisor undermining (Duffy et al, 2002)、negative mentoring experiences (Eby, McManus,

Simon, & Russell, 2000)、generalized hierarchical abuse (Vredenburgh, & Brender, 1998) and abusive supervision. Notably, abusive supervision (Tepper, 2000; Tepper, Duffy, & Shaw, 2001; Tepper, 2007) is representative concept of negative leadership research.

Abusive supervision is defined as "subordinates' perceptions of the extent to which supervisors engage in the sustained display of hostile verbal and nonverbal behaviors, excluding physical contact" (Tepper, 2000, p. 178). Overview of research on abusive supervision, scholars have found this management style is not only damaging to subordinates' work attitude and behavior at the working level, such as job satisfaction (Tepper, 2000; Breaux, Perrewé, Hall, Frink, & Hochwarter, 2008)、OCB (Zellars, Tepper, & Duffy, 2002; Aryee, Chen, Sun, & Debrah, 2007; Harris, Harvey, & Kacmar, 2011; Rafferty, & Restubog, 2011; Xu, Huang, Lam, & Miao, 2011)、emotional exhaustion (Yagil, 2006; Harvey, Stoner, Hochwarter, & Kacmar, 2007; Tepper, 2007; Breaux et al, 2008; Wu, & Hu, 2009; Khan, Qureshi, & Ahmad, 2010), but also have a negative impact on the health of subordinates and family at the non-working level, such as work-to-family conflict (Tepper, 2000; Carlson, Ferguson, Perrew'e, & Whitten, 2011)、family well-being (Tepper, 2007)、family undermining (Hoobler, & Brass, 2006). From the above that, abusive supervision generally lead to negative results for employees.

In addition to concerns about abusive supervision's negative results, another research orientation is to explore whether there is some moderating factor of the relationships mentioned above. Researchers have discussed the moderating factors at four levels, such as norms toward organization deviance at organizational level (Tepper, Henle, Lambert, Giacalone, & Duffy, 2008) ; personality at subordinate level (Tepper, Duffy, & Shaw, 2001; Bamberger, & Bacharach, 2006); social support at team level (Duffy et al, 2002; Hobman, Restubog, Bordia, & Tang, 2009) ; and authoritarian management style at supervisor level (Thau, Bennett, Mitchell, & Marrs, 2009). The above four moderating factors, this study further discussions on subordinates' personality factors, the current study is limited in conscientiousness, agreeableness and neuroticism under five personality traits proposed moderator factor by Tepper et al. (2000) and Bamberger et al. (2006), this study presents future orientation to be a moderator variables, scrutinizing the moderating role of future time perspective in abusive supervision research. Future orientation is based on people's perception of the concept for the past, present and future time. Under the temporal focus, people's thoughts about the past, present and future will directly affect the present attitude, decision-making and behavior, relevant research evidence including goal-setting、motivation and performance (Bandura, 2001; Cottle, 1976; Fried & Slowik, 2004; Nuttin, 1985), self-regulation and learning (Carver & Scheier, 1982;

Sanna, Stocker, & Clarke, 2003), sense-making (Weick, 1979), affect (Wilson & Ross, 2003), and strategic choice (Bird, 1988; Das, 1987; Hambrick & Mason, 1984).

Thus, abusive supervision is the focus of a negative leadership study, the first purpose of this study use justice perspective to analyze the main effect. Moreover, we use future orientation to be a moderating variable, time perspective is one of our research purposes. The expected contribution of this study is the application of justice and uncertainty management theory perspective on the understanding of the main effect of abusive management and future orientation as a moderating effect. Finally, this study further integrates time focus literature to the expansion of existing theories. Hope this study provides more in-depth understanding of the role of abusive supervision.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Abusive supervision

Tepper (2000) defined abusive supervision as ‘‘subordinates’ perceptions of the extent to which their supervisors engage in the sustained display of hostile verbal and nonverbal behaviors, excluding physical contact’’. Abusive supervision has several important features, first, abusive supervision is a subordinate’s subjective assessment for supervisor behavior, when subjectively assessed, and subordinates’ will be affected by subordinate personal traits, work environment and colleagues. Secondly, abusive supervision is a persistent non-physical contact hostile behavior, supervisor use ongoing mistreatment and abusive behavior. Finally, abusive supervision is supervisor for some purposes stubborn behavior, and supervisor does not think that is an abuse and victimization. In other words, abusive supervision is focused on subordinates as the victims (Fox & Spector, 2005), when the supervisor demonstrated abusive supervision, every subordinates feel different, depends on the degree of subordinates’ perception.

Abusive supervision and organizational citizenship behavior

Organ (1988) coined the term “Organizational Citizenship Behavior” (OCBs). OCB has been defined as “individual behavior that is discretionary, not directly or explicitly recognized by the formal reward system, and in the aggregate promotes the efficient and effective functioning of the organization” (Smith, Organ, & Near, 1983; Organ, 1988). With the similar study of the OCB concept including extra-role behavior (Van Dyne, Cumming, & Park, 1995)、prosocial organizational behaviors (Brief & Motowidlo, 1986)、organizational spontaneity (George & Brief, 1992), and contextual performance (Borman & Motowidlo, 1993). Which Borman and Motowidlo (1993) proposed the concept of contextual performance refers to an

individual engaging in non-task activities required, enables organizations to operate more efficiently, this behavior contributes to the formation of social context in the organization.

Interaction between supervisors and subordinates , supervisor continues to show improper behavior, in the long run will lead to psychological problems, such as job nervous and emotional debilitating(Harvey, Stoner, Hochwarter, & Kacmar, 2007 ; Breaux et al, 2008 ; Khan, Qureshi, & Ahmad, 2010), lead to subordinates' feel frustration and helplessness. Face with abusive supervision, let subordinates perceived unfairness (Tepper, 2000, 2007), in fairness perspective, individual motivation is based on a comparison made between colleagues. When Faced with unfair individual messages, will produce a negative reaction (Adams, 1963), including change their input, change their income, distorted perception of their own, distorted perception of others, changing the reference object, changes in the present work. In other words, individual will attempt to determine, through a fair exchange process to reduce social unfairness, individuals face an uncertain environment and treated unfairly, will be timely controlled on the environment, had negative attitudes and behaviors on the organization, let individuals have a negative impact on organizational citizenship behavior. Therefore, we propose the following assumptions:

Hypothesis 1: Abusive supervision will be negatively related to subordinates' OCB.

Uncertainty Management Theory

Lind & Van den Bos (2002) proposed uncertainty management theory (UMT), which aims to explore how individuals respond to and deal with the environment of various uncertainties. Uncertainty will make people have a bad experience, such as fear (Van den Bos et al., 2008), and affect on individual's cognition and behavior (Lind & van den Bos, 2002). UMT noted that fairness is very important for an individual message processing environment uncertainty, fair stimulation slows the individual anxiety generated, thereby reducing the uncertainty (Lind & van den Bos, 2002). Lind & Van den Bos (2002) study also noted that that when an individual in a highly uncertain situation, the message will be special emphasis on fairness, for unfair message generates relatively strong negative reaction.

The moderating role of future orientation

Based on the assumptions discussed above, the effect of abusive supervision influences organizational citizenship behavior. But this paper points out, under certain personality traits and time perspective, impact of abusive supervision on organizational citizenship behavior will deteriorate. This study use future orientation to be moderating variable, studies indicate that future orientation is a positive

personality trait (Trommsdorff, 1983), people will be selected based on experience future goals (Fried et al., 2004). In other words, future orientation is an individual trait with expectations for the future, the ability to interpret and construct (Gjesme, 1983), individual imagination for the future will affect the results of his behavior (Husman & Lens, 1999), and future orientation is regarded as the ability of individuals to conceptualize the future. Future oriented time perspective can be dated back to 1930, proposed by the Kurt Lewin, it will be divided into five dimensions: extension, coherence, density, directionality and affectivity. The more systematic research is to 1970s, Sande (1972) divided it into six dimensions, including length、level of interest、optimism、pessimism、influence and expectations, in which the length is similar to the concept of future. Moreover, future orientation is a social cognitive perspective formed by the social and cultural values, is a belief in the future of the expected target (Bembenutty & Karabenick, 2003; Husman & Lens, 1999; Miller & Brickman, 2004). Above all, future orientation have the concept of time perspective, is a set of cognitive psychological process, individual will pay attention to possible future developments and arise longing perception, and to the process of decision making (Gardner, Dunham, Cummings, & Pierce, 1987; Pierce, Gardner, Cummings, & Dunham, 1989).

According to UMT, when individuals experience high degree of uncertainty, they will pay special attention to the message of fairness, and for the unfair messages produce more negative reactions (Lind & Van den Bos, 2002). The best time perspective of the future-oriented research description is attention, studies indicate that individual height control their attention assigned to the target (Gardner et al.,1987), according to different periods, individuals will transfer its attention (Shipp, Edwards, & Lambert, 2009). Accordingly point of view, when individuals with a high degree of future-oriented, face abusive supervision will produce more perceived unfairness under lengthen the future time, will be perceived more uncertainty, the focus will be allocated to the future more goals, thus ignoring the existing plans and actions (Shipp et al., 2009). In other words, when individuals under highly future-oriented, will produce high uncertainty, and thus the present organizational citizenship behavior produce more negative behavioral responses. Therefore, we propose the following assumptions:

Hypothesis 2: Future oriented will moderate the negative relationship between abusive supervision and organizational citizenship behavior such that the relationship will be stronger when future-oriented is high rather than low.

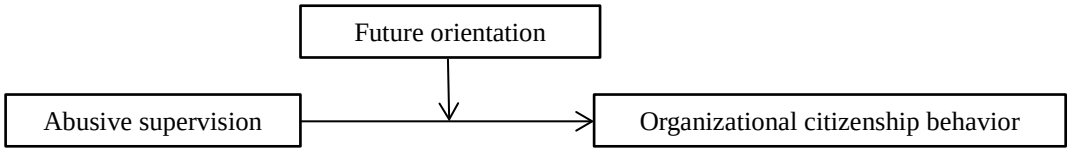

Figure 1 – Theoretical model

METHOD

Sample and Procedure

In this study, in order to avoid common method variance (CMV) (Peng, Gao and Lin, 2006), using paired questionnaire. We collected data for this study from 650 subordinates of 30 supervisors in 30 groups in Taiwan. Part of the questionnaire by the research team directly surveying and recycling, part of the questionnaire commissioned by the colleagues conducted surveying, in order to ensure confidentiality, the questionnaire will be recovered directly into the enclosed envelope. We received responses from 30 supervisors (100% response rate) and 584 subordinates (89.84% response rate). Total data were 650 pairs and 584 pairs of them were valid retrievals. The probability of total effective retrieval is 89.84%. The group sizes of the branches ranged from 5–27 subordinates. Supervisors on sample characteristics, university degree or above accounted for 48.27%, age range between 21 to 50 years old, 21 to 30 years old accounted for 82.53%, 5-10 years of service accounted for 51.72%. Subordinates on the sample characteristics, 21-30 years old accounted for 76.20%, less than 2 years of service accounted for 75.50%.

Measures

This section provides each variable were measured scale sources, reliability and confirmatory factor analysis (CFA). Measures used a five-point Likert-type response scale, with “1” denoting “strongly disagree” and “5” representing “strongly agree”.

OCB. We used OCB scale by Hui, Law, & Chen (1999). Scale includes six items. We used the altruism subscale to measure OCBI and the conscientiousness subscales to measure OCBO. The example items for OCBI are “This employee helps the newcomers even without my asking”. The example items for OCBO are “This employee takes his/her job seriously and rarely makes mistakes”. The coefficient alphas were 0.93 and 0.88 for OCBI and OCBO, respectively. We estimated two measurement models to verify the distinctiveness of OCBI and OCBO. The results of the confirmatory factor analysis (CFA) suggested that the two-factor model provided a good fit ($\chi 2(8) = 43.9$, $p < .001$, root mean square error of approximation [RMSEA] = 0.02, non-normed fit index [NNFI] = 0.98, comparative fit index [CFI] = 0.99, standardized root mean square residual [SRMR] = 0.01).

Abusive supervision. We used abusive supervision scale by Tepper (2000). Scale includes ten items. The example items are “Makes negative comments about me to others”. The coefficient alphas were 0.95.

Future oriented. We used Future oriented scale by Gjesme (1979). Scale includes six items. The example items are “I have been thinking a lot about what I am going to do in the future”. The coefficient alphas were 0.75.

Control variables. We included two indicators of demographic diversity: subordinates age and subordinates seniority. Subordinates age were divided into five categories: below 20,21-30,31-40,41-50, 50 or more. Subordinates seniority were divided into seven categories: 1 or less, 1-2, 3-5,6-10,11-15,16-20, 21 or more.

Convergent and discriminant validity

This study compares the structure factor model and the chi-square difference test (Table 1). The results of the nested model CFA suggested that the three-factor model provided a good fit ($\chi2(167) = 726.97$, $p < .001$, root mean square error of approximation [RMSEA] = 0.08, non-normed fit index [NNFI] = 0.95, comparative fit index [CFI] = 0.96, standardized root mean square residual [SRMR] = 0.05). The three-factor model fit the data better than the one-factor model ($\chi2(3)=12201.38$, $p < .001$) and the two-factor model ($\chi2(2)=917.69$, $p < .001$).

Table 1 – Confirmatory Factor Analyses of the Nested Model

Structure	$\chi2$	$\triangle\chi2$	df	$\triangle$df	RMSEA	NNFI	CFI	SRMR
Model 1	12928.35***	12201.38***	170	3	0.36	0.54	0.59	0.320
Model 2	1644.66***	917.69***	169	2	0.12	0.91	0.92	0.094
Model 3	726.97***		167		0.076	0.95	0.96	0.045

Note. N = 584. ; RMSEA = root-mean-square error of approximation; NNFI = non-normed fit index; CFI = comparative fit index; SRMR = standardized root mean square residual.
* p <0.05 ** p <0.01 *** p <0.001
Model 1: incorporated all three constructs into one factor.
Model 2: combined abusive supervision and future oriented distress into F1, OCB distress into F2 Model 3: represented three independent factors.

RESULTS

Correlation Analysis

Table 2 shows descriptive statistics and inter-correlations for the study variables. The reliability coefficients were all greater than 0.75. The future oriented correlated negatively with abusive supervision ($r = -.19$， $p < 0.001$); The subordinates age correlated negatively with abusive supervision ($r = -.11$， $p < 0.01$); The subordinates seniority correlated positively with subordinates age ($r = .76$， $p < 0.01$).

Table 2 – Means, Standard Deviations, and Intercorrelations

variables	M	SD	1	2	3	4	5
1. Abusive supervision	2.41	0.88	(.95)				
2. OCB	3.80	0.79	-.04	(.93)			
3. Future oriented	3.91	0.63	**-.19*** **	.02	(.75)		
4. Age with subordinate	23.70	4.56	**-.11** **	-.02	.06	—	
5. Tenure with subordinate	2.59	3.41	-.76	-.08	.03	**.76*** **	—

Note. N = 584 . Coefficient alphas are listed in parentheses along the diagonal. * p <0.05 ** p <0.01 *** p <0.001

Hypothesis testing

Table 2 shows the results of hierarchical regression. We tested the hypotheses by regressing OCB on the control variables (Step 1), the main effects of abusive supervision (Step 2), the moderator effects of future oriented (Step 3),and an interaction term consisting of the abusive supervision x future oriented cross product (Step 4). At step1, subordinates seniority on organizational citizenship behavior has significant(β= -.140、-.139、-.139、-.146, $p < .005$). At step 2, the main effects of abusive supervision on organizational citizenship behavior does not have significant, H1 is not supported. At step 4, the abusive supervision x future oriented cross product on organizational citizenship behavior has significant (β= -.087, $p < .005$), H2 is supported. In addition, to further understand the moderator direction of abusive supervision on organizational citizenship behavior, Figure 2 show that the relationship will be stronger when future-oriented is high and the relationship will be weaker when future-oriented is low.

Table 3 – Hierarchical Regression Analysis

Variables	Subordinates' OCB			
	Model 1	Model 2	Model 3	Model 4
Control variable				
Age with subordinate	.050	.046	.046	.051
Tenure with subordinate	**-.140***	**-.139***	**-.139***	**-.146***
Independent variable				
Abusive supervision		-.043	-.044	-.024
Moderator variable				
Future oriented			-.004	-.000
Abusive supervision × Future oriented				**-.087***
R^2	.011	.013	.013	.020
F	**4.038***	**3.016***	2.260	**2.591***
ΔR^2	.011	.002	.000	.007
ΔF	**4.038***	.973	.010	**3.863***

Note. N = 584 . * p <0.05 ** p <0.01 *** p <0.001

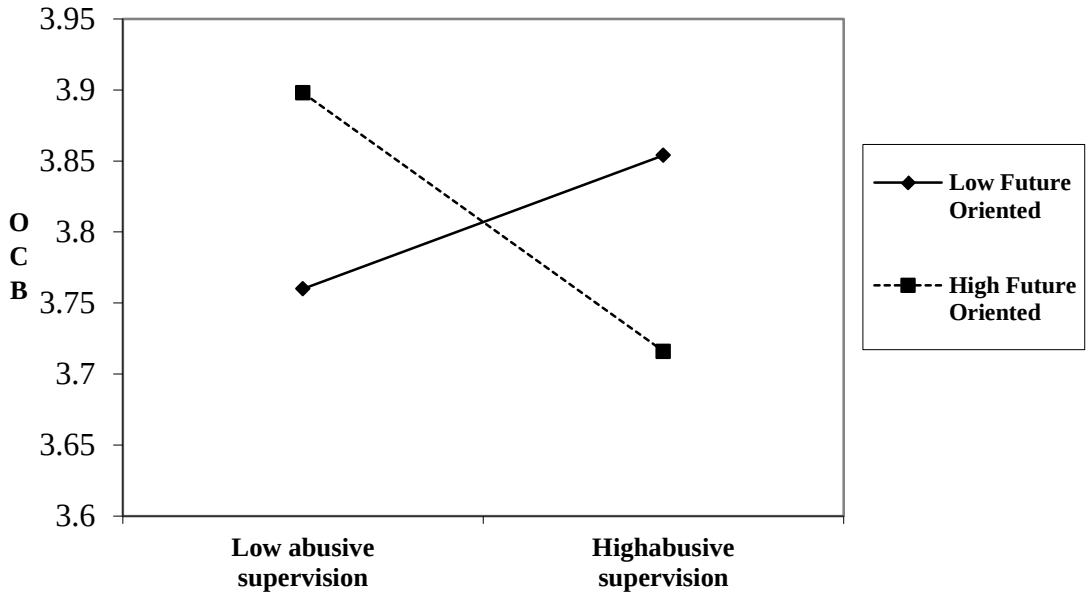

Figure 2 – Two-way interaction predicting OCB

DISCUSSION AND CONCLUSIONS

Discussion and conclusions

Regarding control variables, subordinates' seniority showed positive effect on organizational citizenship behavior. It is possible that more experienced employees have better resistance to stress, relatively able to demonstrate positive effects on organizational citizenship behavior. In terms of main effect, the effect of abusive supervision on organizational citizenship behavior is not supported. Etzoni (1961) pointed out that leaders can through three involvement allows subordinates to show submissive behavior, includes (1) alienative involvement: meaning subordinates to obey the leader, because of fear of punishment or mistreatment; (2) calculative involvement: meaning subordinates to obey the leader, because avoiding disadvantages and (3) moral involvement: meaning subordinates to obey the leader, because internalization or identity. In other words, obedience is the result of the influence of the leader, in this study, supervisor through alienative involvement let subordinates showing submissive behavior. The first reason is alienative involvement. Moreover, Ainsworth (1979) proposed the concept of secure attachment behavior, this study showed that more junior subordinate, subordinate to the leaders and norms are afraid that because of the lack of familiarity. Another reason is secure attachment.

Theoretical and practical contribution

First, the past 20 years, scholars have begun to pay attention the impact of negative leadership behavior on employees and the organization, the effects of abusive

supervision is representative concept of research, the moderator factor is another important research orientation. This study presents future oriented among the existing literature, aimed at understanding the moderating role of time perspective on the consequences of abusive supervision. Secondly, this study uses justice perspective to explain coping and decision behavior when the individual faced with abusive supervision. Finally, through the time perspective, citing future oriented, to rethink the impact of abusive supervision, present the evidence of empirical data, the results of this study are expected to echo.

In practice, supervisors and everyone must conduct high-quality interactive (Nothouse, 1997), this study argues that, because the army as a legitimate armed groups, supervisors' risk in this environment is relatively high, in this organizational culture, fairness opinion is very important, specific practices such as must strengthen communication mechanisms from bottom to top, and strengthen the authority from top to bottom.

Limitations and Future Research

In this study, the research seeks to improve the design and analysis, but there is still the following points should be noted, first, about the external validity issues, in this study, samples from the army, failed to contain Navy and Air Force unit, collected mainly from the southern part of the country; On the other hand, in recent years, corporate leadership style caused a lot of frequent accidents, abusive supervision and other negative leadership become research topic of attention, suggested further increase the sample in order to improve external validity. Second, about the questionnaires distributed process issues, this study used paired questionnaire included supervisor and subordinate questionnaire included. It can avoid common method variance problems. However, part of the questionnaire commissioned colleague to release and recovery, there are doubts about the questionnaire cannot really grasp. Suggested that future studies, we must strengthen and control the process of issuing questionnaires, the researchers themselves should personally release and recycling. Third, about the research design issues, the study was cross sectional of the study design and concluded that a causal inference cannot be true, suggested future research can use longitudinal designed to verify the true causal relationship. Fourth, in terms of the variable, this study use the dependence variable of individual OCB, however, on the OCB category, there are other facets, such as a colleague OCB, organizational OCB, needs to be subsequent in-depth research and analysis. Finally, about the level issues, this study discussed the impact of individual level, however, there are still cross-level factors must be noted, such as team cohesion, team climate and other factors, pending subsequent researchers further reflection. Must strengthen

communication mechanisms from bottom to top, and strengthen the authority from top to bottom.

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INVESTIGATING THE IMPACT OF DESIGN FACTOR ON GREEN SERVICE DELIVERY IN CUSTOMER'S PERSPECTIVE: AN EXPERIMENTAL DESIGN IN TAIWAN'S CONVENIENT STORE

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ABSTRACT

In recent year, environmental issues have evoked people's awareness to environmental protection, starting the trend of green practical management in manufacturing industries. However, few articles examine the green practice issues in service industries. Based on past research of service delivery system, this study aims to investigate green service delivery, including service design factors as antecedents and customer behavior as a consequence factor. Service design factors have four service strategic choices, including structure practice of physical ambient decoration, infrastructure practice of service employee green knowledge training, integration practice of cooperation with upstream suppliers in environmental issues, and experience practice of community activity. This study designs a 2x2x2x2 experiment to analyze the relationships between green strategic choices and green service delivery. According to 400 survey replies, the research finds that all design factors, except structure practice, have positive impacts on customer perceived green delivery. In addition, customer perceived green delivery has a positive impact on customer behavior. This study not only advances the research on green service delivery but also provides the recommendation of green service strategic choices for retailers to participate in green service delivery in the future.

Keywords: green service delivery, service design, convenient stores

INTRODUCTION

Since 1987, UNCSD (United Nations Commission on Sustainable Development) introduced the sustainable development concept and formulated UNFCCC (United Nations Framework Convention on Climate Change) of Kyoto Protocol. The purpose of this convention is to limited carbon emissions in emerging countries. To response to the Kyoto Protocol, Taiwan government held a National Energy Conference in May of 1998, established regulations to reduce the environmental pollution and improve energy inefficient not only in enterprises' purchasing, producing, delivering process but also in our daily life. While companies regard environmental issues as the biggest issue of the 1990s (Kirkpatrick, 1990), people pay more attention on environment protection issues and change their consumption behavior to choose companies with the reputation of being attentive to protecting the

environment (Heslin and Ochoa, 2008). Because of the change of consumption behavior, companies also position themselves as environmentally responsible organizations to fit in the public green issues (Jay, 1990). However, although service is perceived as the current generation of economics (Fitzsimmons and Fitzsimmons, 2008), few studies analyzed green service (e.g., Tootelian and Gallagher, 2009, Zhou, 2013).

Roth and Menor (2003) propose a service delivery system with three primary strategic design choices, including structure, infrastructure, and integration. Later, Voss and his colleagues (2008) add one more strategy choice, naming "customerware," to the previous system to describe the interaction between customers and service delivery system. Based on these studies, this research focuses on investigating the relationships between strategy choice and customer perceived service delivery in the content of green service. Reflecting the popular environmental issues, this study provides several contributions. First, based on the service delivery system proposed by Voss and his colleagues (2008), this study establishes a green service delivery model to illustrate the relationship between service design choices and customer perceived green service delivery. Second, this study analyzes the relationship between perceived green service delivery and customer behavior to evaluate whether green service can increase customer behaviors, in loyalty, repurchase, and recommendation. Third, the conceptual model, as illustrated in Figure 1, can provide a useful roadmap for service companies to adopt green service delivery.

Figure 1 – Conceptual Model of Green Service Delivery

This paper is organized as the following. First, the literatures related to strategic design choices and green service will be reviewed, and the green service delivery model will be established. Next, the methodology of this paper will be illustrated. Third, the results will be discussed, while the conclusions and contributions of this paper will be provided at the end.

LITERATURE REVIEW

Three topics of literature review are discussed in this section. First, service delivery system is illustrated. Second, the green initiatives related to strategic choices are illustrated. Third, the green delivery model is established and the hypotheses are proposed.

Service Delivery System

The service delivery system is a bridge between service strategic design choices and tactics associated with execution, assessment, and renewal processes. The system helps companies to enhance customer perceived service values in service encounters (Chase and Haynes, 2000, Heskett, 1986). The primary framework this study based on is the service delivery system proposed by Roth and Menor (2003). This framework illustrates the relationship between service strategic choices and customer perceived service value. Three primary choices are included in this framework, including structure, infrastructure, and integration. Structure choice includes physical aspects of service, while infrastructure choice considers people and policies. The third choice, integration, discusses service supply chain.

Later, Voss and his colleagues (2008) expand the strategic choices proposed by Menor and Roth (2003) to four categories. Customerware, named by authors, is the fourth strategic choice related to the touch point of customers, including the concepts of experience. These choices will influence the service delivery and further influence the customer perceived service value. Considering Stimulus-Organism-Response (SOR) framework proposed by Donovan and Rossiter (1982), strategic choices are regarded as the stimulus, while customer perceived service value relates to organism. Then, the customer behaviors are considered the responses. Thus, the green service delivery model is established as illustrated in Figure 1.

Green Service Strategic Choices

Structure strategic choice is related to physical aspect of service (Roth and Menor, 2003), similar to the concept of a green building. Over the past decades, some organizations began building and retrofitting existing structure, including interior and exterior building materials, such as applied furniture, fixture, lighting and signage. Companies try to use sustainable, energy-saving, or environmental facility as well as to make effort for implementing recycle and energy conservation practices. For example, Wal-Mart changes lighting and cooling systems to create stores more environmental friendly (Walmart Corporation). Hence, store design has long time been recognized as a major element of a retailer's operation (Babin and Darden, 1995). Installing LED equipment to lower the electricity needs is an example of reducing energy consumption. Kreidler and Joseph-Mathews (2009) demonstrated green ambient and green design layout cues are positively related to green consumer approach behavior.

Infrastructure strategic choice is concerning the programs, policies, and behavioral aspects of service strategy (Roth and Menor, 2003). The infrastructure choice is an issue of dealing with people, leadership, service process, and performance management. In human resource management, it regard to policies for hiring, staff training and rewards to reinforce the service concept. Bitran and Lojo (1993) argued that each infrastructure components are as the key role to design of the quality of the customer interface and build the flexibility into service system. In green service contents, this factor illustrates whether the companies provide their employees green knowledge or whether the companies have policies focusing on sustainable operations.

The primary focus of integration strategic choice is related to service supply chains (Roth and Menor, 2003). Green supply chain is a popular topic recently and includes green procurement and green production (Hervani et al., 2005). In green procurement, the merchandise requires minimizing material inputs and maximizing the use of renewable resources to reduce energy consumption and the impacts to environments (Charter, 1992). Refer to green production, Lai and his colleagues (2010) suggest that green retailers should purchase goods with sustainable manufacturing or with eco-labels. In addition, green retailers should cooperate with supplier not only in designing products with environmental considerations but also in developing reused and recycled packages.

The fourth and most recent strategic choice is related to customer experiences. In this concept, companies create and manage specific customer touch points and interact with them directly and virtually. For instance, through appropriate official website customers can not only directly contact with employee but also chat with other customers for exchanging information. Close and her colleagues (Close et al., 2006) suggest that a community involvement event hold by companies can positively influence attendee's attitude and increase their knowledge toward the sponsor's products.

Green Service Delivery Model

This section establishes the green service delivery model proposed in this paper. The hypotheses are illustrated in Figure 2 and discussed below. First, the relationships between strategic choices and customer perceived green service delivery are deliberated. Later, the relationship between customer perceived green service delivery and customer behaviors is established.

Structure choice is concerning the physical aspects of service strategy (Roth and Menor, 2003). Generally speaking, structure decisions cover the facilities, technology, equipment, and capacity to delivering the intended service concept. These choices concern not only about the physical design layout, size, number, location, and any kind components related to service product process interfaces within in the service atmosphere but also include the aesthetics and appearance of the brick and mortar. Similar to the requirements of a green building, the green initiatives in structure choices will positively influence customer perceived green service delivery; thus, Hypothesis 1 is listed below.

H1: Structure choice has a positive impact on customer perceived green service delivery.

This study regards infrastructure choice primarily as the human resource and training management. These two operations both relate to service strategy because service employees serve as bridges between company and customers. They convey firms' practices and vision to customers through their education and training. De Ruyter and Wetzels (2000) argue the relationship between customers and employees is an important factor to influence customer perceived values and customer satisfaction. Further, employees are critical important in extended, affective and intimate engaging with customers (Price et al., 1995). Thus, through well-trained employees, customers should perceive higher green service delivery, and Hypothesis 2 is proposed.

H2: Infrastructure choice has a positive impact on customer perceived green service delivery.

Integration strategic choice comprises the issues of external and internal integration (Roth and Menor, 2003). In this study, service supply chain is the focal content. Green supply chain has been an important topic in resent research. Different from manufacturers, retailers have only the processes of logistics, selling, and inventory management rather than manufacturing. As the bridge between suppliers and consumers, retailers play an important role to supervise upstream supplier to provide the merchandises that are harmless or environmental friendly for consumers, and have the authority to select the supplier partners who are qualified for the green standard certification. Furthermore, retailer could also become an eco-awareness educator to share information and teach their clients. To satisfy customer needs**,** organizations aim to show their environmental concerns and to increase the market penetration for green product offerings because consumer's environmental consciousness influences their purchasing decisions (Schlegelmilch et al., 1996). In addition, environmental-conscious customers prefer products with eco-design (Chen, 2001). Thus, Hypothesis 3 is listed below.

H3: Integration choice has a positive impact on customer perceived green service delivery.

Experience strategic choice, touch points, deals with the interactions between companies and customers (Voss et al., 2008). To communicate with customers, companies can establish both physical and virtual platforms. Through these platforms, customers have the

opportunities to understand company vision, values, and practices. Baron and his colleagues (2001) propose that creating experiences during service processes makes the practices more understandable and increases customer involvement. Companies holding community activities or serve the local community could develop good relationships with their local customer (Harris et al., 2001). Hypothesis 4 is established.
H4: Experience choice has a positive impact on customer perceived green service delivery.

As a growing percentage of consumers have used their buying power to express their preferences since mid-1990's, green consumption has become a popular phenomenon (Robinot and Giannelloni, 2009). For instance, customers may prefer to purchase products or services from companies with the reputation of attentive the environment. Similarly, Lai and his colleagues (2010) find that customers who have environmental consciousness are more willing to purchase environmental-friendly products. Therefore, Hypothesis 5 is proposed and the green delivery model is illustrated in Figure 2.
H5: Customer perceived green service delivery has a positive impact on customer behaviors.

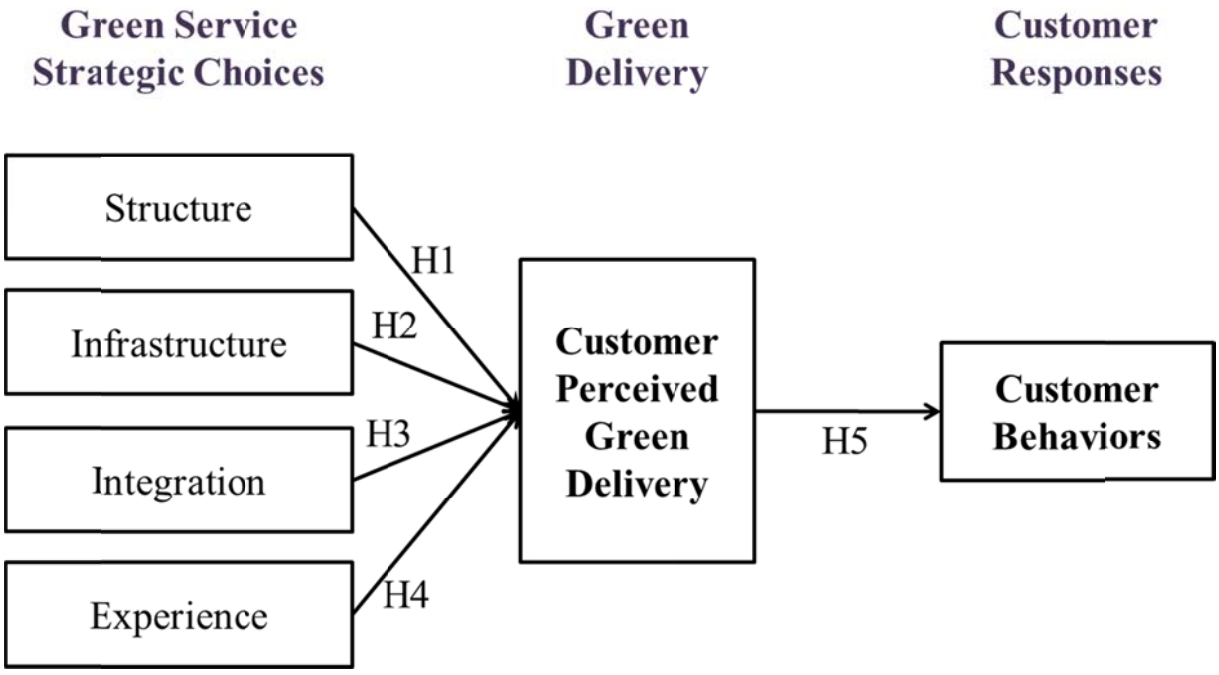

Figure 2 – Green Service Delivery Model

METHODOLOGY

A pilot survey in this study finds that customers seldom notice the green strategic choices of a store; thus, using traditional survey is difficult to find useful information. To deal with this situation, this study adopts the design steps of the scenario-based role-playing experiment proposed by Rungtusanatham and his colleagues (2011). Vignettes are designed to describe the four primary strategic choices, including structure, infrastructure, integration, and experience. The combinations of these four choices with green or non-green practices create a 2x2x2x2 experimental design, suggesting 16 different vignettes. The English translation of the vignettes is listed in Table 1.

Table 1 – Vignette Description

Choices	Green?	Description
Structure	No	To purchase some products, you walk into a convenient store. You feel this store is bright.
	Yes	To purchase some products, you walk into a convenient store. You find an eco-saving label posted on the door, indicating that the energy-saving bulbs used in this store save 11% of the store electricity each year.
Infrastructure	No	While picking the products, you have some questions about the label of the detergent. Thus, you ask a store employee the information of this environmental-friendly product. However, the employee does not know the production information and cannot answer your question.
	Yes	While picking the products, you have some questions about the label of the detergent. Thus, you ask a store employee the information of this environmental-friendly product. The employee understands the product information and provides you more environmental-friendly knowledge.
Integration	No	During the shopping process, you find the products on the shelf are arranged clear and neat. The packages of these products are beautiful.
	Yes	During the shopping process, you find that the store has an environmental-friendly product area. The label in this area says that the products in this area use recyclable, low-pollution, and energy-saving practices.
Experience	No	After check-out, the store employee reminds you the loyalty program of the store, and encourages you to shop more to earn more reward points.
	Yes	After check-out, the store employee reminds you that the store will hold a community activity this weekend. The activity provides a platform for customers to exchange used products and tries to enhance the environmental consciousness of the local community.

After the design of the experiment, a vignette validation stage is necessary. This stage intends to ensure that the vignette is clear, realistic, complete, and contains all necessary information for human subjects to assume their role and to consequently provide their reactions and responses (Rungtusanatham et al., 2011). To determine the realism of the constructed scenarios, we asked 8 subjects to do a test related to whether the scenario sounds realistic and whether the scenario could happen in the real life (Liao, 2007). Afterwards, we confirm that these vignettes sound realistic and could happen in real life. The official questionnaire is designed based on these scenarios.

The official questionnaire includes 4 parts. First, the respondents need to read the vignette of green service. Next, 4 questions of the manipulation check are asked to ensure that the respondents have understood the situation. Thirds, questions related to customer perceived green delivery and customer behaviors are listed. Demographic questions conclude this questionnaire.

This study uses both paper and online survey to collect data from regular customers. After 3 weeks, 492 responses are collected. After invalid samples are deleted, the total sample of valid responses equals to 400. SPSS 18 is the primary statistic software used in this study. Demographic descriptions, independent sample t-test, ANOVA, and simple regression are analyses used in this paper.

ANALYSIS AND DISCUSSION

Demographic Information

400 valid responses are included in the following analyses. The demographic information of these 400 responses is listed in Table 2. From Table 2, we can find that females are the primary respondents. While more than 50% of the respondents have ages between 21 and 25, more than 60% of respondents have college education level. More than 70% of the respondents are students because students are convenient samples and they are legitimate consumers.

Table 2 – Demographic Information

Demographic Variables		**Number**	**Percentage**
Gender	Female	239	59.75%
Age	Below 25	344	86.00%
	Above 25	56	14.00%
Education	College or below	254	63.50%
	Graduate	146	36.50%
Marriage	Single	385	96.25%
Occupation	Student	296	74.00%

Sample t-Test for Main Effects

The results of the sample t-test for main effects on customer perceived green delivery are illustrated in Table 3. From Table 3, we can find that the t-test is not significant for structure choice with p-value = 0.167, indicating that Hypothesis 1 is not supported. Table 3 also shows that the other 3 strategic choices, including infrastructure, integration, and experience, have significant impacts on green service delivery. The green practices in these 3 strategic choices have higher values of customer perceived green service delivery. Thus, Hypotheses 2, 3, and 4 are supported.

Table 3 – Sample t-Test for Main Effects

Choices	**Green?**	**N**	**Mean**	**Std. Deviation**	**T**	**Sig.**
Structure	No	203	3.5337	0.72485	-1.386	0.167
	Yes	197	3.6277	0.62783		
Infrastructure	No	204	3.3799	0.68699	-6.292	0.000***
	Yes	196	3.7883	0.60678		
Integration	No	195	3.4923	0.73555	-2.534	0.012*
	Yes	205	3.6634	0.61192		
Experience	No	186	3.4785	0.73918	-2.772	0.006**
	Yes	214	3.6682	0.61136		

Note: ***p<0.001, **p<0.01, *p<0.05

Factorial Design

As mentioned in the methodology section, this study uses a 2x2x2x2 factorial design. Investigating the interactions among four strategic choices is important. Table 4 illustrates the interaction results with more than 3 choices, and shows that 4-way interaction is not significant while only 1 3-way interaction (Structure*Infrastructure*Experience) is significant.

Table 4 – Interaction Effects of Strategic Choices

Source	Mean Square	F	Sig.
Structure *Infrastructure*Integration	0.002	0.004	0.947
Structure*Integration*Experience	0.388	0.998	0.318
Structure*Infrastructure*Experience	1.647	4.239	0.040*
Infrastructure* Integration*Experience	0.330	0.848	0.358
Structure*Infrastructure*Integration*Experience	1.043	2.686	0.102

Note: ***p<0.001, **p<0.01, *p<0.05

Among the 3 choices of the 3-way interaction, structure choice is the only one without significant result in sample t-test. Thus, we separate our data group into non-green and green groups according to structure choice. Table 5 shows the ANOVA results when structure choice is non-green. Among these factors, only infrastructure choice has a significant result, indicating that when structure choice is not green, only infrastructure choice has a significant impact on customer perceived green service delivery.

Table 5 – ANOVA Results with Non-Green Structure Choice

Source	Mean Square	F	Sig.
Infrastructure	4.073	10.888	0.001**
Integration	0.166	0.444	0.506
Experience	0.095	0.254	0.615
Infrastructure*Integration	1.227	3.281	0.072
Infrastructure*Experience	0.408	1.092	0.297
Integration*Experience	0.002	0.005	0.942
Infrastructure*Integration*Experience	0.100	0.267	0.606

Note: ***p<0.001, **p<0.01, *p<0.05

Table 6 shows the ANOVA results when structure choice is green. From the table, we can find that all interactions are not significant, while all main effects are significant. These results indicate that when structure choice is green, all other 3 strategic choices have positive impacts on customer perceived green delivery.

Table 6 – ANOVA Results with Green Structure Choice

Source	Mean Square	F	Sig.
Infrastructure	14.899	37.025	0.000***
Integration	4.357	10.828	0.001**
Experience	6.770	16.864	0.000***
Infrastructure*Integration	1.107	2.751	0.099
Infrastructure*Experience	1.384	3.440	0.065
Integration*Experience	0.701	1.742	0.188
Infrastructure*Integration*Experience	1.277	3.173	0.076

Note: ***p<0.001, **p<0.01, *p<0.05

Simple Regression

Table 7 shows the regression result with perceived green delivery as independent variable and customer behavior as dependent variable. From the table, customer perceived green delivery has a significant and positive impact on customer behavior with p-value smaller than 0.001. Therefore, Hypothesis 5 is supported. Figure 3 shows the statistical results of the green service delivery model. From the results, we found that for each unit increase in perceived green delivery, the customer behaviors will increase by 0.518 units.

Table 7 – Regression Analysis

Variable	β	t	Sig.
Constant	1.569	12.010	0.000***
Perceived Green Delivery	0.518	14.460	0.000***

Note: ***p<0.001, **p<0.01, *p<0.05

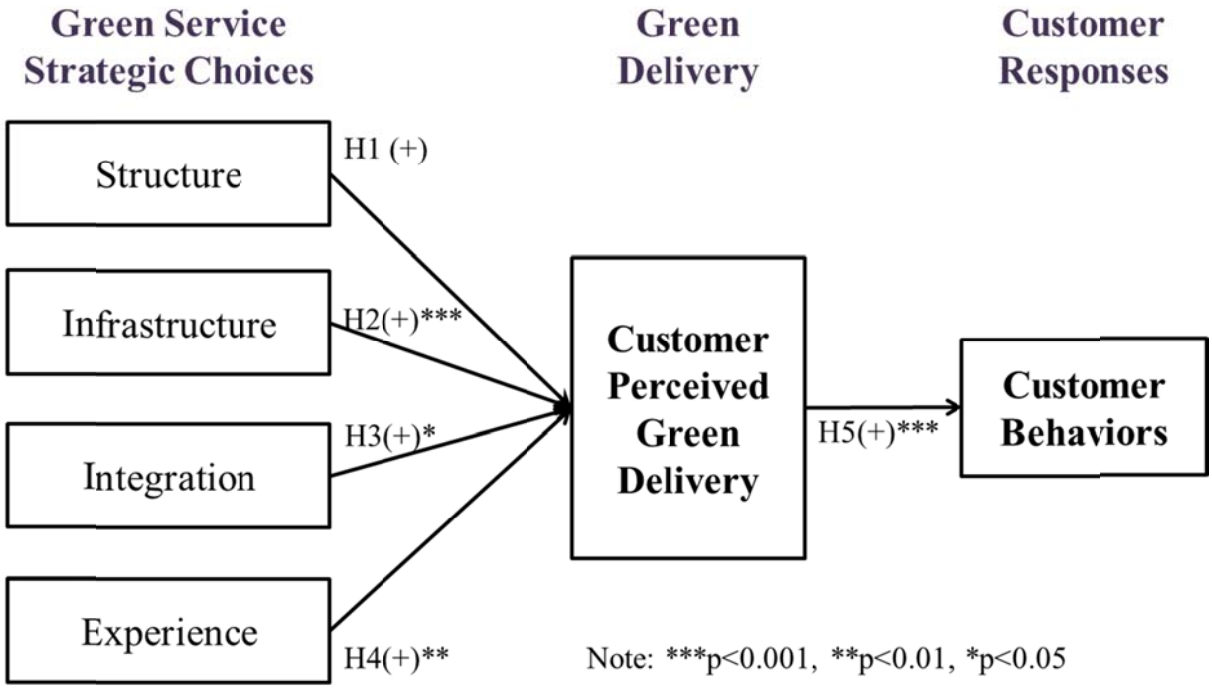

Figure 3 – Statistical Results of Green Service Delivery Model

CONCLUSIONS AND CONTRIBUTIONS

There are three parts in this chapter. The first part is research conclusions. Following conclusions is the discussion of academic contribution and service implications. Finally, research limitations and suggestions for future research are provided at the end of this section.

Conclusions

The purposes of this research are to explore what service provider could do in green service operation management and delivery process as well as to get insights to know which green practices are important in customers' point of view, and further influence their purchase behavior. According to the results in previous section, we provide conclusions for this study.

In structure strategic choice, this study finds that green structure practice does not have a significant impact on customer perceived green delivery. According to our scenario, we find that installing low consumption LED bulbs does not influence customer perception regarding

green service delivery. The primary reason might be the LED bulbs are already installed in lots of businesses. Comparing with other green initiatives, installing energy-saving equipment such as LED bulbs is less complicated, less costly, and faster achievement. The purpose of green structure practices are based on cost reductions and brand equity enhancement, and are comprehensively placed into the retail industry (Kreidler and Joseph-Mathews, 2009). The secondary reason might be the customer's full awareness of energy-saving practices. Since customers has been educated and encouraged to use energy-saving bulbs for several years, they might consider installing LED bulbs a common practice. Another reason might be the difficulties for customers to notice the energy-saving installation. LED bulbs might looks similar to regular bulbs, while energy-saving air-conditioners are not installed in the shopping areas.

In infrastructure strategic choice, this study finds infrastructure practice has a significant impact on customer perceived green delivery. From the vignette we designed, we focus on the practices of service employee's training and interaction with customers. Employees who have green knowledge of product information and who are willing to explain to customers can directly influence customer expectation and green perception.

With regard to integration strategic choice, the results show that integration practice has a significant impact on customer perceived green delivery. In the scenario, integration practice illustrates the cooperation with suppliers to provide products using reusable and recyclable materials. Working with suppliers to provide more environmental-friendly products, the retailers can influence customer perception of their green service delivery.

In the context of the experience strategic choice, the findings indicate that experience practice has a significant impact on customer perceived green delivery. When the retailers hold a community activity to propagate green knowledge to local people, customers will perceived the retailers providing green service delivery.

When considering the interaction effects of the ANOVA, the results show that infrastructure practice is important when the store does not provide green practice in structure choice. However, when the store provide green structure practice, all other three strategic choices, infrastructure, integration, and experience, can enhance customer perception of green service. These results show that structure choice will influence whether customer perception of green service will be impacted by other choices.

The significant relationship between customer perceived green service delivery and customer behavior shows that customers will repurchase or recommend the store when they perceived the green service delivery provided by the store. This implies that green service provided by the store can influence customer behavior.

Contributions

In the past decades research in green subject focuses on manufacturing point view, investigating how to lower the waste consumption in production process, how to reduce the cost by green concerns, and how to establish environmental-friendly logistics. However, green service discussion in academics is few. Some of researchers (Kreidler and Joseph-Mathews, 2009, Low et al., 2001, Robinot and Giannelloni, 2009) suggest for green service practices, but they do not discuss service delivery and customer perception of green service. Hence, this study explores in service delivery process and customer perception. Utilizing past research on service delivery, this study establishes a green service delivery model, investigating the relationships between strategic choices and green service delivery. Further, this study investigates whether customer perceived green service can influence their behaviors.

In managerial implications, we focus service operation management in retail industry. From the results of this study, managers can design their green practices related to the four strategic choices. Considering these four choices separately, the study suggests managers to adopt green practices on infrastructure, integration, and experience. If managers do not want to adopt green practice in structure choice, they can focus on infrastructure practice and still improve customer perception of green service. If service companies adopt green practice in structure choice, the green practice in other 3 choices can further increase customer perception of the green service. This study not only provides suggestions for retailers to adopt green practices in different strategic choices to enhance customer perception of green service but also ensure that green service can change customer behaviors for better performance of the companies.

Limitations

Some limitations of this study are mentioned here. First, most of the respondents in this research are students. Although they might not be able to represent the whole customer group, they are legitimate customers. Second, because of the experiment design, this study cannot include all contents in each strategic choice. However, this study still provides a step stone for future research on more details in strategic choices.

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EFFECT OF LONG-TERM ORIENTED CULTURE ON COMMUNICATION AND PROCESS EFFICIENCY IN SUPPLY CHAIN

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ABSTRACT: To improve process efficiency, firms have attempted to align goals and collaboratively communicate with supply chain partners. However, a firm's culture (e.g., long term vs. short term oriented) might complicate the collaborative efforts. The objective of the study is to explore the impact of long-term oriented culture on goal congruence and collaborative communication, and further on process efficiency of supply chain. Data was collected through a Web survey of U.S. manufacturing firms. Structural equation modeling (LISREL) was used to analyze the data. The results and implications are discussed in the paper.

Keywords: Long Term Orientation, Communication, Structural Equation Modeling.

INTRODUCTION

As the environments become increasingly uncertain, firms have attempted to achieve greater supply chain collaboration (Nyaga et al., 2010; Cao and Zhang, 2011; Verdecho et al., 2012). Supply chain collaboration can generate significant benefits to its members, e.g., reducing risks and decreasing transaction costs (Verdecho et al., 2012).

However, a strong relationship is often related to firm's culture (e.g., short-term vs. long-term interests). Firms with short-term interests view their supply chain members as transaction-based partners (Sheu et al., 2006). The governance is often based on self interests rather than common goals, a sense of duty, or obligation to others (Wuyts and Geyskens, 2005). If one tries to pursue its own objectives over another partner, it will cause conflicts between them and thus

partnering will fail.

The objective of the study is to explore the impact of long term orientation on goal congruence and collaborative communication, and further on process efficiency. Through a large-scale Web survey with manufacturers across the US, the research also intends to develop reliable and valid instruments and to empirically test the relationships among these constructs using structural equation modeling.

CONCEPTUAL DEVELOPMENT

Supply chain members' long-term orientation can enhance goal congruence and collaborative communication, and further achieve process efficiency in the supply chain. These relationships are depicted in a framework shown in Figure 1.

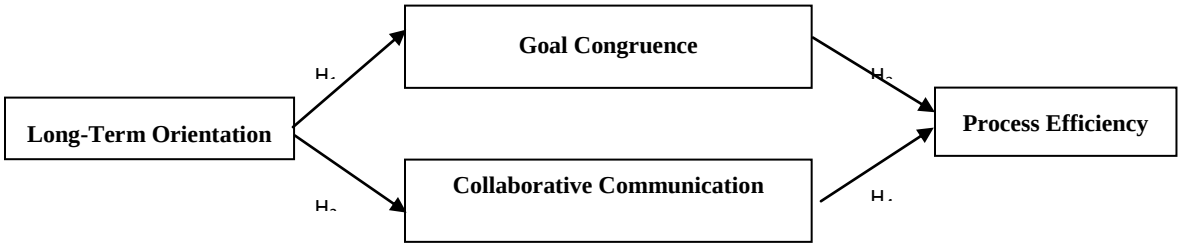

Fig. 1. A Framework

Hypothesis 1: Long-term orientation has a positive effect on goal congruence.

Hypothesis 2: Long-term orientation has a positive effect on collaborative communication.

Hypothesis 3: Goal congruence has a positive effect on process efficiency.

Hypothesis 4: Collaborative communication has a positive effect on process efficiency.

METHODOLOGY

The three steps were carried out in developing instruments for these constructs: (1) item generation, (2) structured interview and Q-sort, and (3) large-scale analysis. First, to ensure the content validity of the constructs, a literature review was conducted to define each construct and generate the initial items for measuring the constructs. Then, a structured interview and Q-sort were conducted to provide a preliminary assessment of the reliability and validity of the scales. The third step was a large-scale survey to validate the instruments.

The goal of item generation is to achieve the content validity of constructs by reviewing literature and consulting with academic and industrial experts. The measurement items for a scale should cover the content domain of a construct (Churchill, 1979). To generate measurement items for each construct, prior research was extensively reviewed and an initial list of potential items was compiled. A five-point Likert scale was used to indicate the extent to which managers agree or disagree with each statement where 1=strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

After the measurement items were created, the pool of items were reviewed and evaluated by practitioners from four different manufacturing firms to pre-assess the reliability and validity of the scales. After two rounds of Q-sort, items were distributed to six academicians who reviewed each item and indicated to keep, drop, modify, or add items to the constructs. Based on the feedback from the reviewers, items were further modified. Then the questionnaire items were sent out for a large-scale survey.

An email list of 5,000 target respondents was purchased. A Web survey was conducted. Excluding multiple names from the same organization, undelivered emails, and returned emails stating that target respondents were no longer with the company, the actual mailing list contained 3,538 names. To enhance the response rate, three waves of emails were sent once a week. Out of the 227 responses received, 211 are usable resulting in a response rate of 6.0%. A chi-square test is conducted to check non-response bias. The results show that there is no significant difference between the first-wave and second/third-wave respondents by all three categories (i.e., SIC code, firm size, and job title) at the level of 0.1. It exhibits that received questionnaires from respondents represent an unbiased sample.

With confirmatory factor analysis in LISREL, steps were undertaken to check (1) unidimensionality and convergent validity, (2) reliability, (3) discriminant validity, and (4) second-order construct validity. The assessment for each construct was conducted in one all-factor first-order correlated model so related multi-items measures are grouped together. Iterative modifications were undertaken by dropping items with loadings less than 0.7 and items with high

correlated errors thus improving the model fit to acceptable levels (Hair et al., 2006). In the cases where refinement was indicated, items were deleted if such action was theoretically sound and the deletions were done one at a time (Hair et al., 2006). Model modifications were continued until all parameter estimates and model fits were satisfactory.

The model fit indices are used to assess unidimensionality and the significance of t-values of each measurement indicator is used to assess convergent validity. The overall model fit indices include comparative fit index (CFI), non-normed fit index (NNFI), root mean square error of approximation (RMSEA), and normed chi-square (i.e., $\chi 2$ per degree of freedom) (Hair et al., 2006). Values of CFI and NNFI between 0.80 and 0.89 show a reasonable fit and scores of 0.90 or higher are evidence of good fit (Joreskog and Sorbom, 1989). Values of RMSEA less than 0.10 are acceptable (Hair et al., 2006). The normed chi-square estimates the relative efficiency of competing models where a value less than 5.0 is preferred for this statistic.

The composite reliability (ρ_c) and the average variance extracted (AVE) of multiple indicators of a construct can be used to assess reliability of a construct (Hair et al., 2006). When AVE is greater than 50% and ρ_c is greater than 0.70, it implies that the variance of the trait is more than that of error components (Hair et al., 2006).

To examine the discriminant validity, a pair-wise comparison was performed by comparing a model with correlation constrained to one with an unconstrained model. A difference between the χ^2 values of the two models that is significant at $p<0.05$ level would indicate support for the discriminant validity criterion (Joreskog and Sorbom, 1989).

Finally, a LISREL model is run to test the hypotheses developed in the framework. Following the steps and procedures for implementing the latent variables, the proposed model was tested .

RESULTS

Following Hair et al. (2006), iterative modifications were made by examining modification indices, correlated errors, and loadings to improve key model fit indices. After modification, the final model fit indices of CFI, NNFI, RMSEA, and normed χ^2 meet the recommended criteria.

Shown in Table 1, the item loadings for each factor are close to or greater than 0.70 and significant at $p<0.01$ based on t-values. All dimensions exhibit good convergent validity. The estimates of AVEs for all the factors are greater than the critical value of 0.50. The composite reliabilities (ρ_c's) for all the factors are above the critical value of 0.70. The results of the AVEs and ρ_c's provide evidence of good reliability for each factor.

To test the hypotheses proposed in the framework, structural equation modeling (LISREL) is

used to assess the model fit with the data. The path diagram for the LISREL model is shown in Figure 2. In terms of overall fit, chi-square statistic is 257.84 with df = 115 and the ratio of chi-square to degrees of freedom is 2.24, which indicates a good fit. The model fit indices NNFI = 0.91, CFI = 0.92, and RMSEA=0.077 are very good.

The result supports Hypothesis 1 and 2. The LISREL path coefficients are 0.59 (t=7.92) and 0.61 (t=8.65) respectively, which is statistically significant at the level of 0.01. This supports the claim that long-term orientation has significant, positive, and direct impact on goal congruence and collaborative communication.

Hypothesis 3 is also supported with the path coefficients 0.21 (t=2.84), which is statistically significant at the level of 0.01. This confirms the claim that goal congruence has significant, positive, and diret impact on process efficiency.

Hypothesis 4 is also supported with the path coefficients 0.43 (t=5.69), which is statistically significant at the level of 0.01. This confirms the claim that collaborative communication has significant, positive, and direct impact on process efficiency. Comparing the path coefficients of H3 and H4, communication has bigger impact on process efficiency than goal congruence.

DISCUSSION AND IMPLICATIONS

The study has developed valid and reliable instruments for long-term orientation, goal congruence, collaborative communication, and process efficiency. All the scales have been examined through rigorous methodologies including Q-sort method, confirmatory factor analysis, reliability, and the validation of second-order construct. All the scales are shown to meet the requirements for reliability and validity and thus can be used to facilitate further empirical research efforts.

This research has linked long-term orientation, goal congruence, collaborative communication, and process efficiency by proposing a model to help understand the phenomenon at the dyadic, supply chain context. As expected, the results support all the hypotheses.

Managerially, this research offers some guidelines to facilitate better management of supply chain relationships by cultivating a culture of long term orientation and collaborative communication.

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LIMITED ATTENTION, ATTENTION ALLOCATION AND LIQUIDITY PROVISION

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ABSTRACT

Using data from the Taiwan Emerging Stock Market, we examined the Limited Attention Hypothesis as put forth by Corwin and Coughenour (2008). In the Taiwan Emerging Stock Market, liquidity is wholly provided by market makers. Limited Attention Hypothesis states that if limited attention forces a specialist to allocate effort across stocks, the specialist's ability to provide liquidity for a given stock can be negatively affected by the attention requirements of other stocks in his market-making portfolio. Because the NYSE is an order driven market, most of the liquidity is provided by traders in the limited order book. Specialists provide supplementary liquidity through ex-post price improvement. Although liquidity is influenced by the actions of specialists, it may also be affected by limit orders and the behavior of other traders. Corwin and Coughenour (2008) tested the Limited Attention Hypothesis by calculating the firm-level liquidity of NYSE securities. Their research, however, was limited because the liquidity provided by specialists could not be isolated. In this research, we were able to isolate liquidity because we tested our hypothesis by examining securities listed on the Taiwan Emerging Stock Market, which is a quote driven market. All of the liquidity provisions can be attributed to the actions of market makers. We also calculated market maker level liquidity in our data, enabling us to examine the relationship between a market maker's attention and his liquidity provision, giving us a more accurate view of the relationship between liquidity provision and attention. The empirical results indicate that market makers allocate effort toward their most active stocks, resulting in increased spread and less frequent price improvement for their remaining market making stocks. Thus, our results indicate that the allocation of effort due to limited attention has a significant impact on liquidity provision in stock markets.

Keywords: Limited Attention, Attention Allocation, Liquidity Provision

UNDERSTANDING ONLINE CUSTOMER REPURCHASE INTENTION: THE PERSPECTIVES OF EXPECTATION–CONFIRMATION MODEL, TRUST, AND JUSTICE

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ABSTRACT
Remaining customers' repurchase intention is important for online sellers. By integrating the perspectives of expectation–confirmation model, trust, and justice, this study develops a theoretical model to examine the antecedents of repurchase intention in the online shopping context. Data collected from 191 customers of Groupon were used to test the proposed model. The results show that perceived usefulness, satisfaction, and trust are the key predictors of repurchase intention, while perceived usefulness and trust exert significant effects on satisfaction as well. The results also reveal that confirmation of procedural justice, confirmation of interactional justice, and confirmation of distributive justice have positive effects on perceived usefulness and trust, whereas confirmation of distributive justice exerts significant influence on satisfaction. The implications for theory and practice and suggestions for future research are also discussed.

Keywords: Expectation–confirmation model, Trust, Justice

1. INTRODUCTION

Online shopping has become an important channel for people to purchase products/services. Despite of its popularity, researchers find that only a small minority of online customers returns to make purchases (Gupta and Kim, 2007; Qureshi et al. 2009). The reason that people abandon their repurchase intention is primarily due to the fact that the Internet makes it easy for online customers to switch from a website to another one providing similar products/services (Li et al., 2006). Thus, it is important to understand what may motivate

customers to stick with a website to purchase products/services repeatedly. To this end, the perspectives of expectation-confirmation model (ECM), trust, and justice are applied.

Bhattacherjee's (2001a) ECM has widely been applied in the information systems (IS) literature with demonstrated validity. According to ECM, an individual's intention to continue using an IS is determined by three variables: satisfaction with the IS, confirmation of expectations, and perceived usefulness (Bhattacherjee, 2001a). Several recent studies have used ECM as their theoretical base to examine users' continuance intention toward IS (e.g., Casaló et al., 2010; Chea and Luo, 2008; Kang et al., 2009; Lee, 2010). Since IS users' continuance decisions are similar to consumer's repurchase decisions (Bhattacherjee, 2001a). ECM is suited to be applied in this study.

Researchers agree that uncertainty is a primary barrier preventing customers from engaging in online transactions (Pavlou et al., 2007). Although many factors may reduce uncertainty, trust is a central concept that that can mitigate uncertainty and thus motivate customers to participate in online transactions (Qureshi et al. 2009; Pavlou et al., 2007). Prior literature has revealed the importance of trust in online shopping as a predictor of repurchase intention (Chiu et al., 2012). However, little studies have been done to integrate trust into ECM. In order to provide more comprehensive understanding of antecedents of repurchase intention, trust is combined with ECM in this study.

In general, people usually expect to be treated fairly by others during social interactions (Turel et al., 2008). Justice is particularly important in online shopping because customers need justice judgments to manage uncertainty (Zhao et al., 2011). Accordingly, fair treatments, such as procedural justice, interactional justice, and distributive justice, could be considered as customers' expectations when they want to carry out online transactions. From the standpoint of ECM (Bhattacherjee, 2001a) and the literature of trust (e.g., Turel et al., 2008), when customers confirm that they encounter a fair procedure of transaction, fair interpersonal treatment, fair information regarding transaction and products, and fair outcomes, customers' usefulness perception, satisfaction, and trust may be formed. However, ECM asserts that confirmation is unidimensional. It is thus limited in explaining how the different types of confirmation of expectations affect customers' affective response and beliefs, which in turn impacts their behavioral intention. Following McKinney and et al. (2002), confirmation in this study is considered as a multidimensional construct and could be classified into three types, including confirmation of distributive justice, confirmation of procedural justice, and confirmation of interactional justice

Overall, the purpose of this study is to identify the antecedents of repurchase intention in online shopping by synthesizing the perspectives of ECM, trust, and justice. In particular, this study aims to address the following questions: (1) what factors are associated with repurchase

intention? (2) What are the factors regarding confirmation of expectations? (3) To what extent does each factor of confirmation of expectation affect perceived usefulness, satisfaction, and trust? The findings may help both academics and practitioners gain insights into how to promote customers' repeat purchase intention.

2. THEORETICAL BACKGROUND

2.1 Expectation-confirmation model

In order to explain a user's intention to continue using an IS, Bhattacherjee (2001a) develops expectation-confirmation model (ECM) based on expectation-confirmation theory (ECT) (Oliver, 1980). There are five main hypothesized linkages in the ECM. First, ECM asserts that user's IS continuance is primarily determined by satisfaction, the user's affective response toward experiences of IS use. Similar arguments can be found in the IS literature that satisfaction will reinforce users' continuance intention toward a system (Limayem,et al. 2007). Next, ECM positively relates satisfaction to confirmation of expectations (Bhattacherjee, 2001a). Confirmation of expectations implies that users' expected benefits can be realized through the usage of an IS and thus leads to positive effect on satisfaction (Hong et al., 2006). ECM also holds that perceived usefulness, a cognitive evaluation of the utility of IS use (Chea and Luo, 2008), has positive effect on satisfaction by acting as a baseline of reference against confirmation judgments (Hong et al., 2006; Lee, 2010). In addition, in line with technology acceptance model (TAM) (Davis, 1989), ECM relates perceived usefulness to user's IS continuance (Bhattacherjee, 2001a). Finally, the level of confirmation is hypothesized to affect perceived usefulness positively (Bhattacherjee, 2001a). This link is supported by cognitive dissonance theory (Festinger, 1957) that rational users may try to remedy this dissonance by modifying their usefulness perceptions when a user's initial perceived usefulness is not concrete.

ECM has been widely applied to understand users' IS usage behavior in a variety of contexts, including online services (Chea and Luo, 2008; Kang and Lee, 2009), and mobile Internet (Hong et al, 2006). Although perceived usefulness and satisfaction are the significant determinants of behavioral intention in ECM, many researches argue that trust is critical in the setting of online shopping, as it reduces the possible undesired behavior of others in the future of others (e.g., Gefen et al., 2003; Qureshi et al., 2009). Some researchers also suggest that it is important to increase customers' trust, value perception, and satisfaction to facilitate customer loyalty (Lin and Wang, 2006). However, little research has incorporated trust into ECM. To fill this knowledge gap, ECM is extended by incorporating trust in this study. In addition, most of the IS studies on ECM view conformation as unidimensional. This conceptualization in contrast to the research on ECT that suggests that confirmation can be

separated into various types according to customers' expectations about online shopping (McKinney et al., 2002). Since ECM is developed based on ECT, this study believes that it is reasonable to treat confirmation as a multidimensional construct to examine the linkages between these different dimensions of confirmation on perceived usefulness, satisfaction, and trust. To this end, this study uses justice theory as the theoretical base to identify the types of confirmation of expectations.

2.2 The role of trust

Trust is an individual's subjective belief that other people will perform expected behaviors and will not act opportunistically by taking advantage of the situation (Qureshi et al. 2009). Moorman et al. (1992), on the other hand, define trust as a person's willingness to rely on others whom one has confidence. Trust is also viewed as a set of specific beliefs dealing primarily with the benevolence (trustee caring and motivation to act in the trustor's interests), competence (ability of the trustee to do what the trustor needs), and integrity (trustee honesty and promise keeping) of another party (Lin and Wang, 2006; McKnight et al., 2002; Qureshi et al. 2009).

Trust is vital in many exchange relationships characterized by uncertainty (Mayer et al., 1995; Qureshi et al. 2009), including online shopping. Trust is so important in online shopping because the interactions between online sellers and customers are carried out in cyberspaces. The lean nature of the electronic environment relative to traditional face-to-face market makes it difficult for customers to assess sellers' credibility and product quality (Ba and Pavlou, 2002; Pavlou et al., 2007). In particular, online customers have to pay upfront before exchange takes place (Qureshi et al. 2009). By trusting, customers reduce their perceived social complexity by ruling out undesired, yet possible, future behavior of others and thus increases one's belief that expected benefits through interactions can be fulfilled (Gefen et al. 2005; Hsu et al., 2011). In the previous literature, trust has been considered as a strong predictor of repurchase intention in online shopping (e.g., Chiu et al., 2012; Qureshi et al. 2009).

2.2 The perspective of justice

In organizations, justice is about the rules and social norms governing how rewards and punishments should be distributed and the procedures used for decisions making (Bettencourt et al., 2005). It describes an individual's fair perception about treatment received from an organization (Aryee et al., 2002). An individual may form his/her perception of justice by comparing the outcomes and processes to acceptable norms (Turel et al., 2008). In the online shopping context, it is expected that process and outcome of the transaction as facilitated by online sellers will form the customers' justice perception (Turel et al., 2008).

Recent studies consider that justice is a multidimensional construct and can be classified

into three dimensions, including procedural justice, interactional justice, and distributive justice (Bettencourt et al., 2005; Fang and Chiu, 2010; Turel et al., 2008; Zhao et al., 2011). Procedural justice refers to fairness of policies, procedures, and criteria during the process of product/service purchasing (Zhao et al., 2011). Interactional justice refers to the interpersonal treatment people receive during the process of purchase activities conducting (Turel et al., 2008; Zhao et al., 2011) and could be encapsulated two distinct concepts—interpersonal justice and informational justice (Turel et al., 2008). Interpersonal justice reflects the degree to which people are treated by others (i.e., online sellers) with politeness, dignity, friendliness, and respect (Fang and Chiu, 2010; Turel et al., 2008), while informational justice refers to the extent to which people are provided with information or rationale as to how decisions are made (Fang and Chiu, 2010). Finally, distributive justice describes the perceived fairness of outcomes of the process (Bettencourt et al., 2005; Colquitt et al., 2006).

Past research suggests that justice is an important cognitive judgment during the formation of satisfaction (Zhao et al., 2011). For example, Zhao et al. (2011) integrate the perspectives of service quality and justice and examine the antecedents of continuance toward mobile value-added services. The results show that interpersonal justice and distributive justice have positive effects of on cumulative satisfaction and transaction-specific satisfaction. In another paper, Bettencourt et al. (2005) examine the antecedents of satisfaction and organizational citizen behaviors by using social exchange theory. The results report that procedural justice, interpersonal justice, and distributive justice exert positive influences on job satisfaction. In addition, justice is also a useful predictor of trust. For instance, by integrating justice and trust to examine the determinants of continuance intention toward knowledge sharing in virtual communities, Fang and Chiu (2010) find that distributive justice, procedural justice, informational justice, and interpersonal justice exert positive influences on trust in members and trust in management. Similarly, in the setting of e-consumer service, Turel et al. (2008) posit that procedural justice and informational justice have positive effects on trust in service provider, while procedural justice exerts significant influence on trust in e-customer service.

In sum, the above literature review suggests that justice is a useful construct to explain the formation of customer satisfaction and trust. Since trust is built if the trustee behaves according to the trustor's expectations, while satisfaction reflects a seller's ability to meet customers' expectations (Kim et al., 2004). This implies that justice can be seen as a persona's expected outcome before carrying out a specific behavior. Therefore, in this study, distributive justice, procedural justice, and interactional justice are treated as customers' expectations regarding purchasing products. From the viewpoint of ECM, once customers obtain transaction experience, confirmation of expectations will be formed by comparing their expectations and their perceived performance. By synthesizing the above arguments, one can

expect that confirmation of expectations can be categorized as three types, including confirmation of procedural justice, confirmation of interactional justice, and confirmation of distributive justice. These three types of confirmation of expectations, on the other hand, are proposed to have positive effects perceived usefulness, satisfaction, and trust.

3. RESEARCH MODEL AND HYPOTHESES

Based on the theoretical background, the research model of this study is proposed (see Figure 1). The model depicts that perceived usefulness, satisfaction, and trust are the antecedents of repurchase intention, while perceived usefulness and trust will have positive impact on satisfaction. Finally, the model asserts that three types of confirmation of expectations (confirmation of procedural justice, confirmation of interactional justice, and confirmation of distributive justice) will influence perceived usefulness, satisfaction, and trust. The hypotheses will be further justified in more detail.

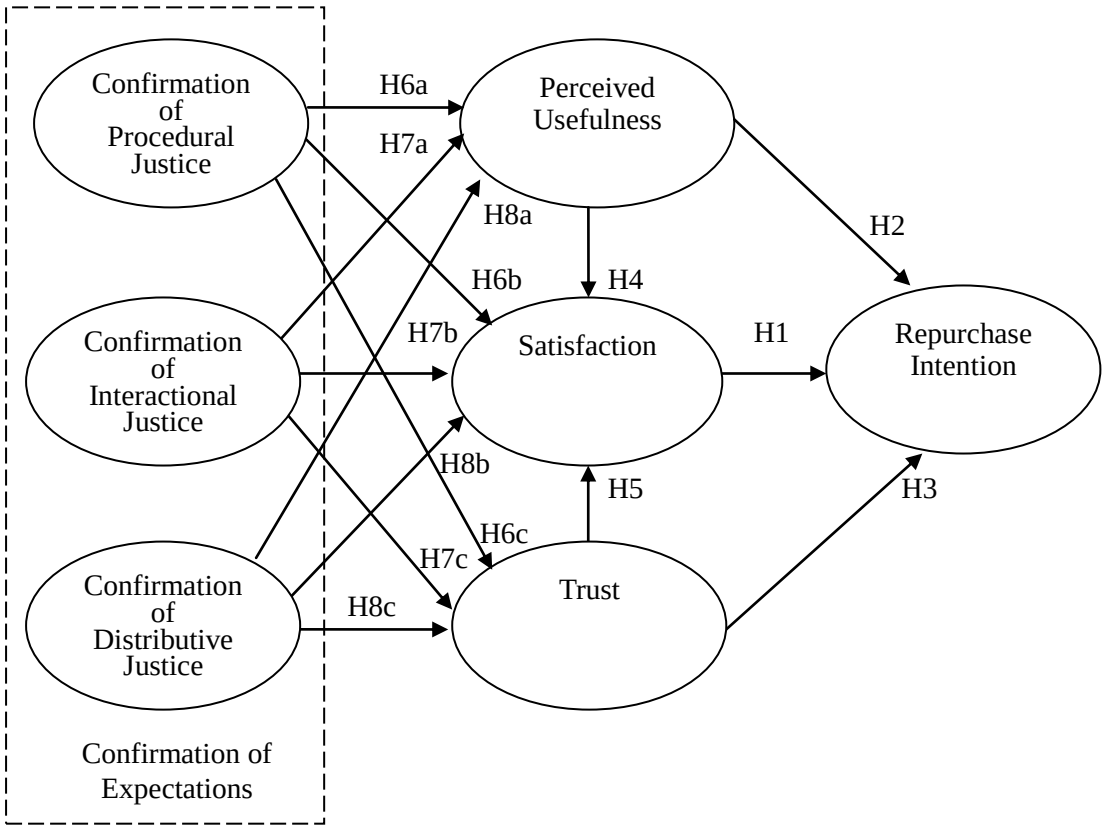

Figure 1 Research model

Satisfaction refers to an affective state representing customers' reaction to a transaction experience with online sellers (Kim et al., 2004; Lin and Wang, 2006). ECM asserts that satisfaction is a major determinate of continuance intention (or repurchase intention) (Chea

and Luo, 2008), which is in line with Anderson and Srinivasan (2003) that dissatisfied customers is more likely to yield to competitor overtures than is a satisfied customers. Researchers have reported that satisfaction is a strong predictor of repurchase intention and customer loyalty (e.g., Bhattacherjee, 2001b; Lin and Wang, 2006). Therefore,

H1: Satisfaction is positively associated with repurchase intention.

Drawing from TAM, perceived usefulness refers to users' perception that IS use will improve their performance (Davis et al., 1989). In the setting online shopping, perceived usefulness reflects customers' subjective judgment about perceived advantages (e.g., efficiency and convenience) by using online shopping websites. In ECT, perceived usefulness is a predictor of continuance intention. Similarly, researchers suggest that users generally think positively about an IS and will continue to use it when they feel that IS use is useful (Lin and Lu, 2011). Evidence supporting the link between perceived usefulness and continuance intention has provided by many studies (e.g., Bhattacherjee, 2001a; Chea and Luo, 2008). Thus, this study proposes the following hypothesis.

H2: Perceived usefulness is positively associated with repurchase intention.

According to Dirks and Ferrin (2001), trust reduces ambiguity and uncertainty in social perceptions and thus cooperative activities can take place. Prior literature argues that the lack of trust is one of the greatest barriers inhibiting online transactions (Gefen et al., 2003). Several researchers also suggest that customers generally away from the online sellers they do not trust (Jarvenpaa and Tractinsky, 1999; Lin and Wang, 2006; Reichheld and Schefter, 2000). Previous studies have found that trust exerts positive influence on repurchase intention (e.g., Lin and Wang, 2006; Qureshi et al. 2009). Therefore,

H3: Trust is positively associated with repurchase intention.

Satisfaction is the result of a customer's perception of value received (Hallowell, 2003; Lin and Wang et al., 2006). Many researchers agree that judgments of value received affect people's perception of satisfaction (Chiu et al., 2012; Weiner, 1986). On the other hand, satisfaction is an affective response. According to Bagozzi's (1992) framework of self-regulatory mechanism: appraisal processes→emotional response→coping response, a cognitively-oriented appraisal of perceived value leads to emotionally satisfying judgments (Chiu et al., 2012). Evidence for the link between value judgments and satisfaction has been provided by previous studies (e.g., Chiu et al., 2012; Lin and Wang, 2006). Therefore,

H4: Perceived usefulness is positively associated with satisfaction.

Generally, one's trust in another will affect his/her attitudes, such as satisfaction (Dirks and Ferrin, 2001; Jarvenpaa et al., 2004). From the standpoint of theory of reasoned action (Fishbein and Ajzen, 1975), trusting beliefs will lead to attitude (customer satisfaction), which in turn impacts behavioral intention, indicating that satisfaction could be considered as a mediating factor between trust and repurchase intention (Lin and Wang, 2006). Past research has found that satisfaction is a factor mediating the influence of trust on customer loyalty (Lin and Wang, 2006). Therefore,

H5: Trust is positively associated with satisfaction.

According to ECM, initial perceived usefulness perceptions could be adjusted based on confirmation experience (Bhattacherjee, 2001a). From the standpoint of cognitive dissonance theory (Festinger, 1957), a rational person tries to remedy cognitive dissonance by modifying their usefulness perceptions be more consistent with reality when they found that their pre-acceptance usefulness perceptions are disconfirmed during actual use (Bhattacherjee, 2001a). The link between confirmation and perceived usefulness has been provided by many studies (e.g., Chea and Luo, 2008; Kang and Lee, 2009). Therefore, we expect that confirmation of justice perceptions will enable customers to modify their usefulness perception.

H6a: Confirmation of procedural justice is positively associated with perceived usefulness.

H7a: Confirmation of interactional justice is positively associated perceived usefulness.

H8a: Confirmation of distributive justice is positively associated perceived usefulness.

Satisfaction refers to the comparison between pre-purchase expectations and the realized value and performance of a product or service (Chiu et al., 2012; Oliver, 1980). This means that satisfaction reflects an overall evaluation of production/service consumption, or a transaction experience (Kauffman, 2010). ECM asserts that confirmation is related to satisfaction because it implies that users' expected benefits of IS use have been realized. In addition, many studies report that just perceptions may influence satisfaction positively as well (e.g., Bettencourt et al., 2005; Kauffman, 2010; Zhao et al., 2011). Empirical evidence supporting the relationship between justice perceptions and satisfaction has been provided by previous literature (Bettencourt et al., 2005; Kauffman, 2010; Zhao et al., 2011). Therefore, we expect that satisfaction will be formed when customer compare their expectations of transaction justices and their actual justice perceptions during transaction process.

H6b: Confirmation of procedural justice is positively associated with satisfaction.

H7b: Confirmation of interactional justice is positively associated satisfaction.

H8b: Confirmation of distributive justice is positively associated with satisfaction.

Trust reflects one's expectations that others in an exchange will behave in a dependent manner and fulfill their commitments (Qureshi et al. 2009). Social exchange theory asserts that trust will be formed when the trustee behaves in acceptable manner and in accordance in the trustor's expectations (Blau, 1964; Kim et al., 2004). In addition, researchers argue that trust will be also affected by justice perceptions (Turel et al., 2008). This is because fair treatments, such as fair outcome, procedure, and interpersonal treatment may signal the trustworthiness of online sellers and also can be perceived as fulfillment of the psychological contract between customers and online sellers (Turel et al., 2008). Turel et al. (2008) and Fang and Chiu (2010) also provides empirical evidence to support that justice perceptions have positive influences on trust. Thus,

H6c: Confirmation of procedural justice is positively associated with trust.

H7c: Confirmation of interactional justice is positively associated with trust.

H8c: Confirmation of distributive justice is positively associated with trust.

4. RESEARCH METHODOLOGY

4.1 Survey administration

The proposed model was tested using the data collected from the consumers of Groupon in Taiwan. Groupon was chosen because it is a well-known online group-buying website in Taiwan. In order to target respondents, a banner with a hyperlink connecting to the Web survey was posted on a number of bulletin board systems (BBS) and Facebook of Groupon. Customers with online group-buying experience were invited to support this survey. The respondents were instructed to answer all of the questions based on their shopping experience with the Groupon. The first page of Web questionnaire stated the purpose of this study and assured the confidentiality. At the end of data collection, a total of 191 questionnaires were collected for further data analysis. Of the 191 respondents, 100 (52.4%) were male, 136 (71.2%) were between 21 and 30 years of age, and about 138 (72.2%) reported having completed a college degree.

4.2 Measurement Development

The questionnaire was developed by adapting measures had been validated by prior literature. Three experts in the IS filed were invited to assess the logical consistencies, ease of understanding, sequence of items and contextual relevance of the questionnaire. The comments and feedback from these experts were used to conduct several minor modifications of the wording and the item sequence. Furthermore, an online pilot test was carried out using 20 undergraduate students with online shopping experience. The instrument was then

modified slightly in accordance with their comments. For all measures, a five-point Likert scale was used with anchors ranging from strongly disagree (1) to strongly agree (5).

5. DATA ANALYSIS

In this research, partial least square (PLS) was used for data analysis. Following the two-step approach recommended by Anderson and Gerbing (Anderson and Gerbing, 1988), this study assessed reliability and construct validity by conducting conformation factor analysis (CFA) in the first step. Then, the structure model was examined in the second step. In the study, we used SmartPLS Version 2.0 M3 (Ringle et al., 2005) in our data analysis.

5.1 Measurement Model

The adequacy of the measurement model was evaluated based on the criteria of reliability, convergent validity, and discriminant validity. Reliability was examined based on the composite reliability values. Table 1 shows that all of the values are above 0.7 (Gefen et al., 2000), indicating adequate composite reliability. Moreover, Tables 1 shows that all the factor loadings exceed the threshold value of 0.6 and all the item-to-total correlation coefficients are also greater than the recommended cut-off value of 0.35. The results reveal that convergent validity is acceptable (Bhattacherjee, 2001a; Turel et al., 2007). Finally, Table 2 shows that all the values of square root of the AVE exceed the correlation shared between the construct and other constructs in the model, demonstrating the accepted discriminant validity (Fornell and Larcker, 1981).

Table 1 Measurement items statistics

Construct	Item	Factor loading	Item-total correlations	CR	AVE
Confirmation of Procedural Justice (CPJ)	CPJ1	0.81	0.79	0.80	0.57
	CPJ2	0.81	0.82		
	CPJ3	0.63	0.65		
Confirmation Of Interactional Justice (CIJ)	CIJ1	0.82	0.83	0.93	0.66
	CIJ2	0.72	0.72		
	CIJ3	0.80	0.83		
	CIJ4	0.81	0.82		
	CIJ5	0.80	0.79		
	CIJ6	0.88	0.87		
	CIJ7	0.86	0.85		
Confirmation Of Distributive	CDJ1	0.61	0.77	0.75	0.61
	CDJ2	0.92	0.81		

Justice (CDJ)					
Perceived Usefulness (PU)	PU1	0.76	0.77	0.84	0.63
	PU2	0.79	0.77		
	PU3	0.81	0.84		
Satisfaction (SAT)	SAT1	0.90	0.90	0.91	0.77
	SAT2	0.85	0.86		
	SAT3	0.88	0.87		
Trust (TRT)	TRT1	0.80	0.79	0.86	0.61
	TRT2	0.76	0.79		
	TRT3	0.78	0.79		
	TRT4	0.78	0.75		
Repurchase Intention (RI)	RI1	0.91	0.90	0.92	0.79
	RI2	0.91	0.91		
	RI3	0.85	0.86		

Table 2 Correlations and the square root of the AVE of latent variables

Construct	Mean	STD	CPJ	CIJ	CDJ	PU	SAT	TRT	RI
CPJ	3.26	0.58	**0.76**						
CIJ	2.99	0.61	0.62	**0.81**					
CDJ	3.92	0.51	0.50	0.40	**0.78**				
PU	3.68	0.58	0.45	0.43	0.51	**0.79**			
SAT	3.78	0.62	0.40	0.40	0.61	0.58	**0.88**		
TRT	3.67	0.59	0.64	0.61	0.67	0.56	0.65	**0.78**	
RI	3.69	0.66	0.50	0.53	0.54	0.62	0.60	0.63	**0.89**

Notes: Diagonal elements (in shade) are the square root of the average variance extracted (AVE). Off-diagonal elements are the correlations among constructs.

4.2 Structural Model

The theoretical model and hypothesized relationships were estimated using the bootstrap approach with a sample size of 500 to generate t-values and standard errors for determining the significance of paths in the structural model. Figure 2 summaries the results of structural model test. As expected, satisfaction, perceived usefulness, and trust have positive impacts on repurchase intention (β= 0.21, 0.33, 0.31; t=2.20, 4.53, 3.71, respectively), validating H1, H2, and H3. Furthermore, perceived usefulness and trust exert positive effects on satisfaction (β= 0.28, 0.33; t=3.91, 3.61, respectively), indicating H4 and H5 are supported. Confirmation of procedural justice, confirmation of interactional justice, and confirmation of distributive

justice have significant impacts on perceived usefulness (β= 0.16, 0.19, 0.35; t=2.12, 2.50, 4.10, respectively). The results support H6a, H6b, and H6c. On the other hand, confirmation of distributive justice exerts significant influence on satisfaction (β= 0.24, t=2.80), meaning H7c is supported. However, Confirmation of procedural justice and confirmation of interactional justice do not affect satisfaction significantly (β= 0.03, -0.04; t=0.38, 0.56, respectively), indicating that H7a and H7b are not supported. Finally, confirmation of procedural justice, confirmation of interactional justice, and confirmation of distributive justice have significant influences on trust as well (β= 0.23, 0.29, 0.44; t=3.33, 5.09, 7.57, respectively), thus H8a, H8b, and H8c are supported.

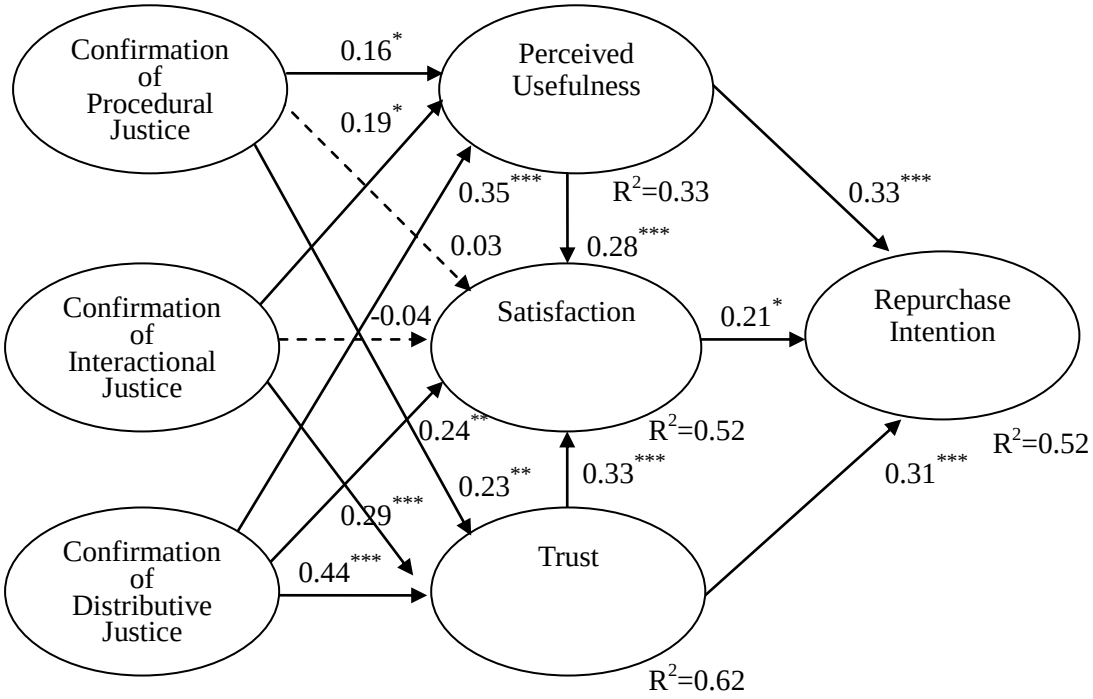

Figure 2 PLS analysis of research model

5. CONCLUSION

5.1 Key findings

Overall, the results provide support for most hypothesized relationships in the model and offer several important findings. The results show that perceived usefulness and satisfaction are the key determinants of repurchase intention, while perceived usefulness has significant effect on satisfaction. These findings are in line with prior studies of ECM (e.g., Casaló et al., 2010; Chea and Luo, 2008; Kang et al., 2009; Lee, 2010), providing additional evidence to confirm the relationship between perceived usefulness, satisfaction, and behavioral intention. The results also reveal that trust exerts positive influence on repurchase intention. This finding extends ECM studies by revealing that trust plays an important role in shaping an individual's

behavioral intention. Consistent with prior literature (Lin and Wang, 2006), our results reveal that trust exert strong and positive influences on satisfaction. This finding confirms the viewpoint of TRA (Fishbein and Ajzen, 1975) that cognitive variables (i.e., trust) will impact affective ones (i.e., satisfaction), which in turn affects conative outcomes (i.e. repurchase intention) (Lin and Wang, 2006).

The results also reveal that confirmation of procedural justice, confirmation of interactional justice, and confirmation of distributive justice have significant impacts on perceived usefulness. The findings are congruent with ECM, confirming the relationship between confirmation of expectations and perceived usefulness. In addition, the results show that confirmation of distributive justice is positively related to satisfaction. This finding is in line with Bettencourt et al. (2005) and Kim et al. (2011), providing an empirical evidence to confirm the link between distributive justice and satisfaction. Directly contrary to expectations, the results show that confirmation of procedural justice and confirmation of interactional justice do not have positive influence on satisfaction. The findings are opposite the results of Bettencourt et al. (2005). One potential explanation for the findings may be that when customers consider that uncertainty existing in the transaction environment, the focus of customers is on the outcomes offered by online sellers rather than on the procedural and interactional justice (Zhao et al., 2011).

Finally, confirmation of procedural justice, confirmation of interactional justice, and confirmation of distributive justice have significant effects on trust. The findings are in line with Fang and Chiu (2010) and Turel et al. (2008), providing an addition evidence to support the link between just and trust formation. The findings, on the other hand, are in line with social exchange theory that trust is built when people believe that their expectations can be met. Finally, among the three dimensions of confirmation, confirmation of distributive justice exerts the greatest effect on trust and satisfaction. This implies that expected benefits customer received from online sellers play an important role in the formation of trust and satisfaction.

5.2 Implications for theory

This study offers several contributions and implications for research. First, although ECM is a useful theoretical lens for understanding the determinants of behavioral intention, little research has been conducted to test the role of ECM in the online shopping setting. This study is one of earlier studies to extend the research context of ECM model from IS continued usage to online shopping setting. This is a contribution of this study. Second, by integrating justice into ECM, this study contributes to current research stream by classifying confirmation of expectations into three different types to examine their effects on perceived usefulness, satisfaction, and trust. Similar to McKinney et al. (2002), the findings of this study pave a

way for further research to examine the complex nature of confirmation by treating it as a multidimensional construct. Furthermore, while trust is critical in guiding individuals' behavior in the various settings, few studies on ECM have incorporated trust to test its influence on behavioral intention. Therefore, studies on online shopping integrating trust into ECM will enhance predictive power of ECM.

5.3 Implications for practice

This study also provides several managerial implications for online sellers. The results show that perceived usefulness, satisfaction, and trust are the predictors of repurchase intention. The results also reveal that online sellers could facilitate customers' just perception to enhance customers' usefulness perception, satisfaction, and trust. Therefore, online sellers should use some strategies and mechanisms to improve customers' justice perceptions. For example, online sellers should deploy a standard operating procedure (SOP) and train the employees to better interact with customers based on SOP, including how to deal with customers' complaints, or how to understand customers' requirements and provide effective solutions promptly to improve customers' interpersonal justice (Zhao et al., 2011). In addition, using social network sites, such as Facebook and Twitter, as an additional channel for online sellers to communication with customers is also a useful strategy to promote interaction quality between sellers and customers. Second, in order to improve informational justice, online sellers should provide sufficient and accurate product information in their websites and social networking sites to ensure that customers can receive timely, tailored, and relevant descriptions about product and customer service.

Third, in order to improve procedural justice, online sellers may also convey the information about how they deal with online transactions, such as privacy protection policy, secure mechanism, transaction procedure, and guarantee for transaction safety. Additionally, online sellers should deploy a mechanism to allow customers to query the current status of orders. Finally, online sellers may build a feedback mechanism and encourage their customers to disseminate their positive purchase experiences with sellers. By doing so, customers may realize that purchasing products with sellers may result in positive outcomes. Customers' perception about distributive justice may be facilitated.

5.4 Limitations

Several limitations of this study should be acknowledged. First, the data of this study were collected from customers of a group-buying website in Taiwan. Future research should test the findings of our study in the different group-buying websites test the generalizability of this study. In addition, owing to the difference of culture in different countries, future studies should also test the research model of this study in other counties to examine the impact of cultural variety. Second, there are many other factors that will influence customer satisfaction,

trust, and perceived usefulness, which in turn impacts repurchase intention. Further research could be done by extending this proposed model to incorporate additional suitable components.

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DEVELOPING A HIGHLY RELIABLE CAE ANALYSIS MODEL OF THE MECHANISMS THAT CAUSE BOLT LOOSENING IN AUTOMOBILES

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ABSTRACT
In this study, we developed a highly reliable CAE analysis model of the mechanisms that cause loosening of bolt fasteners, which has been a bottleneck in automobile development and design, using a technical element model for highly accurate CAE that we had previously developed, and verified its validity. Specifically, drawing on knowledge gained from our clarification of the mechanisms that cause loosening of bolt fasteners using actual machine tests, we conducted an accelerated bench test consisting of a three-dimensional vibration load test of the loosening of bolt fasteners used in mounts and rear suspension arms, where interviews with personnel at an automaker indicated loosening was most pronounced, and reproduced actual machine tests with CAE analysis based on a technical element model for highly accurate CAE analysis. Based on these results, we were able to reproduce dynamic behavior in which larger screw pitches (lead angles) lead to greater non-uniformity of surface pressure, particularly around the nut seating surface, causing loosening to occur in areas with the lowest surface pressure. Furthermore, we implemented highly accurate CAE analysis with no error (gap) compared to actual machine tests.

Keywords: CAE, Bolt fastener, Reliable

1. INTRODUCTION
Japan's automotive industry enjoys a position of international prominence. However, since the industry began to address the problem of recalls following greater social awareness of the issue in recent years, there has been a trend toward increases in both the number of recalls and the number of vehicles involved. Serious quality problems such as this threaten the very social status of the companies involved and could end up compromising the status of the Japanese manufacturing industry as a whole, which has traditionally competed successfully with counterparts in other countries. Consequently, it has become a key for companies to pursue measures to address quality defects and to establish systems for preventing such defects.
Moreover, recent diversification of consumer needs is driving the industry toward a super-fast development and design cycle, and it will be difficult for automakers to survive as companies if they are unable to outcompete their rivals, both domestically and overseas. For these

reasons, automakers are seeking to put in place development and design systems that deliver high quality and short lead times and using computer-aided engineering (CAE) to pursue concurrent engineering. In recent years, the industry has sought highly accurate CAE analysis that yields results that do not diverge from actual machine test results, but the state of the art in such analysis has stopped at relative evaluation, which does not allow companies to perform predictive evaluation. The reason for this impediment lies in differences in how companies developing CAE analysis software and their customers in the manufacturing industry use that software.

Against this backdrop, this paper develops a highly reliable CAE analysis model that facilitates a predictive evaluation-oriented CAE design system. We conducted a two-dimensional CAE analysis to determine test characteristics values for actual machine tests and to set three-dimensional CAE analysis parameters drawing on information gained from previous research(Amasaka, 2010: Amaska and Yamaji, 2008: Amasaka and Onodera, 2012: Hashimoto and Amasaka, 2013: Onodera and Amasaka, 2012: Onodera, et al., 2013: Ueno, et al., 2009: Yamada and Amasaka, 2011). Next, we conducted actual machine tests and a three-dimensional CAE analysis. By applying this model so that we could conduct a three-dimensional analysis after setting only a minimum number of test parameters, we were able to boost the accuracy of the prediction and evaluation processes.

To verify the validity of this model, and to provide an example application, we conducted a bolt loosening vibration test using actual vehicle parts and a CAE analysis, focusing on clarifying the mechanisms that cause loosening of bolts. Specifically, we focused on comparing bolts and nuts with different pitches and studied the causes that lead to bolt loosening by comparing the drop in axial force during bolt fastening and assessing the stress distribution at areas of contact on the nut seating surface(Kasei, et al., 2004).

2. HIGHLY ACCURATE CAE ANALYSIS MODEL

In this section, we will focus on the loosening of bolt fasteners and offer a five-step approach to implementing highly accurate CAE analysis in the development and design process, as summarized in Figure 1.

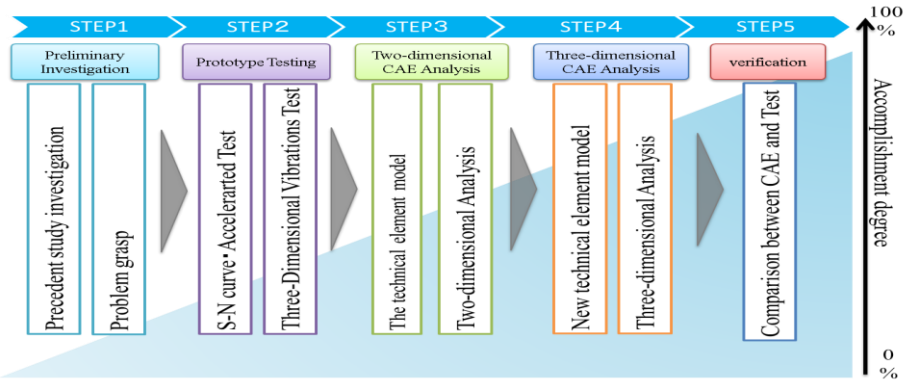

Figure 1_Highly Accurate CAE Analysis Model

2.1 Preliminary Investigation

In order to solve the technical problems that lie behind market complaints (cases where manufacturers are unable to reduce the incidence of functional failures, which is an area of concern in automobile development and design) by determining, for example, why failures occur and the mechanisms that are responsible for them, it is important that step 1 be to engage in cooperative creative activities that bring together the knowledge of in-house and

outside experts. It is also important to use the latest techniques of statistical science to investigate and analyze convergent causal relationships and conduct a detailed analysis of the phenomenon in question in order to deduce the failure mechanism in step 1.

2.2 Prototype Testing

In order to visualize the phenomenon in question, it is necessary to visualize the dynamic behavior that accompanies the occurrence of the problem using actual machines and tests. In this step 2, we search for latent factors that have remained unknown or overlooked using techniques such as N7 (new seven QC tools), SQC (Statistical Quality Control), RE (a reliability technique), MA (multivariate analysis), and DE (experimental design) to analyze the failure and its principal causes in a precise manner.

In this way, the failure mechanism is verified by means of a logical thought process. We also analyze the mechanism based on the phenomena that were visualized through actual machine tests. Then by conducting other tests, we identify issues that could not be fully understood by means of the visualization tests. These issues are identified through the three-dimensional CAE analysis carried out in Step 3.

2.3 Two-dimensional CAE Analysis

In this step 3, we carry out two-dimensional CAE analysis by modeling the phenomenon being studied using CAD based on the parameters obtained during the actual machine tests. The objective is to assess characteristics values and boundary conditions for the three-dimensional CAE analysis and to predict its results.

2.4 Three-dimensional CAE Analysis

Based on the two-dimensional CAE analysis, we then establish a technical element model for three-dimensional CAE analysis and devise an analysis model. In particular, we develop a three-dimensional model that achieves consistency at a qualitative level by using three-dimensional CAD. At this step 4, it will be necessary to conduct actual machine tests that model (qualitatively) the causal relationship characterizing the unexplained mechanism, and it becomes important to select precise calculation techniques, analysis models, and algorithms in order to clearly identify boundary conditions and contact states and conduct a highly accurate numerical simulation.

In addition, we create a technical element model, which is the most important approach model in order to explicate technical problems. Through this process, it is extremely important to shrink the gap by absolute value evaluation of actual machine and tests and CAE results.

In highly reliable CAE analysis, a thorough battery of actual machine tests is performed based on the information gained from the logical thought process described above in order to adequately clarify implicit knowledge about the failure mechanism. Then we integrate the information gained from these work processes to conduct a highly reliable numerical simulation (quantitative modeling) enabling prediction and control of absolute values.

2.5 Verification

In this step 5, we conduct a comparative verification and evaluation of actual machine test results and three-dimensional CAE analysis results. The benefits of this approach model are apparent in its ability to deliver enough accuracy to keep the error within 3%. Additionally, by using a model that increases the accuracy of the analysis, it is possible to transition from relative evaluation to absolute evaluation in the use of analysis results in development. We

believe that this transition will lead to the establishment of a prediction- and evaluation-based design system.

3. EXAMPLE APPLICATION-ANALYSIS OF THE MECHANISMS THAT CAUSE BOLT FASTENER LOOSENING IN BOLT-FASTENED PARTS IN MOUNTS AND REAR SUSPENSION ARMS-

Our purpose was to clarify behavior in terms of stress distribution on nut seating surfaces, which is an important problem when using bolt fastening, and to search for behavior consisting of a reduction in axial force caused by simultaneous vibration from the three axial directions. We focused our tests on the mount and rear suspension arms, both of which are automotive components, and set out to visualize the mechanisms that cause bolt loosening in those parts. To do so, we used fatigue testing (three-dimensional vibration testing) of bolt fasteners to assess the stress distribution on the nut seating surface and the behavior of axial force reduction using time sequences of data.

3.1 Bolts and Nuts Used

We chose M12 10T flanged hexagonal bolts and nuts with three different pitches (0.50 mm, 1.25 mm, 1.75 mm) for testing. Since the bolts and nuts would be used in the rear suspension, we used the largest and smallest pitches of 0.50 mm (see Figure 2) and 1.75 mm (see Figure 4) that could be manufactured in compliance with the JIS standard for bolts and nuts with a pitch of 1.25 mm (see Figure 3).

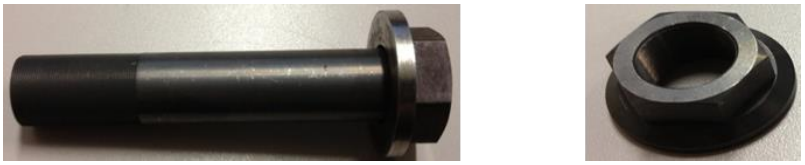

Figure 2_Pitch 0.50mm

Figure 3_Pitch 1.25mm

Figure 4_ Pitch 1.75mm

3.2 Used Equipment

Concerning the equipment used in our tests (see Figure 5), we reproduced a working chassis designed to simulate bench testing of an actual vehicle. Furthermore, the mount and suspension arm shown in Figures 6 and 7 were the automotive parts most prone to loosening according to interviews at Yaei Jidosha Seibikojyo. We combined these parts to conduct tests to subject the bolt fasteners to vibrations in three dimensions.

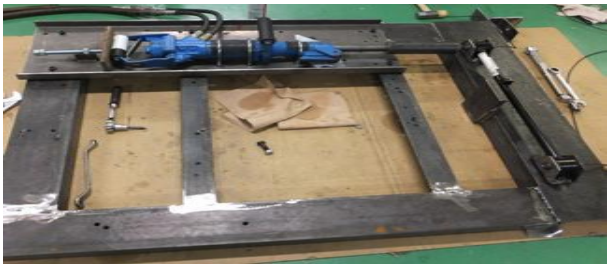

Figure 5_Vibration-Testing Machine

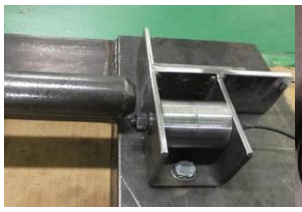

Figure 6_Rigid Part

Figure 7_ Rear Suspension

3.3 Bolt Fastening Test

Our objective in actual machine tests was to ascertain the axial force extraction fastening load at which sliding of the seating surface occurs and to identify the mechanisms that cause bolt loosening due to three-dimensional vibration. First, we determined the stress amplitude value to use in accelerated testing. Furthermore, we identified the loosening mechanism by applying that value to the bolts, nuts, equipment, and parts being used.

3.3.1 Accelerated Test

We used an accelerated test as the first actual machine test. In an accelerated test, it is possible to trigger a failure in a shorter amount of time (smaller number of cycles) than usual by applying a large stress amplitude. Our accelerated stress procedure consisted of creating an S-N curve based on the results of past tests conducted by the Amasaka-Laboratory and then using Miner's rule to calculate the acceleration coefficient (Amasaka and Onodera, 2012: Onodera et al., 2013: Ueno, et al., 2009). We then conducted the accelerated test.

(a)S-N Curve

Figure 8 illustrates the results of plotting a curve consisting of the number of vibration cycles (N) at which bolt loosening occurred in past tests versus the stress amplitude (S) at that point in time.

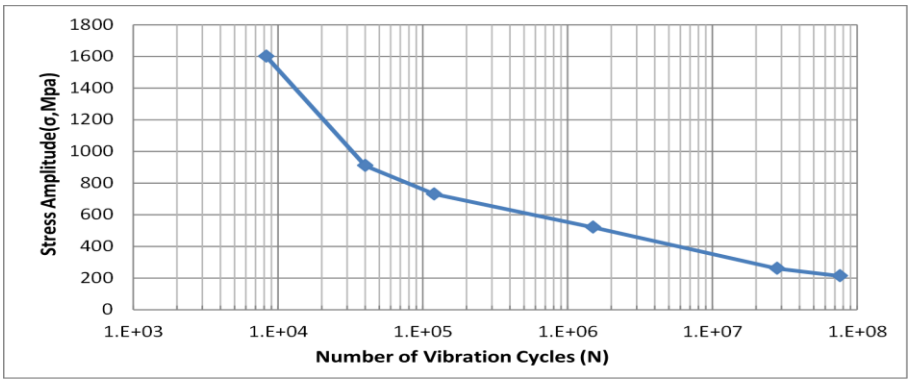

Figure 8_S-N Curve

(b) Miner's rule

$$\sum_{n=1}^{\infty}\left(\frac{n_i}{N_i}\right) = \mathbf{1} \qquad (1)$$

$$N_i * S^{\alpha} = \beta \qquad (2)$$

The approach of Miner's rule can be expressed by equation (1) above. The stress amplitude (S), repeat cycles (N), and stress cycles (n) at the maximum and minimum value points from the S-N curve calculated in (a) are substituted into equation (2) to calculate the acceleration coefficient (α). Then the damage-specific coefficient (β) is calculated from the calculated acceleration coefficient (α) and equation (2), and as a result the stress amplitude (S) is calculated. The stress amplitude value calculated here was used as the stress amplitude in this paper's actual machine tests.

(c)Determining the amplitude output device

Next, we study vibration generators capable of outputting the stress amplitude value calculated using the S-N curve in (a) and Miner's rule in (b). We looked at vibration motors and jackhammers manufactured by EXEN Corp. and Maruzen Co., Ltd., and ultimately chose to use the BH-16 (see Figure 9) as the vibration output device for our actual machine tests.

Figure 9_Jackhammer Manufactured by Maruzen Co., Ltd.

3.3.2 Three-Dimensional Vibrations Test

First, to estimate the vibration load to use in the vibration test, we applied a fastening load of 12 kN to the bolt fasteners in a static test to measure the tester load at which sliding of the seating surface increased abruptly. Specifically, we applied a series of varying three-dimensional vibrations to the fixture holding the mount and rear suspension arm in place (see Figure 5).

Then, we applied vibrations to the tester at a vibration load equivalent to ±20% of the static extraction load. At this point, we ascertained the phenomenon by which bolt loosening occurs due to repeated sliding of the seating surface. In this test, we measured the displacement between the bolt and tester and the trend in the bolt axial force extraction load relative to the number of repetitions. The results are summarized in Figures 10 and 11 below.

In both figures, the 1.25 mm pitch bolts are subjected to vibrations under the same test conditions, but only the suspension arm (see Figure 12) is fastened at both ends by two bolts.

The line graph shows the mount results in yellow, the area of the suspension to which external stress was applied (red circle) in red, and the fixed part on the opposite side (blue circle) in blue. Both show a reduction in axial force, but we found that for the suspension arm, the area shown by the red circle loosened first, and then the area shown by the blue circle loosened in response.
Based on the large reduction in axial force at the mount, we also found a link with suspension arm hazard and the manner in which the bolts loosen.

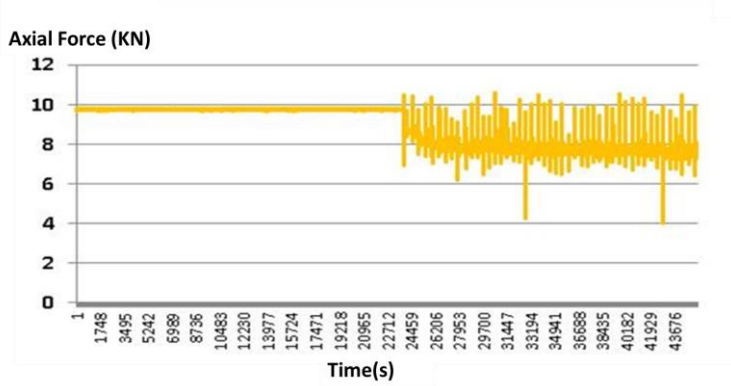

Figure 10_Result of Rigid Part

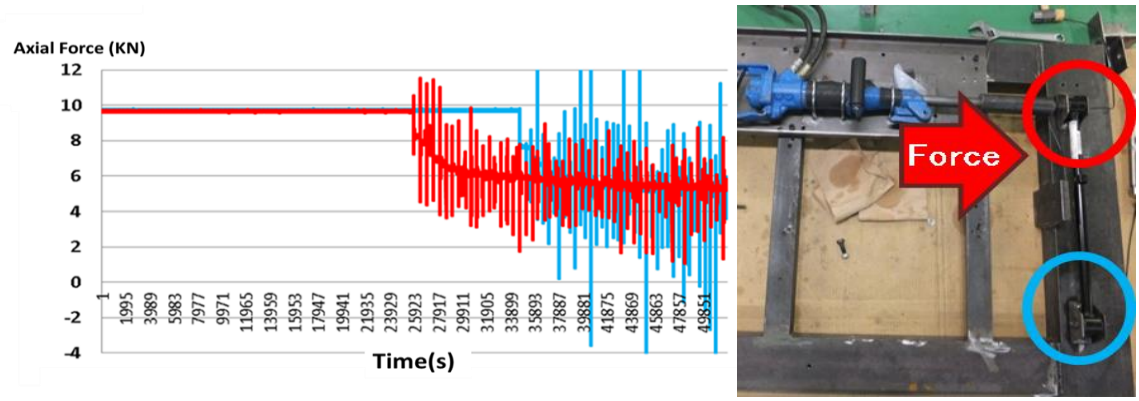

Figure 11_Result of Rear Suspension

3.4 Two-Dimensional Analysis

In this section, we describe how we created a technical element model expressing the elements shown in Figure 12 below in order to ascertain the stress behavior inside the bolt and to improve the accuracy of our three-dimensional CAE analysis. To achieve those objectives, it is necessary to carry out a highly accurate CAE analysis without any inadequacies in terms of modeling, algorithms, theory, or computer technology.
In modeling, the model's material properties must be uniquely selected in the form of a material constitutive model. These properties are then assigned as quantitative values for the constitutive model that defines the material.
In terms of theory, the coefficients of friction serve as important elements. In this case, we assigned the coefficients of friction for the thread and seating surface as quantitative values based on test results. In terms of the calculation technique, we opted to use the penalty method based on consideration of the balance between calculation time and accuracy.
Based on the above considerations, we conducted a finite element analysis using a two-dimensional model taking into account the thread's helical structure and contact.

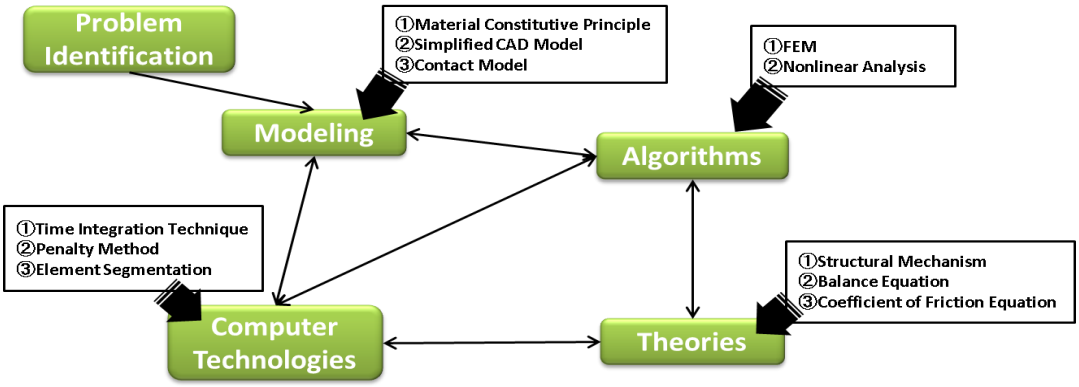

Figure 12_Two-Dimensional Technical Element Model

3.4.1 Result of Two-dimensional Analysis

Figures 13 and 14 illustrate the results of a numerical simulation that applied external force from the left side of the figures to the 0.50 mm and 1.75 mm pitch bolts, respectively, using the same boundary conditions as the actual machine tests. The contours indicate stress, with stress values increasing as the colors change from blue to red. These figures indicate that while the stress spread throughout the bolt with the short 0.50 mm pitch, it was concentrated in the area indicated by the red circle in the bolt with the longer 1.75 mm pitch.

Furthermore, based on the numerical stress distribution, it can be predicted that the 1.75 mm pitch bolt would loosen more readily due to the high load on the thread helix and nut seating surface. Based on this analysis, we were able to estimate such information as the coefficient of friction for each pitch, the element segmentation method, and contact condition, as detailed in Table 1. We then conducted a three-dimensional analysis using the conditions and characteristics values obtained in this step.

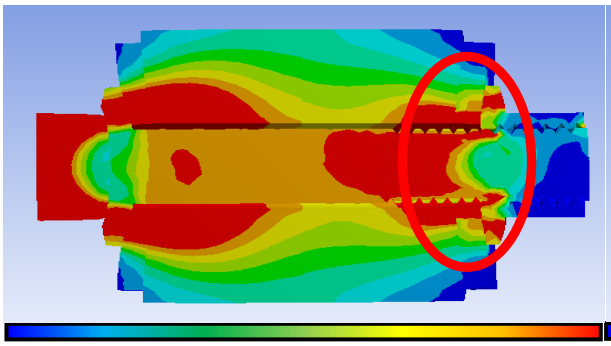

Figure 13_Result of 0.50mm Pitch

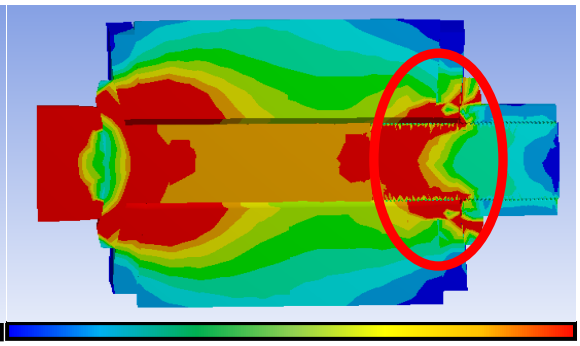

Figure 14_Result of 1.75mm Pitch

Table 1_Information Gained from the Two-dimensional Analysis

Pitch	COF	Element Model	Contact Condition	MAX Stress(Mpa)
0.50mm	0.08691	Equilateral Triangle	Lagrange Multipliers Method	84
1.25mm	0.19398	Equilateral Triangle	Lagrange Multipliers Method	106
1.75mm	0.30420	Equilateral Triangle	Lagrange Multipliers Method	146

3.5 Three-Dimensional Analysis

We created a new technical element model, illustrated in Figure 15, in order to facilitate a highly accurate three-dimensional analysis. Our objectives with this model were to (1) ascertain the contact surface pressure on the nut seating surface and (2) assess the phenomenon of reduced axial force. To achieve these objectives, highly accurate CAE analysis can be performed by implementing modeling, algorithms, theory, and computer technology without any inadequacies. The model diagram expresses the relationships between the elemental technologies of (1) problem identification, (2) modeling, (3) algorithms, (4) theory, and (5) computer technology.

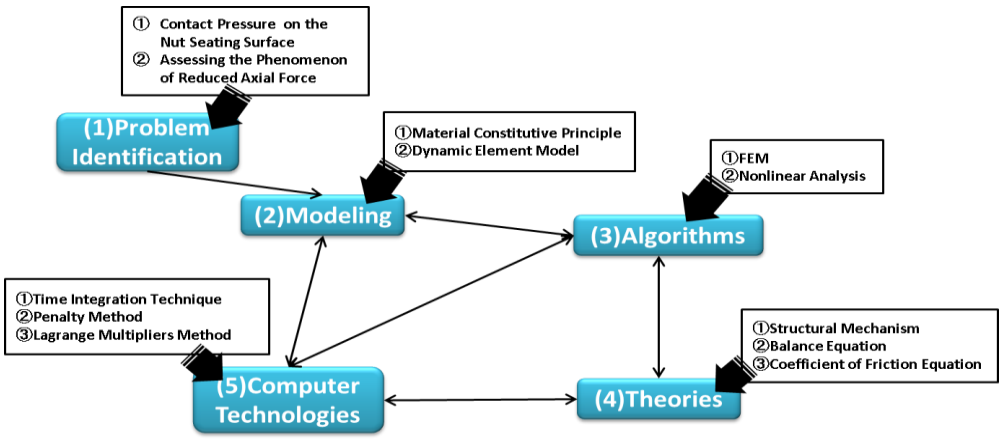

Figure 15_Three-Dimensional Technical Element Model

3.5.1 Problem Identification

We identified the problem as ascertaining the contact pressure on the nut seating surface, as indicated by the example application addressed by this paper, and assessing the phenomenon of reduced axial force.

3.5.2 Modeling

In this section, we model the problem in the form of a mathematical formula. Our dynamic element model used a calculation process that involved applying control to a shape model that reproduced the target objects using CAD(Zhang and Jiang, 2004). The material constitutive principle is necessary in order to numerically assess the target object's material composition values in order to reproduce the results of actual machine tests.

3.5.3 Algorithms

We used the finite element method because it serves as a convenient algorithm. Since it was necessary for us to visualize the contact surface pressure on the nut seating surface in this paper, this approach allowed us to calculate highly accurate results by performing calculations on the level of minute elements. Additionally, we used nonlinear analysis (the Newton-Raphson method) to increase the level of calculation accuracy and set up iterative processing for use when repeatedly calculating, revising, and recalculating solutions(Alba, 2005: Whaley, et al., 2001).

3.5.4 Theories

We used the finite element method because it serves as a convenient algorithm. Since it was necessary for us to visualize the contact surface pressure on the nut seating surface in this paper, this approach allowed us to calculate highly accurate results by performing calculations on the level of minute elements. Additionally, we used nonlinear analysis (the Newton-Raphson method) to increase the level of calculation accuracy and set up iterative processing for use when repeatedly calculating, revising, and recalculating solutions.

3.5.5 Computer Technology

Accurate computer technology is the key to a successful CAE analysis. First, we divided the analysis into steps using the time integration method and performed the necessary calculations. Then we used the penalty method to treat the analysis of the contact surface pressure on the nut seating surface of the bolt fasteners, a nonlinear property, as a linear problem. Additionally, we used the Lagrange multiplier method as a substitute for the penalty method at locations at which we wished to perform particularly highly accurate calculations. However, because that approach requires a higher level of calculation speed than the penalty method, it was necessary to consider the give-and-take between quality and delivery timeframe.

3.5.6 Three-Dimensional Analysis Contents

We then performed our analysis using the algorithms of the technical element model for three-dimensional CAE analysis. This process involves choosing various numerical data and analysis methods. For the CAE model, we uniquely determined the material properties in the form of a material constitutive principle model. Additionally, we assigned properties as quantitative values for the constitutive model that defines the material.

In terms of theory, the coefficients of friction serve as important elements. In this case, we assigned the coefficients of friction for the thread and seating surface as quantitative values based on test results. In terms of the calculation technique, we opted to use the penalty method based on consideration of the balance between calculation time and accuracy.

Based on the above considerations, we conducted a finite element analysis using a three-dimensional model taking into account the thread's helical structure and contact.

3.5.7 Result of Three-Dimensional Analysis

Figures 16 and 17 illustrate the results of an analysis of the contact surface pressure on the nut seating surface immediately after sliding of the seating surface occurred as external force was applied from the bolt part of the bolt fasteners, using the same guidelines as the actual machine test. Both figures show the non-uniformity of stress on the nut seating surface, and it is clear that a high level of stress occurred locally at the beginning of the nut's helical structure. Looking at differences between the two pitches in the area indicated by the red circle, which identifies the beginning of the nut thread's helix, a large amount of stress is distributed across the 0.50 mm pitch nut. In the 1.75 mm pitch nut, the nut has completely loosened and the stress distribution is non-uniform, but there is a high level of stress at the beginning of the thread helix.

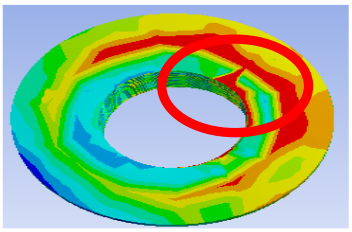

Figure 16_Result of 0.50mm Pitch

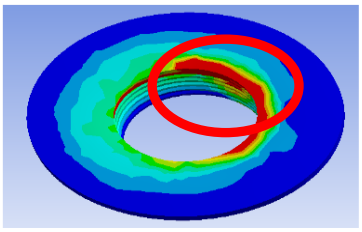

Figure 17_Result of 1.75mm Pitch

Figure 18 provides a relationship diagram illustrating the maximum and minimum stress levels observed in the results of the analysis based on the pitch differences (at the nut seating surface). The larger the pitch, the higher the level of stress, and the minimum stress shows a declining trend. Considering the stress amplitude (average of the maximum and minimum stress values), the amplitude increases with the pitch. The results of our analysis showed that the bolt loosens more easily as the stress amplitude increases.

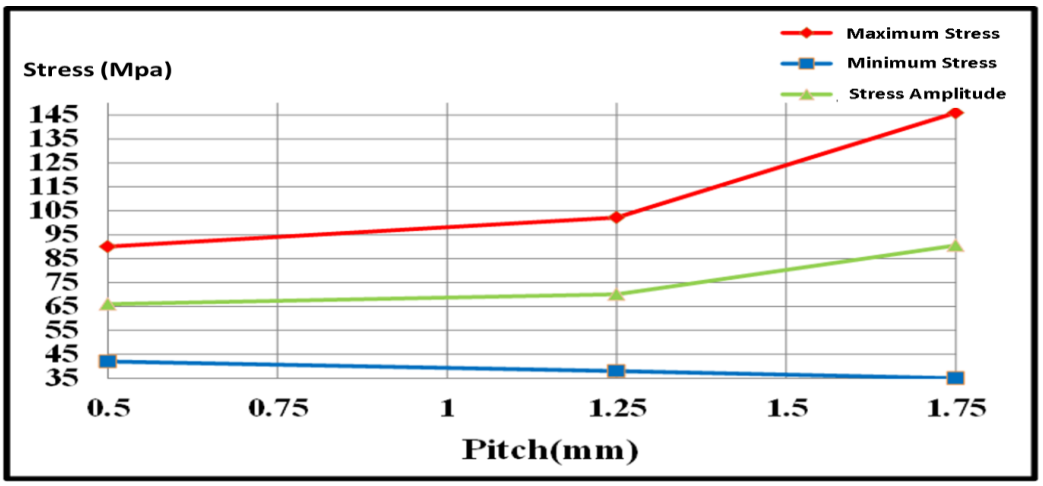

Figure 18_Comparison of Maximum and Minimum Stress on the Nut Seating Surface

3.6 Conclusion of Three-Dimensional Analysis

At this stage, we verified the actual machine tests and CAE analysis results by comparing them from the dual standpoints of time sequence and accuracy. As in the time sequence comparison in Figure 19 axial force is shown on the vertical axis, and number of vibration cycles on the horizontal axis. Actual machine test results are shown in blue, and CAE values in green. The figure reveals that we achieved an analysis with a good level of accuracy in terms of both the timing at which the bolt loosened and in the extent of the decline in axial force. Furthermore, to verify accuracy, we plotted axial force on the vertical axis versus the start and end points on the horizontal axis in Figure 20. The broken lines delineate an error of 3% around the test values; since the CAE analysis results fall within those lines, we can conclude that we were able to conduct a highly accurate CAE analysis.

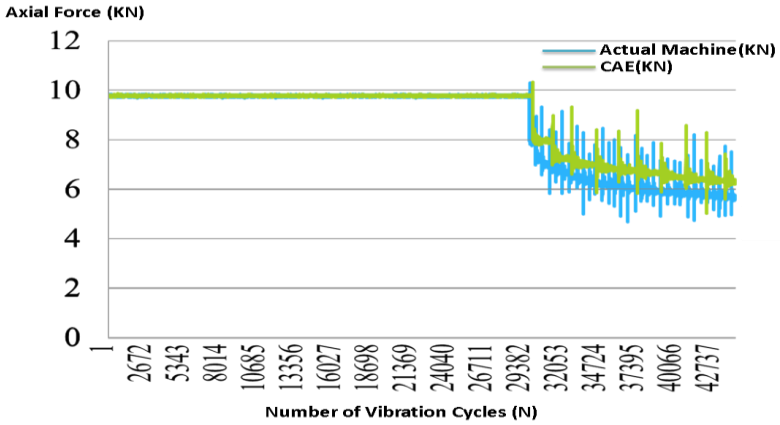

Figure 19_Comparison of Actual Machine and CAE Results (Time Sequence)

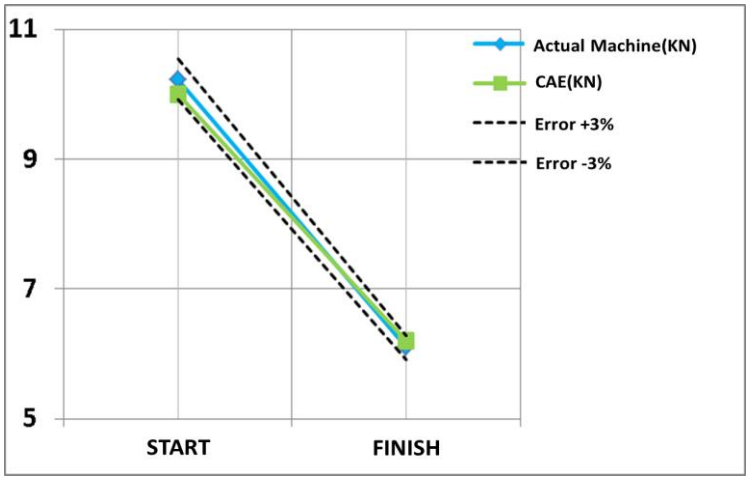

Figure 20_Comparison of Actual Machine and CAE Results (Axial Force)

4. CONCLUSION

In this paper, we developed a highly reliable CAE analysis approach model to help shorten the development and design stage for various manufactured products. We verified the validity of this model by applying it to an analysis of the nut seating surface in automotive bolts and obtained the expected results by conducting a detailed simulation of stress distribution on the nut seating surface.

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THE BUSINESS VALUE OF ENTERPRISE RESOURCES PLANNING SYSTEM (ERP): A PRELIMINARY LITERATURE REVIEW

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ABSTRACT
ERP implementation has already been a very mature research topic. Implementing ERP successfully is not the end of story, but the beginning of a new journey to realize the full benefits of ERP system. ERP benefit studies explore whether and how ERP creates business value for organizations. The objective of this paper is to explore new research directions in the area of ERP business value. Specifically speaking, we propose the following research avenues, investigating the relationship between ERP systems and innovation performance, conducting longitudinal study in this area, investigating the impact of ERP on supply chain management, and seeking appropriate theoretical framework support.

Keywords: enterprise resources planning (ERP), business value, literature review

INTRODUCTION

Enterprise Resource Planning (ERP) is an information system integrating functional silos, such as, finance and accounting, logistics, and human resources, within an enterprise. Blackstone (2010, p50) provided an all-inclusive definition of ERP as "Framework for organizing, defining, and standardizing the business processes necessary to effectively plan and control an organization so the organization can use its internal knowledge to seek external advantage." ERP originated from MRP and MRP II which are designed for manufacturing planning and control. Gradually, with the development of solutions for different industries,

ERP becomes a widely deployed business management system for large enterprises as well as small and medium sized enterprises. A key step in the shift from MRP to MRPII is the integration of accounting system and production system. Integration further drives the evolution from MRPII to ERP (Laframboise and Reyes, 2005). The concept of integration is inherent in the logic of ERP system because all modules share a single integrated database, thus integrating business processes within an enterprise.

Research on ERP comes from different subjects. Accounting scholars consider ERP as an extension, an enhancement or a reorganization of traditional accounting information system (Stefanou, 2006), which reports financial information faster, more accurate and more reliable with embedded controls (Morris, 2011a). Information system academics naturally consider ERP as a major information system investment (Ranganathan and Brown, 2006). Operations management researchers think that ERP directly and obviously integrates business processes, such as production, procurement, inventory management, and distribution (Chou and Chang, 2008). As Anderson, Banker, Menon and Romero (2011) indicated, ERP is an interdisciplinary research field linking accounting, information systems, and operations management research.

ERP implementation experiences strategy development, project initiation, software selection, process mapping, configuration, testing, and go live (O'Leary, 2000). The complexity of ERP implementation leads to high implementation cost making companies unable to afford the failure. To help companies avoid wasting resources and learn from past experiences, earlier research on ERP endeavored to identify critical success factors (CSFs) for implementation, including business process reengineering, change management, user education, and user acceptance (Al-Mashari, Al-Mudimig, and Zairi, 2003). When ERP systems have already entered into a full-fledged stage (Jacobs and Weston, 2007) and ERP implementation has become very mature in different industries (Grabski, Leech, and Schmidt, 2011), it provides an opportunity to explore the more in-depth issues of ERP. One of such issues is whether and how organizations reap benefits from ERP systems. The objective of this review is to explore the potential research avenues in the ERP benefits studies on the basis of a preliminary literature review. For more comprehensive review in ERP studies, Schlichter and Kraemmergaard (2010) and Grabski, Leech and Schmidt (2011) are recommended.

METHOD

This preliminary review is based on about 30 academic articles between 2001 and 2013. The

following keywords, enterprise resource planning/enterprise systems, IS/IT business value/impact/outcome, ERP benefits, organizational/corporate/firm/competitive performance, were searched at ProQuest. Particular attention is paid to top-tier journals in information system, accounting, and operations management, such as, MIS Quarterly, Journal of Management Information Systems, Information & Management, Decision Support Systems, Information Systems Research, Information Systems Journal, Journal of Enterprise Information Management, Journal of Information Systems, Journal of Operations Management, International Journal of Operations & Production Management, Industrial Management & Data Systems, Manufacturing & Service Operations Management, Production and Operations Management. Then, a content analysis was conducted. Because different disciplines have contributed to the ERP research field with different methods, this literature review was organized based on the methodologies used in previous studies.

CAPITAL MARKET AND ACCOUNTING-BASED RESEARCH

The ultimate goal of a business organization is to increase shareholder wealth. Therefore, one stream of ERP benefit research is to investigate whether stock market reacts positively to the ERP implementation announcements by using event study methodology from accounting and finance. The seminal study conducted by Hayes, Hunton and Reck (2001) examined the extent to which ERP increases market value to firms declaring their implementation plans. Generally speaking, capital market reacts favorably to most of the ERP implementation announcements, especially to those made by financially healthy small firms. And, it seems that large ERP suppliers are more welcomed by investors than small vendors. One potential weakness of this study is that the announcement of ERP implementation may not disclose the specific modules and scope of implementation (Morris, 2011a), whereas the role of ERP depends on deploying a series of core modules. This study cannot disclose whether the extent to which ERP systems have been implemented would have different influence on market value of firms. In a response to this weakness, Ranganathan and Brown (2006) revealed that firms deploying ERP systems with broader functional scope and physical coverage capture the highest stock return. Contrary to Hayes, Hunton and Reck (2001), the brand names of ERP vendors make no difference. However, because of short-window event study in these studies, whether ERP can improve firm value in the long term remains unanswered. Along the similar line, Morris (2011b) discovered that firms implementing ERP experience 5-year abnormal stock returns after implementation by using long-window event study.

Besides the capital market research on ERP implementations, another relevant stream is to analyze whether the alleged ERP benefits were reflected in the financial statements. Poston

and Grabski (2001) found residual income and the ratio of period expenses to sales have not been improved significantly, but employee productivity has been increased greatly, after ERP implementation in three consecutive years. In addition, cost of goods sold to revenues decreased only in the third year after ERP implementation. This mixed result in financial performance improvement is contrast to the unanimously positive stock market reaction to ERP implementation in capital market research. This may imply that announcing ERP implementation does not mean the implementation would be a success or directly raise the bottom line. The stock market may overact to the announcement.

On the basis of Poston and Grabski (2001), a series of studies continued to gauge whether ERP implementation improves accounting-based performance measures of an enterprise. Hunton, Lippincott and Reck (2003) showed that return on assets (ROA), return on investment (ROI), and asset turnover (ATO) were considerably better across a three-year period for ERP adopters as opposed to non-adopters. Nevertheless, this advantage over non-adopters is not the result of performance improvement of adopters, but comes from performance deterioration of non-adopters. This result suggests that ERP may be a performance sustainer rather than a performance booster. Nicolaou (2004) observed that firms implementing ERP systems display higher differential financial results only after two years of continual use. It hints that ERP system cannot help an enterprise reap benefits instantly. Different from previous studies, Anderson et al. (2011) inspected the influence of ERP implementation duration on financial performance. The study demonstrated that speedy implementation method outperforms traditional implementation approach in terms of profitability and efficiency.

Because improving profitability is often interwoven with increasing market value to be dual objectives of a business organization, several studies attempt to explore stock market value enhancement and financial performance improvement of ERP implementation simultaneously. Hitt, Wu and Zhou (2002) disclosed that firms investing in ERP are inclined to have more favorable performance in a wide spectrum of financial metrics and higher market valuation. Hendricks, Singhal and Stratman (2007) scrutinized the impact of the most common enterprise systems, ERP, CRM and SCM investment, on firms' long term stock price performance and profitability. The results are mixed. ERP systems do not bring positive stock returns but improve profitability, especially for early ERP adopters.

In summary, capital market and accounting-based research on ERP implementation are not without limitations and weaknesses. In short, stock prices react to a wide variety of factors.

The increase in shareholder value after ERP implementation cannot be fully attributed to the influence of ERP implementation. Financial metrics are highly synthesized results of operating activities, investing activities and financing activities. ERP implementation is only one of business activities. ERP systems are necessary but not sufficient for better financial performance (Poston and Grabski, 2001). In addition, financial measures are usually lagging performance indicators which may not reveal the benefit of ERP implementation very quickly and clearly. Therefore, non-financial metrics measuring operational, managerial, strategic, IT infrastructural and organizational aspects (Shang & Seddon, 2002) should be used to assess ERP benefits. Other methodologies, in-depth case study and large-scale survey, should be employed to understand the details and the mechanisms of ERP influencing organizational performance, because capital market and accounting-based research consider ERP as a black box to improve performance (Hald & Mouritsen, 2013).

CASE STUDY

In order to open the black box, a range of case studies explore the specific ways through which ERP impacts business outcomes. By conducting a single case study on a Canadian aerospace engine manufacturer, Laframboise and Reyes (2005) revealed that ERP affects competitive performance indirectly through its interaction with total quality management initiative and increases the influence of the focal company over its suppliers' quality program. Velcu (2007) adopted a balanced-scorecard approach to assessing ERP benefits by introducing a multiple case study. 14 semi-structured interviews were made for eight mid-sized Finnish companies. ERP benefits in internal processes, customers, learning and growth, and financial were analyzed and summarized in nine observations for ERP implementations motivated by technical reasons and business reasons. Uwizeyemungu and Raymond (2012) claimed that ERP influences business value by its three capabilities, integration, flexibility and transversality, through automational, informational and transformational effects. Three case studies in manufacturing industry through 25 in-depth interviews were performed and a series of propositions were raised. The inherent weakness in these case studies is the lack of generalizability of research findings. Nevertheless, the observations derived and the propositions formulated are valuable for further testing in survey studies that a larger sample size is required for more conclusive research findings.

SURVEY RESEARCH

Some typical survey studies on ERP business value are summarized as follows. Wieder, Booth, Matolcsy and Ossimitz (2006) inspected impacts of ERP adoption, ERP history, and ERP extension on business process performance and overall firm performance. Contrary to the

common belief, ERP adoption does not cause significant performance differences. ERP history only positively relates to overall firm performance. Extending ERP to supply chain areas contributes to better business process performance, but this finding needs to be validated by using a larger sample in future survey studies. Velcu (2010) probed whether ERP systems are conducive to business performance when business strategies align with ERP implementation. The path analysis disclosed that the more ERP matched with business strategy, the more successful ERP was implemented, which in turn leading to internal efficiency benefits through the more positive business process changes, finally internal efficiency benefits bolster customer and financial benefits. By surveying 70 Finnish companies, Kallunki, Laitinen and Silvola (2011) investigated whether formal and informal management control systems (MCS) can be mechanisms mediating the effect of ERP on financial and non-financial performance of a firm. They reveal that formal MCS intervenes positively the effect of ERP on non-financial performance, but informal MCS does not.

Different theoretical lens were applied among the survey studies in order to provide theoretical basis to the mechanism of achieving ERP benefits. Gattiker and Goodhue (2005) investigated intermediate ERP benefits, such as, task efficiency and coordination improvements, through which overall benefits at plant level can be obtained under organizational information processing theory (OIPT) framework. They found out that intermediate ERP benefits mediate the influence of organizational characteristics (interdependence and differentiation) on overall ERP benefits, after controlled for ERP customization, time elapsed since implementation, and data quality. Based on Gattiker and Goodhue (2005), Chou and Chang (2008) proposed that managerial interventions also affect coordination improvement and task efficiency, which in turn influence overall benefits.

Resource-based view (RBV) offers another avenue to recognize the influence of information system within a firm (Wade & Hulland, 2004). Stratman (2007) examined whether a firm's strategic focus influences ERP benefits. The multivariate regression analyses show that firms with operational focus reap larger ERP benefits than firms with market focus. Operational performance partially mediates market focus on market performance and perfectly mediates operational focus on supply chain performance. Therefore, ERP benefits are realized cumulatively and operational performance improvement from operational focus should be the foundation for market and supply chain performance improvements. RBV, OIPT, competitive progression theory and socio-technical theory were quoted to provide theoretical rationales for these findings. From the RBV perspective and using survey data from ERP-implemented manufacturing companies in US, Karimi, Somers and Bhattacherjee (2007)

demonstrated that three IS resources together drive ERP capabilities, which in turn significantly influence business process outcomes, including operational efficiency, operational effectiveness, and operational flexibility. Not only that, IS resources and ERP capabilities complementarily and synergistically impact business process outcomes. Under the framework of contingency theory and RBV, Hwang and Min (2013) analyzed ERP benefits from supply chain perspective. They found that external environment indirectly influences the ERP implementation decision through the mediating role of an internal environment. More importantly, ERP could improve the adopter's supplier capability and performance which create a win-win situation.

DISCUSSION AND CONCLUSION

Because this literature review is of preliminary in nature, the number of papers selected and reviewed is definitely not enough. We still attempt to have a tentative discussion in order to conclude with possible future research avenues.

Although these prior studies explored ERP benefits in terms of financial performance, business value, and organizational performance, whether ERP systems affect innovation performance is still not examined clearly. Innovation is necessary for a company to develop products, offer services, and generate technologies to maintain its competitive advantage over competitors in complex business environment. Hald and Mouritsen (2013) commented that ERP has two opposite effects on innovation simultaneously, on the one hand, limiting or constraining organizational innovation ability; on the other hand, enabling and facilitating organizations to innovate.

In two conceptual papers, Trott and Hoecht (2004a, b) argued that innovation is subjected to human control and is substantially affected by human interaction. Individual creativity plays a great role in the innovation process. Although ERP systems integrate functions of HRM, marketing and R&D to develop products faster, better, and cheaper, ERP suppresses informal human interaction by promoting routines and procedures. A sense of being controlled and reduced autonomy may lower staff morale and impede the potential creativity of the whole organization. On the other hand, efficiently managing the flow of ideas across an organization is what effective product innovation asked for (HassabElnaby, Hwang & Vonderembse, 2012). Masini and Van Wassenhove (2009) indicated that the integration of functional silos in ERP systems tightens link between manufacturing and R&D processes, thus decreasing coordination cost and increasing the speed of product development. Because ERP facilitates information flows on which new product development activities heavily

depend, large volumes of product specification data can be updated and circulated in a timely matter through the value chain. Similarly, Stratman (2007) pointed out that although ERP systems do not directly provide new product development (NPD) benefits, data integration and transaction automation offered by ERP systems may shorten the time to market for new products. To achieve product leadership, enterprise systems like ERP are essential to new product design and development (Bendoly, Rosenzweig & Stratman, 2009). Therefore, a future research area is needed to explore how ERP systems influence innovation performance.

Additionally, previous studies showed mixed results on whether there is time-lag for ERP to influence performance. Ross and Vitale (2000) and Hitt, Wu and Zhou (2002) noticed a dip in business performance after ERP implementation. Others observed improved ERP benefits over time sooner (Hunton et al., 2003; Nicolaou, 2004; Gattiker & Goodhue, 2005) or later (Wieder et al., 2006), whereas Seddon, Calvert and Yang (2010) did not take it for granted that ERP always brings benefits over time. It appears that it is necessary to conduct longitudinal study to investigate the time effect of ERP systems. As Stratman (2007) indicated, large-sample longitudinal survey research is needed to justify the value of ERP systems.

Most of ERP business value studies focus on the influence of ERP on the performance of a single enterprise. However, the current business competition has transferred from single companies to different supply chains. An enterprise must cooperate with its suppliers and customers, thereby calling for supply chain integration which is built upon internal integration within an enterprise. ERP has been proved to be the best vehicle towards such internal integration (Gattiker & Goodhue, 2005; Chapman & Kihn, 2009). Its benefit towards supply chain integration, however, is lacking in previous studies. Therefore, studies on ERP benefits from the supply chain perspective are much needed.

Table 1 shows that most of the studies lack of theoretical support. Among studies with theoretical support, organizational information processing theory (OIPT) and resource-based view (RBV) are widely applied to construct the research models. OIPT asserts that alignment between information processing mechanisms and organizational context influences organizational performance (Gattiker & Goodhue, 2005). It focuses on coping with uncertainty by deploying information systems (Galbraith, 1973; Tushman & Nadler, 1978). RBV argues that unique resources help a firm improve performance and attain competitive advantage (Hwang & Min, 2013). From this perspective, ERP can be considered as one of strategic resources that may complement with other enterprise resources to enhance business performance. In this sense, RBV may provide broader perspective in explaining ERP

influence. Therefore, RBV can be the theoretical framework for ERP business value studies as suggested by Melville, Kraemer and Gurbaxani (2004).

Table 1- A Classification of ERP Benefits Studies by Theoretical Framework

Theoretical Framework	**Studies**
OIPT	Gattiker & Goodhue (2005), Stratman (2007), Chou & Chang (2008)
RBV	Karimi et al. (2007), Karimi et al. (2007), Stratman (2007), Uwizeyemungu & Raymond (2012), Hwang & Min (2013)
Others	Poston & Grabski (2001), Stratman (2007), Hwang & Min (2013)
No theory	Hayes et al. (2001), Hitt, Wu & Zhou (2002), Hunton, Lippincott & Reck (2003), Nicolaou (2004), Laframboise & Reyes (2005), Ranganathan & Brown (2006), Wieder et al. (2006), Hendricks et al. (2007), Velcu (2007), Velcu (2010), Kallunki et al. (2011), Morris (2011b), Anderson et al. (2011)

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THE INFLUENCE OF PRODUCT LIFECYCLE ON THE DEMAND MANAGEMENT PROCESS IN SUPPLY CHAINS

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ABSTRACT
The aim of the paper is to examine the influence of the length of product lifecycle on the demand management process in supply chains. In order to meet this aim, empirical research was conducted among 270 supply chain leaders, representing manufacturing and trading companies. Principal Component Analysis (PCA) with Varimax rotation was performed in order to identify the components of the demand management process. The results were described in the context of three groups which were distinguished with regard to the length of lifecycle of the offered products.

Keywords: demand management, length of product lifecycle, product groups, supply chain processes

1. INTRODUCTION
The coordination of flows between companies operating in global supply chain structures requires possessing reliable information about the market demand. The significance of possessing appropriate information in a supply chain was already highlighted by Forrester in 1950s (Lee et al., 1997), when the effect of enhanced demand changes increasing upward the supply chain was observed. This was the beginning of works related to the implementation of tools, methods or strategies in companies, which would allow to eliminate such negative effect. One of the processes working against the demand uncertainty and variability, as well as the resulting instability of entire supply chains, is the demand management process, which was recognized by The Global Supply Chain Forum as one of the main supply chain management processes (Lambert ed., 2008).
Demand management is the process intended to estimate future demand volumes in order to synchronize activities within the framework of a particular company, whether it is a production, trade or service company (Croxton et al., 2001). The very components of this process in the context of supply chain management have been widely described in the available literature (compare: Lambert ed., 2008; Mentzer and Moon, 2005; Crum and Palmatier, 2003; Mendes, 2011). However, there is a lack of individualized approach and determination of significance of particular components in respect of particular product groups.

One of the highly significant determinants, referred to in his studies by Fisher (1997), is the product lifecycle. Therefore, the examination of the impact of product lifecycle seems to be an interesting and inspiring problem, both in the theoretical and empirical context.
The following structure of the article was proposed in order to achieve this aim. The introduction is followed by the explanation of the notion of product demand management, and then by the description of the significance of product lifecycle in supply chain management. Based on these considerations, the methodology of empirical studies conducted on the sample of 270 European supply chain leaders was proposed. The obtained research results were presented and discussed. Finally, conclusions were drawn and further possible continuations of the undertaken subject matter were presented.

2. PRODUCT DEMAND MANAGEMENT IN A SUPPLY CHAIN

Demand management is defined in many areas of management-related sciences, e.g. marketing, sales, economic forecasting or logistics. It is universally applied, e.g. in the marketing theory. Kotler (1999) claims that demand management is strictly dependent on the marketing activities, which influence the product demand. Following this line of thought, demand management may be treated as marketing management and both notions may be used interchangeably. However, the scientists dealing with the notion of demand management in the context of supply chain management have adopted a slightly different perspective. Mentzer and Moon (2005) regard demand management as a coordination of the flow of information concerning demand across a supply chain, i.e. they base their definitions on efficient product demand planning process, whose main assumption is a relevant information flow between supply chain links (Chen and Wolfe, 2011). This approach has its roots in the forecasting theory, where one of the main stages consists in collecting and analysing data (Makridakis et al., 1998). Crum and Palmatier (2003) focus on a different aspect. In their opinion, demand management is mainly a reaction of supply chains to customer needs in connection with their analysis and reaction to the changing market situation. This approach combines the aspects of marketing and product management. Meeting customer needs is also a significant element of the definition quoted by Croxton et al. (2002). According to them, this process is the coordination of activities intended to meet the demand reported by customers, taking into consideration the company capabilities and resources; it refers to reaching balance between customer needs and company capabilities; it also means planning and organization of extraordinary or emergency activities in the case of occurrence of unforeseen events. Such approach is compliant with the assumptions of the integrated business process concept, i.e. S&OP (Sales and Operations Planning), which was developed by Oliver Wight (Sheldon, 2006). The concept was developed in 1980s and its main assumption consists in maintaining balance in a company between the demand, understood as customer needs, and supply, that is available resources and capabilities of a particular organization (Ling, 2000; Chen and Wolfe, 2011). S&OP is a decision-making process thanks to which tactical plans of all functional units are coordinated with one another and their completion contributes to meeting market needs and making profit (Grimson and Pyke, 2007; Bozarth and Handfield, 2006). The aim of this concept is to reach consensus within the framework of one plan, determining the method of dividing the most important resources, i.e.: people, production capacity, materials, time and money (Ling, 2000).
In each of the above definitions, the key elements are information flow and meeting customer needs, therefore demand management is an attempt to find balance between the demand - meeting customer needs, and the supply - company capabilities and resources (i.e. budget,

production, inventory). The definition of demand management frequently includes the word 'process', referring to a logical and time-organized sequence of activities resulting in a specific external or internal effect. Crum and Palmatier (2003) distinguish between four main stages of the demand management process: (1) demand planning, (2) demand plan verification against company capabilities / resources (budget, production, inventory, etc.), (3) determination of the demand plan, taking into consideration the undertaken marketing and sales efforts, (4) customer order management. Referring to the classic organization management (Stoner et al., 2006), demand management may be defined as art or practice of applying reasonable means for reaching determined demand goals. Then the notion may be considered in respect of classic management functions and, modifying the stages defined by Crum and Palmatier (2003), the demand management process may be divided into: (1) demand planning - goal setting, (2) organization - determination of the method to reach the specified goal, e.g. selection of distribution channels, (3) motivation - organization of marketing activities, (4) control of determined demand plans - determination of target completion level and verification of undertaken activities.

Croxton et al. (2002) represent a different approach, according to which the distinction between strategic and operational elements constitutes a significant element in identifying components for managing product demand in a supply chain. Demand management in a long period (strategic demand management) provides a general framework for essential company decisions, which have a direct impact on the formation of future demand. On the other hand, operational aspects refer to directing everyday activities, taking into consideration strategic aims. Demand management should be regarded as a process both in the strategic and operational context (Croxton et al., 2002).

Table 1 - Demand management process stages (Croxton et al., 2002)

DEMAND MANAGEMENT	
as a strategic process	**as an operational process**
1. Setting aims and strategies 2. Determining forecasting procedures 3. Planning information flow 4. Establishing the synchronization procedure 5. Development of emergency management system - defining scenarios 6. Development of critical values for indices / errors verifying the correctness of the determined plans	1. Collecting data and information 2. Forecasting 3. Synchronization of demand and supply 4. Reduction of uncertainty and increase of flexibility 5. Evaluation of errors in the determined plans - measurement of accuracy

The demand management process in the strategic approach is begun by setting aims and strategies. Managers must take a decision concerning the aspects which should be stressed – that is, whether the application of suitable forecasting tools and methods, or quick reaction and operational flexibility will be most important factor. Here, the identification of product demand variability is essential. The next stage consists in determining forecasting procedures, i.e. taking a decision concerning the suitable organization of the forecasting process, as well as significance and scope of information used in this process. The following issues are important here: planning horizon, sources of information, methods and tools, as well as the level of forecast aggregation (demand planning for the entire volume, or planning individual units (Bozarth and Handfield, 2006)). When the forecasting procedures have been defined, the

next step is to determine the communication network, i.e. to plan the information flow. In demand management, the important thing is the communication between supply chain links, which allows for reducing the Forrester effect, if it is organized in a proper way (Lee et al., 1997). This is possible mainly due to the application of ERP class systems (Enterprise Resource Planning) (Mentzer et al., 2007) and methods of supporting cooperation between companies in the field of product demand planning, i.e. common planning, forecasting and replenishment strategies - CPFR (Collaborative Planning, Forecasting and Replenishment) (Mendes, 2011), or VMI (Vendor Managed Inventory) (Jaspersen and Skjott-Larsen, 2005). It is not only the cooperation and information flow between companies forming a particular network of relations (supply chain) that matters. Equally significant is the synchronization of activities within the framework of a particular company, i.e. the balance between the demand and the supply. These assumptions are in line with the sales and operation planning concept - S&OP, which had already been discussed before. Another two concepts, which allow for finding a balance between customer needs and orders on one side, and production, logistics, marketing and sales costs on the other, are MRP (Manufacturing Requirement Planning) and DRP (Distribution Requirement Planning). At this stage of demand management, the unit responsible for planning and synchronization, as well as the units involved in the process - recipients of the determined plans - are appointed. The fifth stage of demand management in the strategic approach consists in developing the emergency management system. The scenario method, which is one of the heuristic methods of decision-making, is an indispensable tool in this field. As a result of its application, it is possible to identify the events which may disrupt the balance between the demand and the supply - i.e. the synchronization of activities within a particular company in order to determine realistic demand plans. At this stage it is equally important to determine the significance and extent of risks in demand plans which may be caused by specific events. The last step in the described process consists in establishing indices and measures which will allow for evaluating the course of particular stages. Apart from the set of tools, also the limit values, enabling to evaluate whether the performed activities are correct, are specified. One of the measures recommended by Croxton et al. (2002) for evaluating the demand management process in the strategic approach is the EVA (Economic Value Added). This is the difference between the operating profit after taxation and the cost of invested capital (Grant, 2003), an index which allows for evaluating the added value of implemented projects in a particular organization. Other universally applied process measures are forecast errors, specifying to what degree the determined plans have been confirmed by the execution of sales transactions (Makridakis et al., 1998). Another index which may be used for the evaluation of demand management process is OTIF (On Time In Full), universally applied in economic practice and logistics, which determines the level of customer satisfaction. This is a parameter specifying whether the delivery reached the customer on time and at the right volume, as well as measuring the proportion between the number of complete supplies executed in a timely manner against all supplies within a particular company (Christopher, 2013).

At the operational level, product demand management refers to the very process of establishing the forecast on the basis of previously established strategic assumptions. The course of the process begins with collecting relevant information which is to be used later in the forecasting process, i.e. historical data concerning demand or sales, marketing and sales data from the market, or data from ERP class systems obtained from direct customers. The second stage is the data analysis and forecast determination. The most important element at this stage is tracing the forecast errors. It is thanks to them that managers are able to evaluate

the forecasting process, as well as trace and analyse discrepancies between the forecast and actual sales on an ongoing basis. The third step is to synchronize activities in everyday planning within a particular company. At this stage meetings of units involved in the process, which are the recipients of the determined plans, are organized. The synchronization includes particularly areas such as: sales, finances, supply, distribution and production. The fourth stage is the continuation of the previous one and it also concerns synchronization. However, it includes a wider context, i.e. the cooperation between supply chain links in order to reduce uncertainty and increase the operational flexibility. The final stage consists in measuring results and evaluating the determined plans in accordance with the adopted indices, in line with the agreed operational strategy.
Because demand management includes several dimensions, the following research question has been raised:

RQ1: what are the major demand management practices performed in supply chains?

3. THE SIGNIFICANCE OF PRODUCT LIFECYCLE IN THE DEMAND MANAGEMENT PROCESS IN SUPPLY CHAINS

Kotler and Keller (2012) define product lifecycle (PLC) as the formation of product sales and profits in the period from the moment of appearance of a particular product in the market until its withdrawal from that market. This concept is significant in supply chain management due to various actions and strategies applied at different stages of the product lifecycle (Higuchi and Troutt, 2008). There is a difference between the formation of supply chains at the stage of introducing a product in the market and the approach applied at the maturity stage, or during the decline (Bruce et al., 2007; Rogers et al., 2008). Fisher (1997) focused on a different aspect of product lifecycle and classified supply chains with regard to the length of product lifecycle, which serves for distinguishing between two groups of products: functional and innovative. Functional products are traditional products, characterized by long product lifecycle and relatively regular demand reported by customers. Contrary to them, innovative products are products for which the intensity of customer interest declines rapidly. The margin for such products is significantly higher than the margin for functional products. The reasons for such high margins are: high costs of conducting research on a particular product, the costs of introducing market innovation, as well as a high risk of quick withdrawal of a product from the market and replacing it with a different one. Innovative products are characterized by large variations within a particular category - even up to several thousand different types of products are frequently distinguished. These are products with unpredictable demand, and the management of such products is compared to decision-making in the financial market due to a similar risk related to making a wrong decision. The comparison between functional and innovative products due to demand characteristics has been presented in table 2.

Table 2 - Basic characteristics of market demand for functional and innovative products in supply chains.

Characteristics of market demand	**Product type**		**Measure**	**Measure value interpretation**	
	Functional	**Innovative**		**Functional**	**Innovative**
Demand predictability	high	low	Share of demand forecast error in the actual market demand value	10%	40% - 100%
Demand variability degree	stationary	non-stationary			
The length of product lifecycle	long lifecycle	short period of sales during the season	Duration of product lifecycle	more than 2 years	From 3 months to 2 years
			Average price reduction after the season as a proportion between the discounted price and the season price	0%	10% - 25%
Profit amount	low	high	*Contribution margin(*)* as the difference between the sales income and variable costs	5% - 20%	20% - 60%
Product differentiation	standard product	individualized product	Number of specific product variations	Between 10 and 20 variations	Frequently millions of variations
Volume level per stock keeping unit (SKU)	mass product	unit product			
Cost of lack of inventory	low	high	Average rate of lack of inventory	1% - 2%	10% - 40%
Costs of risk related to product ageing	low	high			

Source: Own work based on: Fisher, M.L (1997), "What is the Right Supply Chain for Your Product?" *Harvard Business Review*, Vol. 75, No.2, pp. 105-116; Lee, H.L. (2002) "Aligning Supply Chain Strategies with Product Uncertainties," *California Management Review*, Vol. 44, No. 3, pp. 105-119.

(*) - margin is calculated as price minus variable costs, divided by price and expressed in per cent

Demand management of functional products is based on quantitative methods. These are products for which it is possible to obtain historical data concerning demand volume, which enables to apply both statistical and econometric methods in the forecasting process. The selected product strategies are based on plans, whereas cooperation and exchange of information between supply chain links is rarely applied. It is within this product group that the Forrester effect is noticeable, and the following industries may serve as example: paper industry, FMCG (fast-moving consumer goods), such as e.g. food products, cleaning products, cosmetics, automotive and steel industry. In order to avoid the bullwhip effect efficiently, it is necessary to integrate activities, and especially the information flow within the framework of demand management across the entire supply chain, which is enabled to a different degree by concepts, i.e. effective cooperation with a customer - ECR (Efficient Consumer Response), VMI (Vendor Managed Inventory) or CPFR (Collaborative Planning, Forecasting and Replenishment).
Demand management for innovative products is partly the opposite of the above-described situation. Here, it is not possible to gain access to historical data, because they do not exist. Forecasting is based on market research, or expert and qualitative methods. Due to a high probability of issuing a wrong forecast, scenario methods are also applied. If it is possible, the companies providing innovative products try to depart from forecasting and move to the *pull* concept (Harrison et al., 2003), i.e. activities based on customer orders. Therefore, although the product group is completely different from the one described above, also here the cooperation between supply chain links is significant, however, in a wider context. With short lifecycles, apart from the exchange of information between companies, it is necessary to reduce the order completion time and react quickly to the changing customer needs. The product must be designed, produced and delivered to the market within relevant time, without delays, which is possible, among other factors, thanks to flexible approach and QR (Quick Response).
However, based on the considerations above, the following research questions arise:

RQ2: if it is sufficient to mention two product groups due to the length of product lifecycle, or is it worth to introduce a division into short, medium and long lifecycles?

Therefore, the additional question is emerging:

RQ3: what are the significant demand management practices in supply chains occurring in those three groups of products – short, medium and long lifecycles?

4. RESEARCH METHODOLOGY OF THE INFLUENCE OF PRODUCT LIFECYCLE ON THE DEMAND MANAGEMENT PROCESS IN SUPPLY CHAINS

In order to answer the above research questions and to identify the influence of product lifecycle on the demand management process in supply chains, the results of research based on primary sources were used. The data were collected by means of interviews conducted among production and trade companies, located around Europe. The applied research instrument was the interview questionnaire, allowing for the examination of the demand management process from the point of view of the length of product lifecycle.

4.1. CHARACTERISTICS OF SURVEY SAMPLE

The sample was compiled from the surveys of manufacturing and trading companies operating in supply chains, and initially included 270 organizations. Those firms were leaders or major links located upstream, in the middle or downstream in their supply chains

established by three subsequent major links and accompanying logistic and non-logistic service providers. As a result of the initial data analysis, screening and elimination of observations with missing values, 231 supply chain leaders remained as a subject of further analysis.

The majority of the surveyed firms (57 percent) are trade companies, whereas the remainder of the research sample are manufacturers. The prevailing share of the companies operate in wholesale and retail grocery sector (18 percent), fabricated metal products, industrial and commercial machinery sector and manufacturing of motor vehicles (a total of 12 percent), followed by the companies from a mining industry (6 percent), trading companies (selling cross-industry products, mainly household goods – 4 percent, clothes – 6 percent, chemicals – 4 percent, electronic equipment – 4%).

The survey sample selection was non-probabilistic, so the drawing mechanism was not applied. Only the organizations which expressed their consent took part in the research. Due to this, statistical deduction was not applied for the interpretation of results, whereas the results of empirical data analysis were formulated very carefully, rather in the form of noticeable tendencies than definitive and representative conclusions. Such approach in the research process has a descriptive character and is connected with the necessity to maintain an appropriately high level of reliability of the conducted analyses and conclusions based on them.

4.2. CLASSIFICATION OF RESEARCH SUBJECTS

65 independent variables describing the demand management process were distinguished for the analysis. The first step of the research process consisted in performing the factor analysis - PCA (Principal Component Analysis) with Varimax rotation with Kaiser normalization in order to reduce the number of variables to a smaller set.

The measure of individual sampling adequacy for each of the 65 variables was the inverse covariance matrix. Only the variables whose value on the diagonal was above the cut-off point of 0.5 were selected for analysis (Schmidt and Hollensen, 2006). The number of variables was reduced to 26, which described the examined phenomenon (i.e. demand management process) in over 70 % (Aczel, 1993),

The Kaiser-Mayer-Olkin measure of sampling adequacy at the level of 0.804 was obtained for the performed factor analysis. The obtained result confirms the relevance of applying the factor analysis, because its value is above 0.5. KMO informs that the proportion of variables may be explained by separated factors at the level of 80.4 %.

For each construct, Cronbach's alpha coefficients were used to assess the internal consistency of variables. Their values are above the nominal cut-off point of 0.7 and thus may be considered to be reliable, as they suggest good internal consistency of the ten constructs (George and Mallery, 2003). The PCA factor analysis conducted for 26 variables provided the following structure of 8 factors (table 3):

- Factor 1 - Cooperation strategies applied in the product demand management process
- Factor 2 - Data input sources - customer orders
- Factor 3 - Information flow
- Factor 4 - Data input sources - demand forecasts
- Factor 5 - Relevance of strategic and operational plans determined on the basis of historical data
- Factor 6 - Emergency management system
- Factor 7 - Application of dedicated software in order to determine demand plans in the case of high demand variability and uncertainty
- Factor 8 - Evaluation of the product demand management process

Table 3 - Results of the performed factor analysis

Variables	Component							
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
Product demand uncertainty							-0.665	
Product demand seasonality							0.706	
Product demand increase / decrease dynamics							0.588	
Application of the dedicated software in order to determine the demand forecast							0.703	
Relevance of the determined demand plans							0.567	
Quantitative methods are universally applied in the forecasting process				0.706				
The demand forecasts are the basis of demand plans				0.639				
Evaluation of average forecast error for main product groups for the last financial year								0.741
Direct customers participate in determining product demand plans		0.503						
Customer orders constitute the basis for determining plans		0.698						
The determined demand forecasts are highly significant for the production department		0.558						
Customer orders are a universally applied source of information in the demand management process		0.767						
Strategic planning is highly significant in the demand management process					0.743			
Operational planning is highly significant in the demand management process					0.676			
Historical data are a basic source of information used in the product demand planning process					0.525			
Demand management processes supported by MRP	0.688							
Demand management processes supported by S&OP	0.821							
Demand management processes supported by VMI	0.832							
Demand management processes supported by CPFR	0.829							
Demand management processes supported by DRP	0.752							
Demand management processes supported by QR	0.739							
Application of scenarios taking into consideration unforeseen internal events						0.806		
Application of scenarios taking into consideration unforeseen external events						0.803		
Demand plans are agreed with the supply department			0.622					
Demand plans are agreed with the production department			0.703					
Demand plans are agreed with the distribution department			0.713					
Variance [%]	13.85	11.89	9.78	8.86	8.09	7.72	7.37	5.29
Cumulated variance [%]	13.85	25.74	35.52	44.38	52.47	60.18	67.55	72.84

The obtained factors may be directly referred to the demand management process stages described by Croxton et al. (2002) (see table 1). Relations between the obtained factors and process stages are presented in table 4.

Table 4 - Stages of demand management process and their equivalents in the form of distinguished factors

Product demand management process in the strategic approach	Factor analysis results
1. Setting aims and strategies	Factor 2 - Data input sources - customer orders Factor 4 - Data input sources - demand forecasts Factor 5 - Relevance of strategic and operational plans determined on the basis of historical data
2. Determining forecasting procedures	Factor 7 - Application of dedicated software in order to determine demand plans in the case of high demand variability and uncertainty
3. Planning information flow	Factor 3 - Information flow
4. Establishing the synchronization procedure	Factor 1 - Cooperation strategies applied in the product demand management process
5. Development of emergency management system - defining scenarios	Factor 6 - Emergency management system
6. Development of critical values for indices / errors determining the correctness of the determined plans	Factor 8 - Evaluation of the product demand management process

Table 4 is the answer for the first research question. The PCA factor analysis allows to specify the most significant demand management practices in the studied supply chains.

4.3. ANALYSIS OF THE SIGNIFICANCE OF PRODUCT LIFECYCLE IN THE DEMAND MANAGEMENT PROCESS IN SUPPLY CHAINS

In order to analyse the influence of the length of lifecycle on the demand management process, average factor grades were determined for particular groups. The division into groups was made due to the length of product lifecycle. Three categories of the length of product lifecycle offered by the analysed production and trading companies were determined - up to 2 years, from 2 to 10 years and above 10 years. The basis for the selected factor grouping is the division proposed by Fisher (1997). However, on the basis of the previous practical experiences in analysis, one additional group was taken into consideration, i.e. products for which the lifecycle is longer than 10 years, in order to check whether there is a difference between the demand management for products with average and long lifecycles. The results of average factor assessments for a particular group were presented in table 5.

Table 5 - Average factor assessments in respect of the length of product lifecycle

Product demand management process factors	Product lifecycle (0-2]	(2-10]	(10-…)
Cooperation strategies applied in the product demand management process	**0.16**	-0.03	0.03
Data input sources - customer orders	0.13	**0.21**	-0.14
Information flow	-0.26	**0.16**	0.02
Data input sources - demand forecasts	-0.24	-0.02	**0.16**
Relevance of strategic and operational plans determined on the basis of historical data	0.01	**0.13**	-0.04
Emergency management system	**0.13**	-0.01	-0.05
Application of dedicated software in order to determine demand plans in the case of high demand variability and uncertainty	**0.27**	-0.03	-0.08
Evaluation of product demand management process	-0.09	**0.10**	-0.03

The obtained results were also subject to analysis in the context of operational planning. In order to determine whether the adopted demand management strategies function and enable to perform everyday operations, the following indices were calculated for particular groups with

regard to the length of product lifecycle: (1) average forecast error, (2) sales margin, (3) standard order completion time, (4) special order completion time, (5) order completion levels with regard to flexibility, reliability, timeliness, completeness and inventory availability of supplies. The obtained results for particular groups have been presented in table 6.

Table 6 - Evaluation of the demand management process in respect of the length of product lifecycle

Process evaluation criteria			Product lifecycle (0-2]	Product lifecycle (2-10]	Product lifecycle (10-…)
forecast error		%	**11.40**	7.58	8.52
sales margin		%	15.14	17.75	**21.41**
standard order completion time		days	10	17	**31**
special order completion time		days	25	27	**88**
order completion level	supply flexibility	%	70.13	**87.53**	71.79
	supply reliability	%	81.25	**82.11**	79.69
	supply timeliness	%	81.89	**83.86**	81.43
	supply completeness	%	79.38	**83.63**	83.14
	product inventory availability	%	**65.22**	58.02	44.99

The obtained results, both in table 4 and 5, are the answers of the research questions no. 2 and 3, and confirm that the length of product lifecycle is significant in the course of the product demand management process in supply chains. Both elements, process activities and indices, are significantly different in three distinguished groups.
A detailed discussion of the results, which is the answer to the research questions, is presented below.

4.4. DEMAND MANAGEMENT PROCESS FOR PRODUCTS WITH SHORT LIFECYCLE

The group consists of 55 companies, which are the leaders of their supply chains, which constitutes 24 % of the examined population. The demand for products with short lifecycle offered by those companies is characterized by a high variability and uncertainty, as well as a lack of historical data allowing to determine the sales forecast. This is the reason of the lack of possibility to apply statistical and econometric methods, for which it would be necessary to collect data from at least two settlement periods (Makridakis et al., 1998). Therefore, individual approach is required for such products, whereas forecasting methods are based on heuristic methods supported by mathematical methods dedicated for particular product groups (Fisher and Rajaram, 2000; Stojanovic, 1994; Burruss and Kuettner, 2002/2003). Due to a short lifecycle, information flow in respect of long-term cooperation, such as beginning cooperation within the framework of VMI or CPFR, does not play a significant role. The application of other methods and concepts, such as QR, is significant. A good example here is the Inditex group, operating in the clothing industry, which introduces to the market products characterized by lifecycle not longer than half a year. The implementation of the Quick Response strategy by the group allows it for delivering products to the market within two weeks from the moment of reporting the demand by the network managers, through designing and production stages, to the completion of the supply to the shops. This is an exception in the industry, for which the lead time for introducing products in the market from the moment of creating a product until the moment when the product appears on shop shelves is approximately half a year on the average.
In the event of frequent introduction of new products in the market, there is a high probability of a failure (Wasson, 1994). Due to the demand uncertainty, it is necessary to implement and universally apply emergency management by creating scenarios. The evaluation of demand management process plays a secondary role, which is evidenced by the average forecast error at the highest level among the three described groups. Due to the short lifecycle, it is not

necessary to monitor demand on a constant basis. The applied approach is the one where demand plans and forecasts are determined at the stage of product designing, prior to the introduction to the market (Burruss and Kuettner, 2002/2003), as evidenced by companies such as HP or Intel.
Looking from the perspective of the indices defining everyday operating activities in the demand management process for products with short lifecycles, three parameters should be highlighted. The first two are standard and special order completion time. In both these cases it is the lowest for the three described groups and amounts to 10 and 25 days respectively. What is surprising is the fact that for this product group the inventory availability is the highest of the three described ones. This may be explained by the necessity to create a forecast already at the stage of designing the product, which is directly connected with production in line with a specific schedule. Due to high logistic costs, related to the formation of new distribution channels, the margin for such products is the lowest of all described categories.

4.5. DEMAND MANAGEMENT PROCESS FOR PRODUCTS WITH AVERAGE LIFECYCLE
Products with average lifecycle are present in the market for 2-10 years. This group includes 33 % of the analysed population. The period of moderately stable sales at the maturity stage is relatively long (Higuchi and Troutt, 2008), which could indicate its application in forecasting historical data, however, the basis for forecasting demand plans are customer orders. This is a classic approach to planning activities in a supply chain in accordance with the *pull* concept (Harrison et al., 2003), where it is necessary to include the direct customers in the demand forecast determination process. The obtained information in the form of customer orders is the basis for determining necessary schedules and launch of production. Strategic and operational plans, applied in the management of companies and entire supply chains, are formed on the basis of historical data. However, this is not the main source of information used for developing demand plans. An example of industry operating in line with these rules is the automotive industry, where production is launched at the moment of submitting an order by a customer, and the determined strategic and operational plans are the basis for creating sales targets in particular trade units.
In the demand management process for products with average lifecycle, information flow within a company plays a significant role. Demand plans are verified and agreed with the supply, production and distribution departments. This is the evidence of applying strategies such as: Sales & Operations Planning, Material Requirement Planning and Distribution Requirement Planning. However, internal integration does not incline companies or entire supply chains to use other concepts, such as VMI or CPFR, which constitute the basis for integration in the supply area.
The evaluation of product demand management process is significant for the analysed companies providing products with average lifecycle for the market. The forecast errors are the lowest of all analysed groups. This is caused by the integration of activities in the field of distribution and application in the process of planning customer orders. Thanks to such approach, such companies, and therefore the entire supply chains, are able to avoid the Forrester effect.
In comparison with the products with short lifecycle, the order completion time, both standard and special, is extended. This is the result of acting in line with the assumptions of the MTO (Make to Order) concept (Naylor et al., 1999). The described group is characterized by the highest indices of customer service level, such as: flexibility, reliability, timeliness and completeness of supplies. Also for such results, the justification may be the integration of activities at the bottom of the supply chain. The knowledge of the customer market allows for better adjustment of logistic activities to expectations of customers and particular markets.

4.6. DEMAND MANAGEMENT PROCESS FOR PRODUCTS WITH LONG LIFECYCLE

The last group (most numerous, constituting 43 % of the described population) are companies offering products with long lifecycle (above 10 years). The obtained results confirmed the previous hypotheses, stating that the demand management process for products with average and long lifecycles are executed in different ways. A significant difference consists in departing from the bottom integration and transition to top integration of the supply chain - in the field of supply. The activities are not undertaken on the basis of customer orders, but rather the opposite - they are based on demand forecasts. The demand is characterized by a high stability, and the length of lifecycle provides access to historical data from at least a few, or even several settlement periods. In the demand forecasting process, it becomes possible to apply quantitative methods based on statistical and econometric models (Makridakis et al., 1998), which is one of the main reasons for the unwillingness to integrate activities in the distribution area. However, as it was already mentioned, the integration of activities is undertaken in the supply area. Such companies are disposed to begin acting e.g. in accordance with the Vendor Managed Inventory concept, where suppliers manage the inventory. The fast-moving product (FMCG), pharmaceutical or construction industries can be used as examples here.

Among the indices describing the demand management process, margin requires specific focus, as it is the highest among all analysed groups. This suggests that such products are at the lifecycle maturity stage and they constitute the so-called 'cash cows' (George 1986; Karin et al. 1990). This group is characterized by the longest order completion time among all described categories. Customers have to wait average 3 months for special orders. This result unambiguously indicates the maintenance of high stock levels and acting in accordance with the *push* - MTS (Make to Stock) concept (Naylor et al. 1999). Interestingly, despite maintaining high stock levels, the availability of inventory product is the lowest and does not exceed 50 %.

5. CONCLUSION AND FURTHER RESEARCH

The obtained results show that the product lifecycle is significant in the demand management process in supply chains, which is one of the main processes allowing to achieve success in global supply chain management (Lambert ed., 2008). However, the performed research does not exhaust the undertaken subject matter. From the point of view of global supply chain management, the essential thing is the integrated approach and cooperation both with suppliers and customers. Therefore, the obtained results should be referred to the strategy of cooperation between partners in supply chains and determine the level of integration required for particular product groups. Both information and product flow are interesting in this respect.

Another area worth exploring are the issues related to the subject of product management. The research area undertaken in the article referred only to the single-dimensional segmentation of products in respect of the length of product lifecycle. The problem of product segmentation due to other criteria, including demand variability, number of items offered in stock, or product levels, appears to be interesting (Kotler, 1999). The distinction between product groups in respect of developing a relevant product portfolio, which is usually highly diversified and includes profitable products, as well as those which seem to be withdrawn from the market, also deserves attention. In such context, it seems to be appropriate to apply models for evaluating product portfolios (George, 1986; Karin et al., 1990), e.g. Boston Consulting Group matrix, whose components are the market growth rate and product market share, or General Electric matrix, where classification of products is based on competitive position and market attractiveness.

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IMPACT OF SURFACE ACTING ON EMOTIONAL EXHAUSTION AND CUSTOMER- PERCEIVED SERVICE QUALITY: MODERATION OF SALES ORIENTATION

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ABSTRACT
This study aims to examine the moderating effect of sales orientation on the indirect relationship between surface acting and service quality mediated by emotional exhaustion. The empirical results obtained from the data collected from salespersons-customer dyads in the service industry in Taiwan, including 127 salespersons and 631 of their customers indicate that indirect relationship between surface acting and service quality is moderated by sales orientation. Specifically, this relationship is stronger when sales orientation is higher.

Keywords: emotional labor, emotional exhaustion, sales orientation, service quality

INTRODUCTION

In the service industry, frontline employees are important to create positive customer experiences and achieve good organizational performance. Today, it is common for organizations to emphasize the importance of regulated emotional displays from frontline employees for influencing customers' perceptions during service encounters. Therefore, employees need to modify their true feelings to display the emotion expected from the organization, referred to as "emotional labor" (Grandey, 2000; Hochschild, 1983). Grandey (2000) defines emotional labor as "the process of regulating both feelings and expressions for the organizational goals" (p.97). Research has shown that different emotional display strategies result in different consequences such as burnout, work withdrawal, changes in job satisfaction, and impact on job performance (Morris and Feldman, 1996; Pugliesi, 1999; Rafaeli and Sutton, 1987), although some researchers have found inconsistent results (Grandey, 2003). Recent research began focusing on the factors that might cause such inconsistency, particularly the *moderating effect* of contextual, personal, or interpersonal factors such as emotional intelligence (Wong, Wong, and Law, 2005), organizational support (Duke, Goodman, Treadway, and Breland, 2009), and personality (Austin, Dore, and O'Donovan, 2008).

In sales environment, besides emotion display strategies, salesperson's selling strategies also impact on customer satisfaction and purchases. Two of most recognized selling strategies are customer orientation and sales orientation. However, this is not yet fully understood in emotional labor research. We propose the employee's degree of sales orientation as a moderating mechanism and focus on how it changes the effects of emotional labor strategies on the customer's perception of service performance. In particular, we employ the

conservation of resource theory (COR theory) to explain the moderating effect of sales orientation (SO) on surface acting, emotional exhaustion, and service quality.

This study contributes to the literature in several ways. First, we theoretically and empirically analyze the effect of surface acting on service quality mediated by emotional exhaustion. Second, we emphasize the role of sales orientation as a moderator in the relationship between emotional exhaustion and service quality. By examining this effect, we will be able to extend the boundary condition discussed in emotional labor research. Moreover, we expect to provide a better understanding of how sales orientation moderates the effects of surface acting, emotional exhaustion, and service quality.

CONCEPTUAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Surface acting and its negative consequences

A key element of a service job is to deliver high-quality service to achieve a high level of customer satisfaction (Tsai and Huang, 2002). Service work often requires employees to suppress negative emotions and express positive emotions. Emotional labor is emotional expression and regulation ascribed as a part of the work. The purpose of emotional labor is to influence customers' perceptions during the service interaction, and it involves two strategies: surface acting and deep acting. Employees can choose either strategy when interacting with customers. Surface acting involves managing observable expressions, often considered "faking in bad faith" (Zapf, 2002). Deep acting involves managing and regulating feelings (Wang, Seibert, and Boles, 2013), often considered "faking in good faith" (Rafaeli and Sutton, 1987); here, besides regulating the expressive behavior, the inner feelings are manipulated (Mishra, 2011).

When an employee displays emotions at work, it could be done through either surface acting or deep acting. Regardless of which acting strategy is adopted, emotional labor itself requires an individual's emotional effort and behavior modification to comply with job requirements, and these could lead to a higher level of job-induced tension and stress (Brotheridge and Lee, 2003; Chau, Dahling, Levy, and Diefendorff, 2009; Grandey, 2003), lower self-esteem, or emotional dissonance (Abraham, 1999).

COR theory is one of the most commonly used theories to understand employees' stress and the consequences of stress in organizational settings. The basic concept of COR theory is that "people have an innate as well as a learned drive to create, foster, conserve, and protect the quality and quantity of their resources" (Gorgievski and Hobfoll, 2008). When one faces situations that may lead to a possible loss of physical, personal, or social resources, they will typically try to compensate for the lost resources and minimize potential threats to them. In other words, people are capable of finding ways to replace and protect resources. Individuals feel stressed when their important resources are threatened with loss, when resources are lost, and when they fail to obtain resources after making a significant investment (Hobfoll, 1989, 2001).

According to COR theory, deep acting consumes less resources because it requires employees to reassess the service environment to change their inner feelings and regulate their external emotions (Liu, Liu, and Geng, 2013). Often, customers perceive deep acting as authentic and sincere, and are thus more likely to respond positively (Mishra, 2011). On the contrary, for an employee who uses the surface acting strategy, the discrepancy between the inner emotions and outer expression demands more resources, which can cause psychological strain and a stronger feeling of resource loss. The drain of emotional resources without a source of replenishment could lead to a faster loss of resources and result in emotional dissonance

(Grandey, 2003). Emotional dissonance is strongly associated with emotional exhaustion (Lee and Ashforth, 1996; Wright and Hobfoll, 2004). Emotional exhaustion, the state of fatigue and depletion of psychological resources (Maslach and Jackson, 1981), is one of the most common consequences of emotional labor (Grandey, 2003; Lee and Ashforth, 1996; Wright and Hobfoll, 2004). When employees face emotional exhaustion from surface acting without a way to replenish resources after significant investment, they may attempt to minimize further loss of psychological resources by reducing their willingness to interact with customers or by responding negatively to customers (Côté, 2005; Mishra, 2011; Wright and Bonett, 1997). Nevertheless, research on deep acting does not find a similar effect for emotional exhaustion; in fact, it is found to have no effect in some cases. Therefore, surface acting is probably related to higher emotional exhaustion and lower service quality.

> *Hypothesis1:* Emotional exhaustion mediates the negative relationship between surface acting and service quality.

Sales orientation as facilitator of further resource loss

Personal selling strategies are emphasized in selling context because they could be directed toward customer satisfaction and purchase decisions. Customer orientation (CO) and sales orientation (SO) are two most identified selling strategies. SOCO often is measured as one facet, treating it as one continuous continuum, however recent studies have treated SO-CO as two separated dimensions, and confirmed the presence of two separated facets (Brown, Widing, and Coulter, 1991; Thomas, Soutar, and Ryan, 2001), however empirical implementations are still quite limited (Faramillo, Ladik, Marshall, and Mulki, 2007).

Customer orientation is considered a fundamental concept to marketing management as it refers to the degree a salesperson engages to the practice of marketing concept. Saxe and Weitz (1982) defined customer orientation as "salesperson in practicing marketing concept by satisfying customer's needs". Salespersons with customer orientation (CO) understand the marketing concept and attempt to satisfy customers' needs and develop a strong, long-term relationship with them (Boles, Babin, Brashear, and Brooks, 2001; Lopez, Carr, Gregory, and Dwyer, 2005).

Sales orientation is a factor of "sales orientation—customer orientation" (SOCO).Contrast to customer orientation, salespersons with sale orientation (SO) put their or the organization's needs before the customer's needs, and encourage customers to purchase as much as possible (Arndt and Karande, 2012). In other words, sales orientation focuses on "getting the sale," and possibly use sales techniques to get the customer to buy (Bosworth, Page, and Sherman, 2003); customer orientation focuses on efforts to understand customer needs in order to help them make the best choice (Boles et al., 2001; Faramillo et al., 2007).

On organization side, SOCO is important to the organization since it influences various organization outcomes such as employee innovation, job satisfaction, organizational commitment, turnover intention, job performance (Faramillo et al., 2007). On customer side, customer orientation is key to impact customer relationship, customer satisfaction and loyalty (Faramillo et al., 2007).

Conventional marketing wisdom suggested customer orientation is essential for positive performance, research nevertheless has obtained inconsistent results (Dunlap, Dotson, and Chambers, 1988; Frank and Park, 2006; Swenson and Herche, 1994). In fact, day-to-day business practices found not every salesperson or firm places customer-orientation philosophy (Wachner, Plouffe, and Grégoire, 2009). Wachner et al. (2009) call for empirical attention

shift to sales orientation because for sale to be done, specific selling skills must be present even when the salesperson adopts customer orientation (Wachner et al. , 2009), and salespersons are better off with sales orientation.

Based on the COR theory, we propose SO as a facilitator that will worsen the relationship between emotional exhaustion and service quality. Unlike some service industry frontline workers who provide services without any pressure to make a sale, a salesperson's job performance is often measured by the number and value of sales achieved. In other words, they have to practice marketing (satisfy customer needs) and try to fit the product to customer needs if they do not want to lose business to their competitors. Research shows that when a firm's top management is sales orientated, salespersons have more problems with role conflict and stress and lower job satisfaction (Sumrall and Sebastianelli, 1999). Sumrall and Sebastianelli (1999) point out that while sales orientation may not have a direct negative effect on sales performance, it does have an effect on a salesperson's role identity. Therefore, sales orientation could further deplete salespersons' psychological resources, even without directly affecting their sales performance. We argue that for salespersons using the surface acting strategy, which already influences emotional exhaustion, sales orientation will further increase their level of stress and indirectly affect the customers' perceived level of service quality.

> *Hypothesis2:* The indirect relationship between surface acting and service quality mediated by emotional exhaustion is ***moderated*** by sales orientation; this relationship becomes stronger with higher sales orientation.

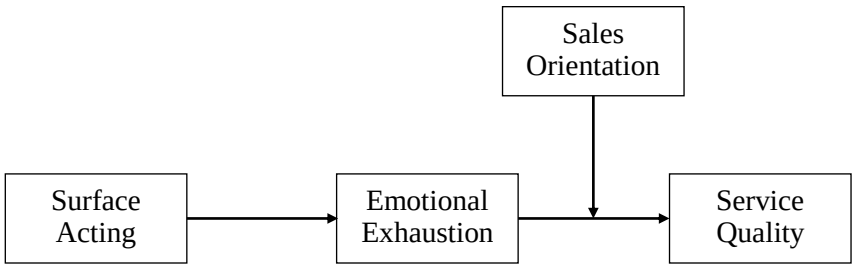

Figure 1 – Research Framework.

METHOD

Sample and Procedure

Our sample is drawn from salespersons in four industries, including banking consultants (investment advisors), department store salespersons, real-estate brokers, and telecommunication service salespersons in metropolitan areas of southern Taiwan. These salespersons have high emotional labor requirements (Hochschild, 1983). Organizations in these industries in Taiwan must also train their employees to display appropriate emotions when interacting with customers. In the survey, we asked the direct supervisors of salespersons to administer and distribute the questionnaires to one salesperson and three to five of their customers who directly received the salesperson's services. The questionnaire for salespersons included the variables surface acting, deep acting, emotional exhaustion, sales orientation, and customer orientation. The questionnaire for customers included the variable service quality; these questionnaires were administered either immediately on site or were taken home by customers after the service interaction was complete. All completed questionnaires were returned in sealed envelopes to the salespersons' supervisors or

researchers. Among the 236 survey packages distributed, 127 were returned. Specifically, we received questionnaires from 127 employees and 631 of their customers, with response rates of 53.81% and 53.47%, respectively. Uncompleted questionnaires and those missing values on all variables were excluded, resulting in a final sample size of 124 participants and 613 customers. The breakup of the considered industries is as follows: banking (45.2%), department store (22.6%), real estate (17.7%), and telecommunication (14.5%). The salespersons in the sample were mostly females (70.2%), with an average age of 32.63 (SD = 7.87). The average work experience for the salespersons was 4.31 years (SD = 5.43). Even the customers were mostly females (60.2%), with an average age of 35.4 (SD = 10.49).

Measures

Surface acting. To measure surface acting, we used Diefendorff, Croyle, and Gosserand (2005) developed 7-item scale. Responses in 5-points Likert scale ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). A sample item was "I put on an act to deal with customers in an appropriate way." The Cronbach's alpha coefficient was 0.91.

Emotional exhaustion. We used the exhaustion dimension of the MBI-GS (Maslach Burnout Inventory-General Survey) scale to assess emotional exhaustion. A sample item was "I feel used up at the end of the workday." Responses in 5-points Likert scale ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). The Cronbach's alpha coefficient was 0.91.

Sales Orientation (SO). We used Thomas et al. (2001) 5-item scale, which is a revised version of the 12-item sales orientation scale developed by Saxe and Weitz (1982). Responses in 5-points Likert scale ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). A sample item was "I try to sell as much as I can, rather than satisfying customers." The Cronbach's alpha coefficient was 0.83.

Service quality. We assessed service quality using Gremler and Gwinner (2000) 6-item scale. A sample item was "In thinking about my relationship with this person, I enjoy interacting with this employee." This scale rated by 3 to 5 customers the salesperson served; responses in 5-points Likert scale ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). The Cronbach's alpha coefficient was 0.95.

Control variables. We control for customer orientation and deep acting in our analysis. *Customer orientation* was measured using a 5-item scale revised by Thomas et al. (2001). A sample item was "I try to understand a customer's needs." The Cronbach's alpha coefficient was 0.89. *Deep acting* was measured using Diefendorff et al. (2005) 4-item scale. A sample item was "I work on developing my inner feelings that I need to show to customers." The Cronbach's alpha coefficient was 0.86. Both scales responses in 5-points Likert scales. We also controlled for industry, the customer's gender, and the customer's age to account for the mediating effect of sales orientation.

Confirmatory Factor Analysis

We conducted confirmatory factor analysis (CFA) to examine how well the data fit the proposed model. Table 1 presents a description of the models and their results. Supporting the independence of the five focal constructs, results indicated that the five-factor model (χ^2 (289) = 504.674; NNFI = .875; CFI = .889; RMSEA = .078; SRMR = .082) fit the data better than the other models. For service quality, based on the data collected from customers, we conducted one-factor CFA to examine whether the six items were loaded onto one factor. The result indicated that the data fit the one-factor model well (χ^2 (9) = 43.587; NNFI = .976; CFI = .986; RMSEA = .079; SRMR = .018).

Table 1 – Confirmatory Factor Analysis of Nested Models

Model	χ^2	df	$\Delta\chi^2$	Δdf	NNFI	CFI	RMSEA	SRMR
One-factor model	1615.959***	299			.265	.323	.188	.195
Two-factor model	1258.753***	298	357.206	1	.462	.506	.161	.174
Three-factor model	893.078***	296	365.675	2	.663	.693	.128	.134
Four-factor model[a]	718.258***	293	174.820	3	.758	.782	.098	.121
Four-factor model[b]	679.824***	293	38.434	0	.780	.801	.103	.101
Five-factor model	504.674***	289	175.150	4	.875	.889	.078	.082

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: SA= surface acting; DA= deep acting; EE= emotional exhaustion; SO= sales orientation; CO= customer orientation; SQ= service quality. One-factor model (SA+DA+EE+SO+CO); Two-factor model (SA+DA+EE, SO+CO); Three-factor model (SA+DA, EE, SO+CO); Four-factor model[a] (SA, DA, EE, SO+CO); Four-factor model[b] (SA+DA, EE, SO, CO); Five-factor model (SA, DA, EE, SO, CO)

RESULTS

Table 2 reports the mean, standard deviation, bivariate correlation, and scale reliability for all the studied variables.

To reduce multicollinearity and facilitate the interpretation of the findings, all variables were grand mean centered. First, hypothesis 1 predicts that the negative relationship between surface acting and service quality is mediated by emotional exhaustion. As shown in Table 3, surface acting significantly predicts emotional exhaustion (β = .301, SE = .128, $p < 0.05$). However, emotional exhaustion could not predict service quality (β = -.011, SE = .041, $p > 0.05$), so hypothesis 1 was not supported. Second, hypothesis 2 predicts that the indirect relationship between surface acting and service quality mediated by emotional exhaustion is moderated by sales orientation. According to Table 3, the interaction term significantly predicts service quality (β = -.129, SE = .036, $p < 0.001$). We have plotted this interaction at conditional values of sales orientation (1 SD above and below the mean) in Figure 2. This graph indicates that the relationship between emotional exhaustion and service quality is stronger when sales orientation is higher. To further determine whether sales orientation strengthened the indirect relationship as predicted by hypothesis 2, we consider an alternative

Table 2 – Means, Standard Deviations, and Bivariate Correlations Among All Studied Variables

Variables	*Means*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1.Industry	2.02	1.10	—											
2.Gender(S)	1.70	.46	-.02	—										
3.Age(S)	32.63	7.87	-.18*	-.25**	—									
4.Tenure(S)	4.31	5.43	-.54***	-.01	.39***	—								
5.Gender(C)	1.61	.24	-.21*	.41***	-.08	.07	—							
6.Age(C)	35.30	7.22	-.30**	-.19*	.52***	.34***	-.13	—						
7.SA	3.52	.76	.11	.11	-.28**	-.12	.06	-.29**	(.91)					
8.DA	3.85	.64	-.07	.11	-.07	.05	.07	-.08	.40***	(.86)				
9.EE	2.73	.88	-.06	.10	-.14	-.10	.03	-.05	.25**	.09	(.91)			
10.SO	2.60	.82	.21*	.03	-.35***	-.26**	.06	-.38***	.28**	.09	.04	(.83)		
11.CO	4.08	.49	-.19*	.04	.02	.11	.09	.06	.06	.20*	-.26**	-.20*	(.89)	
12.SQ	4.07	.41	-.11	.10	-.01	.13	.20*	.02	.14	.26**	-.05	-.01	.30**	(.95)

Note: N=124. Reliabilities are reported in parentheses along the diagonal. Industry was codes as 1 for banking, 2 for department store, 3 for estate, and 4 for telecommunication. (S)= service officer; (C)= customer. Gender was codes as 1 for male and 2 for female. SA= surface acting; DA= deep acting; EE= emotional exhaustion; SO= sales orientation; CO= customer orientation; SQ= service quality.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

model by M*plus* 7.0, including the first stage, second stage, direct, indirect, and total effect of the moderator (sales orientation). The results are shown in Table 4, and we have plotted the moderated mediation interaction in Figure 3. This graph indicates a pattern consistent with our prediction. Specifically, the indirect relationship between surface acting and service quality mediated by emotional exhaustion is stronger when sales orientation is higher.

Table 3 – Overview of Model Results

	Emotional Exhaustion				Service Quality			
	Estimate	S.E.	Est. /S.E.	*p-value*	Estimate	S.E.	Est. /S.E.	*p-value*
Intercepts	.508	.531	.956	.339	-.512	.386	-1.324	.185
Control variables								
Industry	-.164*	.079	-2.086	.037	.023	.040	.570	.569
Gender(Service officer)	.107	.185	.579	.563	-.001	.089	-.014	.989
Age(Service officer)	-.008	.011	-.720	.472	-.005	.006	-.811	.417
Tenure(Service officer)	-.024	.017	-1.420	.156	.011	.007	1.524	.127
Gender(Customer)					.246	.139	1.774	.076
Age(Customer)					.005	.006	.822	.411
Deep acting	.065	.136	.476	.634	.100	.064	1.561	.119
Customer orientation(CO)	-.587***	.147	-3.991	.000	.144*	.072	1.990	.047
Independent variables								
Surface acting(SA)	.301*	.128	2.345	.019	.044	.056	.789	.430
Mediator								
Emotional exhaustion(EE)					-.011	.041	-.255	.799
Moderator								
Sales orientation(SO)	-.136	.100	-1.361	.174	-.007	.049	-.151	.880
Interaction								
SA*SO	-.001	.131	-.009	.993	.062	.052	1.183	.237
EE*SO					-.129***	.036	-3.560	.000

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4 – Overview of Significant Moderated Mediation Effects

	First Stage Effect	Second Stage Effect	Direct Effect	Indirect Effect	Total Effect
Low_ SO (-1 SD)	.302 (.179)	.095 (.052)	-.007 (.068)	.029 (.023)	.022 (.070)
High_ SO (+1 SD)	.300 (.154)	-.116 (.049)*	.095 (.073)	-.035 (.025)*	.060 (.073)
Diffidence	.002 (.214)	.210 (.059)***	-.101 (.086)	.063 (.033)*	-.038 (.090)

Note. SO= sales orientation (SD= .8163). Standard errors are reported in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

DISCUSSION AND CONCLUSION

We examined the moderating effect of sales orientation on the indirect relationship between surface acting and service quality mediated by emotional exhaustion. We developed an integrated conceptual framework by using the conservation of resource theory (COR theory), and the results show that only hypothesis 2 tested is supported. The insignificance of the mediation of exhaustion in the relationship between surface acting and service quality shows that surface acting is harmful to employees' well-being but not necessary jeopardizes the customer's perceived service quality. This finding is partially consistent with that of Grandey (2003). Moreover, the significant moderation of sales orientation (SO) means that when a salesperson is surface acting, the interaction effect of emotional exhaustion and SO could result in a higher level of customer dissatisfaction. Specifically, when a salesperson

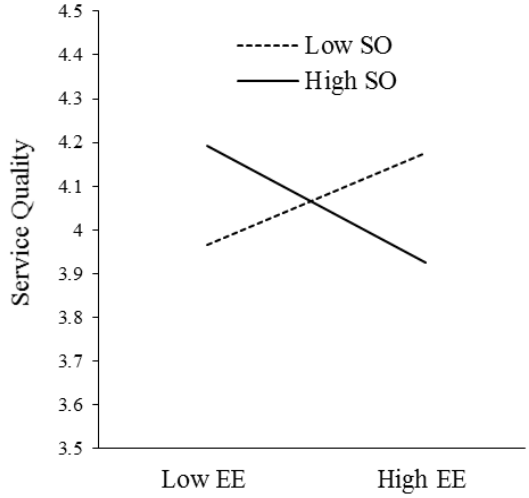

Figure 2 – Sales orientation (SO) moderates the effect of emotional exhaustion (EE) and service quality.

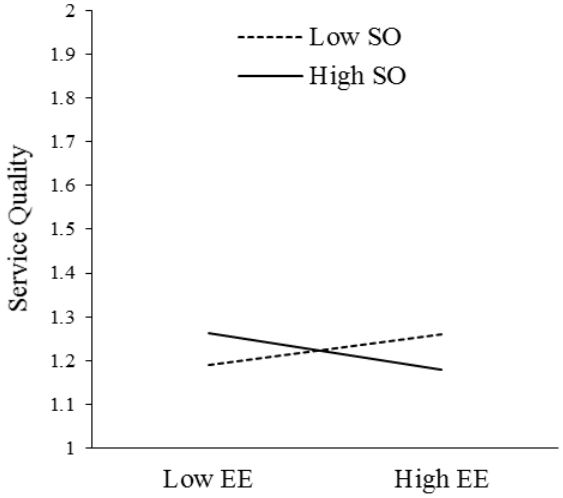

Figure 3 – Sales orientation (SO) moderates the indirect effect of surface acting and service quality mediated by emotional exhaustion (EE).

experiences a high level of exhaustion, a greater SO will have a stronger negative effect on service quality. Overall, the study results demonstrate that the magnitude of the indirect effect was contingent upon the level of the salesperson's SO.

We believe our study contributes to the extension of the boundary condition of emotional labor and its effect on job performance, particularly in surface acting. This study is probably the first to integrate a salesperson's sales orientation into emotional labor studies. Results show that employees in service jobs who also rely on sales performance to achieve work goals are in a more complex situation than those employees who provide services without having the burden of making the sale. Theoretically, the employee's orientation could be the aggregation of the firm's orientation or the managerial level's orientation. Based on our findings, we suggest that researchers should investigate how contextual factors such as the firm's orientation (e.g., sales orientation-customer orientation) influence the employees' acting strategy, and how these affect job performance. In practical terms, the employee might face the dilemma of balancing emotional acting and making the sale. This study suggested that negative results are higher when employees are applying both surface acting and SO. Organizational performance relies heavily on customer satisfaction that could contribute to revenue. This raises interesting questions. Will mangers notice when employees are exercising surface acting and at the same time are sales orientation? What should mangers do if their subordinates are exercising both surface acting and sales orientation, if sales orientation is part of the organization's strategy? We recommend that managers constantly collect customer feedback and pay attention to employees' expressions at work, particularly if sales orientation is part of the organization's strategy.

Our study is subject to several limitations. First, the evaluation of SO is from the employees' viewpoint, which might not reflect their actual opinions. The customer's evaluation of SO could perhaps be considered. Second, we exclude the effect of deep acting and CO from our study. Although these two variables are controlled for in our analyses, we were unable to provide any solid conclusion for the effect of deep acting and CO on the customer's perceived service quality. Third, our sample includes four industries, and considering the number of the employees, it might not be sufficient to generalize the conclusion for all industries. Although

we also control for industry difference in the analysis, we could not exclude the potential complexity of sales situations in these industries. We suggest that future research use a larger sample size or a broader range of industries to generalize our findings.

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ESTABLISHMENT OF A STAFF ALLOCATION METHOD REFLECTING CUSTOMER INFORMATION EXAMPLE OF SERVICES IN GUEST ROOMS AT JAPANESE-STYLE HOTEL

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ABSTRACT

As staff at Japanese-style hotel must provide meticulous hospitality, the way staff members are allocated can have a significant effect on the evaluation of the hotel. In order to increase customer satisfaction (CS), factors such as customer information, time spent with the customer, and staff members' capabilities must be taken into account when deciding the allocation of the hotel's customer-facing staff. It is absolutely vital that the allocation of staff takes such factors into account to prevent the quality of service from deteriorating. Additionally, as customer preferences differ depending on the customer, it is also necessary to quickly and effectively allocate staff based on customer information. At the same time, staff allocation must also take into account both CS and employment costs. Thus, this research investigates the hospitality provided at high-class Japanese-style hotel, and proposes a method of allocating hospitality staff for each day based on multivariate statistical analysis and mathematical programming to reflect customer information and take into account both CS and employment costs, in place of the existing implicit staffing methods that rely on experience. Specifically, a regression formula is created to estimate the level of CS for all customer and staff combinations based on customer preferences, staff capabilities, and the compatibility between the customer and the staff member. Then, a staff allocation method is proposed, using mathematical programming to take into account employment costs and CS. This allocation method enables the optimum staff to be allocated for each situation, and also allows for unexpected changes.

Keywords: Services in guest rooms, Staff allocation method, Mathematical programming

1. INTRODUCTION

Generally speaking, Japanese-style hotels (inns) place far more emphasis on hospitality and customer service than typical Western-style hotels, and as a result spend a great deal of time on individual customers. A survey conducted by the JAPAN RYOKAN & HOTEL ASSOCIATION on customer motives for choosing a particular inn found that people were extremely concerned with how well customers were treated by the staff. Surveys like these tell us that, particularly at high-class inns, staff allocation can have a powerful impact on the reputation of the facility.

Competition in the Japanese-style hotel industry is understandably fierce, and even top-tier inns must balance their overarching emphasis on CS with other important business considerations—such as keeping employment costs low. When it comes to CS, executives and head managers at prestigious inn consider hospitality to be the lifeblood of their operations, and are therefore greatly concerned with how to assign the perfect staff member to each customer in order to foster lasting bonds of loyalty.

The daily staff allocation process is led by the head manager, who looks at customer information, time spent with the customer, staff experience and ability (talent, attentiveness, compatibility with the customer, past performance), and a variety of other factors. However, if we take a closer look at this process, we find that the head manager relies on subjective assessments and past experience in making these decisions—which are sometimes nothing more than spur-of-the-moment choices. This makes staff allocation a challenge in the Japanese-style hotel business, as current methods often compromise customer service quality. In short, the industry needs a new method for logically assigning staff; yet, at the time of this writing, no other studies that address staff allocation at Japanese inns from the perspective of CS were found (Brucker et al, 2010：Christina and Dogan, 2009：Ikegami and Niwa, 2003： Ikegami, 2004)

2. STAFF ALLOCATION BASED ON CUSTOMER INFORMATION

We set out to identify the essential requirements for allocating staff in a way that effectively achieved sufficient customer service and satisfaction. Then, in order to ensure that those requirements could be met at reasonable cost, a staff allocation method was proposed based on a logical calculation of the perfect shifts to achieve higher CS. We then tried to come up with formulas to address the issue, using mathematical programming problems that took into account both CS (based on customer information, reservation data, and so on) and employment costs.

Every customer has his or her own preferences, and putting these into a formula required that

we set up objective variable parameters that reflected changing customer preferences. In other words, boosting CS required that we anticipate satisfaction level using data on individual customer preferences, staff capabilities, compatibility between customers and staff, and so on. Multivariate statistical analysis was used to calculate objective function parameters in advance based on customer feedback.

2.1 Conventional staff allocation methods

A preliminary survey was conducted in order to collect the data needed to come up with a staff allocation method that reflected customer information. We went to a long established high-class inn to find out exactly how the head manager had been structuring the employee shifts. The following data items were gathered to form a clear picture of the conventional staff allocation methods.

1) Exhaustive list of all tasks being carried out at the inn
2) Considerations when making employee shifts
3) Factors impacting CS
4) CS level (seven-point scale)
5) Employee shifts on the day of the survey
6) Data needed to conduct mathematical simulations

Once the data items were collected, they were used to make comparisons with the shifts calculated using multivariate statistical analysis and the staff allocation method proposed by the authors.

2.2 Formula for determining employee shifts

Based on the findings from the above preliminary research, we defined the following essential preconditions for creating the employee shift formulas proposed in section 2.4.

1) Required advanced reservations (e.g. customers even select meal items beforehand)
2) Employee shifts are determined by the previous day
3) The inn knows the customers' schedules (mealtimes, menu selections, etc.) before they arrive
4) All guests in the same party have the same activity schedule
5) Changing the staff member tending to a certain guest is avoided whenever possible
6) Staff allocations include extra personnel on standby

2.3 Mathematical formula: using multivariate statistical analysis to calculate CS

Based on the findings obtained in section 2.1, we came up with a mathematical formula (Formula 1) by applying a multivariate statistical analysis (multiple regression analysis) method

to a causal analysis as shown in Table 1. CS among those who had previously visited the inn (information collected from a customer survey) was used as the explanatory variable, while information on customer interaction collected from the tending staff member was used as the explanatory variable.

Table 1 _ Factors to influence CS

Objective Variable	S_{ij}	**CS**
Explanatory Variable	α_{1i}	**Staff experience**
	$\alpha_{2i}\beta_{2j}$	**Politeness**
	$\alpha_{3i}\beta_{3j}$	**Experience with wedding services**
	$\alpha_{4i}\beta_{4j}$	**Food knowledge**
	$\alpha_{5i}\beta_{5j}$	**Knowledge of the area**
	$\alpha_{6i}\beta_{6j}$	**Good with children**
	$\alpha_{7i}\beta_{7j}$	**Services for elderly and/or disabled guests**
	γ_{ij}	**The differences in age between customer and staff**

Table 2 _ Symbol description (multiple regression analysis)

i	**Staff number**
j	**Customer number**
p	**Factor number to influence CS**
S_{ij}	**CS per unit time when staff i services to customer j**
α_{pi}	**Value of factor p for staff i**
β_{pj}	**Value of factor p for customer j**
γ_{ij}	**The differences in age between customer j and staff i**
ε_k	**Partial regression coefficient(k≧1), Constant term(k=0)**

Mathematical formula

$$S_{ij} = \varepsilon_1 \alpha_{1i} + \sum_{p=2}^{7} \varepsilon_p \alpha_{pi} \beta_{pj} + \varepsilon_8 \gamma_{ij} + \varepsilon_0 \quad \ldots(1)$$

2.4 Applying mathematical programming to develop a staff allocation method

Based on the findings obtained in section 2.3, we applied mathematical programming to propose a staff allocation method that takes both employment costs and CS into account. As mentioned earlier, the method converts the preconditions listed in section 2.2 into a formula using the two methods indicated below. However, when assignments are made after the start of the workday, the allocation done earlier (including the current time *t*) is used as the initial value,

and new staff assignments are made starting with t+1. Also note that the timeframe in this case is split into 30-minute intervals during business hours.

1) Formula for allocating staff prior to the start of the workday
2) Formula for reallocating staff if there are changes to the shift after the work start time t

2.4.1 Formula for allocating staff prior to the start of the workday

Using items 1 to 4 below that need to be considered when allocating staff prior to the start of the workday and the symbols listed in Table 3, formulation is conducted.

1) Maximize CS while keeping employment costs low
2) Shorten the amount of time each staff member spends at the inn
3) Whenever possible, have the same staff member tend to a customer for the duration of their stay
4) Consider extra personnel on standby for staff allocations

Table 3 _ Symbol description (Formula for allocating staff prior to the start of the workday)

Staff={Staff 1, Staff 2, …, Staff m}	**Set of staffs**
Customer={Customer 1, Customer 2, …, Customer n}	**Set of customers**
Hour={Hour 1, Hour 2, …, Hour t}	**Set of hours**
$x_{ijk} : i \in Staff, j \in Customer, k \in Hour$	**Binary variable (1: staff i services to customer j at hour k, 0: not)**
$S_{ij} : i \in Staff, j \in Customer$	**CS per unit time when staff i services to customer j**
$C_i : i \in Staff$	**Cost per unit time when staff i work**
W_1, W_2, W_3, W_4	**Weighting**
$A_{jk} : j \in Customer, k \in Hour$	**Number of staffs that customer j need to at hour k**
$y_{ik} : i \in Staff, k \in Hour$	**Binary variable (1: allocations are carried out prior to and at time k, 0: not)**
$z_{ik} : i \in Staff, k \in Hour$	**Binary variable (1: allocations are carried out posterior to and at time k, 0: not)**
$Hour_j : j \in Customer$	**The servicing time for customer j, Subset of hours**
$R_k : k \in Hour$	**Number of extra personnel on standby at hour k**
T	**Maximum number of extra personnel to each hour and customer**

Formulation

$$Minimize \sum_{i \in Staff,\, j \in Cusomer} \Big(\sum_{k \in Hour_j} (-W_1 |y_{ik} - z_{ik}| C_i - W_2 S_{ij} x_{ijk} + W_3 (y_{ik} + z_{ik})) + W_4 \sum_{k=1}^{Hour-1} \frac{1}{2} |x_{ijk} - x_{ij(k+1)}| \Big) \quad \ldots(2)$$

s.t.

$$\sum_{i \in Staff} x_{ijk} \geq A_{jk} \qquad j \in Customer, k \in Hour_j \quad \ldots(3)$$

$$\sum_{i \in Staff} x_{ijk} \leq A_{jk} + T \qquad j \in Customer, k \in Hour_j \qquad \ldots(4)$$

$$\sum_{i \in Staff,\, j \in Customer} x_{ijk} \geq \sum_{j \in Customer} A_{jk} + R_k \qquad k \in Hour_j \qquad \ldots(5)$$

$$\sum_{j \in Customer_k} x_{ijk} \leq 1 \qquad i \in Staff, k \in Hour \qquad \ldots(6)$$

$$\sum_{j \in Customer} x_{ijp} \leq y_{ik} \qquad i \in Staff, k \in Hour,\ p = \{1,2,\ldots,k\} \qquad \ldots(7)$$

$$y_{ik} \leq 1 \qquad i \in Staff, k \in Hour \qquad \ldots(8)$$

$$\sum_{j \in Customer} x_{ijp} \leq z_{ik} \qquad i \in Staff, k \in Hour,\ p = \{k, k+1,\ldots,t\} \qquad \ldots(9)$$

$$z_{ik} \leq 1 \qquad i \in Staff, k \in Hour \qquad \ldots(10)$$

What follows is an explanation of how each of the above formulas was created by taking into account the allocation considerations listed at the beginning of this section.

1) Maximize CS while keeping employment costs low

For the objective variable (Formula 2), CS can be calculated by using the mathematical formula from the previous section (Formula 1) to determine CS level per unit of time (S_{ij}) and adding this figure to a measure of current staff–customer interaction (x_{ijk}) multiplied by weight W_1 and -1, then solving for the shift that will yield the highest customer satisfaction.

Employment costs are determined based on the amount of time each employee is at the inn. Therefore, this time must be kept to a minimum to save cost. A means for doing this is outlined in (2) below.

In the objective function, by changing weight W_1, which is multiplied by employment cost (C_i), and weight W_2, which is multiplied by CS (S_{ij}), several shifts can be calculated.

2) Shorten the amount of time each staff member spends at the inn

We'll start by defining variables *y* and *z*.

In formulas 7 and 8, *y* is equal to 1 when allocations are carried out prior to and at time *k*. If allocations are not carried out prior to or at this time, *y* is equal to 0 or 1. In the same way, in formulas 9 and 10, *z* is equal to 1 when allocations are carried out posterior to and at time *k*. If allocations are not carried out posterior to or at this time, z is equal to 0 or 1.

Furthermore, the formula has the property whereby adding $-W_1|y_{ik} - z_{ik}|C_i$ to the objective function (Formula 2) to solve for the smallest objective function generates an optimum solution. As a result, the difference between the value of y_{ik} and the value of z_{ik} can be

maximized as the cost of the employee increases. It also has the property whereby adding $W_3(y_{ij} + z_{ij})$ to the objective function (Formula 5.1) to solve for the smallest objective function generates an optimum solution. So if W_3 is set to an extremely high value, allocation can be carried out in such a way that values y_{ik} and z_{ik} are kept at zero whenever possible.

Because of these limitations, y_{ik} is always 1 for every hour k starting with the initial hour when an employee i is assigned, and y_{ik} is always 0 for every hour k prior to that hour. For z, z_{ik} is always 1 for every hour k prior to and including the last hour that employee i spends with a customer, and z_{ik} is always 0 for every hour k after that. Therefore, every hour k where both y_{ik} and z_{ik} are equal to 1 is an hour during which employee i is on the job.

As indicated earlier, $W_3(y_{ij} + z_{ij})$ is part of the objective function (Formula 2), so allocations should be made so that the values of y_{ik} and z_{ik} are at 0 whenever possible. This allows us to calculate a shift that minimizes the amount of time each staff member spends at the inn and the costs.

3) Whenever possible, have the same staff member tend to a customer for the duration of their stay

The penalty for having an employee hand off a customer is represented by W_4. By multiplying the formula that expresses the number of times the employee i assigned to customer j changed by penalty W_4 and adding the resulting figure to the objective function (Formula 2), we can arrive at a solution that indicates the minimum number of employee switches.

Here, the number of employee switches for employee i and guest j is considered linked to changes in the way employee i tends to customers. Once the employee tending to a customer is switched, two changes occur simultaneously: the employee that was able to be assigned at hour k but unable to be assigned to hour $k+1$ changes, and the employee that was not assigned at hour k but able to be assigned to hour $k+1$ changes as well. Therefore, every time an employee switch occurs, it generates two changes in the status of that employee's customer interaction. The number of employee switches is therefore the number of changes in employee customer interaction status multiplied by 1/2. This value is then multiplied by penalty W_4 generated by each employee switch and added to the objective function.

4) Consider extra personnel on standby for staff allocations

Formulas 3 and 4 indicate that the number of employees that interact with customer j for k hours should be at least A_{jk} and at most $A_{jk}+T$. Formula 3 also prevents employee allocation from becoming concentrated on customers with high satisfaction.

Formula 5 indicates that during hour k, staff can be allocated so that there is a standby staff of at least R_k employees.

Finally, during hour k, the number of extra employees is $\sum_{i \in Staff} y_{ik} z_{ik} - \sum_{j \in Customer} A_{jk}$,

and this measure should be taken when staff members are working overtime with other customers or when a new customer needs to be tended to. Formula 6 indicates that individual employees cannot interact with more than one party at the same time.

2.4.2 Formula for allocating staff during shift changes after the workday has started

When shifts change after the workday has already started, there is no need to be concerned about shortening the time that employees are at the inn, since assignments will not affect when they arrive and when they leave. As a result, the objective function in this formula does not take this into account. Instead, the following two factors are considered.

1) Allocate staff so that there are a minimum number of changes from the initial allocation prior to the start of the workday
2) When assignments change, use staff that are already at work (employees cannot be called into work just because of a reallocation)

Table 4 shows the symbols used in the formula. Note that it only contains symbols that were not used in the previous section (see Table 3 in section 2.4.1).

Table 4 _ Symbol description (Formula for allocating staff after the workday has started)

Q	**Now time**
W_5	**Weighting**
$Y_{ik} : i \in Staff, k \in Hour$	**Binary variable (prior to the start of the workday) (1: allocations are carried out prior to and at time k, 0: not)**
$Z_{ik} : i \in Staff, k \in Hour$	**Binary variable (prior to the start of the workday) (1: allocations are carried out posterior to and at time k, 0: not)**
$B_{ijk} : i \in Staff, j \in Customer, k \in Hour$	**Binary variable (prior to the start of the workday) (1: staff i services to customer j at hour k, 0: not)**
$V_{ik} : i \in Staff, k \in Hour$	**Binary variable (prior to the start of the workday) (1: staff spends at the inn, 0: not)**

Formulation

$$Minimize \sum_{i \in Staff,\ j \in Cusomer} \left(-W_2 \sum_{k \in Hour_j} S_{ij} x_{ijk} + W_4 \sum_{k=1}^{Hour-1} \frac{1}{2} \left| x_{ijk} - x_{ij(k+1)} \right| + W_5 \sum_{r=Q+1}^{t} \left| x_{ijr} - B_{ijr} \right| \right) \quad \ldots(11)$$

s.t.

$$\sum_{i \in Staff} x_{ijk} \geq A_{jk} \qquad j \in Customer, k \in Hour_j \quad \ldots(12)$$

$$\sum_{i \in Staff} x_{ijk} \leq A_{jk} + T \qquad j \in Customer, k \in Hour_j \quad \ldots(13)$$

$$\sum_{i \in Staff,\, j \in Customer} x_{ijk} \geq \sum_{j \in Customer} A_{jk} + R_k \qquad k \in Hour_j \quad \ldots(14)$$

$$\sum_{j \in Customer_k} x_{ijk} \leq V_{ik} \qquad i \in Staff,\, k \in Hour \quad \ldots(15)$$

$$x_{ijr} = B_{ijr} \qquad i \in Staff,\, j \in Customer,\, r = \{1,2,...,Q\} \quad \ldots(16)$$

$$V_{ik} = Y_{ik} Z_{ik} \qquad i \in Staff,\, k \in Hour \quad \ldots(17)$$

What follows is an explanation of how each of the above formulas was created by taking into account the allocation considerations listed at the beginning of this section. Formulas 12, 13, and 14 all mean the same thing, so information on these items is omitted.

1) Allocate staff so that there are a minimum number of changes from the initial allocation to the start of the workday

Assignments that took place prior to the current time Q are represented by the constant B_{ijr}, which is substituted for the previous assignments (Formula 16). A penalty W_5 is assigned to any differences between the previous assignment B_{ijr} and assignments that happen after the current time Q (Formula 11).

2) When assignments change, use staff that are already at work

For assignments that happen prior to the start of the workday, Y_{ik} is a binary variable that has a value of 1 for hours of customer interaction prior to and including hour k, and a value of 0 in all other cases. Z_{ik} is also a binary variable that is equal to 1 for hours of customer interaction after and including hour k, and 0 in all other cases.

Therefore, V_{ik} from formula 17 has a value of 1 if employee i is already at work, and a value of 0 if the employee is not. In other words, V_{ik} indicates employee work status. From Formula 15, employee i cannot be assigned ($\sum_{j \in Customer_k} x_{ijk}$=0) during hour k if the employee is not at work (V_{ik}=0). If employee i is at work (V_{ik}=1), the employee is available for an assignment ($\sum_{j \in Customer_k} x_{ijk}$=0 or $\sum_{j \in Customer_k} x_{ijk}$=1). Therefore, when a shift changes during hour k, only the employees that are actually at work can receive assignments.

2.4.3 Expected results from proposed staff allocation methods

Below are the expected results when employees are assigned using the staff allocation method proposed here.

1) Ability to predict the number of additional customers that staff can tend to during each hour

If we use D to represent the number of customers that a single employee can tend to, Formula 18 can be used to calculate the number of additional customers that staff can tend to (e_k) during

hour k by multiplying D by the actual number of extra staff members during hour k.

$$e_k = D(\sum_{i \in Staff} y_{ik} z_{ik} - \sum_{j \in Customer} A_{jk}) \quad \ldots(18)$$

If new customers request a reservation once the workday has started, the number of new customers can be compared to the number of additional customers that the inn can handle (e_k) to immediately determine whether or not the reservation can be accepted.

2) Ability to set restrictions on CS and total employment costs

If we use F to represent the maximum amount of employment costs, adding Formula 19 to constraint conditions allows us to calculate a staff allocation plan that keeps total employment costs under a limit F.

As for CS, the left side of Formula 20 indicates the total CS gained when allocation is implemented. If we set a minimum CS level of G, adding Formula 20 to constraint conditions allows us to calculate a staff allocation plan that keeps total CS above a limit G.

$$\sum_{i \in Staff, k \in Hour} y_{ik} z_{ik} C_i \leq F \quad \ldots(19)$$

$$\sum_{i \in Staff, j \in Cusomer, k \in Hour_j} S_{ij} x_{ijk} \geq G \quad \ldots(20)$$

3) Ability to determine whether a customer can be given the time they require when the need for additional services arises

4) Ability to calculate what time customers can be tended to if services cannot currently be rendered

When a customer requests services that cannot be rendered because of insufficient personnel resources, in order to calculate the time at which the service is available, it should be determined whether customers can receive services by staggering customer interaction time ahead or behind by 30 minutes. In this case, the number of times service is pushed back is represented by m and the number of times it is brought forward is represented by n. The upper limit for the number of hours a customer will allow the service to be postponed is represented by M_2, and the upper limit for the number of hours a customer will allow the service to be carried out in advance is represented by N_2.

5) Ability to set restrictions on the number of hours an individual employee can be assigned

When the weight assigned to employment costs (W_1) is far larger than the weight assigned to CS (W_2), or the weight assigned to CS (W_2) is far larger than the weight assigned to employment costs (W_1), it will generate large variations in the number of hours assigned to each employee during shifts. More specifically, in the former case almost all shifts will be assigned to low-cost employees, while in the latter case almost all shifts will be assigned to the employees that deliver the highest CS. This will put excessive workload on certain employees and can lead to

low employee satisfaction. When there is a significant difference between the values assigned to weights W_1 and W_2, it is necessary to set a cap on the number of hours that can be assigned to a single employee in one day by adding Formula 21 to constraint conditions, in order to prevent the above situation from occurring.

$$\sum_{j \in Cusomer, k \in Hour_j} x_{ijk} \leq H \qquad i \in Staff \qquad \ldots(21)$$

H is the maximum number of hours that a single employee can work.

3. APPLICATION

To apply the method detailed above, we used data collected from interaction with 70 parties of customers at the long established high-class inn mentioned above.

3.1Mathematical formula to calculate CS using multiple regression analysis

We made use of the factors impacting CS listed in Table 1, section 2.3, to develop a mathematical formula for calculating CS.

CS is determined by whether employees have the ability to provide customers with the kind of service they are looking for, as represented by the explanatory variables "politeness", "experience with weddings", "food knowledge", "knowledge of the area", "good with children", and "services for elderly and/or disabled guests". The variable α was therefore used to indicate whether a staff member was skilled in each of these areas, while β was used to represent whether a customer was requesting those services. Multiplying the two variables resulted in a value for each of the six explanatory variables listed above.

Specifically, for the five variables other than wedding experience, areas where the employee was skilled are given an α value of 1, while unskilled areas are given an α value of 0. Services requested by a customer are assigned a β value of 1, while areas that are not that important to the customer are given a β value of 0. The analysis then uses the product of the α and β values. For the wedding variable, the number of weddings handled by the employee in the past is used for the value of α. If the customer requests wedding experience β is given a value of 1, and if wedding experience is not important (the customer is not involved in a wedding party), β is given a value of 0. The analysis then uses the product of these α and β values. In this way, the value of the five explanatory variables other than experience with wedding is 1 only when the employee has the given skills and those skills are important to the customer, and this in turn has an impact on CS.

Table 5 shows collected data used for the multiple regression analysis. Table 6 shows the results of that analysis.

Table 5 _ collected data used for the multiple regression analysis

Sample No.	Staff experience α_{1i}	Politeness $\alpha_{2i}\beta_{2j}$	Experience with wedding services $\alpha_{3i}\beta_{3j}$	Food knowledge $\alpha_{4i}\beta_{4j}$	Knowledge of the area $\alpha_{5i}\beta_{5j}$	Good with children $\alpha_{6i}\beta_{6j}$	Services for elderly and/or disabled guests $\alpha_{7i}\beta_{7j}$	The differences in age between customer and staff γ_{ij}	CS influenced by staff S_{ij}
1	15	1	3	1	0	1	1	4	6
2	9	0	2	0	0	1	1	12	5
3	2	0	1	0	1	0	0	20	4
4	4	0	1	1	0	0	0	35	3
...									
66	7	0	3	1	0	1	0	20	3
67	9	0	3	1	0	0	1	13	4
68	5	1	3	0	0	1	0	22	5
69	8	1	3	0	1	1	1	3	7
70	4	0	2	1	0	0	0	5	4

Table 6 _ the results of the multiple regression analysis

	Objective variable	Residual sum of squares	Multiple correlation coefficient	Contribution ratio R^2	R*^2
	CS	27.083	0.888	0.788	0.76
		R**^2	Residual degree of freedom	Residual standard deviation	
		0.733	61	0.666	
vNo	Explanatory Variable	Residual sum of squares	Variate	Variance ratio	Partial regression coefficient
0	Constant term	52.866	25.783	58.0701	3.983
1	Staff experience	27.152	0.069	0.1553	0.028
2	Politeness	38.212	11.129	25.0656	1.295
3	Experience with wedding services	27.177	0.094	0.2119	0.065
4	Food knowledge	27.104	0.021	0.0467	0.053
5	Knowledge of the area	27.238	0.155	0.3488	0.172
6	Good with children	27.116	0.033	0.0745	0.054
7	Services for elderly and/or disabled guests	28.924	1.84	4.1447	0.707
8	The differences in age between customer and staff	35.058	7.975	17.9614	-0.056

The multiple regression analysis results given in Table 6 show a multiple correlation coefficient of 0.888 (coefficient of determination adjusted for degrees of freedom (R^{*2}): 0.76), indicating a significant causal relationship. The factor in the table with the highest partial regression coefficient, indicating the greatest impact on the objective variable of CS, was $\alpha_{2i}\beta_{2j}$, which is politeness. The next most important factor in terms of CS was $\alpha_{7i}\beta_{7j}$, which is services for elderly and/or disabled guests.

These analysis results allowed us to develop the mathematical formula (Formula 22) below.

$$S_{ij} = 0.028\alpha_{1i} + 1.295\alpha_{2i}\beta_{2j} + 0.065\alpha_{3i}\beta_{3j} + 0.053\alpha_{4i}\beta_{4j} + 0.172\alpha_{5i}\beta_{5j} + 0.054\alpha_{6i}\beta_{6j} + 0.707\alpha_{7i}\beta_{7j} - 0.056\gamma_{ij} + 3.983 \quad \ldots(22)$$

3.2 Comparison with conventional staff allocation methods

We look at items 1 to 4 below, using data collected in the preliminary research described in section 2.1 (shifts arranged using the conventional method without applying the staff allocation method presented here) and comparing it with shifts arranged using the staff allocation method that we derived here. As with the preliminary research, the comparison used ten employees tending to ten parties of customers for a total of 21 hours. The weighted values used were as follows: W_1=1, W_2=1, W_3=10000, W_4=1.

Table 7 _ The result of verification

	Conventional method	Staff allocation method
①Time used to calculate shifts	About 30 min	2.76 sec
②Employment cost	￥85225	￥83880
②CS	454.6	455.8
③Number of employee switches	19 times	11 times
④Amount of time employees spent at the inn		

Staff No.	Conventional method (h)	Staff allocation method (h)	Employment cost per a hour(￥)
1	1.5	1.5	1400
2	8.5	9.5	1035
3	10.5	10.5	850
4	10.5	10.5	850
5	3.0	1.5	1220
6	10.5	9.0	1220
7	9.5	9.5	1035
8	8.0	10.0	1035
9	9.5	10.5	1035
10	10.0	8.5	1220

1) Time used to calculate shifts (calculation time)
2) Employment cost and CS (remuneration between the time the employee clocked in and the time the clocked out was used to represent cost)
3) Number of employee switches
4) Amount of time employees spent at the inn

1) Time used to calculate shifts

Our preliminary research revealed that in the conventional staff allocation method, the manager making the assignments looked at the compatibility between employees and customers to manually arrange the shift—a process that ended up taking around thirty minutes. However, by applying the staff allocation method developed here, it took just two seconds for numerical calculations, representing a major reduction in work time.

2) Employment cost and CS

CS values rose by 1.2 over conventional methods when this staff allocation method was applied. At the same time, costs were reduced by 10 with the new method. The verification process thus indicated that compared with conventional staff allocation, the new method is

capable of designing shifts that lead to greater satisfaction with less cost.

3) Number of employee switches

As mentioned above, changing the employee tending to a customer has a negative impact on CS, and for this reason the number of employee switches must be kept to a minimum. While conventional methods resulted in nineteen such switches, the new method reduced this number to just eleven.

4) Amount of time employees spent at the inn

In the table above, employees who ended up staying at the *inn* for less time under the new method are marked in light blue, while those that ended up staying longer are marked in orange. We found that this new staff allocation method reduced the number of hours worked by relatively costly employees while increasing hours for more economical ones.

3.3 Relationship among CS, employment costs, and maximum number of extra personnel

The shifts designed using the method proposed here examine the following two questions regarding the relationship among the cost spent on employees, CS, and the number of extra personnel. These questions were addressed using the same conditions outlined in section 3.2.

1) How much does CS increase when costs go up?

The graph in Figure 1 shows the relationship between total employment costs and CS. It shows that as total customer satisfaction goes up, labor costs rise as well.

One of the criteria for determining shifts at inns is the point at which costs begin to rise dramatically with increased CS. In other words, an ideal shift is one that has the best cost performance. Figure 1 indicates that the best shift would be one that achieves a CS level of 570 at a cost of 84,992 yen.

2) How many extra personnel are needed to enhance CS?

Figure 2 shows the relationship between total CS (horizontal axis) and the maximum number of extra personnel (vertical axis). It indicates that as total CS goes up, the maximum number of extra personnel also increases.

The next is about the relationship between CS and the number of employees at work. Shifts when CS was 580 or lower had only the minimum required number of employees on staff, some of whom were assigned to tend to customers. Shifts where CS went above 580 required that additional personnel be on hand to offer service and enhance satisfaction. The shifts during which CS rose to 796 and above in particular had the maximum number of extra personnel (nine) on hand, indicating that assigning all available employees to customers will increase CS. In this case, all ten available employees were tending to customers.

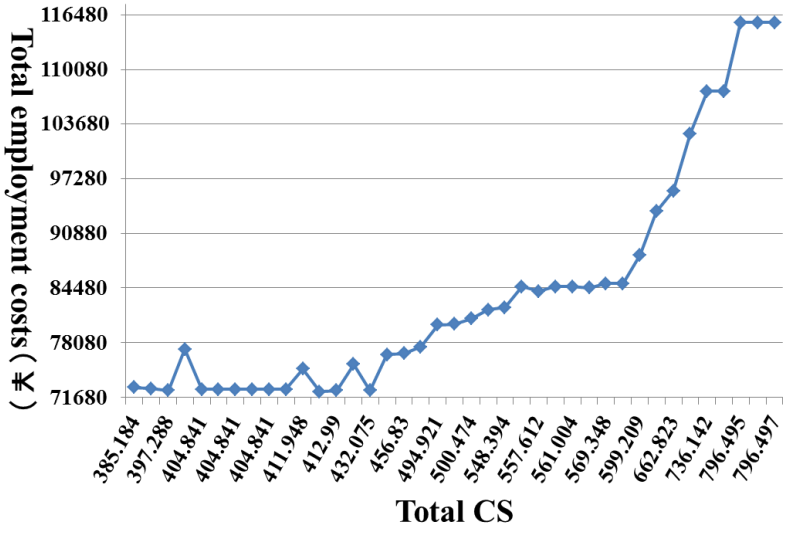

Figure 1 _ The relationship between total employment costs and CS

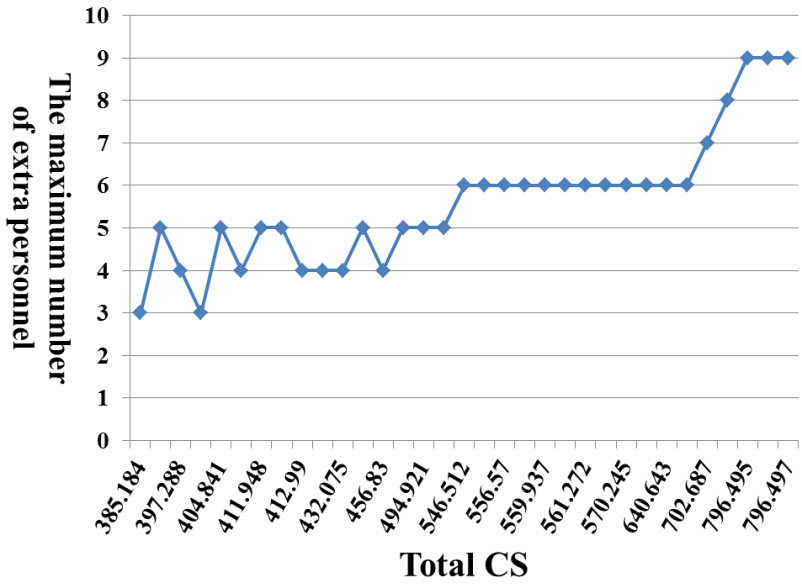

Figure 2 _ The relationship between total CS and maximum number of extra personnel

CONCLUSION

We have seen that applying the staff allocation method developed here allows inns to effectively assign staff members in a way that considers CS, employment costs, and minimizing work times. The method allows the use of weighted employee cost and CS values, changes the number of extra personnel to handle cases where new customers arrive after the workday has started, and offers multiple shift options so that the managers in charge of staff allocation can select shifts to actually assign to their employees. The method is also capable of incorporating

changes in the time spent tending to customers, as when new customers arrive after the workday starts.

In the future, it is required to find ways to more accurately predict customer interaction times based on customer attributes and the type of service required.

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IDENTIFICATION OF HEALTHCARE CLOUD SERVICE DEMAND

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ABSTRACT

The main purposes of this study are to develop a service demand identification method based on the concept of Kano. Healthcare cloud services and diabetes self-management care cloud services are utilized as case studies to the validity of the proposed method. Through survey questionnaires and convenience sampling approach, 311 valid responses out of 500 distributed questionnaires (healthcare cloud service case) and 235 out of 320 distributed questionnaires (diabetes self-management care cloud service case) were returned. The results show that users have higher adoption willingness toward health cloud service system. Additionally, service demand classifications are different between health cloud services (with prevention as main focus) and diabetes self-management care cloud services (with care as main focus). In particular, ease of use, responsiveness, confidentiality and reliability are proven to positively affect the adoption of health cloud service but are found to have no effect on diabetes self-management care cloud services. The findings therefore hope to provide relevant units in the healthcare industry and service industries with helpful designing and planning references.

Keywords: Cloud service, healthcare industry, healthcare cloud service, service demand, Service demand classification identification method

INTRODUCTION

Providing abundant benefits and opportunities derived from cloud service applications, Taiwan government has actively promoted the “Cloud industry development plan” to stimulate cloud service application in four key smart industries with the attempt to further strengthen Taiwan’s advanced technology competitiveness in the global market and enhance business opportunities. Noteworthy, facing emerging challenges in Taiwan’s population structure changes and declining birthrate, the “health” concept has been strongly considered a modern trend. Given that Taiwan’s health care system has gained certain levels of success with sound hardware-based network infrastructure and environment, cloud services in Taiwan healthcare industry has possessed absolute advantages for capturing stable development. For these reasons, this study targets cloud service applications and health care

industry as main research scopes.

It is noted that the main target of the current general health care is to promote an integrated health care system - cloud services to reduce disease severity and enhance care to patients. Nonetheless, healthcare cloud industry in Taiwan is still in the initial stage of development, implying plenty of opportunities for improvement. Hence, sufficient understanding of user demands toward healthcare cloud services application has become an important issue in the healthcare industry.

Concerning user side, healthcare cloud service is viewed as innovative services. Hence, it is critical to understand user behaviors in using innovative cloud services as well as key demand factors since these endeavors beneficially improve cloud service use efficiency, its long-term sustainability, and contribute better to the planning of healthcare cloud services application design. Additionally, since healthcare cloud services are web-based innovative service models in which users receive healthcare services through cloud delivery network, the success of user interface of network information systems plays a critical role to the continuous development of healthcare cloud services. Finally, since healthcare cloud service is a healthcare behavior-based model, customer demands are regarded as key factors influencing users' healthcare cloud service utilization behavior. Consequently, it is essential for organizations to sufficiently explore three characteristics of "innovative service use", "user interface", and "healthcare service use behavior" using healthcare cloud service application once attempting to effectively identify users' service demands.

In practice, once service providers are in accordance with users' real demands to provide corresponding expected services, users' adoption and use willingness toward the service systems would be strongly influenced in terms enhanced effectiveness. For this reason, it is of great importance for service providers in the service design stage to clearly and sufficiently identify users' demand items. Nonetheless, Kano (1984) indicates that not all of service quality elements contribute to the enhancement of customer satisfaction. Hence, in order to better explore the impact of service quality, Kano (1984) has divided service quality factors into 5 categories of must-be factors, one-dimensional factors, excitement factors, indifference factors, and reverse factors. Taking this point, the concept of Kano is utilized in this study.

In sum, this study aims to develop a service demand identification method based on the concept of Kano and through three main dimensions of innovative service use, user interface, and healthcare cloud service use behavior to develop a demand assessment scale toward cloud service application for Taiwan healthcare industry.

Noteworthy, given the premise of health prevention in mind, the main goals of cloud services are to maintain healthcare and restore health conditions for clients and patients. Therefore, in order to clearly and sufficiently identify users' demand items, it is critical to deeply go through users' distinguished points of view on health cloud services and care cloud services. So as to verify the validity of this method application in practice, this research targets healthcare cloud services and diabetes self-management care cloud services as examples for respectively developing methods for identifying demands toward healthcare services and comparing the differences. As such, this study hopes to provide relevant units in the healthcare industry and service industries with helpful designing and planning references.

LITERATURE REVIEW

Innovative service adoption model

Healthcare cloud service model for user is considered an innovative service model which aims to enhance service efficiency and sustainability through conducting sufficient understanding of key factors affecting user demands from the initial stages in service design. In other words, company wishing to effectively provide more innovative services have to figure out how to enhance users' adoption intention. Regarding innovative service adoption

behavior, Rogers (1985) proposes Innovation diffusion theory (IDT) to explore new service concepts that help stimulating innovation diffusion process in user adoption. In IDT theory, users' adoption of innovative technologies/services is influenced by three key factors, including, personal innovativeness, social impact, innovation characteristics. Among these factors, the innovation characteristics have been most widely used to explore the innovative service / technology adoption behavior. For instance, Truman, Sandoe, and Rifkin (2003) point out user experience and product complexity are two key elements influencing consumers' intention of using this product. Lin (2011) states that ease of use and usefulness influence mobile healthcare service adoption behavior. Wu and Wang (2005) through integrating TAM, innovation diffusion model and perceived risks and costs to investigate the key factors to mobile commerce, indicating compatibility is the most critical influencing factors. Hsu, Lu, and Hsu (2007) conduct a case study on MMS transmission services to explore the impacts of IDT on different types of users, concluding that key elements to user adoption intension include comparative advantage, compatibility, and observability.

In addition, Moon & Kim (2001), Bruner & Kumar (2005) and Lee (2010) indicate that innovative products /services once being concurrently provided with entertainment can enhance users' adoption intention. Rice (2002) suggests that good content / information and enjoyable browsing experience are key factors influencing users' intention of re-visiting the website. Liu & Arnett (2000) also points out that four key elements to the website are information and service quality, system use, system design, and playfulness. Therefore, entertainment, enjoyable browsing experience, and playfulness should be included in the users needs consideration.

In sum, this study is based on aforementioned literature to include the factors of innovative features, social impact, and pleasure characteristics to deeply explore customer demands regarding healthcare cloud services.

Information network quality system

Healthcare cloud service is a network-based model, users are required to receive healthcare services through a transmission network of cloud services. Hence, information network system plays a key role to the success or failure of healthcare cloud services. Relevant literatures have also suggested that the improvement of information network system effectively contributes to the continuous success and promotion of healthcare cloud services.

Therefore, DeLone and McLean (2003) proposes the Information system successful model which have been widely used to investigate the success and failure rate of various types of services offered through websites (Dewaynna, Hyonsong, and Rupak, 2009; Mona, Abbas, and Sina, 2009; Wang and Liao, 2008). The study further pointed out that the system quality, information quality and service quality are the key factors for enhancing the willingness of adoption, the user satisfaction level and system efficiency. Furthermore, Zeithaml et al. (2002) indicates website service quality is the key factor in the success of e-commerce, and also proposes e-SERVQUAL model of website service quality which is also widely used in Internet banking, Internet job bank, shopping sites, Web TV, etc. The e-SERVQUAL model includes seven dimensions, i.e. efficiency, fulfillment, system availability, privacy, responsiveness, compensation, contact.

Additionally, Barnes and Vidgen (2000, 2001) indicate that the success of network information system strongly depends on hardware features, website functions, flexible communication systems, and the high level of integration capability of network system in accordance with customer needs. And they also point out service needs shall include three main dimensions which are web information, web interaction, web design. Among these, web information which is similar to the information quality of D&M Information system successful model. Web interaction is the capability of establishing trustworthiness and good

customer relationships. Web design focuses on sensory design and site navigation to enhance customer positive feelings and satisfaction.

In sum, based on aforementioned literature on user interface, network transmission service, the D&M Information system successful model, e-SERVQUAL model, and Barnes and Vidgen(2000, 2001), this study utilizes the key dimensions of information network quality system (i.e. functionality, interactivity, information integrity and accuracy, responsiveness, confidentiality and reliability) to explore customer needs toward healthcare cloud services.

Healthcare service utilization

Healthcare cloud service is an innovative health behavior modules, the continuous improvement of healthcare cloud service efficiency should take into account the key factors which influence user utilization behavior. Regarding in health behavior models, Rosenstock (1966, 1974) proposes the health-belief model (HBM) which can effectively explain and predict the occurrence of healthcare service utilization-related issues. As a result, this model has been popularly applied in the field of medical and social psychology. This model is considered beneficial in clarifying indicators on personal factors which influence adoption intention, i.e. perceived disease threats, perceived interest of actions, perceived action to obstacle, and cues to action.

HBM has also been widely applied in healthcare technology. For example, Huang and Lin (2009) through using health-belief model to investigate customer adoption intention on Home Tele-health technology. Lin (2011) combines the health-belief model, TAM model, and innovation diffusion model to explore the major elements affecting customer willingness to adopt mobile healthcare technology. Therefore, since the main purpose of healthcare cloud services system is to enhance user adoption intention, customer value, and customer satisfaction, this research further integrates HBM to explore customer needs concerning healthcare cloud services, aiming at effectively enhance customer adoption willingness.

Based on aforementioned literature, this research proposes to base on healthcare cloud service utilization dimensions (i.e. perceived disease threats, perceived interest of actions, perceived action to obstacle, and cues to action) to explore customer needs regarding healthcare cloud services.

Kano's two-dimensional quality theory

The two-dimensional quality theory was first proposed by Kano (1984). This theory, which focuses on manufacturing product quality and development, finds out that not all quality elements will contribute to customer satisfaction enhancement; hence, service quality and satisfaction is suggested to have a non- linear relationship. As such, service quality were divided into five categories of excitement factor, one-dimensional factor, must-be factor, indifference factor, and reverse factor as being presented as follows:

1. Must-be factor: Customers will accept the product or service if quality attribute is provided; otherwise, they will feel dissatisfied (if this quality attribute is not provided)
2. One-dimensional factor: Customers will be satisfied if quality attribute is provided; otherwise, they will be dissatisfied
3. Excitement factor: Customers will be satisfied if quality attribute is provided; otherwise, they will accept the product or service with no dissatisfaction
4. Indifference factor: Customer satisfaction will not be affected no matter whether this quality attribute is provided or not
5. Reverse factor: Customers will be dissatisfied if this quality attribute is provided; otherwise, they will be satisfied.

The above factors, the relationship between service quality performance and customer

satisfaction are the linear for one-dimension factor, and must-be factors and excitement factor are nonlinear.

The viewpoint of Kano's two-dimensional service quality is a practical management decisions. In recently, Related studies try to incorporate the concept of two-dimensional quality on the quality management decision-making process. Follow the concept of two-dimensional quality, similarly, when a service provider, according to the users' needs to provide the corresponding service items to service system. Whether the user's willingness to adopt the service system relatively upgrade? Therefore, when the service provider design a service system, to clarify the category of service demand is necessary. To sum, this study will develop a service demand classification identification method base on the concept of two-dimensional quality.

Additionally, on Kano's classification schemes, Brandt(1988) indicated the relationship between service quality performance and customer satisfaction are the nonlinear and symmetry, and employs the dummy variable regression model to identify classification. This method is more practical and simpler than the original Kano method. Nonetheless, dummy variable regression overlooks the rating of average/common performance that could be critical information for the ultimate classification. And the classification is inaccurate when the samples are skewed toward one of the two extreme performance levels. Therefore, Lin, et al.(2010) employ the moderating regression model to improve the problems caused by Brandt(1988). So, this study will employ Lin, et al. (2010)'s moderating regression model to develop service demand classification identification method.

DEVELOPMENT SERVICE DEMAND CLASSIFICATION IDENTIFICATION METHOD

This study aims to develop a service demand identification method (SDC) based on the concept of Kano. As such, service demands were divided into five categories of excitement factor, one-dimensional factor, must-be factor, indifference factor, and reverse factor as being presented as follows:

1. Excitement factor: In this group, if users perceived and desired one service demand more than other services, the extent of this service demand item would be positively reflected in users' adoption intention and vice versa. In other words, as long as the services were identified as relatively important by the users, these service items would be added to the service system and they were able to enhance users' adoption intention toward the systems.
2. One-dimensional factor: In this group, the extent of service demands and users' adoption intention have a positive linear relationship, meaning that users' adoption intention would be high once they thought the services were important whereas users' adoption intention would be low once they perceived the services were not important. In other words, as long as the services were identified as relatively important by users, these service items would be added to the service system and they were able to linear enhance users' adoption intention toward the systems.
3. Must-be factor: In this group, once users perceived one service demand item to be more important than other services, the extent of this service demand item would not affect users' adoption intention. Otherwise, once users perceived one service demand item to be less important than other services, the extent of this service demand item would be positively reflected in users' adoption intention. Therefore, this group reflected a phenomenon that within the must-be factor group, some users might think that these services were essential to the service system while other people might not. Due to this fact, in demand assessment, users might not highlight whether one specific service was important. In other words, these services should be included in the service system.

4. Indifference factor: In this group, users' adoption intention would not be affected no matter whether the service was important or not. In other words, these services did not need be included in the service system.
5. Reverse factor: In this group, the extent of service demands and users' adoption intention have a negative linear relationship, meaning that users' adoption intention would be low if users thought the services were important while users' adoption intention would be high if users perceived the services were unimportant. In other words, as long as the services were identified as relatively important by users, these service items should be excluded from the service system.

Furthermore, this study employed the moderating regression model to develop service demand classification identification method (SDC), being presented as follow:

Step1: Develop a moderating regression model to examine the moderating effect of "perception level" on the relationship between service demands and users'' adoption intention.

$$AI_i = \alpha + \beta_{1j}X_{ij} + \beta_{2j}X_{ij} * Z_{ij},, \text{ where } Z_{ij} = \begin{cases} 1, & \text{if } X_{ij} < m \\ 2, & \text{if } X_{ij} = m \\ 3, & \text{if } X_{ij} > m \end{cases}$$

where AI_i represents the adoption intention of the ith interviewee to the healthcare cloud service system, and X_{ij} was the need of the service item j rated by the ith interviewee. The need rating was assigned by respondents based on a five-point Likert-type scale (1= "extremely unimportant", 3= "average", and 5= "extremely important". The moderator variable "perception" Z_{ij} was then created to verify the moderating effect of the need the jth service item from the ith respondent. The symbol m in the indicator function represented for the median of the scale (i.e., m was average or common need). For instance, if ith interviewee's need of the jth service item was rated as "2", the Z_{ij} value was then coded as 1 because it was lower need. As a result, the moderator Z_{ij} had three perception levels and it included the common need information. The coefficient β_{1j} presented the influence of need of the jth service item on adoption intention; while β_{2j} was coefficient representing the interaction effect.

Step2: Identify service demand classification

Similar to the concept of Lin et al. (2010), if $\beta_{2j} = 0$, it means that the jth service need's extent and users' adoption intention have a linear relationship. Simultaneously, if $\beta_{1j} > 0$, the jth service item belongs to one-dimensional factor group, and if $\beta_{1j} = 0$, the jth service item serves as indifference factor, and if $\beta_{1j} < 0$, the jth service item serves as reverse factor. Otherwise, if $\beta_{2j} \neq 0$, it means that the jth service need's extent and users' adoption intention have a nonlinear relationship. If $\beta_{2j} > 0$, the jth service item serves as Excitement factor, and if $\beta_{2j} < 0$, the jth service item serves as must-be factor.

However, since β_{2j} was estimated through data analysis, it was essential to test whether it was equal to 0 in order to achieve accurate classification. As such, the testing process were described in three steps of (1) developing the regression model $AI_i = \alpha + \beta_{1j}X_{ij} + \beta_{2j}X_{ij} * Z_{ij}$ and computing the coefficient of determination, (2) developing the other regression model a$AI_i = \alpha + \beta_{1j}X_{ij}$nd computing the accordant coefficient of determination, and (3) calculating the change in coefficient of determination $\Delta R^2 = R_2^2 - R_1^2$ to assess the statistical significance of the moderating effect of perception levels.

CASE STUDY

Empirical case and data collection

In accordance with the purposes, this study took diabetes self-management care cloud services and healthcare cloud services as main research cases for developing methods for identifying demands toward healthcare services. The service demand items of each case were identified separately and was then verified for the validity of this model in practical applications. Due to the nature of cloud technology of being a web-based service system, this study aimed to examine participants with internet use experience in both two cases of healthcare cloud services and diabetes self-management care cloud service cases as well as in families with diabetic patients. Through survey questionnaires and the convenience sampling method, 311 valid responses out of 500 distributed questionnaires were returned in case of healthcare cloud services and 235 valid responses out of 320 distributed questionnaires were returned in case of diabetes self-management care cloud services. Concerning the data for healthcare cloud services, the majority were male (57.5%), of whom almost half were unmarried and in the 25-44 year-old group (54.5%) with university degree background (57.2%). Regarding diabetes self-management care cloud services, the majority were male (57.6%), in the 25-44 year-old group (51.5%) with university degree background (57.2%).

Questionnaire design and measures

This study was based on the extant literature to adopt relevant dimension of three main aspects of the innovation adoption diffusion theory, network information system quality, and healthcare utilization as well as through interviews with experts to propose 15 dimensions including relative benefits(6 items), ease of use(5 items), compatibility(4 items), observability(4 items), social impact(3 items), pleasure(4 items), functionality(4 items), interactivity(2 items), information integrity and accuracy(3 items), responsiveness(4 items), confidentiality and reliability(3 items), disease threats(3 items), action to obstacle(2 items), cues to action(2 items), and adoption intention(3 items) with a total of 52 question items, as being shown in Table 1. All items were measured using five-point Likert scale.

All multiple-item variables of questionnaire were tested for reliability using Cronbach's and construct reliability. In health cloud services case, all achieved Cronbach's alpha coefficients ranged from 0.56 to 0.91 and construct reliability ranged from 0.60 to 0.91, in diabetes self-management care cloud services case, all achieved Cronbach's alpha coefficients ranged from 0.56 to 0.90 and construct reliability ranged from 0.60 to 0.90,which were almost greater than the threshold 0.6 (Bagozzi and Yi, 1988), indicating high internal consistency and thus reliability for all measurement indicators.

In the next step, confirmatory factor analysis was employed to examine construct validity of the measurement model. For two cases, all achieved standardized factor loadings ranged from 0.51 to 0.91, which were greater than the threshold 0.50 (Bagozzi and Yi, 1988). Overall, the convergent validity of all measurement indicators were validated (Hair et al., 2010). In addition, discriminant validity test was then performed to establish the distinction among the variables used in this study and can be supported if the average variance extracted (AVE) is larger than the squared correlations between variables. All pairs of the squared correlations among latent constructs were smaller than the AVE of the respective variables. Hence, discriminant validity was supported.

Healthcare cloud service demand classification analyses

To confirm the validity of the service demand classification identification method (SDC), this research employed healthcare cloud services and diabetes self-management care cloud services as case studies to illustrate the analysis processes. The results were presented in details as follows.

1. Health cloud service demand analysis

The study calculated the average need of each service indicator and average of users'

adoption intention. As shown in Table 1, users exerted higher willing to adopt the health cloud service system (mean= 3.883). And respondents perceived 14 service dimensions to be important (all means were higher than 3.584). Among them, the top five most important service dimensions with highest average importance were "information integrity and accuracy" (4.182), "functional" (4.173), "interactivity" (4.168), "responsiveness" (4.043), and "ease of use" (4.042).

Additionally, this study utilized SDC method to analysis demand classification. As presented in Table 1, 14 service dimensions were divided into 4 categories (i.e., one-dimensional factor, must-be factor, excitement factor, and indifference factor). Among these, one-dimensional factors included 7 service demand dimensions (i.e., relative benefit/ (usefulness), ease of use, compatibility, observability, responsiveness, confidentiality and reliability, cues to action). The result showed that except for cues to action which belonged to users'own characteristics, other 6 service dimensions belonged to cloud service quality factors. Therefore, as abovementioned, once these 7 service demand dimensions continued to strengthen their own quality or to increase users' attention to healthcare, users' adoption intention toward healthcare cloud service system would be significantly linear enhanced. In other words, in the early stage of continuous implementation of healthcare cloud services, these 7 dimensions were the demand factors that needed to take into deep consideration in designing services.

Table 1 Health cloud service demand analysis (n=311)

Dimensions	Mean	s.d.	β_{1j}	β_{2j}	service demand classification
Relative benefit	3.943	.571	0.842*	-0.043(ns)	One-dimensional factor
Ease of use	4.042	.666	0.412*	-0.007(ns)	One-dimensional factor
Compatibility	3.935	.652	0.366*	0.023(ns)	One-dimensional factor
Observability	3.706	.711	0.534*	-0.031(ns)	One-dimensional factor
Social impact,	3.722	.748	0.789*	-0.086*	must-be factor
Pleasure	3.768	.716	0.810*	-0.074*	must-be factor
Functionality	4.173	.712	0.187(ns)	0.038(ns)	Indifference factor
Interactivity	4.168	.717	0.227(ns)	0.031(ns)	Indifference factor
Information integrity and accuracy	4.182	.695	0.056(ns)	0.085*	Excitement factor
Responsiveness	4.043	.673	0.416*	0.011(ns)	One-dimensional factor
Confidentiality and reliability	3.584	.793	0.413*	-0.002(ns)	One-dimensional factor
Disease threats	3.596	.617	0.971*	-0.090*	must-be factor
Action to obstacle	3.628	.729	0.107*	0.043*	Excitement factor
Cues to action	3.977	.627	0.36*	-0.019(ns)	One-dimensional factor
Adoption intention	3.883	.699			

Concerning must-be factors with 3 service dimensions (i.e., social impact, pleasure, and disease threats), the results indicated that recommendations from related media or friends, interesting properties, pleasant and excited feelings to explore, curiosity, and users' cognitive diseases threats were all necessary in stimulating users to choose and adopt a healthcare cloud services system. This result strongly implied that healthcare cloud services in its early stage of design should fully consider these 3 service demand dimensions, otherwise the healthcare cloud service system would be difficult to be accepted and adopted. Results regarding excitement factors with 2 service demand dimensions (i.e., information integrity and accuracy,

action to obstacle) presented that when users started to use healthcare cloud service system, their adoption intention would be less affected by information integrity and accuracy as well as individuals'action to obstacle. However, once healthcare cloud service system continued to strengthen its information integrity and accuracy with reminder cloud service functions, it would be able to enhance users' adoption intention toward healthcare cloud service system. Finally, in terms of indifference factors with 2 service demand dimensions (i.e., functionality, interactivity), the achieved results claimed that users' adoption intention would not be affected no matter they perceived the network had higher stability or whether it could improve instant response capability.

2. Diabetes self-management care cloud services demand analysis

Through collecting data from participants with diabetes or having own relatives with diabetes for service demand dimensions that needed attention degree and willingness to use, this study calculated the average degree of importance and average willingness to use of each item. As observed from Table 2, users exerted a high degree of willingness to use (mean= 3.898) toward diabetes self-management care cloud services. Line 2 of Table 4 expressed the average degree of importance. Accordingly, respondents perceived 14 items to be important (the average of all are more than 3.583), in which the top 5 most important items were "information integrity and accuracy", "interactivity", "functionality", "ease of use", and "responsiveness" with corresponding average degree of importance of 4.245,4.241,4.223,4.101 and 4.087, respectively.

In addition, this study aimed to develop the demand category identification method (SDC). The analysis results were shown in Table 2. From line 4,5, and 6, it were indicated that 14 service demands could be divided into four categories of one-dimensional factors, must-be factors, excitement factors, and indifference factors. Among them, one-dimensional factors included four dimensions of relative benefit/(usefulness), compatibility, observability, and cues to action. Except for cues to action which lay in users' own characteristics, the rest of dimensions belonged to cloud service quality. Hence,once the quality of these four service demand dimensions and users' attention were increased, users' willingness to use diabetes self-management care cloud services would be linear enhanced. I other words, demands toward diabetes self-management care cloud services should be sufficiently considered in the design stage. Otherwise, the service would be difficult for users to accept and adopt.

Additionally, excitement factors composed of two main dimensions of information integrity and accuracy and action to obstacle, implying that in the early period of usage, users' willingness to use was less susceptible to information integrity and accuracy while affecting users' cues to actions. For this reason, once the information integrity and accuracy of diabetes self- management care cloud services were strengthened and had reminder function, users' willingness to use diabetes self-management care cloud services would be continuously improved. Finally, indifference factors were proven to consist of five service demand dimension which were ease of use, functionality, interactive, responsiveness, and confidentiality and reliability, suggesting that participants with diabetes or having own relatives with diabetes perceive that diabetes self- management care cloud services were easy to use, the internet possessed a greater stability and can improve its ability of instant response capability as well as users were ready for communication at any time due to well-planning protection of personal data.

Table 2 Diabetes self-management care cloud services demand analysis (n=235)

Dimensions	Mean	s.d.	β_{1j}	β_{2j}	service demand classification
Relative benefit	3.962	.567	0.742*	-0.019(ns)	One-dimensional factor

Ease of use	4.101	.639	0.090(ns)	0.062(ns)	Indifference factor
Compatibility	3.955	.660	0.352*	0.024(ns)	One-dimensional factor
Observability	3.704	.711	0.624*	-0.049(ns)	One-dimensional factor
Social impact,	3.755	.741	0.761*	-0.084*	must-be factor
Pleasure	3.799	.688	0.996*	-0.104*	must-be factor
Functionality	4.223	.677	0.076(ns)	0.058(ns)	Indifference factor
Interactivity	4.241	.680	0.060(ns)	0.069(ns)	Indifference factor
Information integrity and accuracy	4.245	.668	0.030(ns)	0.097*	Excitement factor
Responsiveness	4.087	.677	0.274(ns)	0.043(ns)	Indifference factor
Confidentiality and reliability	3.583	.832	0.317(ns)	0.018(ns)	Indifference factor
Disease threats	3.635	.598	0.908*	-0.072*	must-be factor
Action to obstacle	3.613	.743	0.129(ns)	0.060*	Excitement factor
Cues to action	3.978	.633	0.439*	-0.036(ns)	One-dimensional factor
Adoption intention	3.898	.702			

CONCLUSION

The issues raised were the need of developing innovative cloud services, the effectiveness of domestic healthcare industry, and the consideration of the non-linear relationship between service demands and users' use willingness. On response, this research was mainly based on user demand viewpoint, cloud service application in the healthcare industry, and related theories concerning innovative service adoption, network information system quality, and healthcare utilization to develop an innovative method for customer service demand identification in the healthcare industry. Two cases of healthcare cloud services and diabetes self-management care cloud services were employed. As such, the achieved evidences would provide healthcare providers with useful assistance in the planning and design stages of innovative services in order to stimulate customer satisfaction as well as their continuous use.

This study was through two distinguished user questionnaires to explore user demands toward healthcare cloud services and diabetes self-management care cloud services. From the basis of achieved importance of those service demands, two research cases were utilized to develop a healthcare cloud service demand identification method. The results showed that users of both cloud services exert high use willingness. However, depending on different focuses of healthcare cloud service prevention capabilities or diabetes self-management cloud service care capabilities, users' service demand items would be different (Table 3).

This study has several considerable contributions. First, in this research, customers' service demands toward healthcare cloud service application within the industry were explored using related theories concerning the use of innovative services, network information system quality, and healthcare service use. This is different from past studies which focused only a single theory, considered there was a linear relationship between customer demands and adoption willingness, or employed one case for analysis and illustration. Therefore, this study hopes to present a more complete view of customer demands and stimulate more customers' use intention toward healthcare services.

Table 3 The service demand classifications

cloud services / demand classification	health cloud services	diabetes self-management care cloud service
One-dimensional factor	the relative benefit / (usefulness), ease of use,	the relative benefit / (usefulness) , compatibility,

	compatibility, observability, responsiveness, confidentiality and reliability, cues to action	observability, cues to action
must-be factor	social impact, pleasure and disease threats	social impact, pleasure and disease threats
Excitement factor	Information integrity and accuracy, action to obstacle	Information integrity and accuracy, action to obstacle
Indifference factor	functionality, interactivity	ease of use, functionality, interactivity, responsiveness, confidentiality and reliability

Furthermore, since utilizing different cases of healthcare cloud services and diabetes self-management cloud services to verify the feasibility of the proposed service demand identification approach, this method can beneficially help identify different service demand items in accordance with different purposes. Finally, this research not only contributes to the identification of cloud service demands in the healthcare industry but also effectively provides basis for acknowledging demands in other industries.

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AN INVENTORY MODEL FOR NON-INSTANTANEOUS DETERIORATING ITEMS WITH PRICE- AND STOCK-DEPENDENT SELLING RATE UNDER PARTIAL BACKLOGGING AND INFLATION

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ABSTRACT

This paper presents an inventory model for non-instantaneous deteriorating items with price- and stock-dependent selling rate under inflation and time value of money over a finite planning horizon. In the model, shortages are allowed and the unsatisfied demand is partially backlogged at the exponential rate with respect to the waiting time. We establish the theoretical results and provide an efficient solution procedure to find the optimal number of replenishment, the cycle time and selling price. Then the optimal order quantity and the total present value of profits are obtained. A numerical example and sensitivity analysis will be presented to illustrate the proposed model and particular cases of the model are also discussed.

Key words: Inventory; Pricing; Stock-dependent selling rate; Non-instantaneous deterioration; Partial backlogging; Inflation.

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INTRODUCTION

It has been observed in certain consumer goods that the demand is usually influenced by the amount of stock displayed on the shelves, i.e., the demand rate may go up or down if the

on-hand stock level increases or decreases. Such a situation generally arises from a consumer-goods type of inventory. As reported by Levin et al. (1972), a large pile of goods displayed in a supermarket will lead customers to buy more. Silver and Peterson (1985) also noted that sales at the retail level tend to be proportional to the amount of inventory displayed. These observations have attracted many marketing researchers and practitioners to investigate the modeling aspects of this phenomenon. Padmanabhan and Vrat (1995) considered an EOQ model for perishable items with stock-dependent selling rate for sales environment. Under instantaneous replenishment with zero lead time, they present three models: without backlogging, with complete backlogging and partial backlogging for sales environment. However, for the partial backlogging model case the opportunity cost due to lost sales was not taken into account in Padmanabhan and Vrat (1995). Recently, Hou (2006) extended Padmanabhan and Vrat (1995) by incorporating the effects of deterioration rate, inflation and time value of money to develop an inventory model with stock-dependent consumption rate and with complete backlogging for non-sales environment. However, the uniqueness of the optimal solution for the sales environment and partial backlogging remained further to unexplored. In real life, such as fashionable commodities and high-tech products with short product life cycle, the length of the waiting time for the next replenishment is the main factor for deciding whether the backlogging with be accepted or not. Some customers usually are willing to wait until replenishment, especially if the wait will be short, while other are more impatient and turn to buy from other sellers. To reflect this phenomenon, we allow for shortages and the rate of backlogged demand decreases exponentially as the waiting time for the next replenishment increases. Dye and Ouyang [2005] developed an inventory model in which the proportion of customers who would like to accept backlogging is the reciprocal of a linear function of the waiting time. Recently, Abad (1996, 2001) discussed a pricing and lot-sizing problem for a product with a variable rate of deterioration, allowing shortages and partial backlogging. The backlogging rate depends on the time to replenishment so the more customers must queue up for order, the greater the fraction of sales are lost. However, he does not consider the shortage cost in the objective function. Chern et al. (2008) proposed partial backlogging inventory lot-size models for deteriorating items with fluctuating demand under inflation. Other researchers such as Chang and Dye (1999), Papachristos and Skouri (2003), Wu et al. (2006), Min and Zhou (2009), and Hsieh et al. (2010) have modified inventory policies by considering the time-proportional partial backlogging rate.

In the above literatures, almost all the inventory models for deteriorating items assume that the deterioration occurs as soon as the retailer receives the commodities. However, in real life, most of goods would have a span of maintaining quality or the original condition (e.g. vegetables, fruit, meat and so on), namely, during that period, there was no deterioration

occurring. Recently, some researchers have modified inventory policies by considering the "non-instantaneous deterioration" such as Wu et al. (2006), Chang et al. (2010) and so on.

On the other hand, incorporating the effects of deteriorating items and stock-dependent demand to develop the order-level lot size inventory models were discussed by Datta and Pal (1990), Padmanabhan and Vrat (1995), Sarker et al. (1997), Giri and Chaudhauri (1998), Balkhi and Benkherouf (2004), Pal et al. (2006), Hsieh and Dye (2010), and Chang et al. (2010). Other issues relating to deterioration or batch sizing problem were also addressed by Ghare and Schrader (1963), Shah (1977), Heng et al. (1991), Wee (1995), Goyal and Giri (2001), Teng et al. (2002), and Sana (2010). In addition, the effects of inflation and time value of money on ordering policy over a finite time horizon are also considered in this paper. The pioneer research in this direction was Buzacott (1975), who developed an EOQ model with inflation subject to different types of pricing policies. Recently, Hou and Lin (2006) incorporated the effects of inflation and time value of money to develop an inventory model for deteriorating items with price and stock-dependent selling rates. Other inventory models with inflation, time value of money and deterioration are presented in Ray and Chaudhuri (1997), Sarker et al. (2000), Chung and Lin (2001), Balkhi (2004), Jaggi et al. (2006) and their references.

Base on above situations, the problem of determining the optimal replenishment policy for non-instantaneous deteriorating items with price- and stock-dependent selling rate and partial backlogging under inflation and time discounting is considered in this study. Therefore, the proposed model can be seen as an extension of Padmanabhan and Vrat (1995), Hou and Lin (2006) and Chang et al. (2010). So, a finite planning horizon inventory model for non-instantaneous deteriorating items with price- and stock-dependent selling rates and stockout cost (includes the backorder cost and lost sale cost) is developed where the unsatisfied demand is backlogged and the fraction of shortages backordered increases exponentially as the waiting time for the next replenishment decreases. The rest of the paper is organized as follow. In the next section, the assumptions and notation related to this study are presented. The section 3, we present mathematical model over a finite planning time horizon and then prove that the optimal replenishment policy not only exists but is also unique. The section 4, the model is illustrated with a numerical example adopted from Hou and Lin (2006). In addition, the sensitivity analysis of the optimal solution with respect to parameters of the system and special cases are discussed, which is followed by concluding remarks.

ASSUMPTIONS AND NOTATION

To develop the mathematical model of inventory replenishment schedule, the notation adopted in this paper is as follow:

1) H : planning horizon
2) T : replenishment cycle
3) N : number of replenishment during the planning horizon (a decision variable); $N = H/T$.
4) T_j : the j-th replenishment time; $T_j = T_{j-1}+T$ (j = 1,2,…,N) where $T_N = H$ and $T_0 = 0$.
5) t_d: the length of time in which the product has no deterioration (i.e., fresh product time).
6) t_1: time with positive inventory (a decision variable)
7) $T - t_1$: time when shortage occurs
8) $I_1(t)$: the inventory level at time t ($0 \le t \le t_1$) in which the product has no deterioration
9) $I_2(t)$: the inventory level at time t ($t_d \le t \le t_1$) in which the product has deterioration
10) $I_3(t)$: the inventory level at time t ($t_1 \le t \le T$) in which the product has shortage
11) Q : the 2nd, 3rd, …, Nth replenishment lot size (units)
12) I_m : maximum inventory level per cycle
13) θ : deterioration rate fraction of the on-hand inventory
14) r : discount rate, representing the time value of money
15) i : inflation rate
16) R : the net discount rate of inflation; $R = r - i$
17) A : the replenishment cost per order, $/order
18) c : the purchasing cost per unit, $/unit
19) S : the selling price per unit, where $S > c$, $/unit
20) c_1 : the inventory holding cost per unit per unit time, $/unit/unit time
21) c_2 : the shortage cost per unit per unit time, $/unit/unit time
22) c_3 : the cost of lost sales (i.e., goodwill cost) per unit, $/unit
23) $P(t_1,S,N)$: the total present value of profits over a finite planning time horizon H

In addition, the following assumptions are made:

1) The demand rate $D(t,S)$ is a function of current inventory level $I(t)$ and the constant selling price S. We assumed that $D(t,S) = \alpha(S) + \beta I(t)$ for inventory level $I(t) > 0$, where β is the stock-dependent selling rate parameter and $0 \le \beta \le 1, \alpha(S)$ is a positive decreasing function of S with $\alpha'(S) = d\alpha(S)/dS < 0$. It should be noted that the selling rate function is a special type and not a general function of time t and selling price S.
2) t_d is the length of time in which the product has no deterioration (i.e., fresh product time). After this period, a constant fraction, θ, of the on-hand inventory deteriorates and there is no repair or replacement of the deteriorated units. t_d and θ are given constant.
3) A single item is considered with a constant rate of deterioration over a known and finite planning horizon of length H.
4) The replenishment rate is infinite and lead time is zero.
5) Shortages are allowed and backlogged partially. We adopt the concept used in Abad

(1996), i.e., the unsatisfied demand is backlogged, and the fraction of shortages backordered is $e^{-\delta x}$, where x is the waiting time up to the next replenishment and the backlogging parameter δ is a positive constant.

6) Product transactions are followed by instantaneous cash flow.

MATHEMATICAL MODEL

To establish the total present value function of profits over a finite planning time horizon H, we suppose that the planning horizon H is divided into N equal parts of length $T = H/N$. Hence, the reorder times over the planning horizon H will be $T_j = jT$ $(j = 0,1,2,\ldots,N)$.

The first replenishment lot size of I_m is replenished at $T_0 = 0$. During the time interval $(T_j, t_{j+1}]$ $(j = 0,1,2,\ldots,N\text{-}1)$, the inventory is depleted due to price-and stock-dependent selling rate and deterioration until it is zero at $t = t_j$ $(j = 1,2,\ldots,N)$. During the time interval $[t_j, T_j)$ $(j = 1,2,\ldots,N)$, the inventory level only depends on demand, and unsatisfied demand is backlogged at a rate $e^{-\delta(T_j - t)}$, where $t \in [t_j, T_j]$ $(j = 1,2,\ldots,N)$.

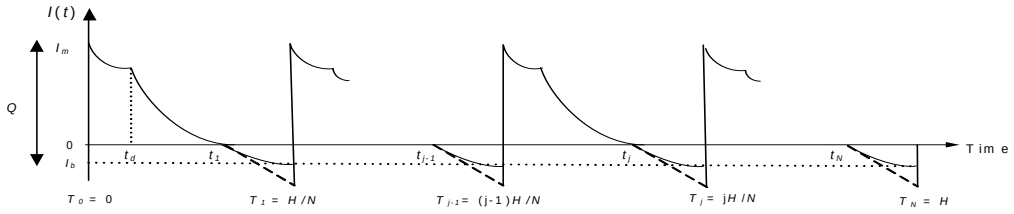

Figure. 1 The graphical representation for the inventory system.

A realization of the inventory level in the system is given in Figure 1. Hence the inventory level during the first replenishment cycle can be represented by the following differential equations:

$$\frac{dI_1(t)}{dt} = -[\alpha(S) + \beta I_1(t)] \qquad 0 \le t \le t_d \tag{1}$$

$$\frac{dI_2(t)}{dt} + \theta I_2(t) = -[\alpha(S) + \beta I_2(t)] \qquad t_d \le t \le t_1 \tag{2}$$

$$\frac{dI_3(t)}{dt} = -\alpha(S)e^{-\delta(T-t)} \qquad t_1 \le t \le T \tag{3}$$

with the boundary conditions $I_1(0)=I_m$, $I_2(t_1) = 0$, and $I_3(t_1) = 0$, the solution of (1),(2), and (3) can be represented by

$$I_1(t) = e^{-\beta t} I_m - \frac{\alpha(S)}{\beta}\left[1 - e^{-\beta t}\right] \qquad 0 \le t \le t_d \tag{4}$$

$$I_2(t) = \frac{\alpha(S)}{\beta+\theta}\left[e^{(\beta+\theta)(t_1-t)} - 1\right] \qquad t_d \le t \le t_1 \tag{5}$$

$$I_3(t) = -\frac{\alpha(S)}{\delta}\left[e^{-\delta(T-t)} - e^{-\delta(T-t_1)}\right] \qquad t_1 \le t \le T \tag{6}$$

Note that the inventory level $I(t)$ is continuous at $t = t_d$ such that $I_1(t_d) = I_2(t_d)$. Therefore, it is easy to show that the maximum inventory level during the first replenishment cycle is

$$I_m = \frac{\alpha(S)}{\beta+\theta}\left[e^{(\beta+\theta)(t_1-t_d)} - 1\right]e^{\beta t_d} + \frac{\alpha(S)}{\beta}(e^{\beta t_d} - 1) \tag{7}$$

During the time interval $(T_j, t_{j+1}]$ (j = 0,1,2,…,*N-1*), the replenished inventory is being consumed due to selling and deterioration. In addition, during the time interval $[t_j, T_j)$ (j =1,2,…,*N*) the inventory level only depends on demand, however, the unsatisfied demand during time interval $[t_j, T_j)$ will be partially backordered at the exponential rate with respect to the waiting time. Under instantaneous cash transaction, the present value of sales revenue during the first cycle is

$$S_a = S\int_0^{t_1}[\alpha(S) + \beta I_1(t)]e^{-Rt}dt + Se^{-RT}\int_{t_1}^{T}\alpha(S)dt$$

$$= \frac{S\alpha(S)}{R}\left[1 - e^{-Rt_1}\right] + \frac{S\beta\alpha(S)}{(\beta+\theta)(\beta+\theta+R)}\left[e^{(\beta+\theta)t_1} - e^{Rt_1}\right] + \frac{S\beta\alpha(S)}{(\beta+\theta)R}\left[e^{-Rt_1} - 1\right] + S\alpha(S)e^{-RT}(T - t_1)$$

$$S_a = S\int_0^{t_d}[\alpha(S) + \beta I_1(t)]e^{-Rt}dt + S\int_{t_d}^{t_1}[\alpha(S) + \beta I_2(t)]e^{-R(t+t_d)}dt + Se^{-RT}\int_{t_1}^{T}\alpha(S)e^{-\delta(T-t)}dt$$

$$= S\int_0^{t_d}[\beta I_m + \alpha(S)]e^{-(\beta+R)t}dt + e^{-Rt_d}S\int_{t_d}^{t_1}[\alpha(S) + \frac{\alpha(S)\beta}{\beta+\theta}(e^{(\beta+\theta)(t_1-t)} - 1)]e^{-Rt}dt$$

$$+ \frac{S\alpha(S)}{\delta}e^{-RT}[1 - e^{-\delta(T-t_1)}]$$

$$= \frac{S[\beta I_m + \alpha(S)]}{\beta+R}\left[1 - e^{-(\beta+R)t_d}\right] + \frac{S\alpha(S)\theta e^{-Rt_d}}{R(\beta+\theta)}\left[e^{-Rt_d} - e^{-Rt_1}\right]$$

$$+ \frac{S\beta\alpha(S)e^{-Rt_d}}{(\beta+\theta)(\beta+\theta+R)}\left[e^{(\beta+\theta)t_1-(\beta+\theta+R)t_d} - e^{-Rt_1}\right] + \frac{S\alpha(S)}{\delta}e^{-RT}\left[1 - e^{-\delta(T-t_1)}\right] \tag{8}$$

Since replenishment in each cycle is done at the start of each cycle, the present value of ordering cost during the first cycle is

$$C_r = A \tag{9}$$

Inventory occurs during time interval $[T_j, t_{j+1})$ (j = 0,1,2,…,*N-1*), therefore, the present value of holding cost during the first replenishment cycle is

$$C_h = c_1\left[\int_0^{t_d} I_1(t)e^{-Rt}dt + \int_{t_d}^{t_1} I_2(t)e^{-R(t+t_d)}dt\right]$$
$$= \frac{c_1(I_m\beta+\alpha(S))}{\beta(\beta+R)}\left[1-e^{-(\beta+R)t_d}\right] + \frac{c_1\alpha(S)}{\beta R}\left[e^{-Rt_d}-1\right]$$
$$+ \frac{c_1\alpha(S)e^{-Rt_d}}{(\beta+\theta)(\beta+\theta+R)}\left[e^{(\beta+\theta)t_1-(\beta+\theta+R)t_d}-e^{-Rt_1}\right] + \frac{c_1\alpha(S)e^{-Rt_d}}{(\beta+\theta)R}\left[e^{-Rt_1}-e^{-Rt_d}\right] \quad (10)$$

Note that the unsatisfied demand during time interval $[t_j, T_j)$ will be partially backordered at the exponential rate with respect to the waiting time t and $t \in [t_j, T_j)$ (j = 1,2,…,*N*). So, the present value of shortage cost during the first cycle is

$$C_s = c_2\int_{t_1}^{T}\frac{\alpha(S)}{\delta}\left[e^{-\delta(T-t)}-e^{-\delta(T-t_1)}\right]e^{-Rt}dt$$
$$= \frac{c_2\alpha(S)}{\delta(\delta-R)}\left[1-e^{-(\delta-R)(T-t_1)}\right]e^{-RT} - \frac{c_2\alpha(S)}{\delta R}\left[e^{-(\delta-R)(T-t_1)}-e^{-\delta(T-t_1)}\right]e^{-RT} \quad (11)$$

and the opportunity cost due to lost sales during the first cycle is

$$C_o = c_3\alpha(S)\int_{t_1}^{T}\left[1-e^{-\delta(T-t)}\right]e^{-Rt}dt$$
$$= \frac{c_3\alpha(S)}{R}\left[e^{-Rt_1}-e^{-RT}\right] - \frac{c_3\alpha(S)}{\delta-R}\left[e^{-RT}-e^{-\delta(T-t_1)-Rt_1}\right] \quad (12)$$

Replenishment is done at $t = T_j$ (j = 0,1,2,…,*N*), the replenishment items are consumed by selling as well as deterioration during time interval $[t_j, T_j)$ (j = 1,2,…,*N*). So, the present value of purchase cost during the first cycle is

$$C_p = cI_m + ce^{-RT}\int_{t_1}^{T}\alpha(S)e^{-\delta(T-t)}dt$$
$$= cI_m + \frac{c\alpha(S)}{\delta}e^{-RT}\left[1-e^{-\delta(T-t_1)}\right] \quad (13)$$

Consequently, the total present value of profits during the first replenishment cycle can be formulated as

$$\pi = S_a - C_r - C_h - C_s - C_o - C_p \quad (14)$$

There are *N* cycles during the planning horizon. Since inventory is assumed to start and end at zero, an extra replenishment at $t = H$ is required to meet the unsatisfied demand of the last cycle in the planning horizon. Therefore, there are *N*+1 replenishments in the entire time horizon *H*, the first replenishment lot size is I_m, and the 2nd, 3rd,…, *N*th replenishment lot

size is

$$Q = I_m + \int_{t_1}^{T} \alpha e^{-\delta(T-t)} dt \tag{15}$$

and the last or (N+1)th replenishment cost size is

$$I_b = \frac{\alpha}{\delta}\left[1 - e^{-\delta(T-t_1)}\right] \tag{16}$$

So, the total present value of profits over a finite planning time horizon H is

$$\begin{aligned}
P(t_1, S, N) &= \sum_{j=0}^{N-1} \pi e^{-RjT} - Ae^{-RH} \\
&= \pi\left(\frac{1-e^{-RNT}}{1-e^{-RT}}\right) - Ae^{-RH} \\
&= \left\{\frac{S[\beta I_m + \alpha(S)]}{\beta+R}\left[1-e^{-(\beta+R)t_d}\right] + \frac{S\alpha(S)\theta e^{-Rt_d}}{R(\beta+\theta)}\left[e^{-Rt_d} - e^{-Rt_1}\right]\right. \\
&\quad \left. + \frac{S\beta\alpha(S)e^{-Rt_d}}{(\beta+\theta)(\beta+\theta+R)}\left[e^{(\beta+\theta)(t_1-t_d)-Rt_d} - e^{-Rt_1}\right]\right\} E \\
&\quad + \left(\frac{S\alpha(S)}{\delta} - \frac{c\alpha(S)}{\delta}\right)\left[1-e^{-\delta(H/N-t_1)}\right] F - AD \\
&\quad - \left\{\frac{c_1(I_m\beta + \alpha(S))}{\beta(\beta+R)}\left[1-e^{-(\beta+R)t_d}\right] + \frac{c_1\alpha(S)}{\beta R}\left[e^{-Rt_d} - 1\right]\right. \\
&\quad \left. + \frac{c_1\alpha(S)e^{-Rt_d}}{(\beta+\theta)(\beta+\theta+R)}\left[e^{(\beta+\theta)t_1-(\beta+\theta+R)t_d} - e^{-Rt_1}\right] + \frac{c_1\alpha(S)e^{-Rt_d}}{(\beta+\theta)R}\left[e^{-Rt_1} - e^{-Rt_d}\right]\right\} E \\
&\quad - \left\{\frac{c_2\alpha(S)}{\delta R}\left[e^{-\delta(H/N-t_1)} - 1\right] + \frac{c_2\alpha(S)}{R(\delta-R)}\left[1-e^{-(\delta-R)(H/N-t_1)}\right]\right\} F \\
&\quad - \frac{c_3\alpha(S)}{R}\left[e^{-R(t_1-H/N)} - 1\right] F + \frac{c_3\alpha(S)}{\delta-R}\left[1-e^{-(\delta-R)(H/N-t_1)}\right] F - cI_m E
\end{aligned} \tag{17}$$

where π is derived by substituting (8)-(13) into (14), T=H/N, $D = \dfrac{e^{RH/N} - e^{-RH}}{e^{RH/N} - 1}$, $E = \dfrac{1-e^{-RH}}{1-e^{-RH/N}}$, and $F = \dfrac{1-e^{-RH}}{e^{RH/N} - 1}$.

When the complete backlogging and instantaneous deterioration are allowed (i.e., $\delta = 0$ and $t_d = 0$), the total present value of profits in (17) becomes

$$P(t_1,S,N)=\{\frac{S\alpha(S)}{R}(1-e^{-Rt_1})+\frac{S\beta\alpha(S)}{(\beta+\theta)(\beta+\theta+R)}(e^{(\beta+\theta)t_1}-e^{-Rt_1})+\frac{S\beta\alpha(S)}{(\beta+\theta)R}(e^{-Rt_1}-1)\}E$$
$$+(S\alpha(S)-c\alpha(S))(H/N-t_1)F-AD-\{\frac{c_1\alpha(S)}{(\beta+\theta)(\beta+\theta+R)}(e^{(\beta+\theta)t_1}-e^{-Rt_1})$$
$$+\frac{c_1\alpha(S)}{(\beta+\theta)R}(e^{-Rt_1}-1)\}E-\frac{c_2\alpha(S)}{R^2}\{R(t_1-H/N)+e^{R(H/N-t_1)}-1\}F-\frac{c\alpha(S)E}{\beta+\theta}(e^{(\beta+\theta)t_1}-1) \quad (18)$$

Then the (18) is the same as the equation (15) in Hou and Lin (2006). On the other hand, when the inflation and time value of money are not considered (i.e., $R = 0$) and the number of replenishment per unit times is equal to $1/T$ (i.e., $H = 1$), hence, the total present value of profits in (17) will form an infinite time-horizon situation and becomes

$$\begin{aligned}P(T,t_1)=\frac{1}{T}\Bigg\{&\frac{S[\beta I_m+\alpha(S)]}{\beta}\left[1-e^{-\beta t_d}\right]+\frac{S\alpha(S)\theta}{\beta+\theta}\left[t_1-t_d\right]\\&+\frac{S\beta\alpha(S)}{(\beta+\theta)^2}\left[e^{(\beta+\theta)(t_1-t_d)}-1\right]+\frac{S\alpha(S)}{\delta}\left[1-e^{-\delta(T-t_1)}\right]-A\\&-\frac{c_1(\beta I_m+\alpha(S))}{\beta^2}\left[1-e^{-\beta t_d}\right]+\frac{c_1\alpha(S)}{\beta}t_d\\&-\frac{c_1\alpha(S)}{(\beta+\theta)^2}\left[e^{(\beta+\theta)(t_1-t_d)}-1\right]+\frac{c_1\alpha(S)}{\beta+\theta}\left[t_1-t_d\right]\\&-\frac{c_2\alpha(S)}{\delta^2}\left[1-e^{-\delta(T-t_1)}\right]+\frac{c_2\alpha(S)}{\delta}e^{-\delta(T-t_1)}(T-t_1)\\&-c_3\alpha(S)(T-t_1)+\frac{c_3\alpha(S)}{\delta}\left[1-e^{-\delta(T-t_1)}\right]-cI_m-\frac{c\alpha(S)}{\delta}\left[1-e^{-\delta(T-t_1)}\right]\Bigg\}\end{aligned} \quad (19)$$

Note that the (19) can be reduced to the case as in Chang et al. (2010) when the backlogging parameter $\delta=\frac{1}{T-t}\ln(1+\tilde{\delta}(T-t))$. Therefore, the model in this paper is an extension of Hou and Lin (2006) and Chang et al. (2010).

The objective of this paper is to determine of the values of N, t_1, and S that maximize $P(t_1,S,N)$, where N is a discrete variable and t_1 and S are continuous variables. For a given value of N, the necessary conditions for P to be maximized are $\partial P/\partial t_1 = 0$ and $\partial P/\partial S = 0$. If the objective function is concave, the following sufficient conditions must be satisfied:

$$(\partial^2 P(t_1,S,N)/\partial {t_1}^2).(\partial^2 P(t_1,S,N)/\partial S^2)-(\partial^2 P(t_1,S,N)/\partial t_1\partial S)^2>0 \quad (20)$$

and

$$\partial^2 P(t_1,S,N)/\partial {t_1}^2<0 \quad (21)$$

Since $P(t_1, S, N)$ as expressed in (17) is a very complicated function due to high-power

expression of the exponential function, it is difficult to show analytically the validity of above sufficient conditions. Therefore, the signs of the above quantities in (20) and (21) are assessed numerically.

NUMERICAL EXAMPLE

To illustrate the developed model we consider the following example.

Example 1. Let $D(t,S) = a - bS + \beta I(t)$, a = 500 units/year, b = 0.2, β = 0.10, θ = 0.2, A = \$80/order, c = \$80/unit, c_1 = \$10/unit/year, c_2 = \$8/unit/year, c_3 = \$6/unit/year, R = 0.1, H = 10 year. Using the solution procedure described above, the optimal total present value of profits is found when the number of replenishment cycle, N, is 6. Hence, the optimal values of t_1, S, and N are t_1^* = 0.751, S^* = 1765.85, and N^* = 6, respectively, and maximum total present value of profits $P(t_1^*, S^*, N^*)$ = \$1581755.9. Then, we have optimal cycle time $T^* = H/N^*$ = 1.667 and optimal order quantity Q^* = 637.70.

CONCLUSIONS

In this paper, an inventory model is developed for non-instantaneous deteriorating items with price- and stock-dependent selling rate under inflation and time discounting. In the model, shortages are allowed and the rate of backlogged demand decreases exponentially as the waiting time for the next replenishment increases. In addition, since the inventory systems need to invest large capital to purchase inventories, which is highly correlated to the return of investment, hence it important to consider the effects of inflation and time value of money in inventory decision-making. The proposal model can be seen as an extension of Hou and Lin (2006) and Chang et al. (2010) to obtain the optimal number of replenishment, the cycle time and selling price by considering exponential partial backlogging and incorporate the effects of inflation and time value of money for a finite planning horizon inventory model with non-instantaneous deteriorating items. We have given an analytic formulation of the problem on the framework described above and have presented an optimal solution procedure to find the optimal replenishment policy. From our research results, we have verified that the effects of price- and stock-dependent selling rate under the conditions of inflation and time value of money. The results indicate that the effects of inflation and time value of money, price- and stock-dependent selling rate, deterioration of items, and backlogging rate on optimal replenishment policy are significant. Hence the above situations should not be ignored in developing the inventory model.

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SUPPLIER GOVERNANCE EFFECTIVENESS: MODERATION EFFECTS OF ECONOMIC DEVELOPMENT AND NATIONAL CULTURE

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ABSTRACT
Transaction Cost Economics (TCE) suggests that firms choose governance mechanisms to ensure fulfillment of contractual obligations and safeguard against opportunism for their outsourcing activities. This study examines how buying organizations govern supplier contracts to improve manufacturing competitiveness. The effectiveness of three primary methods of governance: contractual governance, coordination governance, and information sharing governance, is examined. A research model is developed to decipher the relationships between transaction attributes, governance mechanisms, and performance. Furthermore, we study the moderating effects of economic development and national culture on the effectiveness of the three governance mechanisms. SEM analysis is performed using the data collected from 987 manufacturing plants from 19 countries, and several important findings are presented that would advance the theory and practice in outsourcing. First, we find empirical support for the effects of contractual, coordination, and information sharing governances in improving manufacturing performance. The effectiveness of different governance mechanisms is not equal and is contingent on the nature of the outsourcing. For instance, contractual governance is very effective for mitigating the risk from market, technology, behaviorism and special investment. Both coordination and information sharing governances lessen the opportunistic behavior resulting from asset specificity, but they are not effective when facing environmental uncertainty. Furthermore, the effectiveness of governance mechanisms is moderated by both economic development and national culture. The developed markets and countries with strong uncertainty avoidance prefer to use contractual governance to reduce the opportunistic behavior, while emerging markets and countries with low uncertainty avoidance consider information sharing governance to be more effective.

Keywords: Transaction cost economics, outsourcing, supplier governance

1. INTRODUCTION

Supplier governance is a critical strategic issue for the success of supply chain management (Williamson, 1979; 2008). Transaction Cost Economics (TCE) states the major goal of governance is to reduce opportunism that arises from execution of the contract's uncertain conditions. The contract is the foundation for the overall business transaction and it provides formal governance of the interactions between the buyer and the supplier regarding their responsibilities and behaviors (Jiang et al., 2008, Monczka et al., 2008). Nonetheless, neither buyers nor suppliers have complete knowledge about all the conditions under which the contract will be executed, which is called bounded rationality (Simon 1957). Bounded rationality causes the contract to be modified after signing and such modification is called *adaptation*. In other words, not all aspects of an inter-organizational transaction are likely to be completely detailed by the contract (Handley and Benton, 2009). As a result, additional control mechanism such as relational adaptation (buyer-supplier collaboration, joint problem solving, and information sharing) becomes necessary for settling contractual disputes and safeguarding completion of transactions (Peterson et al., 2002; van Hoek, 2000; Yang et al., 2012). Therefore, the supplier governance has two basic elements, the formal contract and the relational governance. When these two governance mechanisms are both used it is collectively known as hybrid governance (Williamson, 2008). Several studies have confirmed the efficacy of these two governance mechanisms (Liu et al., 2009; Mesquita and Brush, 2008; Yang et al., 2012). Nonetheless, the relative effectiveness of the contractual governance and two relational adaptation mechanisms has never been properly examined.

A further review suggests that the concept of relational governance consists of two separate components: *relational coordination* and *information sharing*. These two components represent the engagement of two different buyer-supplier interaction activities during contract implementation and fulfillment. Even though the literature treats them as a single construct, they are likely to have different effects on reducing opportunism. Furthermore, from the aspect of contingency theory, the relative effectiveness could very well depend on some factors such as stage of economic development and culture. This study intends to extend the discussion of TCE and outsourcing to the contingent effectiveness of contract and two types of relational adaptation. Specifically, we would address the following research questions:

(1) What is the effectiveness of the three governance mechanisms, contract, relational coordination and information sharing, in relation to two primary transaction attributes, asset specificity and environmental risk?

(2) From the aspect of global business, what factors, such as state of economic development and national culture, would moderate the effectiveness of different governance mechanisms.

The paper proceeds as follows. Section 2 provides a literature review in relation to contractual governance, relational governance, and the moderating effect of state of economic development and national culture. Research model and research hypotheses are developed. Section 3 discusses the research methodology, data collection, and constructs measures. Section 4 presents statistical results and discussion, followed by the conclusions in Section 5.

2. THEORETICAL BACKGROUND

The supply chain literature suggests that contractual governance and relational adaptation governances are jointly used for supplier governance (Williamson, 1979, 1985; Rindfleish and Heide, 1997; Grover and Maholtra, 2003; Yang et al., 2012). Both Liu et al. (2009) and Yang et al. (2012) argued that the two governance mechanisms may not be equally effective but offered no specific guidelines as to aligning the adoption with the nature of outsourcing (e.g., asset specificity and environmental risk) and any contingent factors. In this study, we first develop theoretical relationships between two primary transaction attributes, asset specificity and environmental risk, and governance mechanisms. Based on Transaction Cost Economics, a basic research model is developed to examine how both governance mechanisms reduce the opportunism and lead to manufacturing performance. We then review how several contingency factors (economic development, national culture) moderate the relationships developed in the basic research model.

2.1 Supplier asset specificity

Supplier asset specificity is the degree that the supplier has to invest in assets to modify its resources to meet the buyer's requirements (Rindfleish and Heide, 1997). From buyer's perspective, buyers outsource to a supplier so they do not have to purchase, plan and control resources where they strategically feel are not the core of their competitiveness. Yet, asset specificity could cause buyer and supplier opportunism. On the one hand, buyers may leverage the supplier's dedicated assets to lower prices. On the other hand, the supplier may sell their specific products to the competitors. As a result, asset specificity increases contract details due to both buyer and supplier requiring contractual protection against opportunism (Van Hoek, 2000). It is also expected that the supplier asset specificity will directly affect relational governance (Joskow, 1987; Heide and Minor, 1992; Parkhe, 1993. Additionally from the buyer's perspective, the primary reason for outsourcing is their wishing to focus their resources on their competitive advantage by reducing their resource investment costs that they assume will be developed by the supplier. This reduction in buyer's cost implies that supplier asset specificity is positively related to buyer's competitiveness and financial returns.

H1a: Supplier asset specificity is positively related to Manufacturing Competitiveness
H1b: Supplier asset specificity is positively related to contractual governance
H1c: Supplier asset specificity is positively related to coordination governance
H1d: Supplier asset specificity is positively related to information sharing governance

2.2 Environmental risk

Environmental risk has been a central variable considered in outsourcing decision making. Risks associated with outsourcing include the loss of control over the task, function or item being outsourced, a potential degradation of critical capabilities, increased dependency, and financial vulnerability. Additional risks emerge out of market volatility, incomplete specifications, and the inability to measure performance (Ellram et al. 2008).

Most of the TCE literature suggests three types of risk: technology risk (both product and process), market risk (demand uncertainty) and behavioral risk (caused by one party in the contract taking advantage of the uncertainty: opportunism). Technology risk caused by failure of the purchased item not meeting requirements of either the buyer's system or the failure of the purchased item to meet the buyer's customer's requirement. Market risk is the failure of the purchased item to satisfy customer's need. Behavioral risk is the degree that that there is

supplier opportunism. As suggested by (Rendfleisch and Heide, 1997, p.42), these three risks are combined as indicator variables for the latent construct called environmental risks.

Environmental risks are pervasive in all supply chain risks and have several important effects on supplier governance (Buvik, 1998; Ellram et al., 2008). These risks increase supplier performance ambiguity and opportunistic behaviors. It is common for the buyer to lessen these risks using both the contractual governance, and coordination and information sharing. However, it is unlikely that all risks can be eliminated by these mechanisms. Therefore, environmental risks may directly hinder competitiveness.

H2a: Environmental risk is negatively related to Manufacturing competitiveness
H2b: Environmental risk is positively related to Contractual governance
H2c: Environmental risk is positively related to Coordination governance
H2d: Environmental risk is positively related to Information sharing governance

2.3 Contractual governance

TCE suggests that a more specific contract can reduce uncertainty inherent in the outsourcing relationship (Williamson 2008). With higher contract specificity, better control is maintained, and the possibility of opportunistic behaviour or abuse is reduced. The buyer's perceived performance of the sourcing relationship should therefore be better, compared with relationships governed by lower contract specificity. Detailed and clear contract language should therefore be used when formalizing the outsourcing agreement, incorporating clauses to address a variety of contingencies. Of particular consideration should be clauses related to financial repayment, exclusivity, damage for poor technical performance, and damage for late delivery (Mesquita and Brush, 2008). These clauses can effectively lead to lower levels of uncertainty, reduce the risk of opportunistic behaviour, and increase the control and confidence in the outsourcing arrangement.

Contractual governance refers to the degree that the firm uses the formal contracts to control the overall performance of the suppliers. It is the primary methods to evaluate the success of the supplier performance. Its governance purpose is to control buyer-supplier opportunism (Dahistrom and Nygaard, 1999; Liu et al., 2009). Yet, the importance of any clause to control opportunism is whether the firm will enforce its conditions with penalties. This study uses the likelihood that the contract clauses will be enforced as the presence of formal contractual governance. Studies have shown contractual governance is a primary factor to improve the competitiveness of the organization (Dahistrom and Nygaard, 1999; Liu et al., 2009). However, Wang and Wei (2007) found that contractual governance is statistically related to performance but not as strongly related as relational governance. Therefore, we hypothesize that contractual governance is expected to increase competitiveness performance.

H3: Contractual governance is positively related to Manufacturing competitiveness

2.4 Relational governance

Relational governance defines the degree to which the two exchange partners work as a team to solve problems, sharing information to establish joint strategic directions, and produce superior mutual outcomes (Maloni and Benton, 2000). Buvik and Reve (2001, p. 103) argued that relational governance curtails opportunistic behavior and promotes the alignment of interests between two exchange partners.

Based on the literature, this study suggests that there are two different types of relational governance that have different effects on curtailing opportunism and improving competitiveness: *relational coordination* and *information sharing*. These two governance mechanisms represent the engagement of two different buyer-supplier interaction activities during contract implementation and fulfillment. After the contract is signed, buyers and suppliers interact and cooperate with each other with the intention of satisfying contract specifications, and such cooperation is referred to as relational coordination (Heide and John, 1990, 1992; Heide, 1994; Liu et al., 2009). The coordination includes various activities such as developing a standard approach to problem solving, establishing implicit agreements, and making commitment to not alter facts for a party's advantage.

Meanwhile, information sharing is suggested as the other form of relational governance to deal with environmental uncertainties. Information sharing refers to the communication and transfer of information between supplier and buyer during processes of transaction and cooperation. If a manufacturer shares accurate and timely demand and inventory information with its major suppliers, the suppliers have more time to make production schedule and inventory arrangements, which reduces production and inventory cost, and shortens the lead time to the market. Dell is a good example of sharing demand and inventory information with its major suppliers to gain both responsiveness and efficiency advantage over its competitors. On the other hand, as suppliers share production planning, inventory and capacity information with the manufacturer, it increases supply chain visibility, thus helping to improve the delivery performance and customer service level. As a result, the manufacturer can respond to market change more quickly. Overall, previous studies have recognized the central role of information sharing on mitigating the bullwhip effect, reduce costs, and improve supply chain performance.

H4a: Coordination governance is positively related to Manufacturing competitiveness
H4b: Information sharing governance is positively related to Manufacturing competitiveness
H5a: Coordination governance is related to contractual governance
H5b: Information governance is related to contractual governance

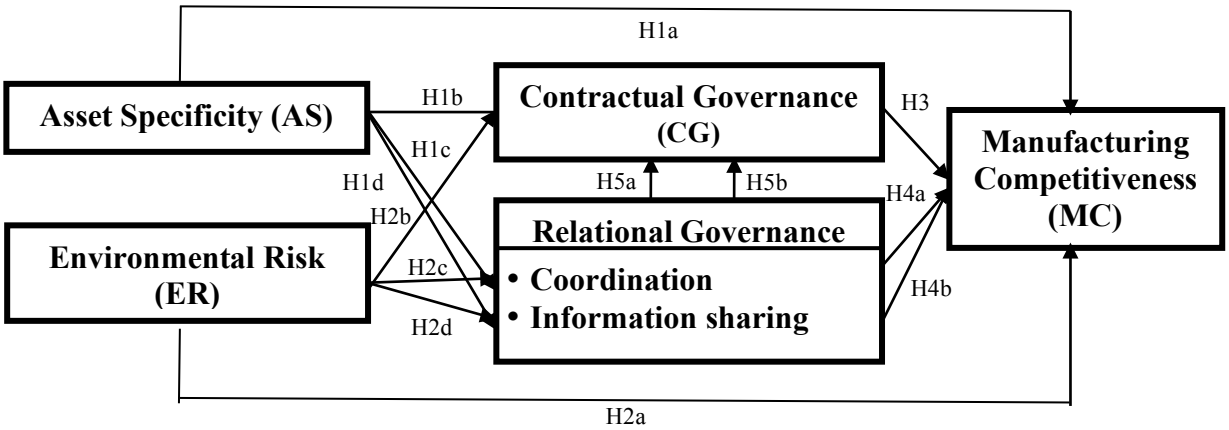

Figure 1 - Research model

Figure 1 displays the research model that illustrates the theoretical relationship among environmental risk, asset specificity, contractual governance, coordination, information sharing, and manufacturing competitiveness.

2.5 Moderators: Economic development and national culture

Motivated by the contingency theory, we hypothesize a few contextual variables that could influence the effectiveness of governance mechanism. Contingency theory suggests that an organization adapts itself with the contextual conditions to maintain or achieve better performance (Donaldson, 2001; Sousa and Voss, 2008). Specifically, the "best" practices should be analyzed within the context in which the firms are operating. The assumption is that a firm must identify specific factors responsible for achieving its competitive edge.

Contingency theory has been applied and verified in several research areas, including strategic management (Doty et al., 1993; Ketokivi and Schroeder, 2004), human resource management (Delery and Doty, 1996), new product development (McCarthy et al., 2006), and forecasting (Kalchschmidt, 2012). In this vein, different contingencies might affect the effectiveness of a particular management approach/practice. Based on the literature and the nature of supplier governance, we choose the following contingency variables in this study: economic development, original of suppliers, and national culture (Sousa and Voss, 2008).

(1) Economic development: Developed vs. Emerging

The literature has recognized the significance of emerging market economies and the differences of management practices between emerging and developed countries. Emerging markets refer to countries that have reached a "minimum level of economic development (usually measured in terms of GDP)" and that are "in the growth phases of their economic cycles". For instance, BRIC countries (Brazil, Russia, India, and China) are frequently considered the most significant emerging markets. A recent global supply chain survey by eyefortransport suggested that developed countries continue to expand their outsourcing activities to emerging markets such as BRIC and Eastern Europe countries. Despite the rising labour costs, China clearly remains an important market while in Brazil local manufacturing incentives and an ever improving infrastructure due to upcoming sporting events such as the 2014 FIFA World Cup and the 2016 Olympic Games are making this South American giant a more attractive option. A recent study from Prologis revealed that Eastern and Central Europe are set to grow in popularity as favoured destinations for warehousing and manufacturing due to the region's economic growth potential and the closeness to the Russian market.

The literature has generally supported the importance of economic development levels as a factor for business operations and management. Nonetheless, with the exception of GroBler et al. (2013), the influence of economic development on outsourcing and supplier management has been ignored. Considering the degree of globalization and the increasing importance of emerging economies, understanding the difference in supplier management between developed and emerging countries is critical.

In general, emerging countries are in their initial stage of developing legal and regulatory systems. Firms typically need to tackle bureaucracies and laws. For instance, Chinese firms are making the transition from socialist planned economy to market-oriented mixed economy (or market socialism). As it develops, we can expect vague laws and regulations are left to individual interpretation. Many U.S. companies have experienced the inconsistent enforcement of rules and regulations, state procurement policies that favor local companies and poor protection for property rights. We hypothesize that firms from emerging markets would not trust using contract to govern their suppliers as their counterparts in developed countries. They may have to support social capital such as joint problems solving and information sharing to mitigate uncertainties and opportunism. Meanwhile, developed

countries have reliable legal systems and naturally would rely primarily on formal contract to govern their suppliers, but so much of relational governance. Accordingly, the following research hypotheses are developed.

H6a–b. The adoption and (b) effectiveness of contractual governance is lower in emerging countries than in developed countries.

H7a–b. The (a) adoption and (b) effectiveness of relational coordination governance is higher in emerging countries than in developed countries.

H8a–b. The (a) adoption and (b) effectiveness of information sharing governance is higher in emerging countries than in developed countries.

(2) National culture

Culture is defined as "the collective mental programming of the human mind which distinguishes one group of people from another" (Hofstede, 1980). Cultural traits affect the way through which people behave and consequently the way through which businesses are managed. Managers must recognize cultural dimensions when practice international business transactions. Several OM studies cautioned about the application of theories developed in North American and European countries to other parts of the world (Pagell et al., 2005; Zhao et al., 2006). For instance, Flynn and Saladin (2006) have studied the role of culture about quality practices and quality management, Wacker and Sprague (1998) concerning innovation and forecasting practices, Voss and Blackmon (1998) have considered differences among national contexts, strategic time orientation and parent ownership and Rungtusanatham et al. (2005) have shown how the adoption of TQM can differ across countries. In a similar vein, Power et al. (2010) compared Asiatic and Western countries in order to shed a light on the importance of national culture in explain differences in the investments in manufacturing practices and performance outcomes. Wiengarten et al. (2011) confirmed the moderating effect of national culture on the relationship between investments in manufacturing practices and operational performance. Further, Yang et al. (2013) observed the effectiveness of purchasing practices being influenced by the changing national culture characteristics respectively. In summary, these researches have shown how the effectiveness of the manufacturing "best" practices can differ according to the culture of the country in which they are applied.

This study validates and reinforces that message. The effects of national culture on outsourcing and supplier governance are recognized but not properly studied or validated (Pagell et al., 2005; Yang et al., 2013). It is vital that managers responsible for global operations understand how resident managers, based in different countries, control opportunism and risk. This study intends to apply Hofstede's culture dimensions to examine cultural differences in the adoption and the effectiveness of outsourcing governance mechanisms. Previous research (Flynn and Saladin, 2006; Wacker and Sprague, 1998, Wiengarten et al., 2011) has assessed national culture through the Hofstede's model (1980). National culture is assessed through four indexes named, respectively, power distance (PDI), individualism-collectivism (IDV), masculinity-femininity (MAS) and uncertainty avoidance (UAI). A fifth dimension, long term orientation, has been added later in the model.

We anticipate that Uncertainty Avoidance (UA) moderate the use of formal and informal governance. UA is refers to as the extent to which a society, organization, or group relies on social norms, rules, and procedures to alleviate unpredictability of future events. This dimension is the reliance on norms and procedures to alleviate unpredictability. The UA dimension is high in cultures that believe risks are dangerous, ambiguity is threatening, nature is controllable, feedback is important, innovations cause uncertainty, people are unpredictable and dissent is intolerable. Employees from high UA cultures are personally motivated to make choices that increase predictability. Because of this, UA is associated with formal systems, process controls, risk-averting group decisions, expert reliance, and a status quo preference. For instance, UA underlines the people's need for rules and standardized procedures, in order to strive with anxieties, ambiguities and risks; quality management is rooted on formal methods (e.g., statistical process control), as a consequence, uncertainty avoidance culture might adopt quality programs in order to mitigate their anxiety and prevent unforeseen risks. We would have expected countries classified as high in uncertainty avoidance to employ more specific contracts.

H9a–b. The (a) adoption and (b) effectiveness of contractual governance is higher in those countries with high Uncertainty avoidance.

H10a–b. The (a) adoption and (b) effectiveness of coordination governance is higher in those countries with low Uncertainty avoidance

H11a–b. The (a) adoption and (b) effectiveness of information sharing governance is higher in those countries with low Uncertainty avoidance.

3. RESEARCH METHODOLOGY

3.1 Data

The data were gathered by the Global Manufacturing Research Group (GMRG). GMRG is an organization of international academic researchers studying the effectiveness of manufacturing practices worldwide in the supply chain (www.gmrg.org). The GMRG developed its database using a common survey instrument for all countries. This survey was developed to empirically test specific issues. It is made up of a required section of demographics, competitive goals and internal performance measures. It also has specific modules designed to test a specific theory using a conceptual model. The module in this is the outsourcing module developed on transaction cost analyses (Whybark et al., 2009). All versions were translated and back translated in each language using multiple academics. The GMRG questionnaires have numerous publications. This study uses the data from the Round 4.0 Survey with 987 samples from 19 countries.

3.2 Data analysis methods

Confirmatory factor analysis (CFA) is employed to examine the reliability and validity of the measurement model. Further, the structural equation modeling (SEM) technique is employed to interpret the causal model, by using LISREL 8.12 as the instrument of information analysis. Each of the path coefficients has been estimated by using the maximum likelihood method, while the model's overall goodness of fit is evaluated by using the following six indicators: chi-square statistic/degree of freedom, goodness-of-fit index (GFI), Normed fit index (NFI), comparative fit index (CFI), root mean square residual (RMR), and root mean square error of

approximation (RMSEA). A series of multiple-group SEM analyses was used to examine whether "Economic development" and "uncertainty avoidance" caused differences in the path coefficient of the structural model. For the testing of the path coefficient, Byrne (1994) suggested that the multiple-group analyses had two stages. First, we were to evaluate the chi-square statistic of the combined model which all path parameters of research model were allowed to vary across these "developed and emerging markets "groups. Second, we were to evaluate the chi-square statistic of the combined model which the path parameters from AS to CG (each pair of these two latent constructs) were constraint to equal for these "developed and emerging markets" groups. We then used the chi-square difference test to compare the first stage model with the second stage model. If significance was reached, "Economic development" qualified as a moderator of research model.

3.3 Properties: Reliability and validity

Except for asset specificity, this study used multiple items variables to present the latent constructs using a structured questionnaire. All multiple-item variables were tested for reliability using Cronbach's α and construct reliability. As shown in Table 1, all achieved Cronbach's alpha coefficients ranged from 0.662 to 0.797 and construct reliability ranged from 0.630 to 0.802, which were all greater than the threshold 0.6 (Bagozzi and Yi, 1988), indicating high internal consistency and thus reliability for all measurement indicators.

In the next step, confirmatory factor analysis (CFA) was employed to examine construct validity of the measurement model. The model fit test results showed all achieved values for fit indicators ($\chi 2/df = 4.57$, GFI= 0.94, AGFI= 0.91, NFI= 0.91, CFI= 0.93, RMSEA= 0.060, RMR=0.048) were all satisfy the threshold recommended by Byrne (1994) and Hu and Bentler (1998), indicating good model fit for the measurement model. Moreover, all achieved standardized factor loadings were greater than the threshold 0.50 (Bagozzi and Yi, 1988) (see Table 1). Overall, the convergent validity of all measurement indicators was validated (Hair et al., 2010).

Table 1 – Reliability and convergent validity analyses (n = 987)

Dimensions	Items	Standardized Factor loading	Cronbach' α	Construct reliability
1. Asset Specificity (AS)	Physical asset investment	---	---	---
2.Environmental Risk (ER)	Technology risk associated with this supplier's products	0.65	0.723	0.725
	Behavioural risk associated with the attitudes of this supplier	0.76		
	Market risk associated with the attitudes of this supplier	0.64		
3. Relational Governance - Coordination (RG(C))	There is a standard approach when solving a problem with this supplier	0.66	0.662	0.630
	This supplier and my firm are committed to relationship of mutual respect, that is, we do not alter facts to own advantage	0.50		
	This supplier and my firm rely on 'implicit agreements' for exchange contingencies not covered by 'formal written agreements'	0.64		
4. Relational Governance - Information sharing	Mutual exchange of information in regards to production forecasts, plans, schedules and supply requirements	0.52	0.724	0.740

(RG(I))	Mutual feedback on how well the outsourced part work, endure and fit the specifications of the final product?	0.67		
	Joint efforts to stabilize production schedules?	0.62		
	Avoidance of requests for schedule changes, especially those requests that tend to disrupt the normal lead time period	0.76		
5.Contractual Governance (CG)	Financial repayment if contract is terminated prior to its ending date	0.66	0.797	0.802
	Exclusivity clause (that is, are you an exclusive supplier by contract?)	0.50		
	Damage for poor technical performance	0.80		
	Damage for late delivery	0.85		
6.Manufacturing Competitiveness (MC)	Manufacturing costs; Product costs; Raw material costs	0.50	0.749	0.748
	Product features; Product performance; Product quality	0.56		
	Order fulfillment speed; Delivery speed; Delivery as promised	0.74		
	Delivery flexibility; Flexibility to change output volume; Flexibility to change product mix	0.79		

Table 2 – Discriminant validity analysis

Dimensions	1	2	3	4	5	6
1. Asset Specificity	(1)					
2. Risk/ Uncertainty	0.0004	(0.47)				
3. Relational Governance - Coordination	0.260	0.026	(0.37)			
4. Relational Governance - Information sharing	0.073	0.029	0.017	(0.42)		
5. Contractual Governance	0.040	0.029	0.012	0.137	(0.51)	
6. Manufacturing Competitiveness	0.044	0.023	0.040	0.073	0.032	(0.43)

Note: the numbers in the lower triangular matrix are the squared correlations; the numbers in parentheses are AVE.

4. SEM ANALYSIS

4.1 Structural model

The SEM technique was used to interpret the researched model (Figure 1). According to the analyzed results (see Table 4), the overall fit indices of the model were all found to be within the acceptable scope, suggesting that the model was a good fit to the data.

As shown in Figure 2 and Table 3, the achieved results supported 9 out of 11 proposed hypotheses, except for hypotheses H4a and H5a. Specifically, Asset Specificity (AS) was found to significantly increase the use of both Contractual Governance (CG) (standardized path coefficient = 0.11) and Relational Governance (RG), including Relational Governance - Coordination (RG(C)) (0.51) and Relational Governance – Information sharing (RG(I)) (0.26) while Environmental Risk (ER) was found to significantly increase the use of CG (0.24) but reduce the values of both RG(C) (-0.16) and RG(I) (-0.17). Moreover, on investigating the direct impacts of AS and ER on Manufacturing Competitiveness (MC), Asset Specificity was

found to have directly positive influence on MC (0.11) whereas Environmental Risk would reduce MC value (-0.13). Other direct impacts were found between RG(I) and CG (0.39), RG(I) and MC (0.15), and CG and MC (0.12). Nonetheless, it was noted that no direct impact was found between RG(C) and CG as well as MC.

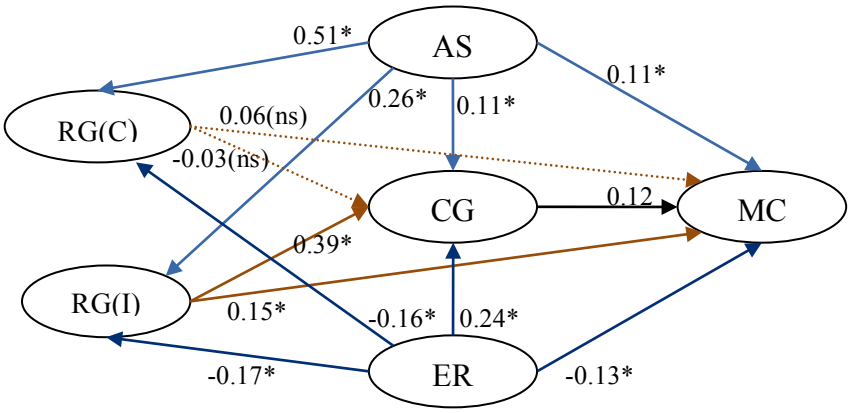

Figure 2 – SEM results: Research model

On further exploring the impacts of AS and ER on MC with the use of CG and RG, AS and ER were found to significant improve MC through enhancing RG(I) and CG. Noteworthy, these situations were not found with the existence of RG(C). These results therefore strongly suggest that asset specificity can significantly stimulate manufacturing competitiveness through the integration of relational governance – information sharing and contractual governance, implying the potential focuses for manufacturing managers once attempting to enhance their competitiveness.

Table 3 – SEM results

Path (hypothesis)	Standard parameter estimate (t-value)	Significance	result
H1a: AS→MC	0.11(2.40)	significance *	Supported
H1b: AS→CG	0.11(2.63)	significance *	Supported
H1c: AS→RG(C)	0.51(12.16)	significance *	Supported
H1d: AS→RG(I)	0.26(6.88)	significance *	Supported
H2a: ER→MC	-0.13(-2.93)	significance *	Supported
H2b: ER→CG	0.24(5.70)	significance *	Supported
H2c: ER→RG(C)	-0.16(-3.84)	significance *	Supported
H2d: ER→RG(I)	-0.17(-4.10)	significance *	Supported
H3: CG→MC	0.12(2.73)	significance*	Supported
H4a: RG(C)→MC	0.06(1.11)	insignificance	Unsupported
H4b: RG(I)→MC	0.15(3.10)	significance *	Supported
H5a: RG(C)→CG	-0.03(-0.54)	insignificance	Unsupported
H5b: RG(I)→CG	0.39(7.97)	significance *	Supported
Fit indices: Chi-square/df=4.707 RMSEA=0.061 (0.057; 0.066); RMR=0.052; CFI=0.92; NFI=0.91; GFI=0.93; AGFI=0.91			

Note: *p<0.05

In summary, the total effects of both Asset Specificity and Environmental Risk on Manufacturing Competitiveness are significant; nonetheless, Asset Specificity has positive effect (total effect = 0.21) while Environmental Risk has negative influence (total effect = -0.15). Concerning the mediating roles of Contractual Governance and Relational Governance on AS → MC and ER → MC, Contractual Governance and Relational Governance – Information sharing (RG(I)) are the partial mediators for the impacts of AS and ER on MC. Relational Governance – Information sharing is a full mediator for the impacts of AS and ER on CG. Noteworthy, the mediating effect of Relational Governance – Coordination (RG(C)) is not significant.

4.2 *Moderating effect*

4.2.1Economic development

One of the objectives of this study is to clarify whether the research model is affected by Economic development which includes developed and emerging markets. First, based on the definition of Morgan Stanley index, 8 developed countries (n= 300) which are Australia, Austria, Germany, Ireland, New Zealand, Sweden Switzerland, Italy and 11emerging markets (n= 687) which are Albania, Croatia, Ghana, Hungary, South Korea, Macedonia, Mexico, Poland, Taiwan, Brazil, China were chosen to conduct the research. A series of multiple-group SEM analyses was then employed to test the moderating effect of Economic development across these two groups.

Economic development is proven to be the moderator and it could be concluded that Economic development has a significant moderating effect on four relationships AS→CG, AS→RG(I), ER→CG, ER→RG(I). As for AS→CG, the developed countries group show significant negative effect while the emerging markets group displays significant positive effect, which in turn proves the moderating effect of Economic development on the relationship. Noteworthy, AS significantly reduces the use of CG in the developed countries while increasing the use of CG in emerging markets, implying the adoption of contractual governance is higher in emerging countries than in developed countries, which is opposite to the proposed hypothesis H6a. As for AS→RG(B), both groups of Economic development show positive effect, in which the achieved value of the developed countries group is significantly higher, implying the adoption of information sharing governance is higher in emerging countries than in developed countries, which supports the hypothesis H8a. Concerning ER→CG, two groups both display significant positive values, which in turn support the hypothesis H6b. Finally, as for ER→RG(I), the emerging markets group displays significant negative effect, which is opposite to the proposed hypothesis H8b.

In summary, the impacts of economic development on the research model are presented as follows: higher AS reduces the use of CG but increases the use of RG(I) in developed countries while higher AS positively stimulates both CG and RG(I) in emerging markets countries. Nonetheless, as aforementioned, the use of CG will help stimulate better performance of manufacturing competitiveness, it is suggested that developed countries could consider applying contractual governance once attempting to enhance their competitiveness. In terms of ER, higher ER positively stimulates CG in both developed countries and emerging markets countries while higher ER reduces the use of RG(I) in emerging markets countries. However, as mentioned before, the use of ER promotes better performance of manufacturing competitiveness. Therefore, it is recommended that emerging markets countries consider implementing information sharing governance.

4.2.2 National culture

One of the objectives of this study is to clarify whether research model is affected by uncertainty avoidance (UA); however, since uncertainty avoidance is a continuous variable, significance would be tested for an interaction latent variable to determine the interaction effect (moderating effect). Holmbeck (1997) indicated that all possible products of the measured indicators could be computed as indicator of an interaction latent variable when examining the interaction effects with continuous variables using a latent variable analysis. Joreskog and Yang (1996), Jaccard and Wan (1996) maintained that fewer terms would be needed but that several continuous had to be imposed to test the significance of the interaction effect.

In this study, we followed the suggestions from the above researchers to examine the interaction effects (Holmbeck, 1997; Joreskog and Yang, 1996). We crossed uncertainty avoidance with each indicator of the latent variable to create their respective interaction latent variable (e.g. cross uncertainty avoidance (UA) with Environmental Risk (ER) to create an interaction latent variable, i.e. UA× each indicator of ER, resulting in 3 interaction indicators), then interaction effect (moderating effect) is tested. First, national culture is proven to be the moderator and it could be concluded that National culture has a significant moderating effect on five relationships AS→CG, AS→RA(C), AS→RA(I), ER→CG, ER→RA(C), and ER→RA(I). As for AS→CG, the achieved path coefficient of Interaction variable shows significantly negative effect (-0.88), which is opposite to the proposed hypothesis H9a that the adoption of contractual governance is higher in those countries with high Uncertainty avoidance. Regarding AS→RA(C), AS is found to have a significantly positive effect on RA(C) (0.37), which is opposite to the hypothesis H10a that the adoption of coordination governance is higher in those countries with low Uncertainty avoidance. Concerning AS→RA(I), the achieved path coefficient displays significantly negative effect (-0.33), which supports the hypothesis H11a that the adoption of information sharing governance is higher in those countries with low Uncertainty avoidance. In terms of ER, it is found to have significantly positive effect on CG (0.11) and significantly negative effect on RA(C) (-0.36), which in turn respectively supports the hypotheses H9b that the effectiveness of contractual governance is higher in those countries with high Uncertainty avoidance and H10b that the effectiveness of coordination governance is higher in those countries with low Uncertainty avoidance. Finally, in terms of ER→RA(I), the achieved path coefficient shows significantly positive effect (0.33), which is noteworthy opposite to the proposed hypothesis H11b that the effectiveness of information sharing governance is higher in those countries with low Uncertainty avoidance.

5. CONCLUSION

As outsourcing continues to grow, supplier management becomes critical to the success of manufacturing firms (Hatonen and Eriksson 2009). Transaction Cost Economics (TCE) suggests that firms choose governance mechanisms to endure fulfillment of contractual obligations and safeguard against opportunism (Williamson 1999) for their outsourcing activities. This study extends the academic discussion of buyer governance by investigating the alignment of governance mechanisms with the nature of outsourcing (transaction attributes) to reduce performance ambiguity and thereby enhance manufacturing performance. We focus on the effects of precontract conditions and governance mechanisms on firm performance. The theoretical argument is that firms need both legal contracts and buyer-

supplier relations to manage "bounded rationality" in purchasing (Liu et al., 2009; Williamson 2008). Overall, the statistical results suggest that manufacturing firms are able to strategically reduce performance ambiguity through hybrid governance of contractual governance and relational governance. The following is a summary of key findings regarding the alignment of precontract conditions and governance mechanisms.

(1) Relational governance. Based on the literature (Poppo and Zenger 2002), this study breaks down relational governance into two separate mechanisms: coordination and information sharing. Among two relational governance mechanisms, information sharing directly increases manufacturing competitiveness. Coordination reduces performance ambiguity. Hence, each of three relational governance mechanisms affects plant performance differently. Overall, the statistical results indicate they are conceptually, empirically, and pragmatically different on plant performance. Future studies should not treat relational governance as one single construct.

(2) Contractual governance. Contractual governance plays an important role in outsourcing. It directly reduces performance ambiguity and enhances manufacturing competitiveness. Due to its effectiveness at controlling buyer-supplier opportunism, contractual safeguard also effectively mediates the impact of asset specificity, environmental uncertainty, and relational governance. In summary, effective contracting practices could mitigate the risks associated with market uncertainty and opportunism and lead to better outsourcing performance.

(3) Asset specificity and uncertainty. The nature of outsourcing affects the choice of governance mechanisms. First, supplier asset specificity directly improves manufacturing competitiveness by encouraging contractual safeguard and information sharing. Next, when facing environmental uncertainty, firms rely primarily on contract mechanism but not relational governance to alleviate performance ambiguity. The contractual safeguard is not sufficient to reduce the negative effect of uncertainty, and ultimately environmental uncertainty leads to lower competitiveness and financial performance. This is consistent with the concepts of "vested outsourcing" and "transformational outsourcing," within which supply chain partners work closely to develop network competence (Hatonen and Eriksson, 2009).

(4) Moderating effects. The effectiveness of governance mechanisms is moderated by both economic development and national culture. The developed markets and countries with strong uncertainty avoidance prefer to use contractual governance to reduce the opportunistic behavior, while emerging markets and countries with low uncertainty avoidance consider information sharing governance to be more effective.

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A CASE STUDY ON APPLICATION OF G-RD TO BUSINESS INTEGRATION AFTER M&A

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ABSTRACT

Enterprises renovate their business structure in order to respond to changes in the business environment. In recent years, an organizational renovation involving other enterprises is increasing due to M&A. The enterprise after M&A needs to define and design business functions and management units such as roles, business assignments, organizations, etc. without duplication in order to carry out business process/operation smoothly. Furthermore, the responsibility demarcation or boundary of management units needs to be defined.

It is necessary to design one new business flow diagram after M&A as a TO-BE model from two or more business diagrams of each enterprise which are described as an AS-IS model. However, two or more business diagrams cannot be merged into one business diagram by utilizing business flow diagrams, such as DFD or Swim lane flowchart. Therefore, it is difficult to find duplication of business functions and relations between management units. To solve this problem, this paper proposes Global Relations Diagram of function and demarcation (G-RD). G-RD utilizing square matrix is able to merge two or more business diagrams into one business diagram. G-RD is also able to rearrange functions, because functions are arranged on the diagonal of a square matrix. Moreover, G-RD is able to define the responsibility demarcation or boundary of management units. Thus, G-RD can define not only the relationships of information between functional assignments but also the relationships of responsibilities between power assignments.

This paper introduces a case study in which G-RD was applied to a business process/operation integration. This case study shows that unnecessary duplication of business functions and management units were deleted by utilizing G-RD.

Keywords: DFD, G-RD, Swim lane flowchart

1. INTRODUCTION

Reorganization, integration, and Mergers and Acquisitions (M&A) of enterprises are performed in order to respond to changes in the business environment promptly. M&A is determined by the analysis of the integration effect and management-resources rearrangement. After the integration of management is decided, the business integration needs to be carried out. Business integration after M&A is a serious issue for the concerned enterprises. If each company tries to bring each business process/operation to a merged company as it is, the duplication of business process/operation will occur and decrease operating efficiency. Moreover, roles, business assignments, organizations, etc. which perform business process/operation overlap and the demarcation or boundary of responsibilities becomes unclear. Therefore, the enterprise after M&A needs to define and design business functions and management units such as roles, business assignments, organizations, etc. without duplication in order to carry out business process/operation smoothly. Furthermore, the responsibility demarcation or boundary of management units needs to be defined.

This paper proposes Global Relations Diagram of function and demarcation (G-RD) (Saito, Udagawa & Mitsukuni, 2011; Saito, Udagawa & Mitsukuni, 2012; Saito, Udagawa & Mitsukuni, 2013; Saito & Mitsukuni, 2013; Shozui & Mitsukuni, 2002). Moreover, this paper introduces a case study which was applied G-RD to a business process/operation integration after M&A and consider effectiveness of G-RD application. Therefore, this paper is not concerned with the analysis of the integration effect and management-resources rearrangement.

2. THE PROBLEMS OF CONVENTIONAL BUSINESS DESIGN METHODS

2.1 Conventional business design methods

There are various design methods which are utilized to define business functions, management units such as roles, business assignments, organizations, etc. and the demarcation or boundary of responsibilities. Enterprise Architecture (EA) enables to describe business processes, business rules, organizations, information, etc. (Zachman, 1987; Sowa & Zachman, 1992). Data Flow Diagram (DFD) expressing functions and relationships between functions is defined by EA as an output of business architecture (DeMarco, 1978). DFD expresses functions and flows of information between functions utilizing circles and arrows.

DFD consists of four base elements such as (1)Dataflow (arrow with name), (2)Function (circle or oval), (3)File/Database (straight line), (4)Input/output (box). DFD shown in Figure 1 is the example containing all of these four elements.

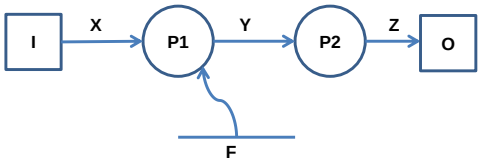

Figure 1-General description rule of DFD.

DFD is the description method which specializes in the relationships of functions and information, and is not able to describe management units such as roles, business assignments, organizations, etc. which perform functions.

In order to design the business process/operation, it is necessary to design functions and relationships between functions, management units which perform business functions, and the responsibility demarcation or boundary of management units. The Swim lane flowchart seen by Unified Modeling Language (UML) activity diagram (OMG, 2005), Business Process Modeling and Notation (BPNM) (OMG, 2011), etc. are the process flow diagrams which are illustrate management units and the responsibility demarcation or boundary of management units. Figure 2 shows Swim lane flowchart of UML activity diagram (Kobayashi, 2005).

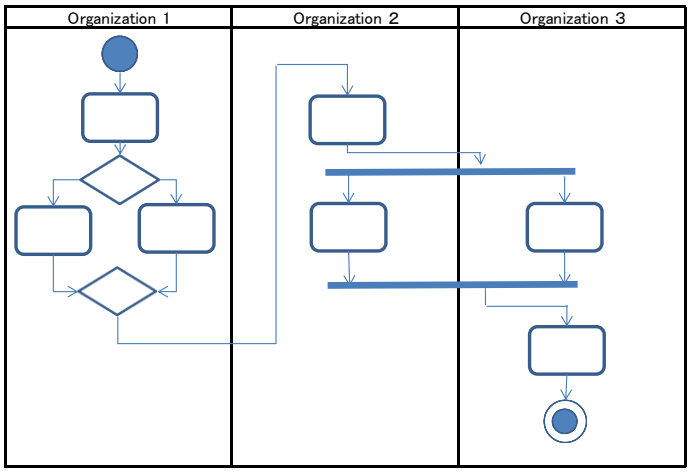

Figure 2- Sample of Swim lane flowchart (UML)

2.2 The problems on application to business integration

It is necessary to design the business process/operation of the enterprise after business integration, if management integration of two or more enterprises such as M&A is carried out. The business process/operation integration after M&A is usually designed through four steps shown in Figure 3.

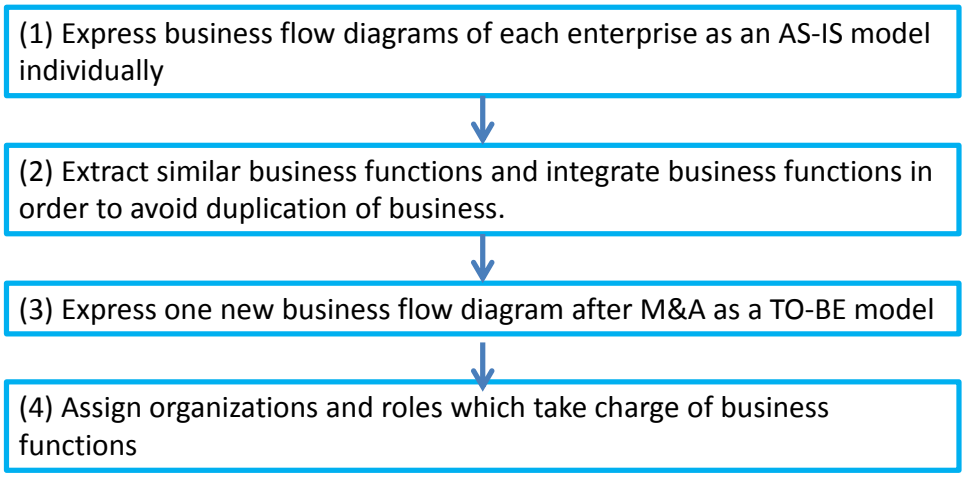

Figure 3-Design steps of business integration

First, each enterprise expresses business flow diagrams as an AS-IS model individually after analysis of business functions and management units of each enterprise by utilizing conventional design methods, such as Swim lane flowchart. Second, similar business functions are extracted from these business flow diagrams and integrate business functions in order to avoid duplication of business. Third, one new business flow diagram after M&A is determined as a TO-BE model by evaluating the existence of and differences between business functions. Finally, organizations and roles which take charge of business functions are assigned.

Usually, conventional design methods such as Swim lane flowchart are utilized in order to design the business process/operation of one enterprise. Therefore, if business integration of two or more enterprises after M&A is designed by utilizing conventional design methods, it is necessary to describe two or more sheets of business flow diagrams of each enterprise as an AS-IS model at first. Next, it is necessary to describe one new business flow diagram after M&A as a TO-BE model. However, two or more sheets of business flow diagrams cannot be merged into one sheet of business flow diagram by utilizing conventional design methods such as Swim lane flowchart. Therefore, it is difficult to find duplication of business functions and relations between these functions when the business flow diagram after M&A is designed as a TO-BE

model.

When performing business integration of two or more enterprises, it is necessary to improve not only business processes but also organizations and roles which perform business functions simultaneously, looking at two or more business flow diagrams. As a result, there are many cases to redesign business processes as well as organizations and roles of management units.

By performing the design steps shown in Figure 3, one business process can be designed at last. Therefore, in order to design the business processes of the enterprise after M&A, these design steps need to be repeated the number of business processes which must be design. Therefore, the business flow diagrams are dozens of sheets and there is the problem that the relationships between business functions from one sheet to another sheet are unclear.

As a result, there are many cases that business integration does not progress as planned.

3. BUSINESS DESIGN METHOD UTILIZING G-RD

3.1 The concept of description method of G-RD

G-RD is a business design method that defines Elements as the roles or functions of business operation/process and information system. The linkages among Elements are defined as Relation, any structure such as structure of businesses, structure of organizations or structure of information systems can be dealt as a same object. When Elements are plotted in the diagonal of square matrix, Relations are described at the intersections of the column and the row of two Elements. As a result, the position of intersection expresses the in-element and out-element at the same time.

Focusing on Elements, outbound from one Element is expressed in vertical direction and inbound is in horizontal direction as Figure 4, thus the direction of Relation is determined. In other words, the column number of Relation expresses in-Element and the row number of Relation expresses out-Element.

This means that Relations are expressed in a counterclockwise direction and an arrow or line which expresses information flow is not necessary. (Arrows are added in some figures in this paper only for explanation purpose. In actual application of G-RD, arrows are not written.)

Moreover, it is possible to breakdown Elements and Relations utilizing Levels in same design method. Based on this concept, G-RD utilizes Square matrix, Elements, Relations and Levels.

For instance, as shown in Figure 5, Relation R1 shows the linkage from Element C to

Element F. Similarly, Relation R2 shows the linkage from Element F to Element C.

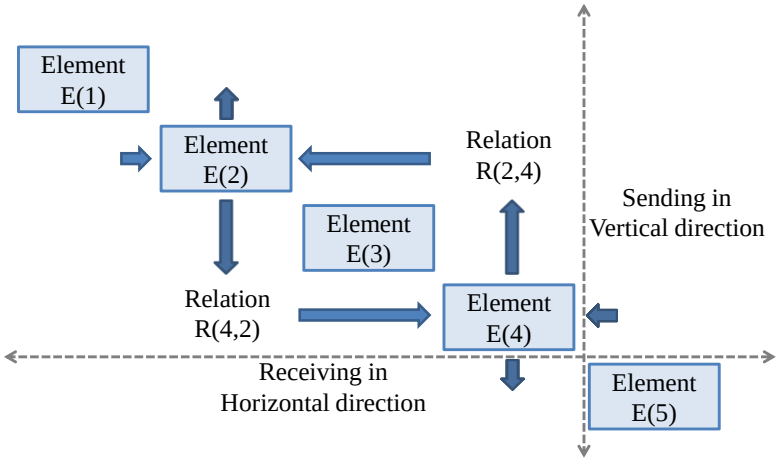

Figure 4- Description rule of relations

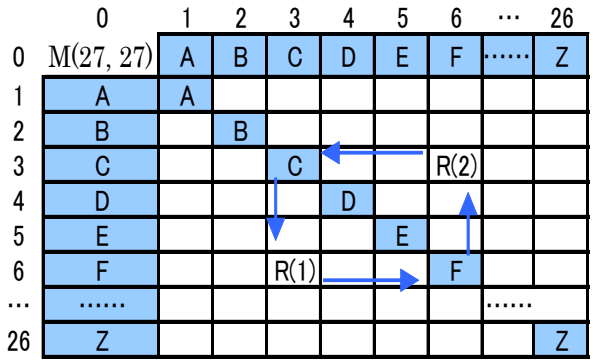

Figure 5- Sample of Relations

3.2 Rearrangement of Elements

It is easy to rearrange Elements because Elements are arranged on the diagonal of a square matrix. For example, Figure 6 shows that Element F which is illustrated in Figure 5 is rearranged in front of Element E.

In this example, one row and one column are added to the row and column in front of Element E at first. Second, the column of the original Element F is copied to the added new column. Third, the row of the original Element F is copied to the added new row. Last, the row and column of the original Element F are deleted. Figure 6 shows a state just before deleting the row and column of the original Element F in order to help an understanding of these operations.

If this feature of G-RD is utilized for business integration, it is possible to gather similar business functions of each company. Moreover, the difference in the

relationships which the business functions of each company have can be clarified.

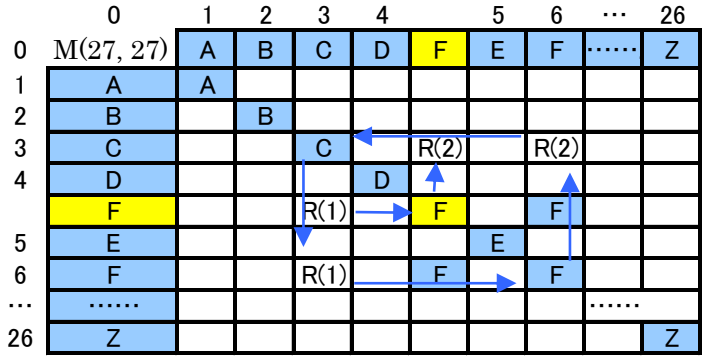

Figure 6- Sample of Element Rearrangement

3.3 Merger of two or more G-RD

Since G-RD is created by a square matrix, two or more G-RD are merged as the same G-RD if G-RD is added to the original G-RD at lower right as shown in Figure 7. If two or more G-RD are merged, the domain where new Relations can add will be produced between original G-RD and added G-RD.

If this domain is utilized for business integration, it is possible to define new relationships between two companies. Moreover, it becomes possible to treat new G-RD as one G-RD by utilizing the rearrangement of Elements shown in Section 3.2.

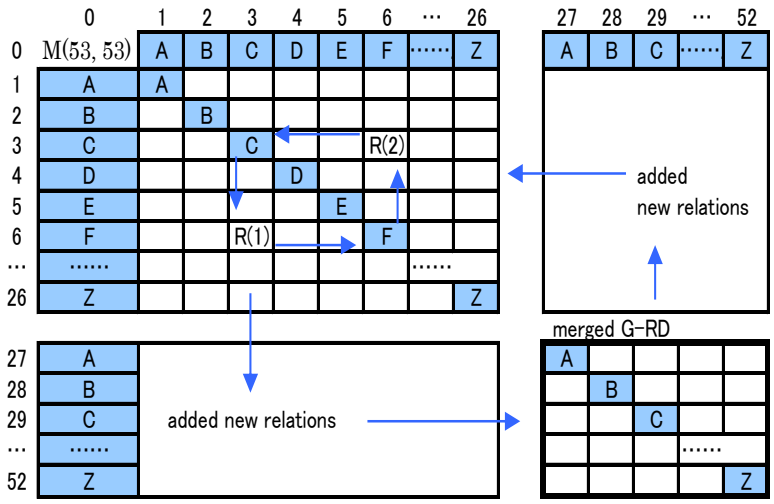

Figure 7-Sample of merged G-RD

3.4 Demarcations of management units

Elements which express management units on a diagonal are arranged to adjoin similar

functions. And the domain (row x column) of two or more Elements is explicitly surrounded by a frame. This frame will show the demarcation or boundary of a management unit.

For example, if Elements C, D, and E of Elements number 3, 4, 5 are surrounded by a frame as shown in Figure 8, this domain from (3, 3) to (5, 5) can be defined as one management unit. Similarly, Elements F, G, and H of Elements number 6, 7, 8, and Elements I, J, K and L of Elements number 9, 10, 11, 12 can be defined as management units.

Moreover, Relations to the inside of the domain (row x column) of a management unit surrounded by the frame are defined under the responsibility for this management unit. On the other hand, Relations to the outside of the domain (row x column) of a management unit surrounded by the frame are defined as Relations to another management unit. For example, Element L receives Relation R (7) which Element D sends. This Relation is a Relation between two management units. Similarly, Relation R (8) and Relation R (9) are Relations between two management units.

If business processes/operations which have the relationships between two or more management units are completed, the power needs to be authorized to the large management unit of the domain from (3, 3) to (12, 12) surrounded by a frame in order to advance cooperation between management units smoothly. And it is necessary to clarify the relationships and rules between management units. In this way, it becomes possible to eliminate the lack and duplication of the relationship between management units by finding the relationships to outside of the management unit.

Thus, since G-RD defines the responsibility demarcation or boundary of a management unit focusing on the relationships, it becomes possible to design the relationships of responsibilities between power assignments, or the relationships of information between functional assignments.

If this feature of G-RD is utilized for business integration, it is possible to define functions of management units and the responsibility demarcation or boundary of management units. And it is possible to design business processes in the new clarified management unit. Moreover, it becomes possible to eliminate the lack and duplication of relationship between management units by checking the relationship to outside of the management unit.

Furthermore, by utilizing a merger of two or more G-RD shown in Section 3.3, it comes to be able to design reassignment of management units, and business process re-engineering (BPR) (Hammer & Champy, 2001).

It is possible to design business processes by utilizing one sheet of G-RD. Therefore, it

can be solved the problem that business flow diagrams are dozens of sheets by utilizing conventional design methods such as Swim lane flowchart.

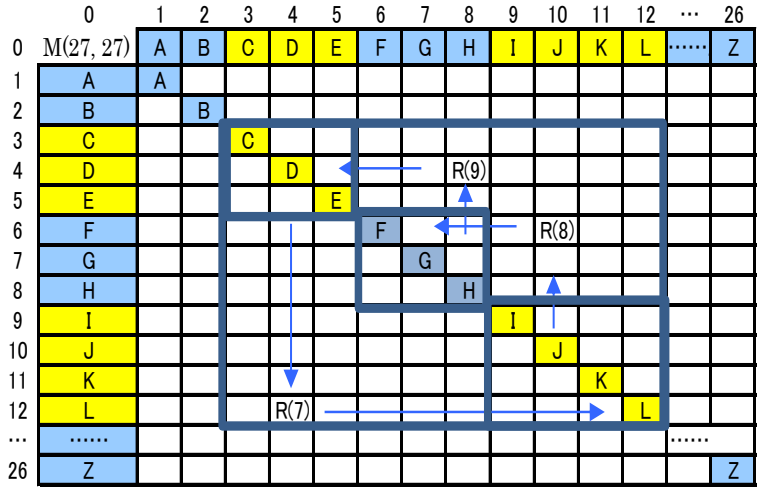

Figure 8- Sample of demarcation

4. APPLICATION EXAMPLE OF G-RD TO MERGER OF COMPANIES

Company A is Do-It-Yourself (DIY) store which has an annual turnover of 440 billion yen. Company A is a holding company established by M&A. Company A consists of three retail companies which have different business areas, and one cooperation purchasing company. Company A tried to design the business assignments utilizing conventional design methods after integration. Though three years had passed, Company A was not able to design. Therefore, Company A decided to re-design the whole business assignments and relationships with the application of G-RD.

The design of business processes utilizing conventional design methods is performed by the procedure shown in Figure 3.

Since new business functions and business processes must be designed looking at some relation diagrams by this method, it is difficult to grasp the whole image of new businesses. Therefore, it is difficult to understand the relationships of the business functions which are focused on and other business functions clearly.

On the other hand, the design steps utilizing G-RD are as follows.

(1) Create G-RD of each company, as shown in Section 3.1.

(2) Merge G-RD of each company into one G-RD, as shown in Section 3.3.

(3) Rearrange Elements so that similar business functions may gather, as shown in Section 3.2.

(4) Define the responsibility demarcation or boundary of management units, as shown

in Section 3.4.

(5) Improve business processes and define business functions and relations in the responsibility demarcation or boundary of each management unit, as shown in Section 3.4.

(6) Define Relations focusing on the relationships of information between functional assignments and the relationships of responsibilities between power assignments, as shown in Section 3.4.

(7) Check that there is no lack or duplication of Element or Relation.

Company A designed new business functions and business processes through these seven steps.

(1) Company A created G-RD of three retail companies as an AS-IS model, as shown in Figure 9.

Supplier	Payment	Order		
Accounts	Accounting			Purchasing results
		Procurement		Purchasing
Delivery		Shipment Order	Logistics	
Direct Delivery			Delivery	Store

Figure 9- G-RD of one retail company

(2) Three G-RD of three retail companies are merged into one G-RD, paying attention to relations with outside of companies, as shown in Figure 10.

Supplier	Payment	Order			Payment	Order			Payment	Order		
Accounts	Accounting			Purchasing results								
		Procurement		Purchasing								
Delivery		Shipment Order	Logistics									
Direct Delivery			Delivery	Store								
Accounts					Accounting			Purchasing results				
						Procurement		Purchasing				
Delivery						Shipment Order	Logistics					
Direct Delivery							Delivery	Store				
Accounts									Accounting			Purchasing results
										Procurement		Purchasing
Delivery										Shipment Order	Logistics	
Direct Delivery											Delivery	Store

Figure 10- Merged G-RD of three retail companies

(3) The business functions which were duplicated in three retail companies were extracted, and rearranged on G-RD as shown in Figure 11. In the example of Company A, since the cooperation purchasing company which performed procurement and logistics together was planned to establish, the business functions of procurement and logistics were deleted from three retail companies, and the duplication of business functions was eliminated. (4) The roles and the demarcation of responsibilities of the cooperation purchasing company were defined and clarified. (5) Improve business processes and define business functions and relations in the responsibility demarcation or boundary of each management unit of the cooperation purchasing company and three retail companies. (6) Relations with the cooperation purchasing company and three retail companies were defined, and (7) Company A checked that there is no lack or duplication of business processes/operations. In this way, the business processes/operations after M&A were created as a TO-BE model.

When Figure 10 is compared with Figure 11, it turns out that Elements are reduced to 10 from 13 (reduced by 23%) and Relations are reduced to 23 from 27 (reduced by 15%). It is suggested that the efficiency of the business processes/operations after a merger increased. After G-RD application, Company A was able to integrate the businesses in one year and a half as planned.

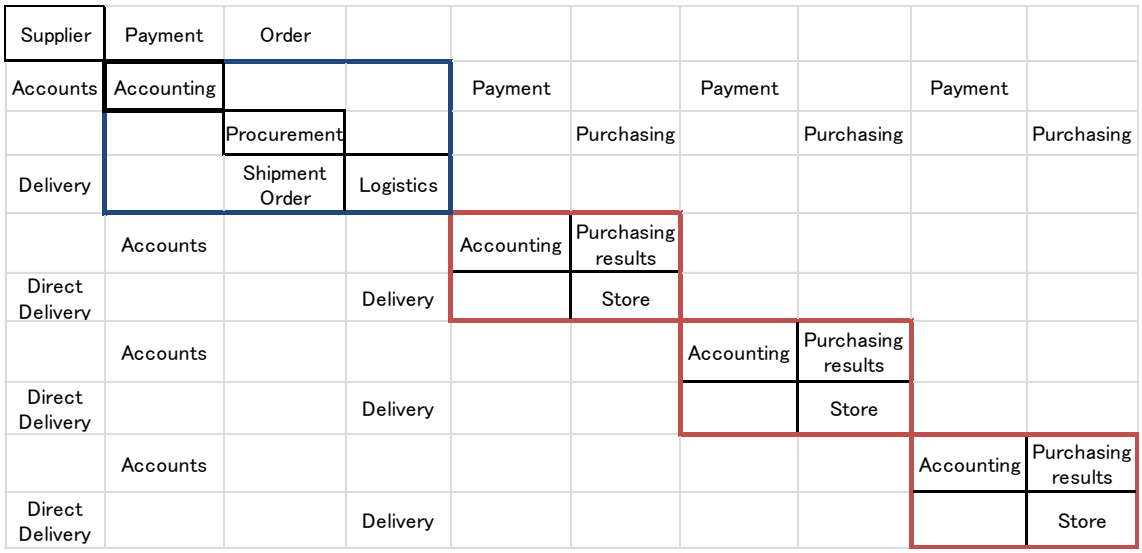

Figure 11- Merged G-RD of retail companies and purchasing company

5. CONSIDERATIONS CONCERNING EFFECTIVENESS OF G-RD

It became clear that the problem "two or more sheets of business flow diagram cannot

be merged into one sheet of business flow diagram" was solved by utilizing G-RD. Moreover, it was also proved that G-RD was effective in eliminating duplication of business functions (reduced by 23%) and relations (reduced by 15%).

Actually, Element was 97 and Relations was 773 after a merger of Company A. G-RD is possible to output as one relation diagram by A0 printer.

Another application of G-RD to the cooking oil company's business integration after a merger showed effectiveness of eliminating duplication of business functions and relations. This cooking oil company was also able to carry out the business integration as planned.

It is suggested that this effectiveness mentioned above is achieved by the feature of G-RD "two or more G-RD created separately can be merged".

6. CONCLUSIONS

This paper introduced the description method of G-RD and mentioned that it is possible to express two kinds of relations between management units utilizing G-RD.

One is the relationships of information between functional assignments and another is the relationships of responsibilities between power assignments. After designing the business integration by a merger, enterprises design and build new information systems in many cases. Elements and Relations are able to break down in multiple levels by G-RD. G-RD which is expressed as outputs of business design can be utilized as inputs of information systems design. Therefore, the information systems design can be processed smoothly without changing the design method.

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UNDERSTANDING THE PRICING DECISIONS IN TAIWANESE METROPOLITAN BUSINESS HOTELS

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ABSTRACT

This study applies quantile regression approach to analyze the pricing decisions in Taiwanese metropolitan business hotel industry and provide a more complete characterization of the determinants of the business hotel prices at different quantiles. Empirical data are drawn from the Internet survey of 199 Taiwanese metropolitan business hotels. The results indicate that room size, swimming pool and fitness center are the main attributes of room rates. However, the closeness to highway, SPA and meeting facilities are not crucial from the price perspective. Moreover, restaurant is the main determinant of hotel price for mid-price business hotels. Budget hotels enjoy the benefit of easy public transportation accessibility in determining hotel price. The empirical results are expected to provide hoteliers with useful information in developing pricing strategies.

Keywords: metropolitan business hotel, pricing decision, quantile regression

INTRODUCTION

The importance of tourism industry and its contribution to the economy is well recognized (Dritsakis, 2004). This benefit is partly caused by the growth of the hotel industry. According to the data from the Taiwanese Tourism Bureau, 31.68% of the daily expenditures from inbound tourists are made within hotels in 2012. This data reflects the necessity of the hotel sector in the tourism industry development. The inbound tourists in Taiwan reached 8 million in 2013. With the expansion of the tourism industry, the number of hotels in Taiwan has increased rapidly in recent years. At least 46 new tourist hotels are expected to open during 2014~2017.

Hotel room rate is one of the main determinants in accommodation selection decisions (Lockyer, 2005). Additionally, room prices influence customer service quality perceptions (Mattila and O'Neill, 2003) and consumer satisfaction (Voss, Parasuraman and Grewal, 1998). Thus, hotel pricing decision is one of most important aspects of hotel marketing strategies and is more flexible than other marketing strategies to accommodate the ever changing environment.

However, hoteliers are not able to maximize their profit via cost control. They must spend more time to decide their pricing strategies (Kim, Han and Hyun, 2004). Compared to other tangible product market, hotel industry demand are highly fluctuating (Chen, Yeh and Hu, 2011). Moreover, hotel service is easily perishable and not preservable. At the same time, service supply is relatively inflexible and cannot be changed overnight (Baum and Mudambi, 1995). Furthermore, the advanced booking characteristics make cancellation and overbooking are easily seen (Lai and Ng, 2005). Thus, hoteliers often encounter uncertain and fluctuating demand, creating difficulties in making price decisions. Their pricing decision may related to its star rating, management style (Israeli, 2002) and facilities (Espinet et al., 2003). Santana-Jiménez and Hernández (2011) suggest that spatial and environment factors also play important roles in pricing decision.

Compared to the normative hotel pricing decision literature, relative few empirical studies have focused on the determinants of hotel price. Most studies used ordinary least square regression approach. However, according to the Internet survey of Taiwanese business hotels in this study, the highest hotel price is six times the lowest for a sample of 199 Taiwanese business hotels. Thus, the empirical results of OLS method may reveal misleading outcome since the prices exhibit a skewed distribution. In contrast, quantile regression

technique often provides a more flexible and complete characterization of the determinants of business hotel prices. However, to our knowledge, few studies apply quantile regression in analyzing pricing determinants and most of them focused on tourist hotels.

Thus, the objective of this study is to understand the pricing decisions of Taiwanese metropolitan business hotels and provide suggestions for hotels' pricing strategies. The rest of this study is organized as follows. The literature review are presented in section 2. Section 3 introduces the methodology we used, Section 4 then describes the data and variables used in this study. Section 5 provides the empirical results. Conclusions are finally drawn in Section 6.

LITERATURE REVIEW

Hotel pricing problems have received more attention in recent years. Some studies have attempted to construct pricing models to maximize hotel revenue or profit (Kim et al., 2004; Koide and Ishii, 2005; Pan, 2007). Kim et al. (2004) introduce a room pricing model which considers fixed and variable costs and profit goal. Koide and Ishii (2005) develop a pricing model to account for early discount, cancellations and overbooking. Pan (2007) also presents a model to determine the optimal hotel pricing strategies in high and low seasons.

Contrary to normative studies, some studies focus on the factors hoteliers account for in realistic price decision making process. Israeli (2002) analyzed whether and how star rating and chain affiliated affect pricing decisions and found that hotel star rating is a stable predictor of room prices. Espinet et al. (2003) examined how hotel characteristics influence holiday hotel price and showed that town, hotel size, closeness to the beach and parking spaces availability are the main attributes of room rates. Furthermore, Monty and Skidmore (2003) suggested that amenities, such as provision of hot tubs, private baths and a larger room are significant determinants of bed and breakfast price. Additionally, location characteristics, day of week, and seasonality are also found to be critical for pricing decisions. Thrane (2007) suggested mini-bar, hairdryer, free parking and distance to downtown are good predictors of Oslo hotel price. Chen and Rothschild (2010) uses the hedonic price approach to examine the pricing decisions in Taipei and suggested that distance to city center, LED TV, conference facilities are the major influences of hotel price. Schamel (2012) also applies the hedonic price approach to compare the key determinants of hotel price between midweek and weekend. Their empirical results reveal that customer rating, star rating, weeks of advance booking and

hotel amenties are major determinants of room rate.

All of the above studies applies hedonic regression. However, the main limitation of this method is that it does not reveal the tail behavior of the distribution. According to the survey of metropolitan Taiwanese business hotels in this study, the highest hotel price is six times the lowest for 199 Taiwanese business hotels. This wide gap reflects that hoteliers may weigh their individual characteristics, operating environment and consumer demand to make their price decision. Quantile regression widens the understanding of hotel pricing decision and is particularly useful when the conditional distribution has an asymmetric shape.

Quantile regression has been widely used in many fields. It is first used to examine wage distribution and its determinants (Buchinsky, 1995; Skoufias, 2003; Min and Kim, 2003; Fersterer and Winter-Ebmer, 2003; Sakellariou, 2006; Pham and Reilly, 2007). Recently, quantile regression also applied to industry analysis. Görg, Strobl and Ruane (2000) provide empirical study on the firm start-up size in Irish manufacturing industry. Lotti, Santarelli and Vivarelli (2003) applied quantile regression to examine the growth pattern and dynamics of Italian manufacturing industry. Krüger (2006) focused on the relationship of current and lagged total factor productivity (TFP) of US manufacturing industry. Yasar, Nelson and Rejesus (2006) also used quantile regression technique to examine the productivity effects of export status at different output in Turkish manufacturing sectors. Wagner (2006) investigated the impact of manufacturing plant characteristics on export activities varies along the conditional size distribution of the export/sales ratio in Germany. Girma and Görg (2007) used quantile regression to analyze the role of efficiency gap in determining whether or not domestic firms benefit from productivity spillovers from FDI in UK electronics and engineering sectors.

However, few studies applied quantile regression in analyzing service sector, especially hotel industry. To the best of our knowledge, only one studies in hotel industry which apply quantile regression. Hung et al. (2010) applies quantile regression analysis to examine the pricing determinants of tourist hotels in Taiwan. The results indicate that hotel size and number of housekeeping staff influence the pricing decision of mid and high price hotels. Hotel age, FIT ratio and hotel types are the major determinants of high price hotels. The main differences between this study and Hung et al. (2010) are using Internet survey data, incorporating hotel amenities variables and focusing on metropolitan business hotels to broader our understanding their pricing decision.

METHODOLOGY

Quantile regression was first proposed by Koenker and Bassett (1978), it enables estimating conditional quantile functions, where each function characterizes the behavior of a particular point in the conditional distribution and thus sketches a full picture of the conditional distribution. Thus, quantile regression approach can therefore obtain a more detail picture of the relationship between metropolitan business hotel characteristics and its price. Basic quantile regression model can be written as:

$$y_i = \beta_\theta x_i^{'} + \mu_{\theta i} \quad \text{with} \quad Q_\theta(y_i \mid x_i) = \beta_\theta x_i \quad 0 < \theta < 1 \ldots, \ldots\ldots\ldots \qquad .(1)$$

where y_i is the correspondence variable, β_θ is the parameters to be estimated, $x_i^{'}$ is the explanatory variables and $u_{\theta i}$ is the residuals. $Q_\theta(y_i \mid x_i)$ represents the θ^{th} conditional quantile of y_i given $x_i^{'}$. The θ^{th} regression quantile solves the following problem:

$$\min_{\beta} = \frac{1}{n}\left\{ \sum_i \theta \left| y_i - x_i \beta \right| + \sum_i (1-\theta) \left| y_i - x_i \beta \right| \right\} = \min_{\beta} \frac{1}{n} \sum_i \rho_\theta \mu_{\theta it} \quad \ldots\ldots\ldots (2)$$

where ρ_θ is defined as :

$$\rho_\theta(\mu_{\theta it}) = \theta \mu_{\theta it} \qquad \text{for} \quad \mu_{\theta it} \geq 0$$

$$(\theta - 1)\mu_{\theta it} \qquad \text{for} \quad \mu_{\theta it} < 0$$

The quantiles of the conditional distribution can be acquired via variation of θ. In order to investigate the relationship of hotel characteristics across the entire conditional room rates distribution, results for the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantiles are examined.

DATA AND VARIABLES

Hotels in Taiwan can be divided into international tourist hotels, general tourist hotels and general hotels. However, comprehensive pricing data is only available for international tourist hotels. Thus, the empirical data used in this study originated from the Internet survey

of Easytravel (www.easytravel.com.tw/) in 2012. To keep the homogeneity of the sample, this study only employs general business hotels in metropolitan area. After discarding with incomplete data, 199 business hotels are remained

Regarding correspondence variable selection, Chen and Rothschild (2010) and Schamel (2012) use Internet survey data in their empirical studies. The data were obtained in a single month to avoid seasonality. Thus, this study also surveys weekday double room rates in each hotel on online travel agent Easytravel in May 2012. Shapiro-Wilk Shapiro-Francia tests confirm the non-normality of the residuals. The results of the Breusch-Pagan test indicate that heteroskedasticity is present in the data. Thus, quantile regression analysis is more suitable than OLS regression. To correct heteroskedacity problem, room rate are natural log-transformed.

The explanatory variables were selected based on the previous studies (fIsraeli, 2002; Espinet et al, 2003; Monty and Skidmore, 2003; Thrane, 2007; Chen and Rothschild, 2010; Schamel, 2012). The definitions of the variables are listed in Table 1.

The empirical model of this study can be written as:

$$\ln \text{PRICE} = \alpha + \beta_1 SPA + \beta_2 FITNESS + \beta_3 POOL + \beta_4 MEETING + \beta_5 RESTAURANT + \beta_6 AREA + \beta_7 DISTANCE1 + \beta_8 DISTANCE2 + \varepsilon \quad \text{.....(3)}$$

Table 1 Definitions of independent variables

Variables		Definition
Response variable	PRICE	log-transformed of daily room rate
Explanatory variable	SPA	Yes=1, no=0
	FITNESS	Yes=1, no=0
	POOL	Yes=1, no=0
	MEETING	Yes=1, no=0
	RESTAURANT	Yes=1, no=0
	AREA	Floor area of standard double room
	DISTANCE 1	The distance from the hotel to nearest highway
	DISTANCE 2	The distance from the hotel to nearest train station

EMPRICAL RESULTS

Table 2 lists the estimated coefficients for SPA, FITNESS, POOL, MEETING, RESTAURANT, AREA, DISTANCE 1 and DISTANCE 2 at the 10th, 25th, 50th, 75th and 90th quantiles. The results of different quantiles are worth further notice.

Table 2 Quantile regression results for business hotel price determinants

	10^{th} quantile	25^{th} quantile	50^{th} quantile	75^{th} quantile	90^{th} quantile
Constant	5.930*** (0.220)	6.193***(0.213)	6.320***(0.250)	6.557***(0.189)	6.633***(0.206)
SPA	0.034(0.287)	-0.153(0.219)	-0.314(0.197)	-0.449(0.227)	-0.752(0.308)
FITNESS	0.219*(0.113)	0.145(0.092)	0.172**(0.070)	0.168**(0.083)	0.064(0.084)
POOL	0.475*(0.249)	0.480**(0.240)	0.378*(0.201)	0.409*(0.218)	0.600**(0.272)
MEETING	-0.004(0.170)	0.068(0.090)	0.046(0.057)	-0.018(0.087)	0.097(0.109)
RESTAURANT	0.152(0.096)	0.120(0.080)	0.109*(0.059)	0.098(0.070)	0.019(0.079)
AREA	0.546***(0.108)	0.503***(0.115)	0.528***(0.128)	0.518***(0.101)	0.589***(0.110)
DISTANCE 1	-0.006(0.090)	0.053(0.093)	0.134**(0.059)	0.104(0.068)	0.036(0.073)
DISTANCE 2	-0.184*(0.099)	-0.186(0.127)	-0.105(0.111)	-0.094(0.111)	0.018(0.114)
Pseudo R^2	0.248	0.214	0.225	0.252	0.235

** significant at 10%-level, ** significant at 5%-level, ***significant at 1%-level*

The size of the room and swimming pool and are the key determinants of business hotel room rates for all price categories. The empirical results also indicate that SPA and meeting facilities are not the major determinants for all quantiles. It implies hotels having large room size and swimming pool can increase their price. However, SPA and meeting facilities are not necessary amenities from the price perspective since the estimated coefficient are not significant for all price categories.

The results show that the estimated coefficients on FITNESS are positive. However, only the quantiles estimated coefficients for the 10^{th}, 50^{th} and 75^{th} are significant, while those for the 25^{th} and 90^{th} quantiles are insignificant. That is, the low price, mid-price and mid-high price hotels are able to charge additional price because of having fitness facilities in their hotel.

The results of quantile regression also reveal that the value of the estimated coefficient on restaurant varies over the conditional price distribution. When the quantile regression is evaluated at the 50^{th} quantile hotel, restaurant has significant positive influence on room rates. It implies restaurant is the main determinants of hotel price for mid-price business hotels. However, for other hotel price categories, restaurant is not the crucial element for pricing decision.

According to the previous studies, hotels located near highways may be able to take advantages of its convenience, thus charging higher price. The results show that Taiwanese business hotels do not take advantage on its closeness to the highway. On the contrary, for the mid-price hotels, distances from the hotel to nearest highway are positively correlated with its

price. This suggests that business hotels, which are located far away from highway, appear more expensive for those in the mid-priced category. This phenomenon implies that easy highway access is not the main concern for business travelers in Taiwan.

Although most studies emphasized the importance of accessibility on hotel pricing decisions, the quantile regression estimates demonstrate an insignificant relationship between distance from the hotel to nearest train station and room price for most price categories. Only the lowest price category hotels are negatively correlated with its price. The main reason for this phenomenon is that budget travelers, compares to luxury travelers, care more about its closeness to public transportation.

CONCLUSIONS

This study provides novel means of identifying the attributes of metropolitan business hotel price. It helps broaden hotel pricing research by considering the influence of hotel characteristics and incorporating the concept of market segmentation. It also provides hoteliers with useful information in shaping pricing strategies. That is, if hoteliers understand the key determinants of business hotel price, they will be able to make marketing efforts on these attributes.

The results of quantile regression reveal that business hotel price is not significantly influenced by SPA and meeting facilities. However, size of the room, fitness center and swimming pool are the main determinants of hotel room rate. Hotel managers should consider provide these amenities to attract business travelers and thus increase its price. However, hoteliers should also take account the cost of having these facilities in their hotel. That is, the cost of amenities improvements should not be overlooked. Regarding the quantile regression results on RESTAURANT, mid-priced category hotels should offer dining options in the hotel. Budget hotels are advised to start-up its business near public transportation to enjoy the benefit of easy accessibility.

The findings should not be over-generalized since the research only focuses on the Taiwanese business hotel industry. However, our results provide evidence of business hotel pricing decisions that offers potential for future study. To enhance the generalizability of the results, further theoretical and empirical studies are required. The data was only limited to weekday double room rates. Pricing determinants of different room types may differ. Moreover, pricing determinants of hotel price across different marketing channels are

interesting topics that worth further study.

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A STUDY OF CEO TRANSFORMATIONAL LEADERSHIP, ORGANIZATIONAL FACTORS AND PRODUCT INNOVATION PERFORMANCE: A THEORETICAL FRAMEWORK AND SCALE MEASUREMENT

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ABSTRACT

The purpose of this study is to provide a theoretical framework and a scale development process, in order to preliminarily address the reliability and validity of CEO transformational leadership, some key organizational factors, and product innovation performance constructs. The measurement scales were pre-assessed using the Q-sort method and exploratory factor analysis was also conducted to assess the construct reliability and validity. This research established a theoretical framework of CEO transformational leadership, organizational factors including innovation strategy, organizational learning, innovation culture, new product development process, and product innovation performance. Q-sort technique can help improve the content validity and the initial construct validity of CEO transformational leadership, some key organizational factors, and product innovation performance. This study provided the initial developmental steps toward the building of a theoretical framework and scale measurement to allow better understanding of the constructs based on the context of firms in Thailand. This will allow researchers to bring new insights when exploring these constructs under differing operational conditions. The findings address additional steps required towards improved methodological aspects in terms of how to pre-validate and develop a measurement scale in various constructs within alternative domains.

Keywords Transformational leadership, upper echelon theory, product innovation

1. INTRODUCTION

An increasing number of firms are recognizing product innovation as essential business imperatives. Many studies have revealed that successful product innovations contribute to better financial performance (e.g., Ar and Baki, 2011; Artz et al., 2010; Evanschitzky et al., 2012). In light of the growing importance of product innovation, researchers have tried to keep up with practices by identifying key antecedents that could drive product innovation practices. Researchers have claimed that leadership is one of key organizational antecedents for product innovation (e.g., Crossan and Apaydin, 2010; Rosing et al., 2011; Smith et al., 2008; Sung, 2011).

More specifically, transformational leadership is one of the emerging research topics in innovation that have increasingly been paid attention by many scholars (Di Benedetto, 2013). Various studies have supported the positive effect of transformational leadership on organizational innovation (Aragon-Correa et al., 2007; Garcia-Morales et al., 2008; Gumusluoglu and Ilsev, 2009; Jung et al., 2008; Matzler, 2008; Noruzy et al., 2013). Nevertheless, few studies have examined the influence of transformational leadership on product innovation and the understanding of the mechanism through which transformational leaders exert this influence is limited (Sattayaraksa and Boon-itt, 2012). To better understand the effect of transformational leadership on product innovation, it is important to identify other related factors. It has been overlooked whether transformational leadership directly affects product innovation or it indirectly influences product innovation through some organizational factors such as organizational culture and strategy.

The purpose of this study is to provide a theoretical framework and a scale development process to address the initial reliability and validity of CEO transformational leadership, innovation strategy, organizational learning, innovation culture, new product development (NPD) process, and product innovation performance constructs in an effort to develop and revalidate scale metrics in different contexts. Hensley (1999) concluded that researchers should focus on such a scale development process to help the newness of research in the management field. Therefore, this study will mainly focus on a scale development process through the Q-sort method and an exploratory factor analysis (EFA), based on the context of firms in Thailand. The results of this study will provide guidelines for a measurement scale that researchers can apply in their future research in the fields of leadership and innovation research. The rest of the paper is organized as follows. In section two, the theoretical background of this study is reviewed and the theoretical framework of this study is explained. Section three presents the research methodology, focusing on the Q-sort method applied for this study. Findings and discussions are provided in section four. The final section summarizes the research contributions and provides suggestions for future research.

2. THEORETICAL BACKGROUND AND FRAMEWORK

This section covers a brief literature review regarding transformational leadership, innovation strategy, organizational learning, innovation culture, new product development (NPD) process and product innovation performance. This section presents the definition of each construct based on the literature. It also reviews upper echelon theory that is the theoretical foundation of the research framework.

2.1 Transformational leadership

Following the studies conducted by Bass et al. (1987) and Bass and Avolio (1994, 1995), transformational leadership consists of the "Four I's": idealized influence (II), inspirational motivation (IM), intellectual stimulation (IS), and individualized consideration (IC). Idealized influence is defined as the leader's charisma or the behavior that makes the leader serve as a role model for the follower (Burns, 1978). The leaders are admired, respected, and trusted. They are reliable and demonstrate high standards of ethics and moral conduct. Inspirational motivation refers to the ways leaders energize their followers by envisioning an attractive future state, providing meaning and challenge to their followers' work, demonstrating commitment to ambitious goals, and communicating that the vision is achievable (Bass and Avolio, 1994). Intellectual stimulation refers to leader actions that stimulate their followers' efforts to be creative and innovative by questioning assumptions, reframing problems, and approaching old situations in new ways (Bass and Avolio 1994).

Individualized consideration stands for leader behavior that pays special attention to each individual's need for achievement and growth (Bass and Avolio, 1994). It represents an attempt on the leaders' part not only to recognize and satisfy the current needs of their subordinates but also to arouse and elevate those needs in an attempt to develop subordinates further. In short, even though there is no single leadership that best fits to all situations (Samad, 2012), this study chooses the transformational leadership style as the predictor of product innovation due to its unique characteristics, its recognition among scholars in the innovation field, and its associations with several types of innovation.

CEOs with transformational leadership are likely to choose strategies that are change- and growth-oriented (Jung et al., 2008). Therefore, transformational leaders who are visionary and committed to the challenge goals are likely to emphasize innovation strategy. Transformational leaders, who are inspirational and ideally influential, are likely to empower their followers to the search for or creation of optimal alternatives. Thus, creativity and risk acceptance are encouraged among employees (Bass and Avolio, 1994) and an innovation culture is developed. In addition, transformational leadership is one of the crucial sources for creating organizational learning (Hult et al., 2000; Slater and Narver, 1995). Transformational leaders can influence learning orientation by being role models, showing individualized consideration, promoting intellectual stimulation, and providing inspirational motivation among employees (Coad and Berry, 1998).

2.2 Innovation strategy

According to Strecker (2009), innovation strategy refers to the sum of strategic choices a firm makes regarding its innovation activity. It is considered a firm wide, cross-functional meta strategy. Wei and Wang (2011) stated that innovation strategy represents the extent to which a firm values and promotes innovation across the organization. Dodgson et al. (2008) concluded that Innovation strategy can guide a firm as to how resources are to be used to meet a firm's objectives for innovation and thereby deliver value and build competitive advantage. Innovation strategy helps firms decide in a cumulative and sustainable manner, about the type of innovation that best matches corporate objectives. In this study, innovation strategy is defined as "a part of the overall business goals and strategic choices of a firm, the adoption of courses of action, and the allocation of resources necessary to meet the firm's objectives for innovation".

2.3 Organizational learning

According to Huber (1991), organizational learning has four organizational processes: (1) knowledge acquisition (KA) (2) information distribution (ID) (3) information interpretation (INI) and (4) organizational memory (OM). Knowledge acquisition is the process by which knowledge is obtained. Information distribution represents the process by which information from different sources is shared and thereby leads to new information or understanding. Information interpretation is defined as the process by which distributed information is given one or more commonly understood interpretations (Huber, 1991). Organizational memory is the means by which knowledge is stored for future use. Organizational learning can be defined as the organizational processes that acquire, share, develop, utilize, and store knowledge for a better organizational performance.

2.4 Innovation culture

Organizational culture can be defined as "the combination of artifacts (also called practices, expressive symbols, or forms), values, and beliefs, and underlying assumptions that organizational members share about appropriate behavior" (Detert, Schroeder, and Mauriel, 2000, p.851). Dobni (2008) defined innovation culture as "a multi-dimensional context which

includes the intention to be innovative, the infrastructure to support innovation, operational level behaviors necessary to influence a market and value orientation, and the environment to implement innovation". This conceptual definition is very broad and captures many organizational factors. Thus, this definition can lead to a complex operational definition with too many measurement items. Hurley and Hult (1998) argue that an innovative culture reflects the extent to which a firm is favorable to developing innovation or whether it resists innovation. Menguc and Auh (2006) conclude that the cultural propensity for innovation is proactive in exploring new opportunities. Santos-Vijande and Alvarez- Gonzalez (2007) state that "an innovative firm must be embedded of a strong culture that stimulates the engagement in innovative behavior". For simplicity and congruence with the definition of organizational culture, innovation culture, here, is defined as a set of shared values and beliefs within a firm that is favorable to exploring new opportunities, developing innovation, and facilitating employees' innovative behaviors.

2.5 New product development (NPD) process

Scholars have proposed various definitions of the NPD process. For example, Cooper (1994) defines the NPD process as "a formal blueprint, roadmap, template or thought process for driving a new product project from the idea stage through to market launch and beyond". The NPD process can be defined as the procedure that takes the new product idea through concept evaluation, product development, launch, and post launch (Crawford and Di Benedetto, 2011). According to Kahn et al. (2012), the NPD process refers to product development stages and gates for moving products from concept to launch, coupled with the activities and systems that facilitate knowledge management for product development projects and the development process. The NPD process is usually depicted as a phased process with evaluative steps between the phases.

2.6 Product innovation performance

Product innovation is the introduction of goods or services that are new or significantly improved with respect to characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics (OECD, 2005). In line with the definition of product innovation by OECD (2005), in this study, product innovation performance is defined as the financial and non-financial performance of new or improved products or services (introduced by the company in the last three years) to create new markets/ customers or satisfy current markets/ customers (adapted from Ar and Baki, 2011; Spanjol et al., 2012; Tsai, 2009; Wan et al., 2005; Wang and Ahmed, 2004)

2.7 The theoretical framework

The theoretical framework (Figure 1) is grounded from upper echelon theory and a multidimensional framework of organizational innovation proposed by Crossan and Apaydin (2010). In light of upper echelon theory, leadership style is a characteristic of top management that can influence strategic choices and firm performances. Upper echelon theory argues that top management makes a difference in strategy formulation and performance (Hambrick and Mason, 1984). Top managers are able to play important roles in setting policy, guiding direction, and making strategic decisions. As a result, their behaviors can influence changes in the organization and employees' behaviors (Engelen et al., 2012). Thus, top manager's behaviors are the driving forces behind the firm's behaviors and performances (Auh and Menguc, 2005; Hambrick and Mason, 1984; Harmancioglu et al., 2010). The theoretical framework explains that a CEO transformational leadership has both a direct and indirect effect on product innovation performance (PIP) through innovation

strategy (INS), organizational learning, innovation culture (INC), and new product development (NPD) process.

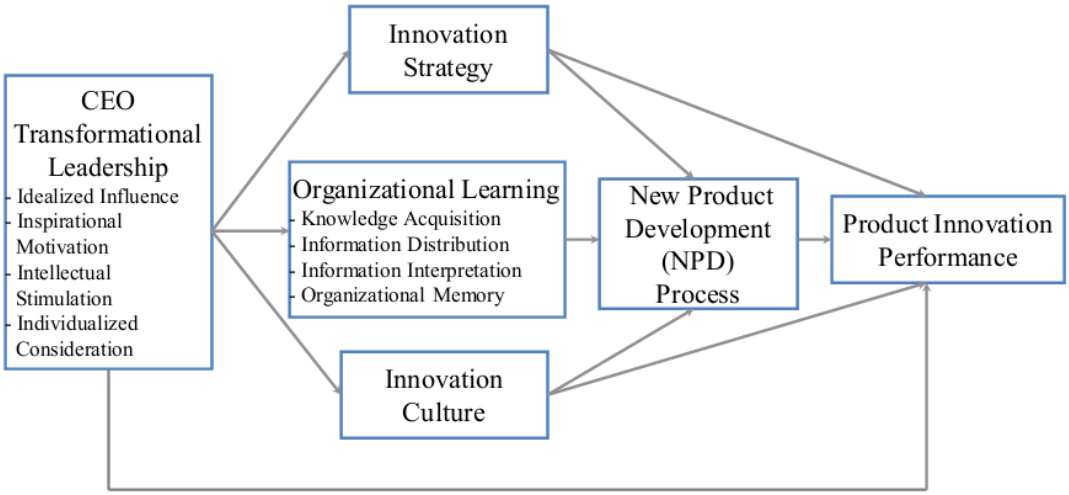

Figure 1 - Theoretical framework

Based on the literature, the definitions of transformational leadership, innovation strategy, organizational learning, innovation culture, NPD process, and product innovation performance are adopted and summarized in Appendix A. The definitions of these constructs are important because the questionnaire items for each construct must represent the operational definitions of these constructs.

3. RESEARCH METHODOLOGY

The development of instruments for all dimensions in this research is carried out in different stages (Schwab, 1980). First, in the pilot stage, items for each construct are adopted from the literature. It is crucial to note that theoretical constructs should be carefully defined from the literature and specialist opinion should be sought to ensure the construction of a reliable instrument; and to enquire whether the items adequately capture the construct domain, leading to robust content validity. Next, the initial set of items is pre-tested with practitioners or academics to provide confirmatory clarity. The second stage includes scale development through pilot testing using expert opinion, and the Q-sort method for pre-assessing initial construct validity and reliability.

The Q-sort method is an iterative process to evaluate reliability and construct validity of questionnaire items before they will be used in the survey research (Nahm et al., 2002). The concept of Q-sort method is to have experts act as judges and sort items into several groups, with each group corresponding to a factor or dimension based on agreement between judges (Moore and Benbasat, 1991). The method has two stages. In the first stage, two judges sort the questionnaire items according to different constructs. In the second stage, questionnaire items that are too ambiguous from the first stage, are reworded or deleted to improve the agreement between the judges. The process is carried out iteratively until the level of inter-judge agreement is satisfactory (Nahm et al., 2002). In the Q-sort method, two evaluation indices are used to measure inter-judge agreement levels: (1) Cohen's kappa (Cohen, 1960) and (2) Moore and Benbasat's hit ratio or the item-placement ratio (Moore and Benbasat, 1991). Cohen's kappa is a measure of agreement that can be interpreted as the "proportion of joint judgment in which there is an agreement after chance agreement is excluded". In terms of the required score in kappa, several studies have considered a score greater than 0.65 to be acceptable (Jarvenpaa, 1989; Li et al., 2005).

Moore and Benbasat's (1991) procedure requires an analysis of how many items are placed by the panel of judges for each round within the target or intended theoretical construct. The higher the percentage of items placed in the target construct, the higher the degree of inter-judge agreement. In essence, item replacement ratios are calculated by counting all the items that are correctly sorted into the target construct by each of the judges and then dividing them by twice the total number of items (Li et al., 2005).

In using the Q-sort method for this study, two operations/new product development managers of Thai firms per round were requested to sort items into different dimensions, including four dimensions of CEO transformational leadership, four dimensions of organizational learning, innovation strategy, innovation culture, NPD process, and product innovation performance. To pre-assess reliability and construct validity, inter-judge raw agreement, Cohen's kappa, and item-placement ratios were considered.

After sorting process, the survey with questionnaire items derived from the final round of Q-sort was sent to manufacturing firms in Thailand. Before conducting factor analysis, the items need to be purified (Churchill, 1979). Corrected item-total correlation (CITC) of each item was examined for purification. Generally, an item should have a CITC close to or greater than 0.50, which indicates meaningful contribution to the internal consistency of the proposed scale. Items were deleted if their CITC scores were below 0.5, unless there were clear reasons for keeping the items. After purifying the items, exploratory factor analysis (EFA) was used to analyze the structure of the interrelationships among a large number of items (Hair et al., 2010). Cronbach's alpha was further computed to examine the reliability of the retained items.

4. FINDINGS AND DISCUSSIONS

As shown in Table 1, the inter-judge raw agreement score was 0.59 (59 percent) and the average placement ratio of items within the same dimensions was 0.63 (63 percent) in the first round. These indicators show a moderately low percentage of items placed in the target constructs. Moreover, Cohen's kappa scores averaged 0.55. In order to improve the agreement score and kappa coefficient, the off-diagonal items in the placement matrix were reworded. Also, it is important to note that feedback from both judges was considered on each off-diagonal item, which is intended to modify and reduce in value. For example, regarding "information distribution (ID)" construct, the placement ratio is 0.3 (30 percent) in the first round. To improve the agreement ratio and placement ratio of this construct, some items that were not placed in the target construct by both judges were reworded for the second round. More specifically, the item "All members are informed about the aims of the company" was reworded to be "Information about the aims of the company is always distributed to employees" and the item "Meetings are periodically held to inform all the employees about the latest innovations in the company" was replace by "Meetings are periodically held to inform all the employees about the latest key information in the company".

Overall, after the reworded items were entered into the second round, the inter-judge raw agreement score increased to 0.78 (78 percent), while the average placement ratio index was moderately improved to 0.81 (81 percent). In addition to these two indices, the Cohen's kappa score averaged 0.76. The inter-judge raw agreement score of 0.78 indicates an acceptable level. Although the second round result met a good overall agreement index, it was possible to improve and revalidate the dimensions. Thus, the off-diagonal items in the placement matrix might be considered too ambiguous. These items were reworded or deleted for the third round sorting. The items that were assessed by judges in the third round of sorting are shown in Appendix B.

Table 1 - A summary of agreement ratio

Agreement ratio	Round 1	Round 2	Round 3
Raw agreement (%)	59	78	84
Cohen's kappa	0.55	0.76	0.82
Placement ratio summary (%)			
Idealized Influence (II)	75	75	83
Inspirational Motivation (IM)	80	70	67
Intellectual Stimulation (IS)	90	70	90
Individualized Consideration (IC)	80	90	100
Innovation Strategy (INS)	57	93	86
Knowledge Acquisition (KA)	43	64	71
Information Distribution (ID)	30	90	100
Information Interpretation (INI)	50	50	80
Organizational Memory (OM)	60	80	80
Innovation Culture (INC)	55	91	86
NPD Process (NPD)	67	83	100
Product Innovation Performance (PIP)	75	92	100
Average	63	81	87

In the third round, the agreement indices slightly improved from the second round. The inter-judge raw agreement scores were 0.84 (84 percent) and the average placement ratio index was 0.87 (87 percent). In addition, the Cohen's kappa score was 0.82. At this stage, the results suggest a high level of inter-judge agreement, indicating a high-level of reliability and construct validity. Table 2 shows a summary of item-placement ratio (hit ratio) for the third round. In Table 2, there were 79 items to be sorted. Each of the theoretical dimensions such as idealized influence (II) is listed in the rows. The perfect item-placement ratio for II would be a score of 12 (6 items x 2 judges). In this case, ten items were placed in the target dimension (actual classification). Therefore, the item-placement ratio for II was 10/12 or 0.83 (83 percent). Moreover, there were some constructs, namely, individualized consideration (IC), information distribution (ID), NPD process, and product innovation performance that obtained a 100% item-placement ratio, indicating a high degree of initial construct validity. However, there were few constructs, e.g., inspirational motivation (IM) and knowledge acquisition (KA) which have low hit ratio, compared to other constructs. Thus, after the third round sorting, the items that were not placed to the target constructs should be deleted. For instance, item IM6, "CEO can tell followers what and how they should do in simple words" and item KA7, "The company has a process to detect fundamental shifts in its industry" were removed from these constructs since these items were too ambiguous and could not exactly explain the definitions of theoretical constructs.

Table 2 - Item-placement ratio (third-round sorting)

	Actual														
Theory	II	IM	IS	IC	INS	KA	ID	INI	OM	INC	NPD	PIP	N/A	**Total**	**Hit (%)**
II (6)	10	2												12	83%
IM (6)		8	4											12	67%
IS (5)			9	1										10	90%
IC (5)				10										10	100%
INS (7)					12					1		1		14	86%
KA (7)					1	10				2	1			14	71%
ID (5)							10							10	100%
INI (5)						1	1	8						10	80%
OM (5)							2		8					10	80%
INC (11)					1	1	1			19				22	86%
NPD (11)											22			22	100%
PIP (6)												12		12	100%

Notes: Total item placement = 158; Hits = 138; Overall hit ratio (%) = 87
Number in the parentheses represents the number of items in that construct

SCALE EVALUATION

Sample

The questionnaire resulting from the third-round sorting consisted of 70 items listed under 12 dimensions. A five-point Likert scale (1 = strongly disagree; 5 = strongly agree) was used. The mail survey with questionnaire items was sent to 3,875 manufacturing firms from various industries in Thailand. The final 264 usable questionnaires were used for analysis; representing 6.8 % response rate. Despite low response rate, the sample size is larger than 100 and thus factor analysis can be conducted (Hair et al., 2010).

To detect non-response bias, the chi-square test and *t*-test were conducted to see whether there were statistical differences between early respondents and late respondents. The results from the chi-square test showed that there were no significant differences between the first quartile and fourth quartile of respondents in terms or position, industry, firm size, firm revenue, firm age, and CEO tenure. Also, the results of *t*-test showed no statistical differences between the two groups in terms of the means for items, indicating that non-response bias was not a problem in this study. As shown in Table 3, respondents were distributed over six industries. The positions of respondents consisted of managers (33%), directors (14.8%), VPs or AVPs (13.3%), CEOs or presidents (22.3%), and others (14.8%). More than half of companies (56.8%) had employees less than or equal to 200 people. Almost half of the respondents (45.5%) were from the companies with CEO tenure over twelve years.

Table 3 - Sample distribution

Measure	Categories	Frequency	Percent
Position of respondents	CEO/ President	59	22.3
	VP/ AVP	35	13.3
	Director	39	14.8
	Manager	87	33.0
	Other	39	14.8
Industry	Automotive	63	23.9
	Food & Beverage	58	22.0
	Chemical products	46	17.4
	Computer & Electronics	43	16.3
	Machinery	30	11.4
	Other	18	6.8
Company size	1-50 people	27	10.2
	51-200 people	123	46.6
	201-500 people	61	23.1
	501-1,000 people	26	9.8
	1,001-2,000 people	14	5.3
	2,001-3,000 people	6	2.3
	more than 3,000 people	7	2.7
Firm revenue	0-50 million baht	32	12.1
	51-200 million baht	78	29.5
	201-500 million baht	52	19.7
	501-1,000 million baht	25	9.5
	1,001-2,000 million baht	27	10.2
	2,001-5,000 million baht	17	6.4
	more than 5,000 million baht	22	8.3
Firm age	0-5 years	22	8.3
	6-10 years	43	16.3
	11-15 years	38	14.4
	16-20 years	45	17.0
	21-25 years	44	16.7
	26-30 years	19	7.2
	more than 30 years	53	20.1
CEO Tenure	0-3 years	42	15.9
	4-6 years	55	20.8
	7-9 years	18	6.8
	10-12 years	29	11.0
	more than 12 years	120	45.5

Item selection, reliability, and initial construct validity assessment

According to Appendix B, the item's corrected item-total correlation (CITC) was shown. There was only one item, namely, IC1 ("CEO treats employees with consideration of their personal feelings") with CITC less than 0.5; it was then deleted for purification.

An exploratory factor analysis (EFA) was then conducted using principal component as means of extraction and varimax as method of rotation. Appendix C to E presents EFA of each construct and the factor loadings of the items (only factor loadings of 0.5 or more were displayed). According to Appendix C, CEO transformational leadership was represented by

three factors and seven-teen items. Items IS4 and IS5 were removed due to a lack of significant loading on any factor. The cumulative variance explained by three factors is 66.64%. Contrary to the theoretical four dimensions of transformational leadership, items IS1-IS3 were combined with IM1-IM5 into the same factor. This result showed that CEO inspirational motivation (IM) was highly interrelated to CEO intellectual stimulation (IS). When a CEO has a challenging vision and motivates employees to achieve that vision, he or she tends to stimulate employees to rethink and solve the problems in new ways. A CEO with inspirational motivation always communicates about the CEO's expectations that employees need to meet. Due to the challenging the firm's vision and the CEO's expectations, a CEO is likely to communicate and encourage employees to find creative and new solutions for the existing problems otherwise employees could not improve their performances, failing to meet the CEO's expectations. These CEO behaviors could explain why the items of IS and IM were possibly loaded into the same factor. In addition, past research has shown that four dimensions of transformational leadership are highly correlated (e.g., Vaccaro et al., 2012; Yang, 2012). Some researchers have averaged all items of four dimensions to form a single scale of transformational leadership (Bass et al., 2003; Gumusluoglu and Ilsev, 2009; Vaccaro et al., 2012). Using data from firms in emerging countries, including Thailand, Wang and Walumbwa (2007) combined the four components into a single transformational leadership factor because the single factor model was a much better fit than the four-factor model. Moreover, Ozaralli (2003) found two factors instead of four dimensions of transformational leadership; charismatic leadership (or idealized influence), inspirational motivation, and intellectual stimulation loaded on one factor and individualized consideration emerged as another factor.

Organizational learning, according to Appendix D, consisted of four factors and six-teen items, which accounted for 71.73% of the variance. Item KA4 was dropped because it had cross-loadings on two factors. Most items, except item KA5, were placed on the target dimensions. From Appendix E, innovation strategy, innovation culture, NPD process, and product innovation performance are the single-factor constructs which contain six to nine items. The cumulative variance explained by the single factors of innovation strategy, innovation culture, NPD process, and product innovation performance are 63.55%, 58.71%, 60.47% and 65.16% respectively. The final Cronbach's alpha for all constructs ranged from 0.82 to 0.92, which showed high internal consistency of proposed scales, based on the acceptable level of alpha at 0.7 (Hair et al., 2010).

5. CONCLUSION AND FUTURE RESEARCH

In summary, this research established an explanatory model of CEO transformational leadership, organizational factors, namely, innovation strategy, organizational learning, innovation culture, NPD process, and product innovation performance through the lens of upper echelon theory. The constructs are operationally defined in terms of their scale development process. The major contribution of this research is the development of a validated scale measurement for collecting data in further research. This study provided the initial developmental steps toward the building of a theoretical framework and scale measurement to allow better understanding of CEO transformational leadership, some key organizational factors, and product innovation performance, based on the context of firms in Thailand, as an example of a country in an emerging market.

The validated measurement scales from this study are beneficial for both researchers and practitioners. Academicians can adopt the proposed scales for future research. Practitioners can use the proposed scales such as product innovation performance as a benchmarking

indicator to compare the firm performance with other firms. The findings of this study revealed that some measurement items that have been used in the context of developed countries may not work well in developing countries such as Thailand. The Q-sort technique can help improve the content validity and the initial construct validity of CEO transformational leadership as well as some key organizational factors related to product innovation. Corrected item-total correlation (CITC) analysis and exploratory factor analysis (EFA) can help validate the items on the underlying constructs.

Based on the EFA results, this study indicated that organizational learning construct can be captured by four dimensions, in line with the literature. However, CEO transformational leadership consists of three factors rather than four theoretical dimensions. However, since it is possible that particular dimensions or constructs differ across countries, industries, or markets, the measurement scales must be considered to be of limited generalizability. Future studies should test the reliability and validity of the proposed measurement items in different contexts. Also, future research may test the theoretical framework by conducting a large scale survey. More advanced techniques such as structural equation modeling can be used to test the relationships between transformational leadership, organizational factors and product innovation performance.

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Appendix

Appendix A *- Definitions of transformational leadership, organizational factors, and product innovation performance*

Constructs	Definitions	Literature
Idealized Influence (II**)**	The leader's charisma or the behavior that makes the leader to serve as a role model for the follower	Bass and Avolio, 1994, 1995; Engelen et al., 2012; Mohammad Al-Omari and Hung, 2012; Sun et al., 2012
Inspirational Motivation (IM)	The ways leaders energize their followers by envisioning attractive future state, providing meaning and challenge to their followers' work, demonstrating commitment to ambitious goals, and communicating that the vision is achievable	Bass and Avolio, 1994, 1995; Engelen et al., 2012; Menguc et al., 2007
Intellectual Stimulation (IS)	The leader actions that stimulate their followers' efforts to be creative and innovative by questioning assumptions, reframing problems, and approaching old situations in new ways	Bass and Avolio, 1994, 1995; Chang, 2012; Menguc et al., 2007; Paulsen et al., 2013; Sun et al., 2012; Thunyasunthornsakun, 2012
Individualized Consideration (IC)	The leader behavior that pays special attention to each individual's need for achievement and growth	Bass and Avolio, 1994, 1995; Chang, 2012; Engelen et al., 2012; Garcia-Morales et al., 2008; Menguc et al., 2007; Sun et al., 2012; Thunyasunthornsakun, 2012
Innovation Strategy (INS**)**	A part of the overall business goals and strategic choices of a firm, the adoption of courses of action, and the allocation of resources necessary to meet the firm's objectives for innovation	Dodgson et al., 2008; Nybakk and Jenssen, 2012; Oke et al., 2012; Terziovski, 2010; Wei and Wang, 2011
Knowledge Acquisition(KA)	The process by which knowledge is obtained	Huber, 1991; Hult et al., 2005; Lopez et al., 2005; Jimenez-Jimenez and Sanz-Valle, 2011; Lopez-Sanchez et al., 2011; Santos-Vijande et al., 2012
Information Distribution (ID)	The process by which information from different sources is shared and thereby leads to new information or understanding	Huber, 1991; Hult et al., 2005; Lopez et al., 2005; Jimenez-Jimenez and Sanz-Valle, 2011
Information Interpretation (INI)	The process by which distributed information is given one or more commonly understood interpretations	Huber, 1991; Tohidi and Jabbari, 2012; Santos-Vijande et al., 2012; Sinkula, 1994; Slater and Narver, 1995
Organizational Memory(OM)	The means by which knowledge is stored for future use	Huber, 1991; Hult et al., 2005; Lopez et al., 2005; Jimenez-Jimenez and Sanz-Valle, 2011
Innovation Culture (INC)	A set of shared values and beliefs within a firm that is favorable to exploring new opportunities, developing innovation, and facilitating employees' innovative behaviors	Berson et al., 2007; Detert et al., 2000; Hult et al., 2005; Hurley and Hult, 1998; Kahn et al., 2012; Liao et al, 2011; Menguc and Auh, 2006; Menor and Roth, 2007; Terziovski, 2010; Uzkurt et al., 2013
New Product Development Process (NPD)	The procedure that takes the new product idea through concept evaluation, product development, launch, and post launch	Cooper and Kleinschmidt, 1995; Crawford and Di Benedetto, 2011; Im et al., 2003; Kahn et al., 2012; Menor and Roth, 2007 Salomo et al., 2007
Product Innovation Performance (PIP)	The financial and non-financial performance of new or improved products or services (introduced by the company in the last three years) to create new markets/ customers or satisfy current markets/ customers	Ahmad et al., 2013; Ar and Baki, 2011; Lau et al, 2010; Matzler et al., 2008; Prajogo et al., 2007; Spanjol et al., 2012; Tsai, 2009; Wan et al., 2005; Wang and Ahmed, 2004; Yang et al., 2012; Zhang and Duan, 2010

Appendix B - *Items after third-round sorting and CITC*

Construct	Item	Item description	Corrected item - total correlation (CITC)
CEO Transformational Leadership - *Idealized Influence (II)*	II1	CEO is admired.	0.68
	II2	CEO is trusted.	0.73
	II3	CEO leads by example.	0.68
	II4	Employees identify with and want to imitate their CEO.	0.65
	II5	CEO demonstrates high standard of ethics and moral conduct.	0.73
	II6	CEO specifies the importance of having a strong sense of purpose. [1]	
CEO Transformational Leadership - *Inspirational Motivation (IM)*	IM1	CEO shares a compelling vision/goal with their followers.	0.68
	IM2	CEO motivates the followers by communicating that vision is achievable.	0.74
	IM3	CEO gets the group to work together for the same goal.	0.72
	IM4	CEO clearly communicates about the expectations that the followers need to meet.	0.64
	IM5	CEO motivates the followers by providing meaning and challenge to the followers' work.	0.78
	IM6	CEO can tell followers what and how they should do in simple words. [1]	
CEO Transformational Leadership - *Intellectual Stimulation (IS)*	IS1	CEO purposefully seeks different perspectives when solving problems.	0.70
	IS2	CEO encourages employees to think about old problems in new ways.	0.69
	IS3	CEO stimulates employees to rethink some things that they never have questioned before.	0.68
	IS4	CEO does not criticize employees' ideas if their ideas differ from CEO's idea.	0.54
	IS5	CEO gets employees to look at problems from many different angles.	0.73
CEO Transformational Leadership - *Individualized Consideration (IC)*	IC1	CEO treats employees with consideration of their personal feelings.[2]	0.44
	IC2	CEO can help employees to improve their professionalism.	0.71
	IC3	CEO is capable of guiding their followers on the job.	0.71
	IC4	CEO always supports employees to continuously develop their skills, knowledge, and expertise.	0.69
	IC5	CEO treats employees as individuals rather than just as members of the group.	0.60

Appendix B - *Items after third-round sorting and CITC (continued)*

Construct	Item	Item description	Corrected item - total correlation (CITC)
Organizational Learning - *Knowledge Acquisition (KA)*	KA1	Employees attend fairs and exhibitions regularly.	0.58
	KA2	New ideas and approaches on work performance are gathered and experimented continuously.	0.66
	KA3	We collect and use the information generated during organizational changes.	0.68
	KA4	Information from customers is regularly obtained.	0.62
	KA5	Information from suppliers is often gathered.	0.60
	KA6	The company gains information about changes in its customers' product preferences. [1]	
	KA7	The company has a process to detect fundamental shifts in its industry (e.g., competition, technology). [1]	
Organizational Learning - *Information Distribution (ID)*	ID1	Information about the aims of the company is always distributed to employees.	0.59
	ID2	Meetings are periodically held to inform all the employees about the latest key information in the company.	0.58
	ID3	The company has formal mechanisms to guarantee the sharing of the best practices among the different fields of the activity.	0.75
	ID4	When something important happens to major customers, the whole company knows about it shortly.	0.60
	ID5	When one unit finds out something important about competitors, it is fast to alert other units.	0.66
Organizational Learning - *Information Interpretation (INI)*	INI1	We systematically examine and update our opinion about the business environment.	0.77
	INI2	We try to develop an interpretation as uniform as possible of relevant information.	0.71
	INI3	Market information is interpreted by members from various functions.	0.62
	INI4	We develop a shared understanding in our company of the available market information.	0.77
	INI5	Several opinions are considered to assess and interpret market situations.	0.77
Organizational Learning - *Organizational Memory (OM)*	OM1	The company has databases to store its experiences and knowledge so as to be able to use them later on.	0.67 0.77
	OM2	Databases are always kept up-to-date.	0.81
	OM3	The company has stored a great deal of knowledge about its market.	0.74
	OM4	The company has stored a great deal of experience with its market.	0.60
	OM5	There is access to the organization's database and documents through some kind of network (e.g. intranet).[1]	
Innovation Strategy (INS)	INS1	The company emphasizes the need for innovation for a company growth.	0.70
	INS2	The company sets objectives for innovation.	0.81
	INS3	The company strategy has a priority on various types of innovation.	0.81
	INS4	The company has a plan to focus on different types of innovation (product, process, business models, etc.)	0.82
	INS5	The company emphasizes on developing innovations through allocation of substantial financial resources.	0.70
	INS6	Internal cooperation is an important part of innovation strategy implementation.	0.64
	INS7	There is the strategy on collaborating with external partners to seek ideas for innovation.	0.63

Appendix B *- Items after third-round sorting and CITC (continued)*

Construct	Item	Item description	Corrected item - total correlation (CITC)
Innovation Culture (INC)	INC1	The company culture is committed to innovation.	0.73
	INC2	The company actively seeks innovative ideas.	0.77
	INC3	The company is always seeking for new opportunities.	0.72
	INC4	Employees take risks by continuously experimenting with new ways of doing things.	0.58
	INC5	The company culture encourages employees to share knowledge.	0.81
	INC6	The company culture encourages open communication among employees.	0.75
	INC7	The company encourages risk-taking efforts.	0.66
	INC8	The company culture encourages the collaboration with external partners such as suppliers.	0.71
	INC9	The company rewards behaviors that relate to creativity and innovation.	0.64
	INC10	The company values flexibility. [1]	
	INC11	The company is customer-oriented. [1]	
New Product Development Process (NPD)	NPD1	A common NPD process cuts across organizational groups.	0.66
	NPD2	NPD process consists of formal stages of development activities.	0.78
	NPD3	Go/ no-go criteria are clear and predefined for each review gate of NPD process.	0.74
	NPD4	NPD process is flexible to meet the needs, size, and risk of individual projects.	0.75
	NPD5	The company applies a systematic new idea screening procedure.	0.76
	NPD6	There is a preliminary market assessment before a project of new product moves to development phase.	0.77
	NPD7	There is a preliminary technical assessment before a project of new product moves to development phase.	0.78
	NPD8	The company performs a prototype or sample test with customers.	0.63
	NPD9	The company makes strong promotion efforts for new product launch through advertising and sales promotion.	0.68
	NPD10	NPD Process is managed according to milestone plan. [1]	
	NPD11	Core objectives and timetable for NPD are only infrequently altered. [1]	
Product Innovation Performance (PIP)	PIP1	The company's new products gain higher market share than those of major competitors.	0.72
	PIP2	New products achieve the company's stated objectives of the percentage of sales with respect to new products, against total sales.	0.70
	PIP3	The number of product innovations developed by my company is higher than major competitors'.	0.76
	PIP4	The level of newness of the company's new products is greater than that of major competitors.	0.82
	PIP5	The company's new products are often first-to-market.	0.72
	PIP6	Customers are satisfied with the company's new products as a whole.	0.66

Notes: [1] an item that was deleted after third-round sorting

[2] an item that was removed because its CITC was lower than 0.5

Appendix C - *Exploratory Factor Analysis for "CEO Transformational Leadership"*

Item	Item Description	Component (Factor Loading)			Cronbach's alpha	Cumulative Variance Explained (%)
		1	2	3		
IM1	CEO shares a compelling vision with their followers.	0.75			0.92	66.64
IM2	CEO motivates the followers by communicating that vision is achievable.	0.77				
IM3	CEO gets the group to work together for the same goal.	0.70				
IM4	CEO clearly communicates about the expectations that the followers need to meet.	0.78				
IM5	CEO motivates the followers by providing meaning and challenge to the followers' work.	0.77				
IS1	CEO purposefully seeks different perspectives when solving problems.	0.57				
IS2	CEO challenges employees to think about old problems in new ways.	0.58				
IS3	CEO stimulates employees to rethink some things that they never have questioned before.	0.57				
II1	CEO is admired.		0.75		0.88	
II2	CEO is trusted.		0.77			
II3	CEO leads by example.		0.72			
II4	Employees identify with and want to imitate their CEO.		0.74			
II5	CEO demonstrates high standard of ethics and moral conduct.		0.71			
IC2	CEO can help employees to improve their professionalism.			0.69	0.84	
IC3	CEO is capable of guiding their followers on the job.			0.77		
IC4	CEO always supports employees to continuously develop their skills, knowledge, and expertise.			0.78		
IC5	CEO treats employees as individuals rather than just as members of the group.			0.68		

Appendix D *- Exploratory Factor Analysis for "Organizational Learning"*

Item	Item Description	Component (Factor Loading)				Cronbach's alpha	Cumulative Variance Explained (%)
		1	2	3	4		
OM1	The company has databases to store its experiences and knowledge so as to be able to use them later on.	0.74				0.89	71.73
OM2	Databases are always kept up-to-date.	0.76					
OM3	The company has stored a great deal of knowledge about its market.	0.78					
OM4	The company has stored a great deal of experience with its market.	0.80					
KA5	Information from suppliers is often gathered.	0.54					
INI2	The company tries to develop an interpretation as uniform as possible of relevant information.		0.51			0.88	
INI3	Market information is interpreted by members from various functions.		0.83				
INI4	The company develops a shared understanding in the company of the available market information.		0.79				
INI5	Several opinions are considered to assess and interpret market situations.		0.67				
ID1	Information about the aims of the company is always distributed to employees.			0.83		0.83	
ID2	Meetings are periodically held to inform all the employees about the latest key information in the company.			0.81			
ID3	The company has formal mechanisms to guarantee the sharing of the best practices among the different fields of the activity.			0.55			
ID4	When something important happens to major customers, the whole company knows about it shortly.			0.57			
KA1	Employees attend fairs and exhibitions to gain new information and knowledge regularly.				0.79	0.82	
KA2	New ideas and approaches on work performance are gathered and experimented continuously.				0.81		
KA3	We collect and use the information generated during organizational changes such as NPD and process improvement.				0.69		

Appendix E *- Exploratory Factor Analysis for Innovation Strategy, Innovation Culture, New Product Development Process and Product Innovation Performance*

Construct	Item	Factor Loading	Cronbach's alpha	Cumulative Variance Explained (%)
Innovation Strategy	INS1	0.79	0.91	63.55
	INS2	0.88		
	INS3	0.87		
	INS4	0.87		
	INS5	0.75		
	INS6	0.70		
	INS7	0.71		
Innovation Culture	INC1	0.79	0.92	58.71
	INC2	0.82		
	INC3	0.76		
	INC4	0.67		
	INC5	0.85		
	INC6	0.77		
	INC7	0.74		
	INC8	0.77		
	INC9	0.72		
New Product Development (NPD) Process	NPD1	0.72	0.92	60.47
	NPD2	0.81		
	NPD3	0.79		
	NPD4	0.79		
	NPD5	0.80		
	NPD6	0.81		
	NPD7	0.83		
	NPD8	0.70		
	NPD9	0.72		
Product Innovation Performance	PIP1	0.81	0.90	65.16
	PIP2	0.79		
	PIP3	0.83		
	PIP4	0.88		
	PIP5	0.80		
	PIP6	0.73		

THE IMPACTS OF PROCESS RECOVERY COMMUNICATION ON CONSUMER BEHAVIORS

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ABSTRACT

The characteristics of services such as intangibilities and inseparability make it difficult for business to operate service perfectly and prevent service failures during service delivery. Successful complaint management should not only be restricted to a company's efforts to handle problem and mend customer satisfaction after service failure, but also make a company learn from customer comments and complaints in order to improve its service process to avoid similar failures. Process recovery communication (PRC) or feedbacks to consumers that portray how firms have executed complaint-based process improvement are important. The current study examines the impact of PRC on consumer behaviors by conducting two studies. The results show that PRC positively impacts consumers' overall satisfaction and positive emotion and also decrease negative emotion after service failure. In addition, PRC has positive impact on consumer behaviors whether consumer experiences outcome failures or process failures. After the service process is recovered, companies should communicate with customers through personal touch or mass media to enhance customer behaviors if companies want to maximize the return on complaint management efforts.

Keywords: service failure, service recovery, process recovery communication, satisfaction, consumption emotion

INTRODUCTION

Different from manufacturing service has four specific characteristics, including intangibility, inseparability, heterogeneity, and perishability (Fitzsimmons and Fitzsimmons, 2008). Because of intangibility and perishability, service cannot be stored for inspection. Inseparability indicates that service delivery and customers exist simultaneously so companies cannot check their service before delivery. Heterogeneity of customer perception makes same service might not satisfy all customers. All these characteristics show that preventing service failure during service delivery is difficult for companies. Ideally, service providers can maintain a high level of service quality all the time and failures should not occur in the

service process, but employees make mistakes, system may breakdown, customers in service process might cause problem for other customers or firms (Gronroos, 2007). Therefore, service failure occurs in several situations and service providers need to deal with these situations and are responsible for recovering the failure to satisfy customers (Gronroos, 2007). If service providers give well-managed recovery to customers, the recovery can positively impact on a trust relationship between service providers and their customers and can deepen customer's commitment towards the service providers (Tax et al., 1998).With the advance of internet technology, the e-commerce has gradually altered the styles and patterns of retailing, and at the same time, influenced the service recovery practices, which may affect customer post-purchase intentions in the context of e-tailing (Kuo and Wu, 2012). In addition to recovering customer complaints, businesses should also improve their service to prevent future similar failures. The book, "*One click: Jeff Bezos and the rise of Amazon.com*" (Brandt, 2011), discusses that Amazon.com developed or improved several service processes according to customer complaints and comments from email, raising its reputations. Because of the innovative service processes, customers spread the positive using experience of Amazon.com on the Internet. In recent years, more research concerns with customer complaint management, e-tailing service failure, and recovery management (e.g., Ha and Stoel, 2012, Kuo and Wu, 2012).

Customer service department usually need complete two tasks. First is to restore dissatisfied customers to a state of satisfaction after the service failure. These actions, called "customer recovery," involve apologizing, showing empathy, or providing compensations or restitutions (Johnston and Michel, 2008). Past studies show that the customer recovery has varying influences on satisfaction, repurchase intentions and word-of-mouth (Gelbrich and Roschk, 2011). Second is to analyze the complaints, find the root causes of failures, and improve service processes to prevent future failures, which is called "process recovery" (Johnston and Michel, 2008). The study of Van Vaerenbergh and his colleagues (2012) discussed that firms not only learn from customer complaints to improve their processes for preventing similar failures, but also communicate with customers how they have executed complaint-based process improvement. These communications are called "process recovery communication" (PRC).

The importance of PRC toward companies is that it explains reasons of service failures and communicate to customers that how companies improve their service process or internal process according to customer complaints. Past study suggests that PRC positively affects customer's overall satisfaction, repurchase intention, and word-of-mouth through four studies with scenarios (Van Vaerenbergh et al., 2012). If companies do not conduct PRC with customers while service failure occurs, it might induce customers' negative emotion or attitude toward companies and further spread negative word of mouth. Using Eslite, one of famous bookstores in Taiwan, for instance, customers complained that they could not purchase certain books in Eslite. However, Eslite didn't explain the reasons when customer complaints. Without official explanation, people said that those books are not sold in Eslite because the contents in the books are not friendly to China. Customers get angrier about this reason, though it might be rumor. Because Eslite didn't provide good PRC, this failure caused customer's negative emotions and attitudes. Thus, we believe that it is important for companies to do PRC after customers experience service failures.

However, empirical research examining the area of PRC toward consumer emotions and attitude is not explored. Although many authors have attributed a high degree of emotionality to loyalty, consumer's emotional responses to service recoveries still have been ignored

largely (Chebat and Slusarczyk, 2005). But, it is evidently that how service providers respond to service failures is likely to influence consumer's emotional states, with a result of either endearing them to the organizations or driving them away (DeWitt et al., 2008). In addition, past studies related to PRC focus on physical channels, instead of virtual channels. Therefore, this study designs two experimental scenarios, chain restaurant (physical channel) and online bookstore (virtual channel), to test the effects of PRC on customer outcomes, including attitude, consumption emotion, overall satisfaction and eWOM intention.

The remainder of this study is as follows: we provide the theoretical background in the next section, which is followed by the methodology. After discussing the results, we conclude this study with contributions, implications, and some limitations for further research.

LITERATURE REVIEW

This study focuses on the concept of process recovery communication and is grounded on several theoretical views, including service recovery, eWOM, attitudes, and consumption emotions. The research model and its hypotheses will also be discussed in this section.

Service Recovery

Service recovery can be defined as the responses and activities conducted by service providers to deal with service failures effectively and to handle customers complaints (Kelley and Davis, 1994, Chang et al., 2012). After a good recovery, satisfaction with services usually can be raised (Gronroos, 2007, Spreng, 1995). Moreover, it is claimed that good service recovery can make frustrated or complaint customers more satisfied than they would have been if no service failure had occurred at that time (Gronroos, 2007, Kelley and Davis, 1994). Thus, if service providers can do recovery to customers in an effective way, customer loyalty can be raised. Also, when it comes to the issue of service recovery, perceived justice theory usually played an important role and applied in service failure and recovery context (Parasuraman et al., 1991, Van Vaerenbergh et al., 2012). Generally, service recovery can eliminate the anger and dissatisfaction of customers. However, Hart and his colleagues (1990) indicated service providers spend more than half all efforts to respond to customers complaints actually reinforce negative reactions to the service. In addition, Holloway and Beatty (2003) contended that even service companies provide compensation to customers, there are still 57% of customers are not satisfied the way of compensation or handling the complaint. Therefore, how to operate service recovery in an effective way is a critical issue for all service organizations.

In this study, process recovery communication (PRC) is applied to explore its effect on consumer behaviors. In service recovery, two dimensions, psychological and tangible, are discussed in the past studies (Miller et al., 2000, Schweikhart et al., 1992). About psychological type of service recovery, there are two techniques recommended, which are empathizing and apologizing. About tangible type of service recovery, service organizations usually provide fair restitution for the costs and inconveniences caused by the service failure or provide value-added atonement for the customer who has a bad experience during service process. Both of these two types are important for companies. So, in this study, process recovery communication can be seen as psychological type of service recovery and applied to explore its effect on consumer behaviors. Next part will further discuss the context of process recovery communication.

Process Recovery Communication

Miller and her colleagues (2000) proposed that service recovery has three phases. Customers face service failure and then expect the service recovery during the pre-recovery phase. Next, customers accept the service recovery from service providers during the immediate recovery phase. Last, customers finally accept follow-up service recovery in follow-up recovery phase. Among these phrases, follow-up recovery might not be necessary based on the success of the immediate recovery efforts and antecedent factors such as the type of service failure or the severity of the service failure. However, a successful complaint management should not only mend customer satisfaction after service failure but also learn from customer comments and complaints to improve its service processes to avoid similar failures in the future (Van Vaerenbergh et al., 2012).

There are several guidelines discussed the development of recovery system, and one of them is "keep the customer informed", which means customers should be told that the service failure or mistake has been acknowledged and that the recovery process is underway (Gronroos, 2007). Finally, when the problem has been solved, service providers should notify customers the result and what kind of action they have taken to improve the service process in order to prevent the similar failure in the future (Gronroos 2007). Van Vaerenbergh and his colleagues (2012) refer process recovery communication (PRC) to communication about complaint-based process improvements to customers, which represents one kind of feedback to customers. Some scholars (e.g., Boshoff, 1999) also suggested that once the process is recovered, firms may inform the complaining customers about the improvement made and the action is called "feedback", which refers to "the situation in which once the problem is solved, the service firm provides information about the problem and what is being done to resolve it. For example, if a customer lodges a complaint and the firm's procedures are changed in some way due to the customer's input, then the service firm should inform the customer of the developments (Boshoff, 1999). Thus, according to above discussion, PRC can be seen as "feedback".

In addition, the related theoretical foundations related to PRC are perceived relationship investment theory and perceived justice theory (Van Vaerenbergh et al., 2012). Wulf and his colleagues (2001) defined perceived relationship investment as consumers' perception of the extent to which an organization devotes time, resources and efforts to maintain or enhance its relationships with customers. So, customers who receive PRC might perceive the efforts and investment that business do for them and thus encourage customers to stay in the relationship. Furthermore, Parasuraman and his colleagues (1991) indicated that perceived justice theory also describes that consumers want service providers to play fair: they pay for service and they expect reliable service in return.

eWOM intention

There has been a paradigm shift in word-of-mouth communication because of the advent of the Internet and information technology. In the traditional context of word-of-mouth (WOM), it was originally defined as an oral form of interpersonal noncommercial communication among acquaintances. Nowadays, WOM has evolved into a new form of communication, which is called electronic word-of-mouth (eWOM) communication (Cheung and Lee, 2012). eWOM communication can take place in several settings and also can be defines as "all informal communications directed at consumers through Internet-based technology related to the usage or characteristics of particular goods and services" (Litvin et al., 2008). In the studies of Cheung and Lee (2012), it is discussed that consumers can post

their opinions, comments, and reviews of product or services on weblogs, discussion forums, retail websites (e.g. Amazon.com), newsgroup and social networking sites (e.g. facebook.com).

There are several differences between eWOM and WOM. For example, unlike traditional WOM, eWOM communications possess extraordinary scalability and speed of diffusion because of the power of Internet and eWOM communications involve several ways to exchange information in asynchronous mode (Hennig-Thurau et al., 2004). That is, customers can use various electronic technologies such as social network, blogs, and online discussion forums to facilitate information exchange among communicators (Cheung and Lee, 2012). Also, eWOM communications are more measurable than traditional WOM because of the advance of technology. Therefore, the format, quantity, and persistence of eWOM communication have made them more observable. Lastly, consumers only can judge the credibility of the communicator on the basis of the related cues through online reputation systems such as online ratings and website credibility (Cheung and Lee, 2012). Moreover, the rise of new media such as social network changes the customer relationship by providing customers a good platform to exchange their ideas or opinions toward companies after customers experience services or purchase goods (Hennig-Thurau et al., 2010).

Van Vaerenbergh and his colleagues (2012) mentioned that PRC can affect customer outcomes such as repurchase intentions and word-of-mouth intentions through higher perceptions of the firm's relationship investment and overall justice. In addition, communicating complaint-based process improvements to consumers might give consumers a positive impression (Hart et al., 1990). Thus, we can expect that PRC improves overall satisfaction. Also, we assume that after touching the PRC of service providers, customers have willing to publish their thoughts, opinions, and feelings about product and service either by directly emailing the organization concerned or by writing on blogs or their websites (Schindler and Bickart, 2005). First and second hypothesis is developed as follows:

H1: Customers who receive PRC report have more favorable overall satisfaction than customers who do not receive this communication.

H2: Customers who receive PRC report have more favorable eWOM intention than customers who do not receive this communication.

Attitude

Attitude in consumer behavior is a complex and multi-dimensional cognitive state. For instance, consumers prefer a specific brand in terms of the attributes of the brand in his memory (Howard and Sheth, 1969). In the definition of Allport (1935), it is defined that "attitude are learned predispositions to respond to an object". Moreover, in the past study of Green (1954), it is suggested that the concept of attitude is "a consistency or predictability of response." Many researchers view attitudes as an affective construct and reflect "predisposed" response to the object which is consistent with consumers' favorable or unfavorable manner. In addition, Zajonc and Markus (1982) have investigated that attitude as a construct lay bare all feelings by which a person and object, or an issue is evaluated or judged. That is, if people accept the attitude toward an object, and they would possibly perform a specific behavior to the object. People would buy brands or products they like best and endure the behavior.

In addition, in the study of Tannenbaum (1956), it is indicated that there have been many studies of attitude change through communication. Also, some scholars such as Kiesler and his colleagues (1984) and Siegel and his colleagues (1986) investigated the effect of computer-mediated communication (CMC) and face-to-face communication and they

contended that more attitude change was found resulting from CMC than from face-to-face communication. Thus, we believe that if service providers do the process recovery communication to customers after the service failure, customers may change their attitude. So we developed hypothesis as following:

H3: Customers who receive PRC report more favorable attitude toward eWOM than customers who do not receive this communication.

Consumption Emotion

In past study of Westbrook and Oliver (1991), consumption emotion can be defined as "the set of emotional responses elicited specially during product usage or consumption experiences, as described either by the distinctive categories of emotional experience and expression (e.g. joy, anger, and fear) or by the structural dimensions underlying emotional categories, such as pleasantness, unpleasantness, relaxation/ action or calmness/ excitement". Moreover, the constructs of emotions play an essential role in goods and service evaluations (Bagozzi et al., 1999). In addition, Westbrook and Oliver (1991) indicated that emotions are emotional responses obtained specifically during product or service usage, or because of the consumption experience.

Negative emotions will lead to customers' behavioral intentions or behaviors if service providers do not fix the service failures well (Harrison-Walker, 2012). So, how to alleviate the impact of negative emotion on behavioral outcomes is important to managers. In the study of McColl-Kennedy and Sparks (2003), they indicated that customer discontent can be moderated if customer can understand that the action taken to recover a failure was feasible option. Moreover, consumers want to understand why things go wrong and why specific countermeasures were taken. That is, when service failures occur, consumers not only want service recovery from service providers, but also want to understand the causes of service failures and get the explanations from service providers. Moreover, another key point of lessening the impact of negative emotion is that service providers need to demonstrate the efforts they did for customers during the service recovery process (McColl-Kennedy et al., 2003). Also, process recovery communication appears in both perceived relationship investment theory and thus enhances customer outcomes (e.g. repurchase intention and WOM intention) (Van Vaerenbergh et al., 2012). The perceived relationship investment can be defined as consumers' perceptions of the extent to which an organization devotes time, resources, and effort to maintain or enhance its relationship with customers (Wulf et al., 2001). So, customers can infer from PRC that organizations have put time, resources, and effort into assuring the reliability of future service, so customers are less likely to experience failures in the future (Johnston and Michel, 2008). Thus, we believe through PRC, customers can know the investment of service providers on service recovery process and the improvement on service process and thus customer's negative emotion can be reduced. Based on the above, we hypothesized that:

H4: Customers who receive PRC report have less negative emotion than customers who do not receive this communication.

The majority of past studies focus on customers' negative emotion (e.g., Wetzer et al., 2007), but the possible coexistence of positive emotion and negative emotions has been largely neglected in service recovery research (DeWitt et al., 2008). For instance, when business provides a success recovery, a customer's negative emotions (e.g. rage) may be decreased, while certain positive emotion (e.g. happiness) may be increased. Similarly, poor service

recovery has possibility to both exacerbate negative emotion and reduce positive emotion. Based on the above, Hypothesis 5 is proposed and the experimental model is illustrated in Figure 1.

H5: Customers who receive PRC report have more positive emotion than customers who do not receive this communication.

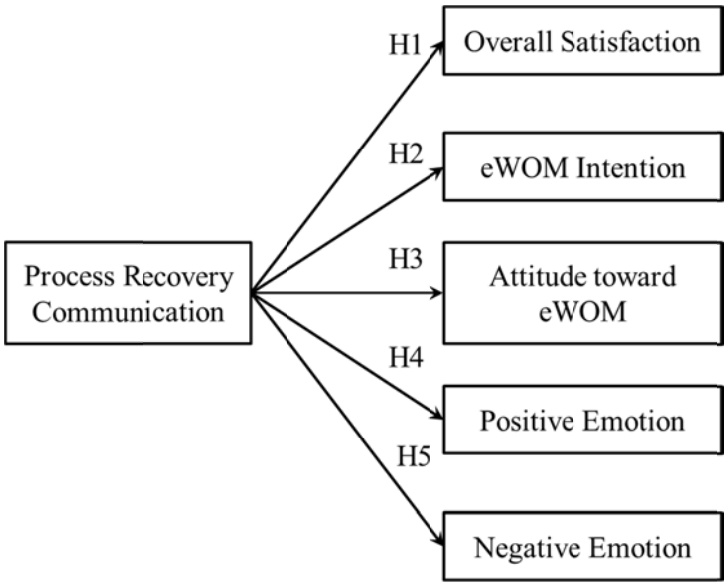

Figure 1 Research Model

METHOLOGODY

This experiment design refers to scenario-based role-playing experiment. Rungtusanatham and his colleagues (2011) indicated that a scenario-based role-playing experiment can describe varying versions of scenarios and convey the information with specific levels of factors. Scenario-based design are frequently used in service recovery research (e.g., DeWitt et al., 2008, Van Vaerenbergh et al., 2009) since scenarios enable the manipulations to be operationalized easily. Moreover, the varying versions should be clear and realistic with complete information let respondents to assume their role and to eventually provide their reactions and responses.

To design a realistic scenario, this study follows the 3-stage design processes proposed by Rungtusanatham and his colleagues (2011). In the first stage, pre-design stage, we collect information related to chain restaurant and online bookstore. In the second stage, design stage, we develop the scenarios with different factors. These scenarios are listed in Table 1. Two setups, chain restaurant and online bookstore, are used in the study to represent the physical and virtual environments. Every setup has 3 situations, including no PRC, PRC with one to one, and PRC with one to many. These 3 situations are all built upon the base scenario. The last stage, post-design stage, is to check whether the scenarios sound realistic and whether the scenarios could happen in real life. After ask several respondents, these scenarios are good enough for official survey.

Table 1 – Vignette Description

Setup	Situation	Description
Chain	Base Scenario	1. Customers to the chain store.

Restaurant		2. The checkout staff has forgotten to check with the rewards points of loyalty card. 3. Customers convey the complaint to chain restaurants. 4. Person responsible for complaints was not available. 5. Customers leave contact the information to chain store.
	No PRC	1. None. 2. Customers don't get any inform from the chain restaurant.
	One to one PRC	1. Few days later, customer gets a letter from the chain restaurant. 2. The content of the brochure is: "Based on your complaint…" 3. Process recovery: new POS system and new loyalty card.
	One to many PRC	1. Few days later, customer gets a brochure from the chain restaurant. 2. The content of the brochure is: "Based on a number of complaints …" without explicit referral to the customer. 3. Process recovery: new POS system and new loyalty card.
Online Bookstore	Base Scenario	1. Customers to the online bookstore. 2. The online bookstore has forgotten to inform customer while the book that customer ordered already arrived the assigned channel store. 3. Customers log in the online bookstore and leave the complaints on the website.
	No PRC	1. None. 2. Customers don't get any inform from the online bookstore.
	One to one PRC	1. Few days later, customer gets an email from the online bookstore. 2. The content of the email is: "Based on your complaint…" 3. Process recovery: new online tracking system
	One to many PRC	1. Few days later, customer finds the new message on the website of online bookstore. 2. The content of the message is: "Based on a number of complaints …" without explicit referral to the customer. 3. Process recovery: new online tracking system

The official questionnaires have two studies, Study 1 and Study 2. The purpose of Study 1 is to investigate the situations of no PRC, one to one PRC, and one to many PRC in both chain restaurant and online bookstore setups. This study has two parts. First, respondents read through the scenarios; second, the respondents answer their perception of the scenario.

Study 2 focus on the changes of the customer perceptions. The questionnaire of this study has four parts. First, respondents read a service failure scenario, and then, they answer their perceptions of the scenario. In the third part, respondents read another scenario related to PRC, and they will answer their perceptions again for the scenario in the third part.

Most of the respondents are students in the College of Management at Yuan Ze University. Although they cannot represent all customers, they are legitimate customers in the

real world. In addition, this study has two setups, including chain restaurant and online bookstore. Most students are familiar with both setups. After several rounds of collection, we have total 203 valid responses. The primary statistic software used in this study is Statistical Packages for Social Science Version 20 (SPSS 20.0).

RESULTS AND DISCUSSIONS

This section shows the results of data analyses as well as the discussions of the results. First, we will discuss the Study 1, which compares the differences among no PRC, one to one PRC, and one to many PRC. After Study 1, we will discuss Study 2, which analyzes the changes of customer perceptions before and after PRC.

Study 1

The demographic information of Study 1 is listed in Table 2. It shows that more than 50% of the respondents are female, age 20 or younger, and undergraduate students. We also found that 58% of the respondents have service failure experience in the past 6 months. While all respondents have chain restaurant purchase experience in the past 6 months, only 59% of the respondents have online bookstore purchase experience in the past half year.

Table 2 – Demographic Information (Study 1)

Variable	Category	N	Percentage
Gender	Female	71	68.9
Age	20 or younger	55	53.4
Education Level	Undergraduate	89	86.4
Service Failure Experience in the past 6 months	Yes	60	58.3
Purchase Experience in the past 6 months (Chain Restaurant)	1 or more times	103	100
Purchase Experience in the past 6 months (Online Bookstore)	1 or more times	61	59.2

The ANOVA results are listed in Table 3. This table includes both overall satisfaction and e-WOM intention. From the table, we find that the average overall satisfaction is significantly different among 3 PRC groups. Further investigation finds that no PRC has a significantly lower average satisfaction than the other two groups. However, one to one PRC and one to many PRC have similar average satisfaction. Considering eWOM intention, the average value is similar across 3 PRC groups. These results are similar between two setups, chain restaurant and online bookstore. From these results, we find that PRC has a significant and positive impact on overall satisfaction while PRC does not have a significant impact on eWOM intention. Therefore, we can confirm that Hypothesis 1 is supported, while Hypothesis 2 is not.

Table 3 – The ANOVA Result (Study 1)

Variables	PRC Situation	Chain Restaurant	Online bookstore
Overall Satisfaction	One to one PRC	4.74	4.79

	One to many PRC	4.25	4.68
	no PRC	2.67	2.82
	F statistic	52.757 ***	46.572 ***
e-WOM Intention	One to one PRC	4.14	4.06
	One to many PRC	4.07	4.17
	no PRC	3.67	3.50
	F statistic	1.521(n.s.)	2.443(n.s.)

Note: ***p<0.001, **p<0.01, *p<0.05

Study 2

The demographic information of Study 2 is listed in Table 4. It shows that more than 50% of the respondents are female and undergraduate students, while more than 50% of the respondents have ages of 21 or older. We also found that 51% of the respondents have service failure experience in the past 6 months and 99% of the respondents have chain restaurant purchase experience in the past half year. In Study 2, only chain restaurant setup is used in the scenario; thus, past purchase experience related to online bookstore is not asked.

Table 4 – Demographic Information (Study 2)

Variable	Category	N	Percentage
Gender	Female	66	66
Age	20 or younger	48	48
Education Level	Undergraduate	73	73
Service Failure Experience in the past 6 months	Yes	51	51
Purchase Experience in the past 6 months (Chain Restaurant)	1 or more times	99	99

Customer perception in Study 2 is asked before and after PRC manipulations. The customer perception before manipulation serves as a check point to make sure respondents before different PRC scenarios have similar perceptions toward the service failure situation. The results not shown here display similar perceptions. The ANOVA results of the customer perceptions, including attitude toward eWOM, negative emotions, positive emotions, overall satisfaction, and eWOM intention, after PRC manipulation are listed in Table 5. In Table 5, we find that the average values of negative emotion, positive emotion, and overall satisfaction are different across 3 PRC groups. Further investigation shows that no PRC group has a significantly lower average value than the other two groups, while the average values are similar between one to one PRC and one to many PRC groups. Considering eWOM variables, both attitude toward eWOM and eWOM intention are not significantly different across 3 groups. From these results, we find that Hypothesis 3 is not supported, while Hypothesis 4 and 5 related to emotions are supported.

Table 5 – The ANOVA Results After PRC Manipulations (Study 2)

Variables	PRC Situation	Average Value
Attitude toward eWOM	One to one PRC	4.23
	One to many PRC	4.01

	no PRC	3.66
	F statistic	1.093(n.s.)
Negative Consumption Emotion	One to one PRC	2.40
	One to many PRC	1.95
	no PRC	4.94
	F statistic	84.899***
Positive Consumption Emotion	One to one PRC	4.37
	One to many PRC	4.70
	no PRC	2.12
	F statistic	63.742***
Overall Satisfaction	One to one PRC	4.48
	One to many PRC	4.66
	no PRC	2.44
	F statistic	76.342***
eWOM Intention	One to one PRC	4.25
	One to many PRC	4.10
	no PRC	3.63
	F statistic	1.522(n.s.)

Note: ***p<0.001, **p<0.01, *p<0.05, n.s. = Not Significant

Table 6 – The Paired t-Test Results Before and After PRC Manipulations (Study 2)

Situations	Variables	Average Change	p-Value
One to one PRC	Positive Consumption Emotion	-2.01091	<0.001
	Negative Consumption Emotion	3.02066	<0.001
	Overall Satisfaction	-1.43400	<0.001
	Attitude toward eWOM	.69849	.421
	eWOM Intention	.21867	.468
One to many PRC	Positive Consumption Emotion	-2.28156	<0.001
	Negative Consumption Emotion	3.25556	<0.001
	Overall Satisfaction	-1.35107	<.0001
	Attitude toward eWOM	-.09591	.732
	eWOM Intention	.69849	.130
No PRC	Positive Consumption Emotion	.08793	.361
	Negative Consumption Emotion	.12532	.558
	Overall Satisfaction	.47914	.030
	Attitude toward eWOM	.47420	.058
	eWOM Intention	.39632	.508

Paired t-test is also conducted to test the customer perceptions before and after PRC manipulations. Table 6 shows the t-test results. From the table, we find that in one to one PRC and one to many PRC situations, the before and after customer perceptions on positive emotion, negative emotion, and overall satisfaction are significantly different, indicating that customers have more positive emotion, less negative emotion, and more satisfaction. However, the attitude toward eWOM and eWOM intention do not change after PRC manipulations. In no PRC situation, only overall satisfaction changes before and after PRC manipulation, showing that overall satisfaction is lower after no PRC. However, the other four customer perceptions do not have significant changes after no PRC when compared with the value before PRC.

CONCLUSIONS AND CONTRIBUTIONS

Conclusions

As we expect, Study 1 provides support for the effectiveness of PRC to complaining customers, which significantly enlarge their overall satisfaction than the complaining customers who don't receive PRC. Also, the result of Study 1 is also similar to prior literature (e.g., Van Vaerenbergh et al., 2012), even though PRC has no specific effect on eWOM intention. Gustafsson (2009) discussed that overall satisfaction is one kind of backward-looking perception. That is, overall satisfaction can be viewed as entire evaluations of service quality that customers have perceived or have encountered in whole purchasing experience and are more subject to influence and thus might increase more easily after the communication of process recovery. But eWOM intentions can be regarded as forward-looking perception, which involves the customers' future intentions toward the service providers, and thus are more difficult to influence through PRC. Also, the reason that the effect of PRC on eWOM intention is not strong may involve the nature of role. Compared to word of mouth behavior, electronic word of mouth behavior may be less personal in that it is not face to face and it is more powerful because of accessibility of the Internet. Moreover, the key eWOM player is online opinion leader (Litvin et al., 2008), and our participants in the current study are all students. The possibility that most of students are online opinion leaders is low, so it might explain that even though our participants experience PRC after the service failure, they still have not strong willing to express their opinion online.

As we expect, PRC still enhances the customer's overall satisfaction but not increases the eWOM intention, which is the same result as Study 1. Even though there is no effects of PRC on eWOM intention during a univariate analysis, the result of paired sample t-test (Table 6) indicated that customers will raised their eWOM intention after receiving PRC. In other words, there are still some possibilities that consumers have intention to do eWOM after receiving PRC from service providers. In Study 2, we also explore the effective of PRC on consumption emotion and attitude toward eWOM and it increases positive emotion, decreases negative emotion, and has no significant impact on attitude. The purpose of this research to explore the negative emotion and positive emotion in the same time is that the majority of service recovery research focuses on customers' negative emotion (e.g., Andreassen, 1999, Bougie et al., 2003) but neglects the possible coexistence of positive and negative emotion. The results of current research indicates that when service providers (chain restaurant) provides a good communication of process recovery, a customer's negative emotion (e.g. irate and enraged) can be reduced and positive emotion (e.g. enjoyment and joy) can be raised, which is also supported by past research (DeWitt et al., 2008). So, our findings with two dimensions (negative emotion and positive emotion) provide the further understanding of the role of consumption emotion in service recovery.

Customer's attitude toward eWOM cannot be affected by PRC may have several reasons. One of possibility is that the nature of role, as we discussed before. The participants of this research are all students and most of them might not be online opinion leaders, who have higher willingness to express their opinions via the Internet. Moreover, it is also important about the "place" where customers will express its opinion. The objective of attitude in our study is the behavior of electronic word of mouth (eWOM). If we further explore eWOM in past researches, it is discussed that consumer's perception on online social tie (Sun et al., 2006), social trust (Hau and Kim, 2011), and similarity with others (Chu and Kim, 2011) have been found to be the major antecedents that affect eWOM behaviors. In other words,

consumers will have strong intention to share information in online community if consumers are familiar with each other. However, in our operational definition of attitude toward eWOM and related items do not focus on one place such as Facebook or other online platforms where our participants are familiar with their online community members. Thus, our participants don't have high probability to express their opinions online even though experiencing PRC from service providers. So, we believe that PRC might affect customers' attitude toward eWOM and eWOM intention when the customers are online opinion leaders and they have own familiar online community or platforms.

Academic Contributions

The current study provides four contributions. First of all, Miller and her colleagues (2000) provided a better understanding of the service recovery process, including pre-recovery phrase, immediate recovery phase and follow-up phase. While majority of past literatures (e.g., Chang et al., 2012, Spreng, 1995) focused on immediate recovery phase, our current research explored follow-up phase, which involves psychological recovery through communication of process recovery. Secondly, it consists of few researches focusing on service literature about process recovery communication (Van Vaerenbergh et al., 2012). This study contributes to service recovery literature by explaining the effectiveness of PRC on consumption emotion, including negative emotion and positive emotion. The findings show that if consumer receives PRC from service providers after service failure, consumer's positive emotion can be raised and negative emotion can be reduced simultaneously.

Thirdly, fewer studies discuss empirically the relationship between PRC and overall satisfaction in Asia area. But the present research empirically examines whether PRC has impacts on overall satisfaction for Asia consumers. The results show that if customers receive PRC from service providers after service failure, it can positively affect overall satisfaction. That is, we broaden the database that the effectiveness of PRC on consumer behaviors in Asia. Fourthly, the present study explores the effectiveness of PRC on different types of service failures. The result shows that PRC has significantly influence on customers' overall satisfaction whether they experienced.

Managerial Insights

This research provides insights for understanding managerial implications. First of all, PRC should be integrated part of service recovery. The results of this study show that if service providers improve their process according to customers' opinion, the communication of process recovery can successfully increase overall satisfaction and positive consumption emotion, and decrease the negative consumption emotion. That is, managers should target customers who experienced a service failure and use the communication of process recovery in one-to-one media (letter or email) or one-to-many media to explain the reason and the process of improvement, which can attenuate negative outcomes of service failures.

Secondly, we suggest that companies should provide online community for their customers. Customers can give advices or provide their complaints on the community if experience the service failures. Companies can understand their drawbacks, analyze the root of service failure in order to improve their service process immediately and further communicate with their customers about the improvement on their services rapidly.

Thirdly, past studies indicated that providing compensation to customers instantly during immediate recovery phase is important while service failures occurs (Miller et al., 2000). However, our study further indicates that managers should adopt PRC, including detailed

explanation and apology for the service failure, and steps for preventing the errors from recurring during the follow-up recovery phase. The outcome is that providing a good explanation can effectively reduce customers' dissatisfaction, negative emotion and increase customers' positive emotion. Moreover, past study (e.g., Harrison-Walker, 2012) contended that if the error of service failure is in fact uncontrollable and unavoidable, then the company should clearly explain the situation to customers and demonstrate the service failure is unavoidable. Therefore, to the extent that the company is successful with its explanations, customers' negative emotions may be reduced or eliminated.

Finally, about the forms of communication, both Study 1 and Study 2 show that PRC to complaining customers that use both one-to-one and one-to-many ways yield similar effects. So, we suggest that companies should adopt the way of one-to-many communication, since the costs associated with personal communication are higher than those for one-to-many communication (Pelsmacker et al., 2006). It is trade-off for service providers, since past studies indicated that adding personal communication to customers might increase customer evaluations. Nevertheless, personal communication also requires higher costs (Wulf et al., 2001), but our finding shows that both of these communication ways can yield similar effects. So, on the basis of cost effectiveness, companies can adopt the one-to-many media (such as Facebook or Google Plus) to communicate with their customers. Moreover, one of benefits for companies to use one-to-many media is that the new media is rising (Hennig-Thurau et al., 2010). New media such as Facebook, Google, YouTube and Twitter, can reach almost everywhere and anytime. So, mangers might use new media to offer the summary of PRC to customers and guide customers to more detailed message which posted on the companies' website or blog, which further communicate complaining customers and non-complaining customers in the same time.

Limitations

Few limitations exist in the current research, but also some opportunities for ongoing research. A scenario-based experimental design is used to induce service failure and service recovery in the present research. Even though we adopt and re-adjust the scenarios from past literatures and assess the realism of the scenarios in both pilot and main study, a discrepancy could exist between actual experiences and hypothetical scenarios. Future researches might investigate the effect of PRC by relying on real complaint data gained through a field experiment or do case study with real company to enhance the availability of research. But there are still some opportunities to researchers to explore similar applications in different settings and contexts. Overall, more works and researches should be discussed in follow-up recovery phase.

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THE CONCEPTUAL FRAMEWORK TO DEVELOP COORDINATION MECHANISM ENHANCING SUSTAINABILITY IN SUPPLY CHAIN

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ABSTRACT
Sustainable supply chain management (SSCM) has been increasingly drawing attention from researchers. Generally, there are three main aspects of sustainability namely environment, social and economic. Although all are similarly important, very limited amount of research has been done regarding incentives or remuneration scheme/mechanism to attract coordination for sustainable supply chain. Therefore, this paper aimed to explore research direction on sustainable supply chain in the last decade focusing on economic aspect in order to clarify the objective of SSCM specifically in pragmatic, and to explore research directions on coordination mechanism for sustainability. Through the systematic literature review, a conceptual framework of considering criteria coordination mechanism that enhance sustainability in supply chain was proposed in order to be a guidance for further study on designing coordination mechanism aiming to enhance sustainability in supply chain.

Keywords: Sustainable Supply Chain Management, Coordination, Economic

INTRODUCTION

Sustainability has been an emerging issue that drawing attentions from researchers recently. Industrial noitulovetoward globalization has led to excessive utilization of existing scarce resources trying to meet economy of scale in business. The situation has privileged for firms that have more power and more chances to access those scarce resources. Consequently, it has caused series of social and environmental problems since everything has linked and interrelated from time to time. As a result, new trend toward sustainability development in order to balance three bottom line which are environment, social, and economics aspects is gradually important not only in academic but also in business management as well.

In term of sustainable development, majority quoted definition defined by the Brundtland Commission as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Three aspects of sustainability include social, economic, and environmental needs should be balanced since the beginning or in short term in order to sustain positive outcome in the long term (The World Bank Group, 2001). The philosophy behind this is "everything is linked as a system". Typically, one need can conflict with another. In order to find mutual consensus, these needs have to be

prioritized under limitations criteria, and sometimes it has to trade off (The World Bank Group, 2001).

When considering in more specific point of view under the context of supply chain management, emerging situation has also brought more and more intense business environment for supply chain members e.g. intense rivalry, effects from government intervention, higher requirements and more specific international standards and regulations (Dey at al, 2011), increasing need and expectation from customers especially in social and environment issue (Jorgensen & Knudsen, 2006). Moreover, globalization has also accelerated changing environment over time. As a result, player in supply chain that cannot cope with this fast changing environment and unexpected risk occurring may lose its competitiveness. Regarding the sustainability philosophy, not only affects on its individual performance but also consequently affects other interrelated trading partners unavoidably. Therefore, to survive and gain competitive advantage in this situation, coordination among chain members seeking for mutual sustainability goals is even more challenge in supply chain management context nowadays.

In general, scope of sustainable supply chain management (SSCM) context is focus on stakeholders and process aiming to integrated three sustainable development goals of supply chain members. The most quoted definition of SSCM is *"The management of material, information and capital flows as well as cooperation among companies along the supply chain while integrating goals from all three dimensions of sustainable development, i.e., economic, environmental and social, which are derived from customer and stakeholder requirements"* as defined by Seuring and Müller (2008). In order to make the flow of these substances (e.g. material, information, capital) smoothly, the systematic coordination in key business process among chain members both upstream and downstream is a key success factors to improve the long term economic performance individually and for the whole chain at last (Carter & Rogers, 2008; Awasthi et al, 2010). When all partners along the chain e.g. customer, stakeholders; are satisfied by coordinating relationship, it will also secure long term business operation (Carter & Rogers, 2008; Bai & Sarkis, 2010; UN, 2010).

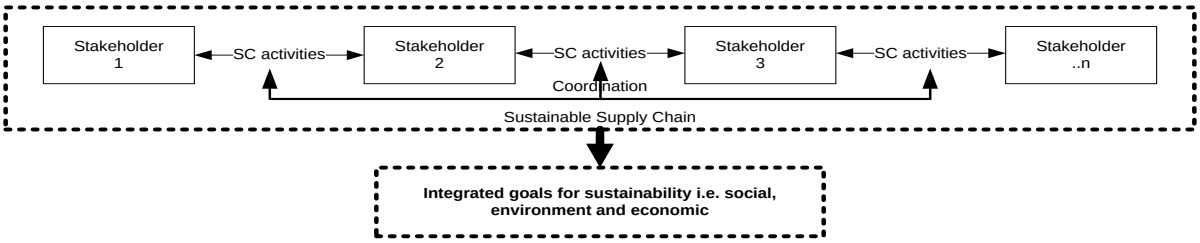

Figure 1 - Basic framework of sustainable supply chain

Obviously, the basic paradigm of sustainable development is also becoming the intrinsic concerning criteria for sustainable supply chain management. The objective of sustainable development is trying to balance needs of this three-based bottom line since the beginning to sustain development outcome by prioritizing needs and trade off. Whereas, SSCM is trying to integrate goals which fall in an intersection area of these three criteria. SSCM emphasizes on coordination in main activities among key members along the chain in order to achieve these goals. Although SSCM considers more specific in particular supply chain, but many resilient supply chain can be linked together and further becoming a robust network. Therefore, it can be implied that sustainable supply chain can generate solid structure for sustainable development.

Review of literature showed that supply chain, that adopted sustainability concept in all key partners along its chain, has generated benefit for not only members but also built up solid structure for sustainable development as well. In an internal perspective, sustainable supply chain has helped its partners to achieve higher economic performance (Carter & Rogers, 2008) to explore novel areas for competitive advantage (Markley & Davis, 2007), to minimize financial risks, and to increase profits (Fawcett et al, 2008). External factors such as international law and regulations, customer and social expectation have driven firms to increase their concern toward sustainable business conduct. Although, these action was happen with its own interest, but it also being an interest of its stakeholders that contributing for society at large (UN, 2010). However, there were limited literatures defining how to encourage continuous coordination among supply chain partners in pragmatic view. Whereas economic, one of sustainable paradigm, is essential in order to develop sustainable supply chain.

The purpose of this paper was to provide a systematic review of the evolution of sustainable supply chain management over the last decade e.g. trends, potential consensus in findings and approaches across studies that guiding for future research and facilitating sustainable supply chain management context especially on coordination mechanism. Finally, the framework of coordination mechanism enhancing sustainability in supply chain was proposed.

METHODOLOGY

To answer two research questions; "What are concerning factors to enable sustainable coordination/commitment in supply chain?", and "What kind of coordination mechanisms have been applied currently to enhance sustainability in supply chain and what are their shortcomings?"; the systematic literature review was applied for this study. Following the five steps of systematic review process (Whittemore & Knafl, 2005) the methodology structure of this paper was presented in Figure 2. However, review of literature in this paper was limited only in published paper exclude working paper, technical report (Kitchenham, 2004) to avoid irrelevant information, time consuming and bias in findings.

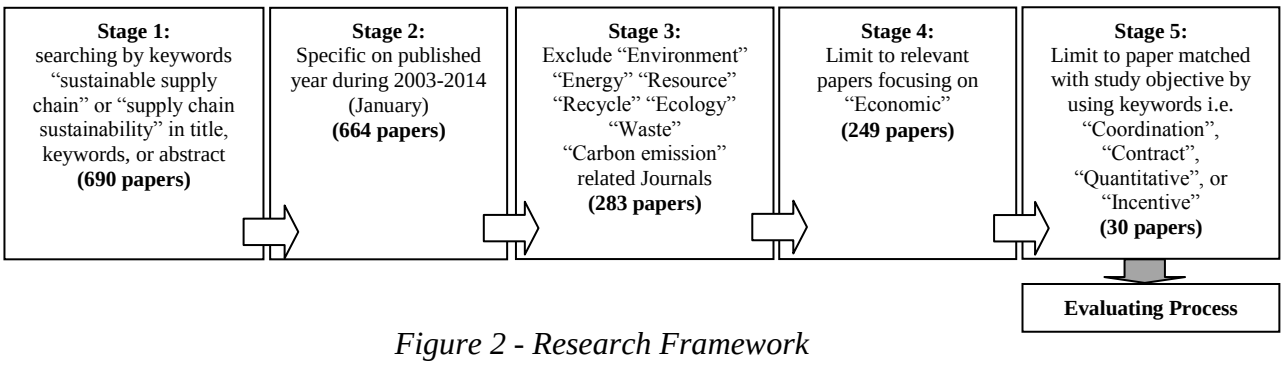

Figure 2 - Research Framework

Essentially, coordination is crucial in order to sustain long-term relationship in any particular supply chain. However, none of published papers in the last decade has conducted systematic literature review considering on how to generate long-term relationship in sustainable supply chain and with what kind of mechanisms. This also was confirmed by Brandenburg et al (2014) who stated that further assessed quantitatively in economic contributions of vertical coordination was a research gap in sustainable supply chain management context. In an attempt to propose the framework of coordination mechanism enhancing sustainability in supply chain,

a systematic literature review was a key methodology addressed in this paper leading to answer these questions.

FINDINGS

Trend in sustainable supply chain study

Sustainable supply chain has been a new emerging issue in the last decade as shown by only 26 out of 690 papers were published before 2003. Trend of papers published was increased sharply since 2010. However, most researchers have paid attention on environmental aspect more than other bottom line of sustainability. Reviewed data showed that almost 50% of papers were published in environmental, energy, or ecology related journals. And there were only 5% (30 out of 664 papers) that concern in an aspect of economic focusing on coordination for sustainability. This scenario pointed that further study to extend understanding and pragmatic applying of coordination mechanism enhancing sustainability in supply chain is essential.

Concerning Scope

It was found that researchers had concerned coordination issues under each factors of basic bottom line in an extensive point of view. In an economic aspect, the most considering issues was profit, profit sharing, revenue allocation (Gao et al, 2006; Bai et al, 2010; Lee at al, 2011; Barari et al, 2012; Cervellon & Wernerfelt, 2012; Bocken et al, 2013; Grimm et al, 2013; Hansen & Schaltegger, 2013; Okongwu et al, 2013; Palsule-Desai et al, 2013; Hsueh, 2014; Sun & Debo, 2014). For social aspect, the most considering issue relates to CSR contribute to community's development (De Brito et al, 2008; Bai & Sarkis, 2010; Faisal, 2010; Fabbe-Costes et al, 2011; Cervellon & Wernerfelt, 2012; Hansen & Schaltegger, 2013; Wang & Sarkis, 2013; Hsueh, 2014; Yue et al, 2014). Finally for environmental aspect, key area of consideration is quite broad depend on researchers interest e.g. green marketing (Faisal, 2010; Liu et al, 2012); green production (Barari et al, 2012; Hsueh, 2014); green supply chain (Faisal, 2010; Ashby et al, 2012); ecology (Bai et al, 2010; Fabbe-Costes et al, 2011; Bai et al, 2012; Hansen & Schaltegger, 2013; Wang & Sarkis, 2013); waste management (Hall & Matos, 2010; Bocken et al, 2013;); energy saving (Preuss, 2009; Hall & Matos, 2010; Cervellon & Wernerfelt, 2012; Tang & Zhou, 2012; Okongwu et al, 2013; Theißen & Spinler, 2014; Yue et al, 2014).

However, most papers (20 of 30) studied coordination in an intersection area of the three bottom line of sustainability. As we scoped our study to focus on an economic aspect, therefore all 30 papers concerned in an aspect of economic but in different degree of consideration. Distinctly, 28 papers basically focused in an economic aspect whereas 2 papers emphasized on an intersection area between "environment" and "social" aspect. This showed that economic is crucial for sustainable supply chain management. Conversely, when environment and social aspects has been reached in such a period then it has generated an economic outcomes finally (Hall & Matos, 2010; Ashby et al, 2012). Therefore, main objective for coordination along supply chain is not only to maximize profit while sustaining environmental and/or social aspect but it also has to find an equilibrium point maintaining fair and satisfaction benefit sharing along its members in order to generate flourish relationship in supply chain.

Enable factors to sustain coordination/commitment in supply chain

In SSCM, enable factors can be categorized into two perspectives as defined by Lee & Klassen (2008) i.e. a driver and enablers. Driver is defined as a factor that motivates firms to adopt sustainable supply chain management. Whereas, enabler is a factor that enhancing sustainability along supply chain process among its members (Lambert, 2008). Market turbulent nowadays, a consequence of globalization, has brought sustainability issues becoming more

significant alternative for the next era. Growing concern and needs from supply chain stakeholders e.g. raw material producers, customers, investors and other related parties e.g. communities, government, NGOs, etc. under this external business environment has driven and sometimes forced firms to turn into sustainability direction in order to accomplish mutual basic goals i.e. environment, social and economic. In order to thrive in this multiplicity circumstance, SSCM is an alternative. Over decades, sustainability has been conceptualized and further developed into international political advocacy and gradually transforming into conventional business philosophy and practice (Liu et al, 2012). All of these needs drive companies to adopt sustainability philosophy in order to manage variety of requirements from involved parties in order to accomplish mutual goals in sustainability.

Furthermore for internal perspective, adopted sustainability philosophy into corporate strategy and operation also gaining competitive advantage for a firm itself (Markley & Davis, 2007; Carter & Rogers, 2008; Winter & Knemeyer, 2013) and gaining good reputation publicly (Markley & Davis, 2007) which finally will bring economic benefit for a firm in the long run. For example, one of the largest apparel exporters in Sri Lanka named Brandix Lanka Limited (Brandix) has implemented a Code of Conduct in efforts to abolish child labour employment in the company itself, and also its suppliers and subcontractors. As a result, it has brought a positive impact on the community through improved education and career path for young people. Moreover, the company has also gained competitive advantage through alleviating high level of trust and good reputation from its customers. It has enlarged its markets from further developed partnership with many international buyers in North American and European markets. It also has attracted and retained capable employees, which has led to significant cost reductions due to its highly satisfied workforce. Consequently, this has created further business development and opportunities (UN, 2010).

On the other hand, negligence on sustainability management may cause disaster. Not only losing large amount of money for penalties, but it also causes further tremendous effects e.g. bad public image, lessen consumer goodwill, and dumping firm value finally (Peters et al, 2011). For example, in 1990s Nike had countered with brand image crisis due to its suppliers abusive child labour practices which reported by media. Finally, its reputation had been seriously damaged and its products had been boycotted by customers globally which caused the company massive budget to regain its competitive position (UN, 2010). Summary of drivers was shown in table 1.

Table 1 - Summary of drivers

Aspects of sustainability	External Drivers	Internal Drivers
Environment	Growing concern toward environmental deterioration: e.g. more intense policy, legitimate regulation and standard created by government (Faisal, 2010); enlarged markets for green/eco-friendly products (UN, 2010).	
Social	Growing concern on sustainable development: e.g. intergovernmental bodies level (UN) emphasize on alleviating social and human standard of	

Aspects of sustainability	External Drivers	Internal Drivers
	living (UN, 2010); customers, NGOs, employees, communities expect socially-consciousness from firms (Carter & Easton, 2011).	
Economic	Expectation on satisfactory monetary outcome from supply chain partners e.g. investors, business partners, stakeholders, companies, employees (UN, 2010).	Internal management expectation to improve firm efficiency and competitiveness (Markley & Davis, 2007; Carter & Rogers, 2008; Winter & Knemeyer, 2013)

In common, internal drivers seem to have more influence on businesses to implement sustainability strategy and practice. Recent study from the "Supply Chain Sustainability Advisory Group, United Nations" (UNGC, 2013) showed that main driver for traceability; i.e. tool which helps to enable greater supply chain sustainability; came from internal drivers such as risk management, firm standard/compliance, and branding/corporate reputation. While external drivers such as industry standard, NGO pressure, government regulation, investor/shareholder pressure, or even consumer pressure showed less influence.

However, in actual market situation, firms need to coordinate with others along supply chain in order to achieve sustainable objectives since business and society are intensely and vigorously interdependent (UN, 2010). In addition, not only short term but they also have to coordinate to sustain long-term relationship, which leads to prosperous long-term success (UN, 2010). In this continuous period, enable factors are involved in order to enhance sustainability relationship.

As mentioned earlier, SSCM requires systematic coordination with its key stakeholders, i.e. upstream and downstream, through key business process in order to improve long term relationships. Theoretically, supply chain management comprise of three inter-related components i.e. "Network Structure"-supply chain members and parties connected by processes; "Management Process"-activities that connects with key supply chain members to derive output of value to customers; and "Management Components"-integration and management methods applied for each process connection (Lambert, 2008). Enablers were found in any components as summarized in Table 2.

Table 2 - Summary of key enablers

SC Management Components	Enablers
Network Structure i.e. supply chain members	- Aware of sustainable practices (Faisal, 2010) and perception of value (Grimm et al, 2013) both monetary and non-monetary outcomes (Walter et al, 2001; Walter & Ritter, 2003), may lead to mutual goals and consensus position. - Managerial commitment and actions of key partners toward sustainability practices (Faisal, 2010; Grimm et al, 2013). Discontinuous actions may hinder motivation to sustain relationship. - Sufficient capability and facilities e.g. funds in order to accomplish sustainable standard and practice in long-term (Faisal, 2010; Grimm et al, 2013).
Management Process i.e. activities among	- Communication and information sharing , both in backward (Faisal, 2010) and forward supply chain (Liu et al, 2012) generate more effective integration effects. - Openness on sustainability disclosures of firms (Okongwu et al, 2013) e.g. reporting

SC Management Components	Enablers
supply chain members	on risk reduction could generate brand integrity (Snir, 2001). - Collaboration activities e.g. training, employee can enhance supply chain capabilities to sustain in the long-run (Bai & Sarkis, 2010; Grimm et al, 2013).
Management Components i.e. integration and management methods applied for each process connection	- Relationship management (Lambert, 2008) e.g. trust and transparency can generate highly collaborative relationship (Cox et al, 2007; Faisal, 2010; Grimm et al, 2013). On the other hand, lack of trust, long-term commitment, and transparency may generate obstacles on collaboration and participation (Jenkins, 2006; Ciliberti, 2008; Walker et al, 2008; Awaysheh & Klassen, 2010; Grimm et al, 2013). - Bargaining power (i.e. degree that others chain members rely on their resources (Crook & Combs, 2007) of focal firms e.g. focal firm that lack of bargaining power tends to face reluctant relationship with other partners in order to adopted sustainability practice. Whereas involvement of other beneficiaries or stakeholders in supply chain e.g. NGOs or social organizations, may facilitate sustainability environment and may positively influence SC partners' behavior (Argenti, 2004; Seuring & Müller, 2008; Grimm et al, 2013)

In addition, since economic aspect is important for sustainability therefore fairly benefits calculation and sharing along supply chain e.g. by contract mechanism should be another motivation factor that facilitating long-term relationship under management component.

Summary of applied methodology

Only 1/3 papers conducted quantitative research whereas most of them conducted qualitative research. Main objective of each method was summarized as showed in Table 3.

Interestingly, most research on coordination issues within the sustainable supply chain context were descriptive which reflected an important of literature review on idea conceptualization. Pragmatic perspective exploration through surveying or case studies methodology helped to construct further theory building especially in an emerging issue as SSCM. Recently, researchers gradually developed further study on coordination for sustainability in broad directions e.g. supplier selection methodology, performance measurement framework, decision making framework, improving sustainability through specific supply chain management process, improving supply chain efficiency through coordination, applying mathematical model in order to explain different strategies or scenario, or proposing new mathematical model to maximize supply chain profit.

However, finding showed that there has been an opportunity for quantitative research in order to further develop coordination model based on sustainable supply chain conceptual framework especially in coordination mechanism to enhance sustainability in supply chain in different scenario, environment or industries. There were only 4 papers that focusing on coordination by contract or considering an economic factors as a motivation for sustainability, which was the key area of interest in our study.

Review of coordination mechanisms enhancing sustainability in supply chain

Review of literature showed that quantitative study especially in poleveding noitanidrooc nahcemi msbased on cimonoce thematic area under ytilibaniatsus context was still scarce since only 4 papers was fallen into this category (Table 4). Therefore, there is opportunity for further develop new model applying other types of contract apart from basic price only, wholesale

price or revenue sharing contract model to facilitate long term relationship leads to supply chain sustainability. We found that all of 4 selected papers considered economic aspect as a basic motivation to ensure coordination under specific purpose of three base bottom line (Barari et al, 2012; Palsule-Desai et al, 2013; Hsueh, 2014); or to sustain long-term relationship (Sun & Debo, 2014) in supply chain. However, these economic mechanism seem to enhance sustainability majority in forward supply chain process e.g. selling and marketing function. Only Palsule-Desai et al (2013) considered sourcing function in backward supply chain.

Table 3 - Summary of main objective of each methodology from literature review

Methodology	Type	Main objective
Qualitative	1) Literature Review	- to explore an existing literature in sustainable supply chain issues in order to define gaps and limitations of current situations and try to identify opportunities, challenges as well as research directions and deployed conceptual framework for further study (Varma et al, 2007; Preuss, 2009; Ashby et al, 2012; Tang & Zhou, 2012; Yue et al, 2014).
	2) Survey	- to explore and explain a specific phenomenon and emerging issues that need to be addressed and resolved (Zuo et al, 2009; Ragasa et al, 2011). - to explore an opinion of people toward sustainability issues e.g. green supply chain and environmental aspect (Cervellon & Wernerfelt, 2012; Bocken et al, 2013). - to investigate impact of sustainability movement toward firm performance (De Brito et al, 2008).
	3) Case Study	- to explore and analyze new emerging issues that showed limited evidence of previous study under researchers' key area of interest (Hall & Matos, 2010; Hansen & Schaltegger, 2013).
	4) Combining Methodology	- applied 2 types of research methodology i.e. firstly, conducted literature review in order to construct an idea then followed by survey or comparative case studies in order to generate an idea into more pragmatic view (Fabbe-Costes et al, 2011; Theißen & Spinler, 2014)
Quantitative	1) Correlation	- to explore relationship or association among variety of factors (Bai et al, 2010; Bai et al, 2012; Wang & Sarkis, 2013)
	2) Modeling	- to propose a new mathematical model that bridge sustainability issues to supply chain management (Lee at al, 2011; Barari et al, 2012; Hsueh, 2014; Sun & Debo, 2014).
	3) Combining Methodology	- to bridge gap in sustainable supply chain management and also further applied case study (Palsule-Desai et al, 2013) or simulation to explain and interpret quantitative outcomes from mathematical model (Gao et al, 2006).

The most utilized mechanism found from literature was the Cost-Revenue Sharing contract which was applied in both forward and backward process (Table 5). Another applied mechanism was the basic wholesale price contract that was applied to sustain long-term relationship in a turbulent market situation. Moreover, all developed model shared the same common objective which was to maximize total supply chain profit but in different perspective. Sun & Debo (2014), and Hsueh (2014) considered in a dyadic chain perspective whereas Barari et al (Barari et al, 2012) and Palsule-Desai et al (2013) considered a 3-stages supply chain and network

respectively. However, papers were still limited on variety of application e.g. textile, handicraft, dairy, newsvendor, seasonal products.

Table 4: Summary of study scope from reviewed papers.

Authors	Type of Network			SC process	Scope of study
	Dyad	SC	NW		
Barari et al, 2012		/		Forward	Established the economic welfare in a 3 agent sc to observe the greenness association in a market, which is neutralized by the forces of demand, governed by the aspect of price and marketing under green sc practice.
Hsueh, 2014	/			Forward	Proposed a mathematical model aiming to maximize SC profit and CSR performance by determining the optimal SCR investment, the wholesale price, and the revenue sharing ratio in order to achieve channel coordination.
Palsule-Desai et al, 2013			/	Backward	Proposed a non-cooperative game model to justified stability issues in a 2-stages SC comprise of both independent and network producers that compete through marketing agent e.g. cooperative who operates in competitive environment and governed by profit sharing coordination mechanism that influences individual players' decisions.
Sun & Debo, 2014	/			Forward	Applied mathematical model to describe how an informal long-term relationship between a manufacturer and a retailer performs in turbulent market environments characterized by uncertain demand.

Note: Dyad = Dyadic relationship; SC = Supply Chain; NW = Network

Table 5: Summary of coordination mechanism based on economic thematic area from reveiwed papers.

Criteria	Author/Year			
	Barari et al, 2012	Hsueh, 2014	Palsule-Desai et al, 2013	Sun & Debo, 2014
Perspective	Focused on economic aspect to ensure environmental coordination.	Focused on an intersection area of 3 based paradigm.	Focused on economic and social aspect.	Focused on economic aspect to sustain long-term relationship.
Industry/ Products	Textile & handicraft industry in India	Seasonal, perishable products	A case of dairy cooperative network in India	Newsvendor product e.g. food, pharmaceutical, fashion
Network Structure	3 stages supply chain: 1 producer-1 retailer-1 buyer	Dyad chain:1 manufac. – 1retailer	Network: 2-tier supply chain for 1 product with many producers	Dyad chain: 1 manufac. – 1 retailer
Management Process	Forward supply chain (marketing & selling)	Forward supply chain (marketing)	Backward supply chain (sourcing)	Forward supply chain (Selling)
Management Component	Coordination by contract	Coordination by contract	Coordination by contract	Coordination by contract
Basic Model	- Game theory (A	- Revenue sharing	- Game theory	- Game theory (A

Criteria	Author/Year			
	Barari et al, 2012	**Hsueh, 2014**	**Palsule-Desai et al, 2013**	**Sun & Debo, 2014**
	two- players game)	contract	- Revenue sharing contract	single period game) - Wholesale price only contract
Model Objective	Maximize supply chain profit whereas green cost has been sharing among players in the chain.	Maximize total supply chain profit and maximize CSR performance.	Maximize profit generated for producers network which parameter was decided by marketing agent (co-op.)	Maximize total supply chain profit under production environment.
Contributions	The first paper that established the economic welfare in a 3-stages supply chain with greenness association.	The proposed RS-CSR contract was designed to achieve different level of CSR performance subject to corporate culture and their expectation toward its profits and CSR performance.	The study showed linkage on stability and efficiency of supply chain networks within the supply chain coordination context.	The proposed wholesale price contract in a repeated-game context showed that it was easier to sustain a long-term partnership in the production environment than in the former.
Shortcomings	The model calculation was limited only at marketing process. It should be further develop to extend to manufacturing process to overcome environment problem.	The model was calculated with pre-determined demand based on an assumption that the demand follows normal distribution. However, this factor should be further calibrated by real cases survey.	The model ignored producers capacity constraints and assumed that they were identical.	The model was not taking some factors into consideration e.g. imbalance power between manufacturer and retailer, carried over inventory.

None of reviewed papers has studied from real case of agricultural production e.g. rice production that has unique characteristics. Generally, rice production consists of large number of small farmers and only single farmer makes no affects on market situation. These small farmers tend to form a group of farmers e.g. agricultural cooperative to gain more bargaining power in the market. Moreover, farmers have to face with uncertain output quantity and quality due to uncontrollable factors e.g. climate, environment and disease. Furthermore, quantity and quality of crops also dictate the crop price especially at the beginning of harvesting season. In this situation, farmers tend to have only limited chance to sell a certain amount of their products i.e. at the beginning of harvesting season due to limited household cash flow and also because of product characteristics that decayed by time. Whereas in forward supply chain e.g. rice mills, wholesalers, distributors, exporters tend to have chance to make more profit all year round due to sequential chances to sell based on market price situation. Imbalance profit sharing in rice supply chain put more intense pressure on backward stakeholders. This real case scenario reflects vital need for sustainable supply chain management especially in coordination

mechanism to integrate more coordination relationship among backward and forward process in the supply chain network by emphasizing role of farmers organizations like cooperative to become a coordination agent (dominant player) in supply chain.

The case study has brought a germination idea for further develop coordination mechanism to enhance sustainability in agricultural cooperative supply chain which has been drove intensely by market environment to implement sustainability strategic management. Unique characteristics of agricultural production supply chain require integration coordination among its members. Therefore, further study need to broader unit of analysis covering backward and forward process in 3 stages supply chain network i.e. multi farmers-1 producer (Co-op)-1 retailer. Considering in a perspective that a cooperative is a focal firm who propose coordination mechanism to its members and retailer to sustain long-term relationship under market circumstances; e.g. intervention policy which effects supply price, market price which dictates selling price, salvage value of unsold inventory at a producer warehouse; aiming to maximize total supply chain profit with incentive sharing scheme for farmers. This further study will explore what kind of contract that cooperative can propose to its supply chain members to enhance robustness and long-term relationship while lessen role of government intervention.

SUMMARY

This study applied a systematic literature review in order to develop the conceptual framework of coordination mechanism enhancing sustainability in supply chain. Finding of literature review showed that there were limited studies on how economic aspect can contribute to sustainability in supply chain. SSCM context as a basic analysis framework helps to clarify supply chain characteristics and related factors contribute to sustainability, which are useful for further develop coordination mechanism. External market environment e.g. growing concern and needs of supply chain stakeholders and other related parties, as well as internal driver e.g. needs to improve sustainable competitiveness to achieve economic goal have driven firms to turn into SSCM practice.

During transition for sustainability, enable factors which we found in all aspect of supply chain management components are involved in order to enhance sustainability relationship and to improve long-term economic performance of its chain. For instance, supply chain member awareness and commitment on mutual sustainability goal (Network Structure), integration of main business process through information sharing and collaboration activities (Management Process), and systematic coordination through long-term relationship management (Management Components). In general, economic expectation is crucial for individual firms. Therefore, considering on incentive calculation and fairly sharing along supply chain members should be another key enabler leads to mutual supply chain sustainability goal while not harm or even improve its own performance. The conceptual framework of this study was shown in figure 6.

Gap findings from literature review showed that further study to extend understanding and pragmatic applying of coordination mechanism enhancing sustainability in supply chain is essential especially quantitative research in order to further develop coordination model based on sustainable supply chain management conceptual framework in different scenario,

environment or industries. Gaps from an analysis of previous research on coordination mechanism under SSCM context were shown in table 6.

Contribution from this study generated an analysis guideline for further development of supply chain coordination mechanism aiming to enhance sustainability in supply chain. Finding showed gaps for future study in another analysis perspective e.g. move from business entity to social enterprise scenario as a dominant player in supply chain who initiates mechanism to sustain long-term relationship in its chain. Mechanism development from this pragmatic point of view will bring more benefit for many involved members especially in social development purpose while maintaining competitiveness for supply chain in real market situation. Furthermore, strengthening role of these social enterprises will create solid landscape for sustainable development of the country. On the other hand, weakness of these social networks may effects country efficiency.

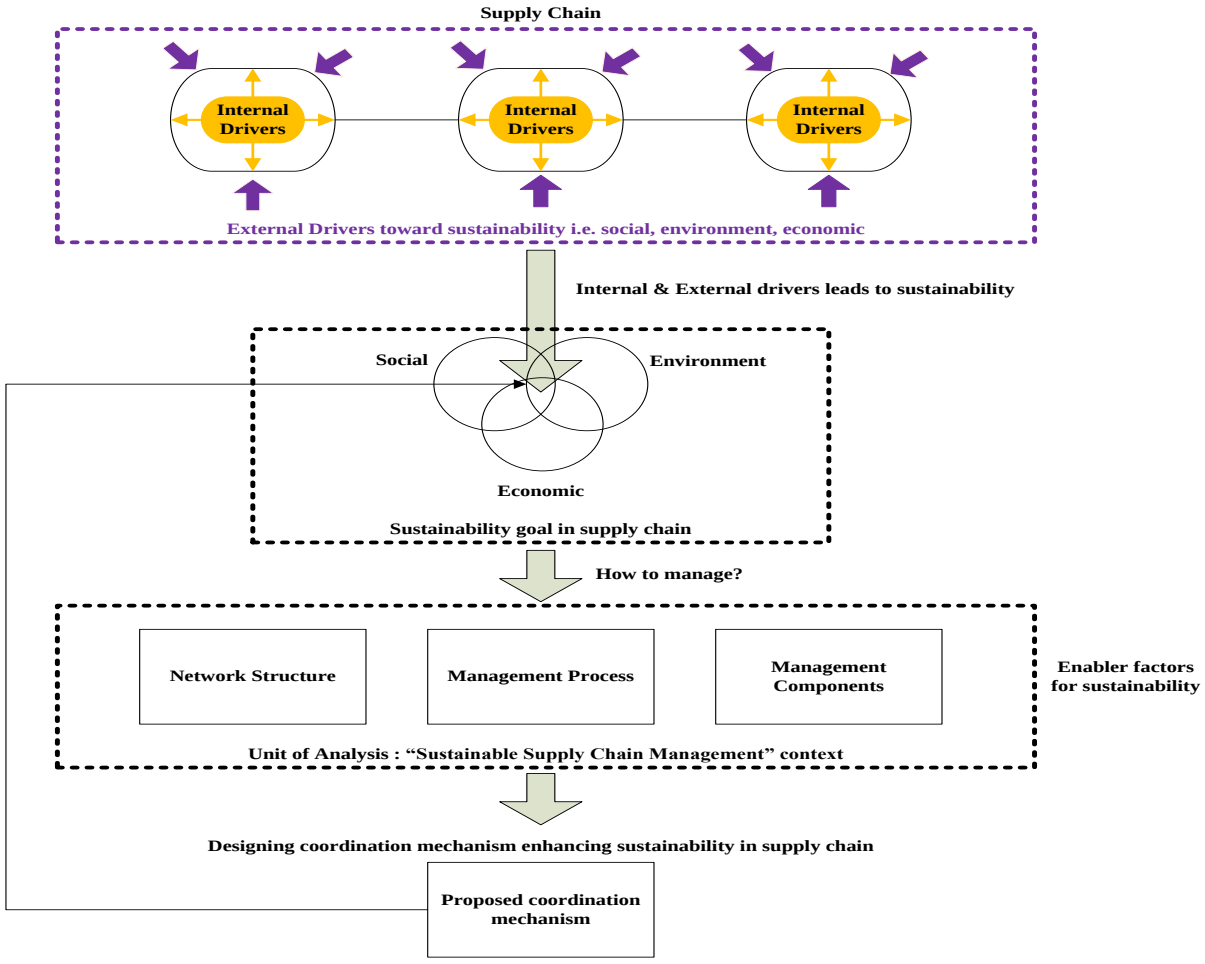

Figure 6 : The conceptual framework to develop coordination mechanism enhancing sustainability in supply chain

Another interesting finding pointed that economic aspect has became an intrinsic criteria driven businesses to implement sustainability strategy and practice. However, each members in supply chain needs to integrate its own economic expectation with other chain members' expectations

namely social, environment and economic in order to achieve sustainability purpose. Pragmatically, a recent pilot study was conducted to determine the key criteria for paddy rice selling decision. Participants were selected from thirty Thai-Hom-Mali-Rice farmers who are members of three agricultural cooperatives in the northeastern part of Thailand. Result showed that the critical driving force for paddy rice selling decision was financial outcomes. This could be due to the farmers' limited source of income. In general, farmers had an impression that being a member of an agricultural cooperative would entail other benefits for them in both financial and social aspects. For example, *Financial aspect*-generate constant income, reduce production costs; *Social aspect*-knowledge & knowhow to improve production process and lessen costs, social support scheme to improve members quality of life. Moreover, they have also believed that their cooperative has very high level of trust, reliability and goodwill toward their members.

Table 6: Conclusion of gap findings from literature review

Unit of Analysis	**Research Gap**
1) Drivers:	- Previous study showed that economic goal (internal driver) is crucial for general business entity to contribute to sustainability practice. Most study considered sustainability in a perspective of business entity aiming to increase its competitiveness as priority purpose while maintaining environment and social concern (e.g. CSR activities) to secure its position in the market and reduce risks from stakeholders' expectations, industry standard, or regulations. Only a few studied in a perspective of social enterprises which main driver is to alleviate social aspect of sustainability. Although these social enterprises play crucial role in sustainable development and value creation in supply chain, but some still have limited competitiveness in turbulent market situation. Therefore, it is essential requirement for further development on mechanism, which these social enterprises can implement, to strengthen its competitiveness as well as its role as a dominant player in supply chain. - Need for further study in different scenario or industry such as agricultural industry that have unique characteristics both in terms of products, players and supply chain structure.
2) Enable Factors (under SSCM context):	
2.1) Network Structure	- Most of previous study considered dyadic relationship between 1 manufacture and 1 retailer. None of them study supply chain as a network in 3 stages supply chain e.g. in supply chain of social enterprise that involved with many supply chain members [e.g. multiple suppliers: 1 manufacturer (social enterprise) : 1 retailer].
2.2) Management Process	- Most study emphasized on coordination in forward supply chain involved with marketing and selling process. Only 1 study was found considering sourcing process in backward supply chain. However, involvement of both backward and forward in coordination management should generate more solid relationship in practice.
2.3) Management Components	- Although contract has been the most developed mechanism to sustain long-term coordination in supply chain but limited on variety such as basic price only contract, wholesale contract, or revenue sharing contract. It is a gap for further study in other types of contract that generate sustainability in supply chain.

The pilot case study also brought up other interesting issues for further study. Regarding the intense competition and high fluctuation of current market, small farmers are forced to unite and become a larger group, e.g. agricultural cooperative, aiming to increase their bargaining

power and to survive in an intense environment. Basically, groups of farmers play crucial role of not only increasing bargaining power for themselves, but also alleviating social outcomes for their members. Therefore, empowering these groups by becoming self-reliance community leads to sustainable development, improving quality of life, and increasing household economic for their members accordingly under fairness philosophy.

This case has encouraged further investigation on effects of economic incentive as a mechanism to encourage sustainability coordination in agricultural supply chain. The proposed conceptual framework developed from this study is useful to clarify related factors crucial for further develop new coordination mechanism. The new proposed contract model, which will be developed from pragmatic scenario, can further enhance the competitiveness in particular supply chain. In addition, this developed model can be used to help gearing organizations toward sustainability strategy and practice focusing on social and economic paradigm.

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ALIGNMENT BETWEEN PERFORMANCE METRICS AND BUSINESS STRATEGY: DOES IT IMPACT ORGANIZATIONAL PERFORMANCE?

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ABSTRACT
This study establishes that a certain type of performance metrics (operational/financial or strategic/relational) is more suitable for pursuing a particular business strategy—prospector/reactor. Using data from 372 organizations, we test hypotheses about the relationships between types of performance metrics emphasized and 1) structural variables, such as organization size and nature of the organization—manufacturing/service and multinational/domestic) and 2) the type of business strategy pursued. We also investigate the overall organizational performance impact of the fit between the types of performance metrics utilized and the business strategy pursued.

Keywords: performance measurement, operations strategy, business strategy

INTRODUCTION
The researchers have long emphasized the importance of aligning the organization's strategy with an internal evaluation of the firm's resources and an external appraisal of environmental opportunities and threats (cf., Ansoff, 1965 and Andrews, 1971). Alignment, important in both formulating as well as implementing strategies, is fostered through bringing in line and adjusting key processes and decisions within the firm (Galbraith & Nathanson, 1978; Lorange & Vancil, 1977; Stonich, 1982; Kaplan, 2005). Vertical alignment refers to the configuration of strategies, objectives, action plans, and decisions throughout the various levels of the organization--corporate, business, and functional (Kathuria et al, 2007).

There is general agreement in the operations strategy literature that the decisions regarding the structure and infrastructure of an organization should be in line with its competitive strategies (cf., Hayes & Wheelwright, 1984; Anderson, Cleveland & Schroeder, 1989; Ward,

Leong & Snyder, 1990; Hill, 1994). Alignment requires a shared understanding of organizational goals and objectives among managers at various levels and within different units of the organizational hierarchy. A firm's ability to seek and maintain a competitive advantage rests upon its ability to acquire and deploy resources that are congruent with the organization's competitive needs (Porter, 1996).

Operations strategy research has underscored the need to match strategic decisions in various areas (structural or infrastructural) with the competitive strategies of a company. For example, the alignment of technology and process choice decisions with competitive priorities has been examined by Hill (1989), Kleindorfer & Partovi (1990), Safizadeh et al. (1996), among others. On the infrastructural side, Berry and Hill (1992) examined the choice to manufacture, plan and control systems. Jayaram et al. (1999), Kathuria & Partovi (1999), Santos (2000), and Ahmed & Schroeder (2003) studied the work force and related human resource management decisions.

Lately, performance measurement, one of the infrastructural decision areas, has also been the center of attention for academics and practitioners alike. For the performance measurement systems to contribute to organizational performance, it is important that they are consistent with the organizational environment and strategies (Kennerley and Neely, 2003; Pinheiro de Lima et al., 2010). Gosselin (2005) observed several significant relationships between financial versus nonfinancial measures and contextual factors, such as strategy, decentralization and environmental uncertainty.

The purpose of this research is to examine the relationships between the managerial emphases on different types of performance metrics used and 1) structural variables, such as the organization size and nature of the corporation (manufacturing/service and multinational/ domestic) and 2) the type of business strategy pursued. It also explores a contingent relationship between organizational performance and the match between the types of performance metrics utilized and the business strategy.

HYPOTHESES

Structural Variables and Performance Metrics Emphasized

Most researchers accept that services and manufacturing firms are different on many fronts, including the measurement of performance which is considered to be more difficult especially on quantitative measures (Chase, 1978). Therefore, we contend that the types of performance metrics deployed by managers in service firms will be different from those in manufacturing firms.

Managers in multinational companies are more aware of international competitive trends than those in domestic firms due to the extent of exposure to globalization (Kathuria et al., 2008). International location requires understanding the local culture and establishing an image of a quality service provider (Cook et al., 1999). It may also be more demanding to exercise control in international markets because of varying customer expectations there (Sarathy, 1994)

compared to those in familiar domestic markets. Hence, performance measures emphasized by managers in multinational companies will be different from those in domestic firms.

In smaller organizations, the decision makers, usually the owners, are well versed with the daily activities and performance and hence do not require elaborate performance evaluation measures. As firm size increases, performance measurement tends to become more sophisticated due to increased communication and control problems (Libby and Waterhouse, 1996). Hence, the performance measures emphasized by managers are influenced by the size of the organization.

H1: The type of performance metrics emphasized will differ by:

a) *Nature of the organization-manufacturing or service,*
b) *Global exposure—part of a multinational corporation or not, and*
c) *Size of the organization.*

Strategy and Performance Metrics Emphasized

The need to link performance metrics to the strategic intentions of a firm has long been identified by Skinner (1969). Richardson, Taylor & Gordon (1985) and Giffi, Roth & Seal (1990) have suggested that performance metrics should correspond to the content of a manufacturing strategy, which includes the competitive strategies emphasized. A performance measurement system is designed to support the strategic initiatives of a firm (Wouters and Sportel, 2005). In the cases of world-class manufacturing organizations, researchers have found evidence of a consistency between organizational objectives and performance measures (Lockamy and Spencer, 1998). When performance measures are aligned with strategic objectives, it helps an organization to link its operations to strategic goals (Hudson et al., 2001).

For this study, we chose the Miles and Snow (1978) typology to assess the strategic initiatives of participating firms that have been used extensively in a range of industries (Desarbo et al., 2005; O'Regan and Ghobadian, 2005). Since we intend to study both manufacturing and service firms, the Miles and Snow typology is better suited given its generic nature. The typology classifies firms into four domains based on their business strategies: Defenders, Prospectors, Analyzers, and Reactors.

Defenders are characterized as offering a low variety of outputs with high volume, and hence compete on the basis of price, quality and shorter lead times. They seem to have an internal orientation as they stress efficiency and little or no product/market development. They tend to focus on doing the best job possible in a limited area and ignore changes in the external environment that have no direct influence on current areas of operations. Hence, we contend that the managers in Defender firms will place higher emphasis on utilizing operational and short-term financial performance measures.

Prospectors are portrayed as the polar opposite from Defenders as they focus on market opportunities and developing new products/services. They seem to have an external and relational orientation as they operate within a broad product-market domain that undergoes

periodic redefinition. They value "first in" in new product and market areas and respond rapidly to early signals concerning areas of opportunity, which often lead to a new round of competitive actions. Hence, managers in such organizations are more likely to emphasize performance related to the number of new products/services launched, customer relations, environmental concerns, community relations, supplier integration, etc., so as to gain the market share based on these actions.

Analyzers stand somewhere in between Prospectors and Defenders as they share characteristics of both. Hence, we expect their managers to emphasize a mix of short-term operational/financial as well as relational measures. Reactors do not seem to have a clear focus and instead react to the actions of other firms. They simply respond to environmental pressures to remain in business. Hence, the managers in such firms will neither have a clear direction nor a greater emphasis on any particular set of performance measures.

H2: Managers will emphasize a certain type of performance metrics depending upon the type of business strategy pursued:

d) In Defender firms, managers will place higher emphasis on operational/financial performance metrics as compared to relational metrics
e) In Prospector firms, managers will place higher emphasis on relational performance metrics as compared to operational/financial metrics
f) In Analyzer firms, managers will place a moderate emphasis on a mix of operational/financial and relational performance metrics
g) In Reactor firms, managers will emphasize neither operational/financial nor relational performance metrics.
h) Emphases of managers in Defender firms on operational/financial metrics will be higher than those in Prospector, Analyzer and Reactor firms.
i) Emphases of managers in Prospector firms on relational metrics will be higher than those in Defender, Analyzer and Reactor firms
j) Emphases of managers in Analyzer firms on operational/financial metrics will be higher than those in Prospector and Reactor firms
k) Emphases of managers in Reactor firms on both operational/financial and relational metrics will be lower than those in the other three types of firms.

Business Strategy, Performance Metrics Emphasized and Organizational Performance

The contingency theory perspective on strategy-performance alignment is that performance metrics should be aligned with the firm's strategy and/or value drivers (Fisher, 1995; Langfield-Smith, 1997). Under this approach, performance is likely improved when ''measurement gaps'' between the firm's strategic priorities and performance measurement practices are minimized (Ittner, 2003). Thus, performance is expected to be higher when the managers emphasize the right type of performance measures that are congruent with the strategic orientation of the firm. In the field of operations strategy, Kathuria (2000) found that his four strategic groups of manufacturers—Do All, Efficient Conformers, Speedy Conformers, and Starters--performed better on those performance criteria that were consistent with their respective competitive

priorities. Thus, when managers in a given manufacturing or service organization emphasize the performance measures (operational or relational) that are consistent with the strategic orientation (Defender or Prospector), we would expect to see enhanced organizational performance on the relevant organizational performance metrics (Financial or Customer-focused).

H3: Alignment between business strategy and the type of performance metrics emphasized will enhance organizational performance.

a) *When managers in Prospector firms place a greater emphasis on relational metrics, their firms will perform better on customer acquisition, satisfaction and retention*
b) *When managers in Analyzer firms place a greater emphasis on operational/financial metrics, their firms will perform better on ROI, profit/sales ratio, etc.*

METHODOLOGY

Sample and Data Collection

A preliminary draft of the questionnaire was discussed with academic scholars and practitioners to assess the content validity prior to pilot testing. Next a pilot test was conducted with a group of six firms, whose inputs were used to improve the clarity, comprehensiveness and relevance of the survey instrument. Next, we contacted the firm's management directly in order to select a list of companies prepared to cooperate with the research. Names and e-mail addresses of managers were found out during telephone contacts. We had to identify the key figures in the company who would be able to fill in the questionnaire. Furthermore, the respondents had to be clearly identifiable in terms of name and job role. After three follow ups by e-mail and phone calls made to non-respondents to increase survey response rate, 386 organizations replied that yielded a response rate of 48%. Of the 386 organizations, the 14 that were construction and mining companies were excluded, thus resulting in an effective sample size of 372 manufacturing and service organizations—relevant to this study. The respondents included top and middle management in terms of CEO, CFO, Controller, and Operation managers.

Measures

The ten items used to assess the managerial emphasis on performance metrics were taken from Ittner et al. (2003). The respondents were asked to which extent the managers in the company emphasized each measure on a scale of 1-6, with 1 being to a very great extent. The eight organizational performance items have been compiled from the studies of Rosenzweig et al. (2003), Govindarajan (1984), Govindarajan and Gupta (1985), Chenhall and Langfield-Smith, (1998), and Bisbe and Otley (2004). The respondents were asked to rate the performance items from the last two years on a scale of 1-7, with 7 being well-below average in comparison with the industry average. Both scales, when factor analyzed with Varimax rotation, resulted in two factors each, and are appended in Appendices I and II. The business strategy measure was based on the Miles and Snow typology and the four types are described in Appendix III.

RESULTS AND DISCUSSION

Hypotheses 1 and 2 were tested using ANOVA and post-hoc Scheffe tests (Tables 1 and 2). Hypotheses H1a and H1b were supported ($F=26.6$, p-value <0.0001 and $F=28.2$, p-value <0.0001 respectively), but not H1c. The industry type (manufacturing or service), and the type of organization (multinational or domestic) do play a role in terms of what types of performance metrics are emphasized. The organization size, measured in terms of the number of employees, was not a determinant in the types of metrics emphasized by managers.

Hypothesis 2 was partially supported as the managers in firms pursuing one of the four types of business strategy—Defender, Prospector, Analyzer or Reactors—in general emphasized operational/financial and/or relational performance measures as expected. Specifically, H2a was supported as managers in Defender firms emphasized operational/financial metrics more so than the relational metrics. Hypothesis H2d was also supported as managers in Reactor firms placed relatively low emphasis on both types of metrics compared to their counterparts in the other three types of firms, but they emphasized operational/financial metrics more than the relational metrics. Hypotheses H2b and H2c were both not supported. In fact, contrary to expectations, managers in Prospector firms placed a higher emphasis on operational/financial metrics than on relational metrics.

Hypothesis H2e was partially supported as emphases of managers in Defender firms on operational/financial metrics was higher than those in Reactor firms but not in the other two. Hypothesis H2f was supported as emphases of managers in Prospector firms on relational metrics were higher than those in Defender, Analyzer and Reactor firms. Hypothesis H2h was also supported as emphases of managers in Reactor firms on both operational/financial and relational metrics were lower than those in the other three types of firms. Hypothesis H2g was partially supported as emphases of managers in Analyzer firms on operational/financial metrics was higher than those in Reactor firms but not Prospector firms.

Hypothesis 3 was tested by way of the interaction terms after statistically controlling for the three structural variables and the strategy pursued. First, the multivariate approach (MANOVA) was used and then the subgroup analyses. MANOVA is preferred over separate univariate analyses of variance (ANOVA) for the following reasons: a) to control the overall Type I error, b) to evaluate the mean differences on both types of organizational performance measures simultaneously, while controlling the intercorrelations among them, c) to provide a more powerful test with an increased probability of rejecting a false null hypothesis by examining both sets of measures simultaneously, and d) to enhance interpretation of results by considering criterion variables simultaneously (Bray and Maxwell, 1985). After performing overall MANOVA, subsequent comparisons were performed using Bonferroni adjustment of the alpha level (Type I error, i.e., probability of rejecting a true null hypothesis) if necessary.

The overall model was significant for both sets of organizational performance measures—Financial ($F=4.357$, p-value=<0.0001, eta squared=0.206) and Customer-focused ($F=3.540$, p-value=<0.0001, eta squared=0.174). The intercept was significant too, which captured the cumulative coefficients of the nth "dummy" for the categorical variables, but none

of the control variables were significant. The interaction of Strategy Types with the managerial emphasis placed on Operational/Financial performance metrics was not significant with either type of organizational performance. The interaction of Strategy Types with the managerial emphasis placed on Relational performance metrics, however, was significant for both types of organizational performance--Financial (F=4.059, p-value=0.003, eta-squared=0.05) as well as Customer-focused (F=2.332, p-value=0.028, eta-squared=0.03). Thus, H3 is partially supported.

Hence, when managers emphasize the 'right' type of performance measures--Relational (employee relations, innovativeness, community, alliances across functions, and environmental performance, etc.)--that are consistent with the business strategy pursued by their companies (Prospectors), the organizational performance measured in terms of customer acquisition, satisfaction, and retention resulting in increased market share is enhanced. Thus, consistent with our expectations, the fit between the type of performance metrics emphasized and the type of strategy pursued has a significant impact on organizational performance.

CONCLUSION

The strategy researchers have long maintained that for the performance measurement systems to contribute to organizational performance, it is essential that they are consistent with the organizational environment and business strategies, but the empirical research in this area has been sparse. Based on a sample of 372 firms (246 manufacturing and 126 service), this research established that managers in manufacturing firms seem to place greater emphasis on both operational/financial and relational metrics as compared to those in service firms. Managers in multinational firms (both manufacturing and service) seem to emphasize both sets of performance metrics more than their domestic counterparts, which may be due to the long and varied experience of the multinationals that are supposedly aggressive to venture outside of their domestic domains.

With regard to compatibility between the business strategy pursued and metrics emphasized, both Defender and Prospector firms emphasize operational/financial metrics more so than the relational metrics. Defenders, however, emphasize operational/financial metrics more than do the Reactors, and Prospectors emphasize relational metrics more than do the other three—Defenders, Analyzers and Reactors. Firms pursuing a certain strategy and desiring to improve their organizational performance on certain criteria do emphasize the corresponding metrics.

Managers can benefit from these findings by selecting and emphasizing the 'right' types of performance metrics that are consistent with their business strategies and structure of the organization. Future research should examine if the managerial characteristics, such as age, education, job tenure, and organizational tenure, influence the choice of metrics, and if age of the firm has a bearing on the choice of metrics as well as strategy pursued.

Table 1: Analysis of Variance Results for Hypothesis 1

Factor	Performance Metrics Emphasized 1-To a very great extent, 5-To a very little extent, 6-Not at all							
	Operational/Financial				Relational			
	N	Mean	Std. dev	F[#]	N	Mean	Std. dev	F[#]
Industry type				26.6****				2.20*
-Manufacturing	246	2.00	0.72		246	3.06	0.97	
-Service	126	2.41	0.76		126	3.21	0.89	
Exposure/Focus:				28.2****				13.9****
-Multinational	176	1.93	0.64		176	2.92	0.90	
-Domestic	196	2.33	0.79		196	3.23	0.96	
Organization Size	No significant difference				No significant difference			
-Fewer than 500								
- ..								
-More than 10,000								
Strategy Type				4.64***				9.1****
-Defender	59	2.16	0.80		59	3.18	0.88	
-Prospector	159	2.09	0.78		159	2.98	0.94	
-Analyzer	99	2.09	0.59		99	3.11	0.85	
-Reactor	23	2.70	1.00		23	4.04	1.1	

[#]one-tailed p-value ****p<0.001 ***p<0.01 **p<0.05 *p<0.10

Table 2: ANOVA Results for Hypothesis 2

Factor	Organizational Performance Measures[!] 1-Well above average, 7-Well below average							
	Financial				Customer-Focused			
	N	Mean	Std. dev	F[#]	N	Mean	Std. dev	F[#]
Strategy Type				15.1****				14.6****
-Defender	59	2.97	1.09		59	3.15	1.08	
-Prospector	159	3.11	1.07		159	2.96	0.83	
-Analyzer	99	3.43	1.07		99	3.23	0.89	
-Reactor	23	4.67	1.62		23	4.28	1.05	

[!] In comparison with the industry average, how would you rate the performance of your company over the last two years in terms of the following indicators?
[#]one-tailed p-value ****p<0.001 ***p<0.01 **p<0.05 *p<0.10

Post-hoc Scheffe (at p <0.05):
Financial Performance
Defenders >Analyzers and Reactors
Prospectors> Analyzers and Reactors
Analyzers>Reactors

Customer-focused Performance
Defenders > Reactors
Prospectors> Analyzers and Reactors
Analyzers>Reactors

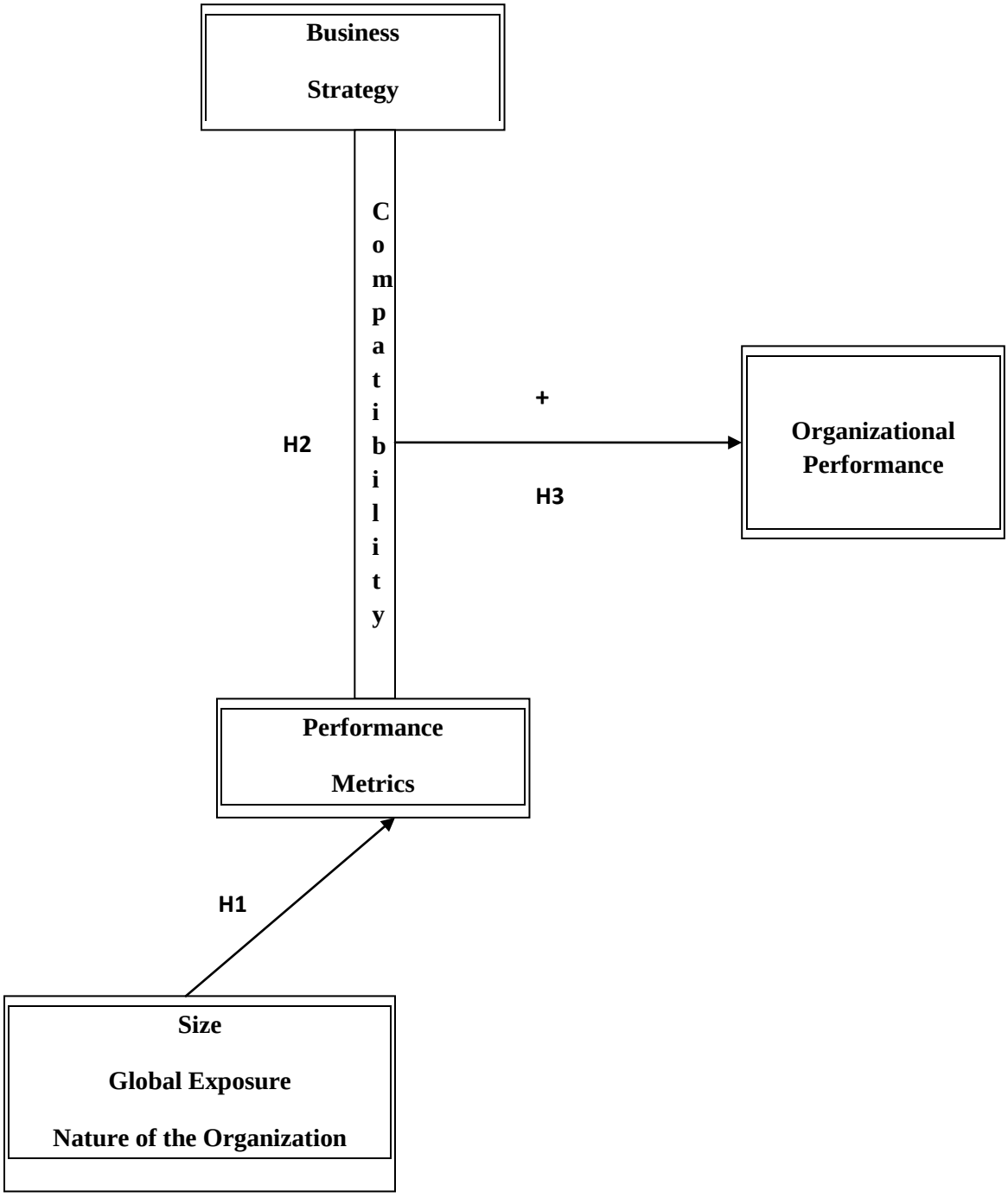

Figure 1. The Conceptual Model

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APPENDIX I. Factor Loadings for Performance Metrics Emphasized

Factors	Factor Loadings	
	1	2
1. Relational Metrics (Eigenvalue=4.77, % Variance=47.677)		
Community - public image, community involvement, etc.	**.821**	.016
Environmental performance - environmental compliances, etc.	**.792**	.242
Innovation and learning - number of new products and/or services launched, training, etc.	**.750**	.255
Alliances - joint marketing, joint product designs, etc.	**.734**	-.009
Employee relations - employee satisfaction, safety, etc.	**.606**	.422
Supplier relations - on-time delivery, suppliers integration, etc.	**.594**	.499
Customer relations - market share, customer satisfaction, etc.	.553	.529
2. Operational & Financial Metrics (Eigenvalue=1.28, % Variance=12.8)		
Operational performance - productivity, lead times, etc.	.238	**.794**
Short term financial results - operating income, sales growth, etc.	.147	**.670**
Quality - quality performance, defect rates, etc.	.432	**.666**

APPENDIX II. Factor Loadings for Organizational Performance Measures

Factors	Factor Loadings	
	1	2
Financial Performance (Eigen value= 4.88, % Variance Explained=60.97)		
Rate of profit growth	**.895**	.241
Profit/sales ratio	**.893**	.249
Return on investment (ROI)	**.886**	.244
Rate of sales growth	**.765**	.386
Customer-focused Performance (Eigen value= 1.23, % Variance Explained=15.35)		
Customer retention	.221	**.828**
Customer satisfaction	.167	**.806**
Acquisition of new customers	.288	**.788**
Increase in market share	.440	**.706**

APPENDIX III. Strategy Types Pursued.

Which one of the following descriptions most closely fits your organization compared to other companies in the industry?

☐ **Type 1:** This type of organisation attempts to locate and maintain a secure niche in a relatively stable product or service area. The organisation tends to offer a more limited range of products or services than its competitors, and it tries to protect its domain by offering higher quality, superior service, lower prices, and so forth. Often an organisation with this type of strategy is not at the forefront of developments in the industry - it tends to ignore industry changes that have no direct influence on current areas of operations and concentrates instead on doing the best job possible in a limited area.

☐ **Type 2:** This type of organisation typically operates within a broad product-market domain that undergoes periodic redefinition. The organisation values "first in" in new product and market areas even if some of these efforts prove not to be highly profitable. The organisation responds rapidly to early signals concerning areas of opportunity, and these responses often lead to a new round of competitive actions. However, this type of organisation may not maintain market strength in all areas it enters.

☐ **Type 3:** This type of organisation attempts to maintain a stable, limited line of products or services, while at the same time moving out quickly to follow a carefully selected set of the more promising new developments in the industry. The organisation is seldom “first in” with new products or services. However, by carefully monitoring the actions of major competitors in areas compatible with its stable product-market base, the organisation can frequently be "second-in" with a more cost-efficient product or service.

☐ **Type 4:** This type of organisation does not appear to have a consistent product-market orientation. The organisation is usually not as aggressive in maintaining established products and markets as some of its competitors, nor is it willing to take as many risks as other competitors. Rather, the organisation responds in those areas where it is forced to by environmental pressures.

A STUDY OF PLANE BOARDING STRATEGIES IN THE U.S. AIRLINE INDUSTRY

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ABSTRACT
The purpose of this paper is to provide a comprehensive review of the plane boarding strategies currently adopted by major airlines in the United States. Each of them is defined and graphically illustrated. In addition, a number of new enplaning procedures as well as some realities in plane boarding are discussed. We conclude by highlighting the main contribution of the present study and pointing out several directions for future research.

Keywords: Airline industry, plane turnaround, plane boarding

INTRODUCTION
Today, 15 mainline and 70 regional carriers own a fleet of 7,200 passenger and cargo aircraft to provide domestic and international transportation services in the United States (Federal Aviation Administration, 2013). They have been experiencing financial difficulties in recent years due to increasing fuel prices, fierce market competition, and operational inefficiency. Consequently, all of them are looking for ways to provide better services at lower costs in order to survive and thrive. One of the key areas identified for improvement is plane turnaround.

Turnaround consists of landing, taxiing, parking, passenger deplaning, baggage unloading, cargo unloading, refueling, maintenance, cabin cleaning, galley servicing, cargo loading, baggage loading, passenger boarding, taxiing, and taking off (Nyquist and McFadden, 2008). As such, turnaround time is the length of time period between a plane's arrival at an airport and its departure from it. Several studies have pointed out that passenger boarding is the most time-consuming activity in the plane turnaround process (Marelli et al., 1988). Long boarding time often results in late departures, which in turn might cause passengers to miss connecting flights and hurt an airline's on-time rating as well as profits.

This paper aims to survey the plane boarding strategies currently adopted by major airlines in the United States and introduce several new enplaning procedures. Some realities in plane boarding will also be discussed.

EXISTING BOARDING STRATEGIES
It is a common practice in the U.S. airline industry to allow first- and business-class travelers, frequent flyers, passengers requiring special assistance, and uniformed military personnel to board first. Then a range of boarding methods are employed to get the rest of the passengers on

the aircraft. The most popular boarding approaches are briefly examined below (Bachmat et al., 2009; Nyquist and McFadden, 2008):

(1) Back-to-front (BTF): This strategy calls for dividing the seats in the cabin into a number of zones with each zone consisting of several rows, the first zone being at the back, and the last zone being at the front. Passengers with seats in the first zone are loaded first and those with seats in the last zone are loaded last. A graphical illustration of BTF is given in Figure 1, where there are eight rows of six seats each. The top of the chart point to the front of the aircraft, the cells represent the seats, and the number in each cell indicates the zone number. Moreover, R, A, B, and C denote the row number, the left widow seat, the left middle seat, and the left aisle seat, respectively. Likewise, D, E, and F denote the right aisle seat, the right middle seat, and the right window seat, respectively.

R	A	B	C	D	E	F
1	4	4	4	4	4	4
2	4	4	4	4	4	4
3	3	3	3	3	3	3
4	3	3	3	3	3	3
5	2	2	2	2	2	2
6	2	2	2	2	2	2
7	1	1	1	1	1	1
8	1	1	1	1	1	1

Figure 1 - Boarding Sequence Based on BTF Strategy

(2) Rotating zones (RTZ): This strategy divides the seats in the cabin into a number of zones with each zone consisting of several rows, the first zone being at the back, and the last zone being at the front. Passengers sitting in the first zone are loaded first, who are followed by those sitting in the last zone. This alternation process continues towards the center of the aircraft until everyone is on board. A graphical illustration of RTZ is given in Figure 2.

R	A	B	C	D	E	F
1	2	2	2	2	2	2
2	2	2	2	2	2	2
3	4	4	4	4	4	4
4	4	4	4	4	4	4
5	3	3	3	3	3	3
6	3	3	3	3	3	3
7	1	1	1	1	1	1
8	1	1	1	1	1	1

Figure 2 - Boarding Sequence Based on RTZ Strategy

(3) Outside in (OSI): Based on this strategy, passengers with window seats on either side of the aisle are loaded first, followed by those with middle seats, and then those with aisle seats. A graphical illustration of OSI is given in Figure 3.

R	A	B	C	D	E	F
1	1	2	3	3	2	1
2	1	2	3	3	2	1
3	1	2	3	3	2	1
4	1	2	3	3	2	1
5	1	2	3	3	2	1
6	1	2	3	3	2	1
7	1	2	3	3	2	1
8	1	2	3	3	2	1

Figure 3 - Boarding Sequence Based on OSI Strategy

(4) Reverse pyramid (RVP): According to this strategy, the order in which passengers with seats in the various areas of the plane are loaded is as follows: rear window, rear middle, front window, front middle, rear aisle, and front aisle. A graphical illustration of RVP is given in Figure 4.

R	A	B	C	D	E	F
1	3	4	5	5	4	3
2	2	3	5	5	3	2
3	2	3	5	5	3	2
4	1	3	5	5	3	1
5	1	3	4	4	3	1
6	1	2	4	4	2	1
7	1	2	4	4	2	1
8	1	2	4	4	2	1

Figure 4 - Boarding Sequence Based on RVP Strategy

(5) Random (RAD): Based on this procedure, passengers are loaded on a first-come-first-served basis. A graphical illustration of RND is given in Figure 5.

R	A	B	C	D	E	F
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
4	1	1	1	1	1	1
5	1	1	1	1	1	1
6	1	1	1	1	1	1
7	1	1	1	1	1	1
8	1	1	1	1	1	1

Figure 5 - Boarding Sequence Based on RND Strategy

NEW BOARDING PROCEDURES

Aside from those described above, a number of new boarding procedures have been developed of late to expedite the enplaning process. Two of them are simulation-based and they are discussed below:

(1) Steffen (STF) method: Steffen (2008) argues that the best boarding system should be a combination of filling window seats first, then middle seats, and finally aisle seats while also spacing the flyers two rows apart. Based on his idea, the first seat to be taken is the back window, followed by the third-to-back window on the same side, and so on up the aisle.

Then the other side of the plane would work similarly: outside-first and back-to-front. When all the window seats are taken, the middle-seat passengers will fill in back to front, and finally the aisle seats will be loaded in the same way.

(2) Milne-Kelly (MNK) method: This procedure proposed by Milne and Kelly (2013) assigns individual passengers to seats based on the amount of luggage they carry so that all of the carry-on bags are distributed evenly throughout the plane. Passengers then board the aircraft according to the sequence determined by STF.

REALITIES IN PLANE BOARDING

Despite the fact that innovative enplaning rules such as those delineated in the previous section have been proven to be more efficient than the traditional boarding approaches in theory, they have not been applied in practice. Similarly, there are many other ways in which the boarding time can be shortened but few of them have been implemented. These happen for a variety of reasons including the following:

(1) Due possibly to the codeshare agreements between airlines or recent mergers of major carriers, there are many special customers who always get on the plane early. The problem is that they tend to clog up the aisle when passengers with economy-class seats board. Moreover, families travelling with small children are often permitted to enplane together, which can further disrupt the boarding system.

(2) One major variable that keeps upsetting the airline industry's planning efforts is the unpredictability of human behaviors including such time-killing activities as passengers jumping the line or perching on armrests to stuff a bag into the overhead bin. Because of these and other problems, some carriers feel that changing boarding procedures is less effective than other tactics such as limiting carry-on luggage.

(3) The standard allowance for commercial flights typically includes one baggage-type item and a personal item (e.g., briefcase or purse). However, some airlines are strict about not letting oversized carry-ons go past the gate into the jet bridge while others are liberal in enforcing the limits.

CONCLUSIONS

Commercial airlines must provide quality services at low costs to survive and grow in the highly competitive market. It has been found that plane turnaround is a promising area for efficiency improvement and one of its key activities is passenger boarding. Loading travelers on the aircraft quickly will not only generate more revenues, but also lead to increased customer satisfaction. This paper contributes to the existing literature by reviewing the traditional plane boarding strategies adopted in the U.S. airline industry as well as a number of new, innovative enplaning procedures.

As part of our future research, we plan to formulate the plane boarding problem as a mathematical program whose goal is to minimize the time required for eliminating the total interferences among passengers getting on a flight. Hopefully, the analytical model will be more efficient and more flexible than those suggested by van den Briel et al. (2005), Bazargan (2007),

and Soolaki et al. (2012). We also expect to expand our work to study the aircraft boarding problem for wide-body aircraft with two aisles (e.g., Boeing 747).

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Topics：Healthcare Management

Determinants of the cross-region Health Care Utilization

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Abstract

The barriers to accessing medical care are divided into three types: structural barriers, financial barriers, and personal barriers. In this study, the accessibility of medical care was evaluated by considering the level of cross-regional health care received by people in Taiwan. We obtained the characteristics of the patients and those of the hospitals that they visited to analyze the accessibility of medical care for patients by using the NHI Research Database (NHIRD). We selected patients diagnosed with osteoarthritis for analysis. The purpose of this study was to observe how factors affect the use of cross-regional health care by residents. The results of this study can be used as a reference for policy investigation.

Keywords: the accessibility of health Care; the utilization of cross-regional health care; National Health Insurance

Introduction

The implementation of the National Health Insurance (NHI) program in 1995 was a crucial step in advancing social welfare and policy development in Taiwan. Although the access to medical care has become substantially more widespread after the NHI program was implemented, substantial discrepancies in the distance to hospitals that affects a patient's hospital-seeking behavior exist between different districts and communities (Chang, et al., 2009). The barriers to accessing medical care are divided into three types: structural barriers, financial barriers, and personal barriers（Andersen and Aday，1995；Alberts, et al.，1997；Cunningham, et al.，1995；Dunne, et al.，1994；Tanser, et al.，2006；Williams，1987）. In this study, the accessibility of medical care was evaluated by considering the level of cross-regional health care received by people in Taiwan (Chang, et al., 2009).

To differentiate the barriers to accessing cross-regional medical care, we adopted the following research method: First, we categorized the regions into three groups: regions with abundant, moderate, and scarce medical resources. Second, in 2005, the copayment required in district hospitals, regional hospitals, and medical centers was respectively increased from NT$50, $140, and $210 to NT$80, $240, and $360 for people without a referral. Finally, by adopting a fixed-effect logit model, we investigated whether structural barriers, financial barriers, and personal barriers affected the utilization of cross-regional medical care after controlling for unobserved heterogeneity.

We obtained the characteristics of the patients and those of the hospitals that they visited to analyze the accessibility of medical care for patients by using the NHI Research Database (NHIRD). We selected patients diagnosed with osteoarthritis for analysis. The results of this study can be used as a

reference for policy investigation.

Materials and Methods

Data and Variables

The NHIRD, which was maintained by the National Health Research Institute (NHRI). The data is longitudinal medical claims (inpatient and outpatient) of NHI enrollee. We select all the inpatient and outpatient claim data of patients diagnosed with osteoarthritis from 2004 to 2008. In addition, we excluded patients from remote communities and mountain and islet districts. We divided the samples into four groups based the group of enrollment as follows: farmers, unemployed, retired soldiers and their families, and the others. We selected 65–85-year-old osteoarthritis patients who were insured oneself or insured through their spouse. Regarding the severity of osteoarthritis in patients, we divided the samples into three groups based the number of osteoarthritis visits as follows: patients who visited less than 6 times (hereafter called Sample I), over 6 times but less than 10 times (Sample II), and over 10 times (Sample III). After obtaining the samples, we transformed the osteoarthritis claim data into the data based on the unit of person/year.

We evaluated the accessibility of medical care for patients within the residential regions and the visited towns in which the percentage of their visits occurred over 50%, and measured the distance between the centers of residential regions and the visited towns. We defined the distance between the residential region and the towns with the most visits as the standard of distinction. Cross-regional health care was defined if the distance between the residential region and the town that received the most visits was over 10 (or 25) kilometers. In addition, the health state of patients can be measured using the following two variables: the number of outpatient visits and

whether they have had internal derangement of the knee joint (IDK), or knee replacement.

Model

The estimative model adopted in this study is defined as

$$y_{it} = \beta_0 + \beta X_{it} + \varepsilon_{it} \qquad (1)$$

where y_{it} is whether the patient i received medical care by visiting a different area in the period t; y_{it} is 1, the patient received cross-regional medical care. X_{it} includes the factors of visit cost, the characteristics of the patients (age group, insurance status, and health state), and the years. Finally, ε_i is an error term that comprises other factors, which cannot be observed. To control the effects that influence the decision of the patients and those that cannot be observed, we performed empirical analyses using the fixed-effect logit model, and excluded these variables.

Samples

According to Table 1, this result of Sample I indicates that the rate that females are diagnosed with osteoarthritis is higher than that of males. the average age was 74 years old and the percentage of those aged 70–75 years was the highest among the age groups. According to the insured status of the patients, farmers represent the majority of the samples. Moreover, patients who had internal derangement of the knee joint (IDK) or received a knee replacement comprised only 1% of the samples; approximately 65% of the samples made less than 40 outpatient visits in a year. On average, the number

of outpatient visits was 37 times.

Results

According to Table 2 (Sample I), we determined that the increase in copayment in 2005 did not decrease the use of cross-regional health care, and the district with scarce medical resources exhibited a greater increase after the copayment raise in 2005. One explanation might be that there is a capacity constraint that limits outpatient services offered by hospitals. While individuals residing in districts with abundant medical resources reduced their hospital visits, those residing in the districts with moderate or scarce medical resources increased their hospital visits. (Sheu et al., 2010). In addition, the use of cross-regional medical care was differentiated because of the difference in the patients' age, insurance status, the patients had received a knee replacement or other operations, and the number of outpatient visits.

Table 3(Sample II) show that the increase in copayment increased the use of cross-regional medical care over a distance of 10 km. If we consider 25 km as the dividing line, the use of cross-regional medical care by these patients did not increase. Furthermore, people who had a high number of visits had a low probability of using cross-regional medical care.

According to Table 4(Sample III), we determined that the influence of copayment adjustment, age, insurance status, and whether they have received operations on the use of cross-regional health care is not substantial. However, people with the same conditions who had a high number of outpatient visits exhibited a decrease of using cross-regional medical care.

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Table 1. Descriptive Statistics of Variables [a]

Variables	All			districts with abundant medical resources			districts with moderate medical resources			districts with scarce medical resources		
	SampleI	SampleII	SampleIII	SampleI	SampleII	SampleIII	SampleI	SampleII	SampleIII	SampleI	SampleII	SampleIII
Male	43.82%	42.28%	44.49%	47.68%	45.21%	48.32%	40.23%	37.78%	40.45%	44.11%	43.52%	44.20%
Age(year)												
Average age	74.01	74.24	74.97	74.41	74.48	75.17	73.86	73.99	74.76	74.02	74.26	74.96
65-70	31.12%	28.71%	23.99%	30.36%	27.56%	22.80%	31.36%	29.64%	24.56%	31.52%	28.85%	24.53%
70-75	29.30%	30.00%	28.50%	28.01%	28.29%	27.37%	30.90%	31.95%	30.45%	28.81%	29.78%	28.09%
75-80	25.83%	27.38%	30.58%	27.19%	29.26%	32.37%	25.04%	26.07%	29.05%	25.47%	27.03%	30.20%
80-85	13.75%	13.90%	16.93%	14.44%	14.89%	17.46%	12.70%	12.34%	15.94%	14.20%	14.35%	17.18%
group of enrollment												
farmers	46.35%	38.92%	32.99%	33.07%	29.48%	25.42%	73.67%	70.76%	64.75%	30.79%	22.23%	17.79%
unemployed	22.85%	26.13%	27.67%	26.70%	27.82%	28.84%	9.85%	10.90%	13.08%	32.28%	36.10%	36.44%
retired soldiers and their families	14.39%	18.27%	22.35%	20.89%	24.43%	28.07%	7.51%	9.46%	12.19%	15.71%	20.39%	24.65%
the others	16.42%	16.68%	16.99%	19.34%	18.26%	17.67%	8.97%	8.89%	9.98%	21.23%	21.28%	21.12%
Health status												
Operations [b]	1.17%	5.64%	5.74%	1.06%	5.11%	5.60%	1.36%	7.91%	7.39%	1.08%	4.26%	4.74%
the number of visits												
<40	64.25%	45.82%	22.93%	63.01%	43.86%	20.90%	66.38%	49.39%	27.04%	63.21%	44.59%	21.78%
40-75	30.60%	44.51%	52.97%	31.31%	45.42%	52.14%	29.14%	42.20%	52.29%	31.43%	45.57%	54.06%
>75	5.15%	9.66%	24.10%	5.68%	10.72%	26.96%	4.48%	8.41%	20.67%	5.36%	9.83%	24.16%
average	37.36	48.77	66.41	38.18	50.24	69.10	36.02	46.62	62.66	37.40	49.31	66.80

Notes:

a. We divided the samples into three groups based the number of osteoarthritis visits as follows: patients who visited less than 6 times (hereafter called Sample I), over 6 times but less than 10 times (Sample II), and over 10 times (Sample III).

b. patients had internal derangement of the knee joint (IDK) or received a knee replacement。

Table 2. Analyses of using cross-regional medical care by Patients with Osteoarthritis：Fixed-effect logit model (Sample I)

	All		districts with abundant medical resources		districts with moderate medical resource		districts with scarce medical resources	
the standard of using cross-regional medical care	10 km	25 km	10 km	25 km	10 km	25 km	10 km	25 km
The increase in copayment	0.1182**	0.1139**	0.0806**	0.1507**	0.1023**	0.0991**	0.2033**	0.1491**
	[0.0127]	[0.0191]	[0.0246]	[0.0383]	[0.0203]	[0.0301]	[0.0230]	[0.0351]
Age								
70-75	-0.0733**	-0.1470**	-0.0983*	-0.2045**	-0.1021**	-0.1411**	-0.0442	-0.1129*
	[0.0199]	[0.0301]	[0.0409]	[0.0631]	[0.0312]	[0.0473]	[0.0359]	[0.0548]
75-80	-0.0209	-0.0744	-0.0422	-0.1235	-0.0625	-0.0463	-0.0273	-0.1335
	[0.0312]	[0.0470]	[0.0621]	[0.0960]	[0.0492]	[0.0738]	[0.0563]	[0.0855]
80-85	0.1252**	0.1525*	0.0505	0.0409	0.1025	0.1699	0.1331	0.1343
	[0.0431]	[0.0647]	[0.0842]	[0.1295]	[0.0692]	[0.1028]	[0.0773]	[0.1176]
group of enrollment								
unemployed	-0.0402	-0.1529*	0.018	0.0063	0.1998*	0.2570*	-0.128	-0.1263
	[0.0504]	[0.0711]	[0.1187]	[0.1742]	[0.0925]	[0.1303]	[0.1054]	[0.1439]
retired soldiers and their families	-0.1011	-0.3484**	-0.0177	-0.1258	0.1983	0.2408	-0.1156	-0.2767
	[0.0535]	[0.0763]	[0.1219]	[0.1801]	[0.1018]	[0.1438]	[0.1100]	[0.1528]
the others	0.2507**	0.1528*	0.0886	0.1047	0.2035**	0.2301*	0.0712	0.005
	[0.0441]	[0.0617]	[0.1086]	[0.1570]	[0.0644]	[0.0943]	[0.0984]	[0.1305]
Operations	0.3840**	0.3271**	0.3258**	0.3414**	0.4340**	0.3892**	0.3867**	0.2765**
	[0.0366]	[0.0550]	[0.0751]	[0.1193]	[0.0546]	[0.0812]	[0.0679]	[0.1009]
the number of visits								
40-75	-0.2944**	-0.2921**	-0.3523**	-0.3447**	-0.3293**	-0.3190**	-0.2155**	-0.2197**
	[0.0128]	[0.0194]	[0.0251]	[0.0391]	[0.0207]	[0.0309]	[0.0229]	[0.0345]
>75	-0.6667**	-0.5703**	-0.7825**	-0.5507**	-0.7132**	-0.7891**	-0.5269**	-0.4099**
	[0.0310]	[0.0468]	[0.0572]	[0.0892]	[0.0536]	[0.0810]	[0.0544]	[0.0824]
observations	266,133	118,103	68,493	29,048	105,296	47,382	82,471	35,967

Notes: Standard errors are in parentheses. All regressions include years. * significant at the 5% level; ** significant at the1% level.

Table 3. Analyses of using cross-regional medical care by Patients with Osteoarthritis：Fixed-effect logit model (Sample II)

	All		districts with abundant medical resources		districts with moderate medical resource		districts with scarce medical resources	
the standard of using cross-regional medical care	10 km	25 km	10 km	25 km	10 km	25 km	10 km	25 km
The increase in copayment	0.2759*	0.1171	0.3981	0.359	-0.0058	-0.2625	0.4029*	0.3291
	[0.1116]	[0.1750]	[0.2436]	[0.4261]	[0.1957]	[0.2982]	[0.1810]	[0.3208]
Age								
70-75	-0.2616	-0.0797	-1.2133*	-0.4004	-0.0874	0.2226	0.0475	-0.0438
	[0.1801]	[0.2822]	[0.4769]	[0.6441]	[0.2909]	[0.4504]	[0.2997]	[0.5498]
75-80	-0.4822	-0.1171	-1.1089	0.1295	-0.1731	-0.1072	-0.5489	0.0843
	[0.2813]	[0.4377]	[0.6672]	[1.0195]	[0.4578]	[0.7024]	[0.4726]	[0.8449]
80-85	-0.2029	0.4139	-1.5556	0.76	0.1116	0.5231	0.2323	0.7759
	[0.3945]	[0.6194]	[0.8815]	[1.4791]	[0.6669]	[1.0671]	[0.6704]	[1.1257]
group of enrollment								
unemployed	-0.0155	0.3763	0.2787	-16.4027	-1.23	0.3142	0.7725	13.6292
	[0.5162]	[0.6322]	[1.3573]	[1,362.0464]	[0.9965]	[1.2108]	[1.3277]	[871.4237]
retired soldiers and their families	0.0363	0.2196	0.1326	-16.9233	-0.8411	0.4113	0.9889	13.4251
	[0.5329]	[0.6646]	[1.3862]	[1,362.0466]	[1.0285]	[1.2119]	[1.3472]	[871.4239]
the others	0.5468	1.0104	0.8946	-15.0378	-0.7486	0.3108	0.716	12.8037
	[0.4761]	[0.5928]	[1.2571]	[1,362.0462]	[0.7432]	[0.8767]	[1.3039]	[871.4241]
Operations	0.1099	0.0789	-0.2809	-0.6525	0.3126	0.1457	-0.1339	0.6166
	[0.1785]	[0.2810]	[0.4113]	[0.6339]	[0.2623]	[0.4693]	[0.3233]	[0.5194]
the number of visits								
40-75	-0.3067**	-0.4443*	-0.7181*	-0.9790*	-0.1981	-0.0741	-0.1981	-0.5901
	[0.1148]	[0.1820]	[0.2815]	[0.4447]	[0.1859]	[0.2853]	[0.1892]	[0.3751]
>75	-0.6719**	-0.6538	-1.5605**	-2.6590**	-0.453	0.7105	-0.3383	-1.0407
	[0.2322]	[0.3647]	[0.5349]	[1.0310]	[0.3998]	[0.6386]	[0.3850]	[0.6987]
observations	2,894	1,174	632	247	1,006	429	1,100	376

Notes: Standard errors are in parentheses. All regressions include years. * significant at the 5% level; ** significant at the1% level.

Table 4. Analyses of using cross-regional medical care by Patients with Osteoarthritis：Fixed-effect logit model (Sample III)

	All		districts with abundant medical resources		districts with moderate medical resource		districts with scarce medical resources	
the standard of using cross-regional medical care	10 km	25 km	10 km	25 km	10 km	25 km	10 km	25 km
The increase in copayment	0.1912*	0.174	0.0747	0.0739	0.2827	0.1477	0.2509	0.235
	[0.0832]	[0.1352]	[0.1671]	[0.2658]	[0.1541]	[0.2605]	[0.1352]	[0.2373]
Age								
70-75	-0.0798	-0.1286	-0.2336	-0.4925	0.1966	-0.0751	-0.2233	0.0088
	[0.1584]	[0.2355]	[0.3627]	[0.5324]	[0.2873]	[0.4214]	[0.2560]	[0.4334]
75-80	-0.0352	-0.0613	-0.2088	-0.6531	0.1767	0.4527	-0.0403	-0.0493
	[0.2256]	[0.3462]	[0.4688]	[0.7031]	[0.4175]	[0.6518]	[0.3725]	[0.6181]
80-85	-0.0589	-0.0861	-0.8459	-1.8903	0.0738	0.8736	0.6132	0.4079
	[0.2963]	[0.4725]	[0.6083]	[1.0270]	[0.5504]	[0.8584]	[0.4931]	[0.8297]
group of enrollment								
unemployed	-0.175	0.3302	0.0385	0.5519	1.1795	14.0907	-0.1943	0.88
	[0.3717]	[0.5346]	[0.7894]	[1.0735]	[0.8929]	[408.9522]	[0.8581]	[1.1385]
retired soldiers and their families	-0.157	-0.0658	0.1728	0.2551	1.5064	14.6857	-0.1987	0.338
	[0.3828]	[0.5474]	[0.8100]	[1.0832]	[0.9259]	[408.9525]	[0.8698]	[1.1603]
the others	0.0799	0.1802	-0.0471	0.1112	0.2444	13.22	-0.0765	-0.6602
	[0.3274]	[0.4668]	[0.6674]	[0.9849]	[0.5693]	[408.9506]	[0.8116]	[0.9276]
Operations	0.135	0.0102	0.1332	-0.2947	0.4562*	0.2988	-0.1285	-0.003
	[0.1272]	[0.1967]	[0.2682]	[0.4578]	[0.2069]	[0.3578]	[0.2322]	[0.3221]
the number of visits								
40-75	-0.5870**	-0.5669**	-0.9079**	-0.7469*	-0.5869**	-0.6832*	-0.4870**	-0.4569
	[0.0985]	[0.1531]	[0.2092]	[0.3207]	[0.1684]	[0.2892]	[0.1707]	[0.2593]
>75	-0.8928**	-1.0549**	-1.1076**	-1.0435**	-0.7613**	-1.2167**	-0.9377**	-0.9451**
	[0.1338]	[0.2066]	[0.2658]	[0.3930]	[0.2406]	[0.3958]	[0.2322]	[0.3669]
observations	5559	2171	1526	619	1638	644	2030	699

Notes: Standard errors are in parentheses. All regressions include years. * significant at the 5% level; ** significant at the1% level.

THE RELATIONSHIP BETWEEN TIE STRENGTH, ABSORPTIVE CAPACITY, AND INNOVATION PERFORMANCE IN INNOVATION NETWORKS: EVIDENCE FROM CHINA

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ABSTRACT
In innovation networks, firm innovation performance is affected by external tie strength and internal knowledge absorptive capacity. This study aims to empirically examine the path relationship between tie strength, absorptive capacity (ACAP) and firm innovation performance. Based on data from 278 Chinese manufacturing firms, this study demonstrates that tie strength is positively related to innovation performance. We also find that ACAP has a positive impact on innovation performance and it mediates the relationship between tie strength and innovation performance. Then we analyze the effect of ownership and industry, and the results show that in private firms and traditional manufacturers, tie strength has no direct effect on innovation outcomes, but it can influence innovation indirectly through ACAP.

Keywords: Tie strength, Absorptive capacity, Innovation performance

INTRODUCTION

With the increasing complexity and uncertainty of innovation, nowadays it is difficult for companies to obtain all the information and knowledge needed for innovation within the organization, and in order to maintain competitive advantage, organizations have to seek cooperation in various stages of innovation (Escribano et al., 2009). In this sense, establishing an innovation network with other relevant organizations has become rather prevalent. Many practical evidences, such as Toyota, Silicon Valley, and Zhongguancun, have indicated that innovation networks play a unique role in promoting firms' innovation. The key idea is that

through the exchange and coordination of resources and information in the value chain, firms can benefit from synergies in production, management and knowledge transfer, which can lead to greater levels of both product and process innovations (Tomlinson, 2010). Despite of all these advantages of innovation networks, the problem lies in how companies can facilitate this network to achieve a high innovation performance.

It is widely acknowledged that inter-firm cooperative ties now play an important role in promoting innovation within firms (Freel & Harrison, 2006; Propris, 2000, 2002). The strength of ties between members has been a main factor for success in networks (Thorelli, 1986). However, sociological theory offers two different views on which type of network tie strength is more conductive to innovation: the strong ties or weak ties. Being a supporter of "strong ties" view, Coleman (1988, 1994) highlights the solidarity benefits of professional networks and argues that the closure of the networks is an important prerequisite for social capital, which will enhance innovation and knowledge generation (Landry et al., 2002). Another rationale offered to support this view is that strong ties can boost knowledge sharing and information flows between network members (Inkpen & Tsang, 2005), hence the innovation speed will be accelerated. Nonetheless, according to the weak-tie theory originally advanced by Granovetter (1973), distant and infrequent relationships (i.e., weak ties) are efficient for knowledge sharing because they provide access to novel information by bridging otherwise disconnected groups and individuals in an organization. Strong ties, in contrast, are likely to lead to redundant information because they tend to occur among a small group of actors in which everyone knows what the others know. Nonetheless, both theoretical views seem to have ignored a vital intermediary factor: absorptive capacity (ACAP). According to Cohen and Levinthal (1990), ACAP refers to the ability for a company to acquire knowledge or information, assimilate it, and then exploit it into commercial end. Absorptive capacity, as a dynamic capability, enables a firm not only to acquire and assimilate external information or knowledge but also to create value and to gain and sustain a competitive advantage through the management of external knowledge (Camisón & Forés, 2010). Thus, we propose that absorptive capacity may be an effective transformation mechanism to transform the knowledge and resources gained from external links into firms' innovation output.

However, most extant researches about the innovation network are conducted in western context, and there is a dearth of empirical studies that investigate the links between strength of ties, absorptive capacity, and innovation output in eastern countries, especially in China. We believe there are at least two reasons for the necessity of China-based studies. Firstly, although turning itself into the world's manufacturing powerhouse, China is often blamed as a "copycat" of the western world and Chinese companies are thought to produce products with low quality and technology. According to a recent research by Forbes, among the 100 most innovative companies, there are only 5 rooted in China, compared with 39 in the US and 11 in Japan[1]. Therefore, we intend to help Chinese companies improve their innovation capacity by leveraging innovation networks. Secondly, in Chinese culture, businesses attach a great emphasis to network relationships, or Guanxi (Xin & Pearce, 1996). This "Guanxi" culture

[1] Source: http://www.forbes.com/innovative-companies/

usually leads to strong ties within the innovation network. Thus, China provides a highly interesting setting for examining the role of tie strength in innovation promotion.

Therefore, the purpose of this paper is to critically examine the nature of the relationship between tie strong, absorptive capacity and firm innovation performance under the Chinese circumstances, based on innovation network theory. In line with this research agenda, data from 278 Chinese manufacturers were collected and we utilized structural equations modeling (SEM) to explore the possible relationship. The remainder of this paper is organized as follows. The literature is reviewed and the hypotheses are developed in Section 2. Section 3 focuses on the empirical study, outlining data and variable measurement. Section 4 describes the empirical results and discusses the effect of industry and ownership. Concluding remarks and implications for further research and practice are presented in Section 5.

THEORETICAL BACKGROUND AND RESEARCH HYPOTHESES

Tie strength and absorptive capacity

Granovetter (1973, 1983) identified three types of tie strength: strong, weak and absent. He defined the strength of a tie as a combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and the reciprocal services which characterize a tie. Absorptive capacity (ACAP) is an integrative concept, and was divided into three dimensions by Cohen and Levinthal (1990), namely acquisition, assimilation, and exploitation. Although we have not found literatures preciously examining the impact of tie strength on absorptive capacity, there are plenty of evidences proving that tie strength can influence the different stages of ACAP. However, there is still a controversy as for the impact.

One augment for strong ties is that trust generated by close relationship can benefit the acquisition of new knowledge sources (Roberts, 2000). Flap and Volker (2003) believe that a strong relationship is relatively reliable and through strong ties, participating members are more inclined to cooperate and help each other to achieve resources and benefit sharing. Therefore, as a social capital, enterprise network is an effective channel for companies to acquire resources and information (Tsai & Ghoshal, 1998). Burt (2009) adds that maintaining a certain degree of tie strength can ensure the effective transfer of the necessary knowledge, thereby increasing the absorptive capacity of the firm. Vinding (2006) argues that the organization’s development of closer external relationships increases the potential effect of transferring information as well as tacit knowledge. Todorova and Durisin (2007) reviews the prior literatures and concludes that the improvement of absorptive capacity is associated with the firm’s investment of social network and the network integration, which indirectly reflects the positive impact on the relationship between tie strength and ACAP. An empirical study by Murovec and Prodan (2009) also found that innovation cooperation with different types of partner organizations is positively related to ACAP.

However, counter to the trust-based rationale, strong ties can also bring a severe problem: knowledge redundancy (Granovetter, 1973, 1983). Under weak ties, network members usually have distinctive backgrounds, skills and expertise, which is a significant source of innovative knowledge and ideas. Uzzi (1997) also agrees that close partnerships between the

companies would be detrimental to the mobility of the company itself and the knowledge sharing in the network. Weak ties can ensure the freshness and breadth of new knowledge and information, and make the network more dynamic and flexible, thus improving business agility (Kraatz, 1998). Koschatzky (1998) argues that innovation network is a relatively loose, informal system, which is better for knowledge learning and exchange.

Some extant literature on networks and alliances combines both arguments and assumes an inverted U-shaped relationship between tie strength and new knowledge acquisition (McFadyen & Cannella, 2004; Uzzi, 1997). Strong ties are only beneficial within a certain range, and after a certain point, stronger ties suffer from "overembeddedness," resulting in diminishing availability of new knowledge as the partner firms become too similar (Hagedoorn & Frankort, 2008; Uzzi, 1997).

The reason for the controversy is believed to lie in the ignorance of contingency factors such as environment and organization itself (Koberg et al., 2003; Gulati, 1999). Take the consideration of Chinese culture, Guanxi (Chinese for "relationship"), which is built on trust and communication, usually implies strong ties and it is rather important for the knowledge transfer in China (Ramasamy et al., 2006). During the interviews with some Chinese managers, we found that they are not worried about knowledge redundancy, because knowledge transfer in Chinese networks are relatively slow and difficult and they have to build strong relationship to gain the necessary knowledge. Hence, this study implies the following hypothesis:

Hypothesis 1: Strength of ties is positively associated with network members' absorptive capacity.

Tie strength and firm innovation performance

When joining an innovation network, a firm is always expected to cooperate with other partners to get higher innovation performance. Innovation network can be conceived as a support network between innovating actors who negotiate and come to an agreement, thus making up for the inadequacy of institutional and organizational forces which primarily serve the status quo (Harrisson & Laberge, 2002). In similar vein, Harris et al (2000) defines innovation network from the perspective of participants. They posit innovation networks are composed of different innovation actors such as enterprises, institutions or groups, and these actors jointly participate in the design, development, production and sales of new products and services, and jointly promote the implementation and diffusion of innovation activities. Furthermore, they suggest that innovative network is synergistic, implying that the overall innovation capability owing to innovation network is greater than the sum of the individual's innovation capability. However, the relationship between strength of ties in innovation network and the member's innovation performance receives relatively limited empirical attention, thus hindering the testing and practical implications of important theoretical arguments in both networking and innovation field. This work focuses specifically on this relation, examining whether strong or weak ties with other partners translate into innovation outcomes.

Initially, we should figure out how network participants can benefit from innovation

network. The principal benefits of networking of innovation can be summarized to be:(1) acting as a key vehicle for obtaining access to external knowledge and resources (Lowik et al., 2012; Powell et al., 1996); (2) risk sharing (Grandori, 1997); (3) pooling complementary skills (Hagedoorn & Duysters, 2002); (4) safeguarding property rights when complete or contingent contracts are not possible (Liebeskind et al., 1996). Different strength of ties would influence the realization of these benefits. As we have discussed above, the first benefit may be directly related to ACAP, rather than innovation performance, and the results may be quite confusing. However, the other three advantages are more likely to be taken in the presence of strong ties through established trust, collaboration routines and better understandings for each other. This implies that strong ties can improve innovation immediately as a result of reducing the risks of opportunism and facilitating complementation, irrespective of whether it promotes knowledge absorption. Examples of the positive effects of strong ties on significant innovations are found in recent studies of Li et al. (2008) and Phelps(2010).

In Chinese context, firm-level guanxi reflects networks among organizations, or the links between firms and the task environment or government officials. Chinese firms develop guanxi as a strategic mechanism to overcome competitive and resource disadvantages by cooperating and exchanging favors with competitive forces and government authorities (Park & Luo, 2001). Therefore, we believe that Chinese companies could better utilize the benefits of innovation networks through long-term and strong relationships because their overall attitudes towards strong ties are rather optimistic and welcoming. For example, Perks et al. (2009) found in Chinese high-tech organizations, guanxi acted as a significant support for integration of R&D and marketing, and as a unifying force in new product development. Thus, we hypothesize:

Hypothesis 2: Tie strength is likely to have a positive effect on firm innovation performance.

Absorptive capacity and firm innovation performance

A firm's absorption capacity is not a goal in itself but can generate important organizational outcomes (Fosfuri & Tribó, 2008). In this highly cooperated society, internal innovation is not sufficient to create competitive advantages, which requires firms to engage in external knowledge acquisition, assimilation and exploitation. For example, Cohen and Levinthal (1994) further expanded the connotation of ACAP in *Fortune Favors the Prepared Firm* and argued that ACAP not only enables a firm to exploit new extramural knowledge, but to predict the nature of future technological advances more accurately. In other words, the current investment in ACAP will bring innovation returns in the future. Previous empirical investigations have generally provided support for the notion that ACAP, among others, is related to innovative capabilities and innovation performance (Wu & Shanley, 2009; Subramaniam & Youndt, 2005; Daghfous, 2004). One rationale for this notion is that ACAP promotes the speed, frequency, and magnitude of innovation (Kostopoulos et al., 2011). A high level of absorptive capacity is coupled with first mover advantages, quick responsiveness to customers, and avoidance of “lock-out effects” and “competency traps” (Zahra & George, 2002; Hamel, 1991), which could facilitate firms to obtain superior

innovation performance.

All the three stages of absorptive capacity can contribute to firm innovation performance. Firstly, acquiring new knowledge could help to reduce the number of product defects, and shorten the product development cycle (Dyer & Singh, 1998), thus speeding up the pace of new product introductions, and eventually improving innovation performance. To be specific, obtaining information from supply chain partners (i.e. suppliers, customers) enables a firm to get more ideas about new products design (Stock, et al., 2001) and identify more technological opportunities (Nieto & Quevedo, 2005). Another advantage of knowledge acquisition is that it enables companies to better understand customers' needs, which is important to product improvements and the development of new feature functions (Von Hippel, 2007). Secondly, knowledge assimilation is helpful to avoid repetitive and redundant work and to update the firm's knowledge base to the latest tendency, and hence allows the company to overcome some "competency traps" (Atuahene-Gima, 2003). Assimilating knowledge also avoids path dependence on knowledge, so that companies can survive in the adjustment of capacities (Todorova & Durisin, 2007). Firms that consistently invest on assimilating and exploiting new external knowledge are more likely to capitalize on changing environmental conditions by generating innovative products and meeting the needs of emerging markets (Lichtenthaler, 2009). Finally, Knowledge exploitation is a must step to transfer the knowledge into practical use since it needs perfect organizational mechanism to exploit external information for certain use (Zahra & George, 2002). Therefore, the following hypothesis is postulated:

Hypothesis 3: A firm's absorptive capacity is positively related to its innovation performance.

METHODOLOGY

Data Collection and Sample

All the data for this study comes from the Chinese manufacturing enterprises. Since the establishment of innovation network is usually costly (Gemiinden et al., 1996), we defined our sample within grown-up companies. The selection of the sample was based on the following principles: (1) it must be an independent corporate; (2) it must be a complete operating entity with specific products, fixed sales channels and production technology, rather than just implementing part of the enterprise functions; (3) it must be of a certain size, with at least 100 employees; (4) it has been at least three years since its founding. We identified a sample of 600 suitable Chinese manufacturers from a database of Chinese Financial & Economics 2008 provided by Guotaian Data Service Centre (CSMAR®). These firms are all Non-listed Manufacturers, including textile and garment industry, household appliance, IT & Electronics and motor vehicle assemblers. Questionnaires were delivered mainly through four methods: e-mail, fax, speed-posts or on-site collection. The respondents were required to be the chief executive officers (CEOs) or senior managers who had a full understanding of the firm's external links with other organizations (suppliers, buyers, distributors, governments, research and training institutions, financial institutions, etc.) and the firm's processes, technologies and products.

Since the questionnaire was originally developed in English and later translated into

Chinese, we asked some experts in innovation field to identify the consistence meaning of each term at the initial stage. Furthermore, before the formal distribution, we also conducted a pilot test with several some senior managers to ensure whether the questionnaire can be totally understood by the respondents and can measure variables accurately, as well as to examine the convenience to informants. After ensuring the quality and feasibility of the questionnaire, we began to deliver questionnaire in a large scale. In the end, a total of 278 complete usable questionnaires were received, with a valid response rate at 46.3%. The distribution of sample firms with regard to ownership, industry and firm size (number of employees) are contained in Table 1.

Table 1 - Sample distribution (N=278)

		Samples	Percentage (%)
Industry	Textile and garment	63	22.7
	Household appliance	26	9.4
	IT & Electronics	118	42.4
	Automobile	71	25.5
Ownership	State-owned/held	53	19.1
	Private	128	46
	Wholly foreign-owned	51	18.3
	Sino-foreign joint	41	14.7
	Collective	5	1.8
Size	<=100	43	15.5
	101-500	85	30.6
	501-2000	54	19.4
	>2000	96	34.5

Variable Measurement

Strength of ties

Granovetter's (1973) four dimensions of tie strength include relationship length, mutual confiding, reciprocal services and emotional intensity. This framework was initially intended for inter-personal relationships, but has been widely adapted for the inter-firm context (Rindfleisch & Moorman, 2001; Rowley etal., 2000). However, providing the characteristics of the ties established in innovation network, we still adapted the scales to better fit the requirements of our work. Four new dimensions were developed including: (i) contact time; (ii) resources input; (iii) cooperation range; (iv) reciprocity of the relationship. *Contact time* implies the frequency and length of the contact with other network partners. *Resources'input* is more suitable to reflect the depth of the cooperation between the enterprise and innovation partners than the emotional depth index (Rowley et al., 2000). *Cooperation range* is the reflection of inter-firm intimacy level with respect to the willingness to share complex technology and additional information. *Reciprocity* refers to the extent that the parties take active responsibility for the partner firm's well being, as well as their own (Stanko et al., 2007). This four-item scale was designed to investigate a firm's innovative interactive

activities with five types of organizations: universities and research institutions, governments, financial institutions and intermediaries, suppliers and customers, and competitors. Each item used seven-point Likert-type scales, anchored by significantly agree/significantly disagree.

Absorptive capacity

Previous studies tend to use R & D intensity as a proxy of absorptive capacity (Flatten et al., 2011), but this operationalization just treat absorptive capacity as static resource and not as a process or capability thus cannot capture the richness and multidimensional nature (Lane et al., 2006). In this study, we adopt the original three-dimension proposed by Cohen & Levinthal (1990) and also very popular in research area to fully conceptualize absorptive capacity, namely, knowledge acquisition, knowledge assimilation and knowledge exploitation. Absorptive capacity (ACAP) was operationalized as the sum of the following submeasures: (1) the firm can identify and acquire external knowledge that is critical to its operations; (2) the firm has special procedures and practices to help employees absorb new knowledge and combine it with the existing knowledge; (3) the firm can apply new knowledge to practice, and refine new skills from it. In order to help respondents better understand each item, we explain each item with its specific manifestation at the end of the questionnaire. Each scale item was measured on a seven-point Likert-type scale (1= significantly disagree, 7=significantly agree).

Innovation performance

Gemünden et al. (1996) proposed a two-dimensional measurement of innovation performance: product innovations (technically improved or totally new production outputs) and process innovations (modified or new ways of producing outputs). Product innovations included product improvement and new product development while the criteria for process innovations consisted of labor costs, lead time, productivity of the equipment and consumption of materials and energy. This classification was comprehensive and laid the foundation for the measurement of innovation performance. Some subsequent researches improved and revised this method (Bell, 2005; Ritter & Gemünden,2004). Based on such previous works, we have outlined a set of items which we adapted to be more complete and feasible under Chinese context. These items are: (i) we introduce more new products; (ii) our product improvement has a very good market reaction; (iii) our new products have high technology content; (iv) we introduce more new production operation process; (v) in the development of new products, our input-output ratio is very high; (vi) we have the first-class crafts and processes. We still use a 7-point Likert scale ranged from “significantly disagree” to “significantly agree” to measure this variable by comparing with its competitors.

Reliability and validity

To ensure the reliability of the scale, we conduct reliability analysis for each construct. A series of Cronbach’s alpha results are provided: 0.972 for tie strength, 0.954 for absorptive capacity, and 0.903 for innovation performance. Each of the three multi-item constructs produces a coefficient alpha exceeding the generally accepted level of 0.70. Therefore, we

can assume that the convergent reliability of each measurement is acceptable. Apart from convergent validity, we also evaluated discriminate validity by conducting constrained and unconstrained model of each pair of variables.

A confirmatory factor analysis (CFA) was first performed in order to examine construct and discriminant validity. All factors received loadings over 0.5, and all the fit statistics indicated a good fit to the data (see Table 2). These results reveal good construct validity of the scale and the model. Discriminant validity was established by ensuring that the average variance extracted for each multi-item construct was greater than the shared variance between constructs (Fornell & Larcker, 1981). As such, all pairs of constructs reveal an adequate level of discriminant validity (see Table 2).

Table 2 –Confirmatory factor analysis results

Variables	Standardized Factor Loadings	R^2	S.E.	Composite Reliability	Average Variance Extracted
Tie strength				0.912	0.725
TS1:Contact time	0.869	0.755	0.245		
TS2:Resources input	0.939	0.882	0.118		
TS3:Cooperation range	0.885	0.784	0.216		
TS4:Reciprocity	0.692	0.479	0.521		
Absorptive capacity				0.918	0.791
AC1:Knowledge acquisition	0.782	0.612	0.388		
AC2:Knowledge assimilation	0.925	0.857	0.143		
AC3:Knowledge exploitation	0.950	0.903	0.097		
Innovation performance				0.904	0.610
I1：New products	0.726	0.528	0.472		
I2：Market reaction	0.804	0.646	0.354		
I3：High technology content	0.781	0.610	0.390		
I4：New process	0.784	0.614	0.386		
I5：Input-output ratio	0.811	0.658	0.342		
I6: First-class crafts and process	0.779	0.606	0.394		
Recommended levels	0.50-0.95	> 0.50		> 0.60	> 0.50

RESULTS

Aggregate results

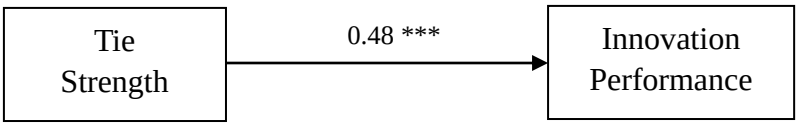
To test the proposed model, structural equation model (SEM) analysis was performed. To effectively test the mediation effect of absorptive capacity, we built two competitive models and estimated the parameters respectively. We first construct a direct impact model (model 1, see Figure 1) to verify the impact of tie strength on firm innovation performance. The result of model 1 shows that when there is no intermediary role of absorptive capacity, tie strength is significantly positively related to firm innovation performance ($\beta = 0.48$, $p<0.001$).

Hypothesis 2 is supported.

Then we constructed mediating variable model (Model 2, see Figure 2) to verify the relationship between tie strength, absorptive capacity and innovation performance in innovation networks. Since the fitting degree of the initial model was not satisfactory, according to the modification indices provided by AMOS, we modified our model for four times by gradually releasing four pairs of error variables. The structural results of this modified model are shown in Figure 2. The modified overall model provides an excellent fit to the data with a non-significant chi-square statistic (χ^2 =74.070, p=0.076>0.05). In addition, we further evaluated various fit indices including absolute fit indices, incremental fit indices and parsimony fit indices and found all these goodness-of-fit indices have satisfied the recommended criteria (See Table 3). Therefore, the modified model can be identified as the final model which will be used to test the appropriate hypotheses. We believe the path results can reflect the "causality" in this study relatively rationally and effectively.

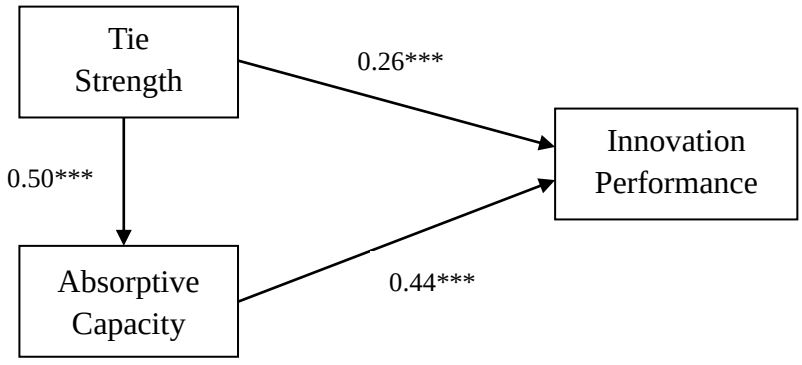
Path estimates in Figure 1 provide support for Hypothesis 1, as the relationship between tie strength and absorptive capacity is positive and highly significant (β=0.50, p<0.001). The results also provide support for Hypothesis 2, as the path between tie strength and innovation performance is also positive and significant (β=0.26, p<0.001). The path coefficient of absorptive capacity on innovation performance is positive and significant (β=0.44, p<0.001), hence confirming Hypothesis 3.

Comparing Model 1 and Model 2, the results show that tie strength not only has a direct impact on firm innovation performance (direct effect = 0.26), but also has an indirect impact on firm innovation performance with the indirect effect is 0.50*0.44=0.22. Therefore, absorptive capacity has an incomplete mediation effect between tie strength and firm innovation performance.



χ^2=40.472(p=0.119), χ^2/df=1.011,GFI=0.973, CFI=0.995, RMSEA=0.033

Figure 1 -Direct impact model



χ^2=74.070(p=0.076), χ^2/df=1.277,GFI=0.962, CFI=0.994, RMSEA=0.032

Figure 2- Mediating variable model

Table 3 – Fit results of the modified structural model

Path		Path coefficients	S.E.	C.R.	P-value	Standandized path coefficients
Absorptive capacity	<— Tie strength(H1)	0.565	0.073	7.692	***	0.5
Innovation performanc	<— Tie strength(H2)	0.269	0.07	3.85	***	0.257
Innovation performanc	<— Absorptive capacity(H3)	0.411	0.063	6.49	***	0.444
Reciprocity	<— Tie strength	1				0.699
Cooperation range	<— Tie strength	1.282	0.079	16.199	***	0.891
Resources input	<— Tie strength	1.323	0.094	14.148	***	0.928
Contact time	<— Tie strength	1.192	0.088	13.58	***	0.875
Knowledge	<— Absorptive capacity	1				0.947
Knowledge	<— Absorptive capacity	0.936	0.036	26.091	***	0.927
Knowledge	<— Absorptive capacity	0.742	0.041	18.052	***	0.78
I1: New products	<— Innovation performance	1				0.723
I2: Market reaction	<— Innovation performance	1.067	0.069	15.484	***	0.806
I3: High technology c	<— Innovation performance	1.11	0.091	12.205	***	0.778
I4: New process	<— Innovation performance	1.079	0.085	12.695	***	0.792
I5: Input-output ratio	<— Innovation performance	1.123	0.089	12.59	***	0.802
I6: First-class crafts	<— Innovation performance	1.154	0.092	12.515	***	0.781
Fit indices	χ^2/df	1.277	NFI			0.973
	GFI	0.962	RFI			0.963
	AGFI	0.941	IFI			0.994
	RMR	0.052	PCFI			0.739
	RMSEA	0.032	PNFI			0.723

*Notes: ***p<0.01, **p<0.05, *p<0.1*

The effects of ownership and industry

In order to analyze the potential effect of the contingency factors, we focus on two control variables: ownership type and industry sector. According to our received questionnaire, there were five ownership types involved: private owned, state-owned or held, Sino-foreign joint, wholly foreign-owned, and collective firms. Since we only collected five collective firms' data in our sample, we decided not to take this ownership type into consideration. To simplify the problem, we further classified sample firms into three categories: state-owned (53), private (128) and foreign-invested (92). Among them, state-owned firms included firms owned or held by the state and foreign-invested firms included firms exclusively owned by foreigners and Sino-foreign joint ventures. Then, we classified the industries into two categories: high-tech manufacturing and traditional manufacturing. High-tech manufacturing referred to the electronics and communications equipment manufacturing industries while traditional manufacturing comprised textile or garment industry, appliance manufacturing, and automobile industry. As such, there are 118 high-tech manufacturing companies and 160 traditional manufacturing in our sample. We validated our theoretical model respectively in different industries and ownership types, and the results are shown in Table 4.

Table 4 – Results of control variable models

Path	Direct impact model	Mediating model	Ownership (Model 3)			Industry (Model 4)	
			State-owned	Private	Foreign-invested	High-tech	Traditional
Absorptive capacity <--- Tie strength (H1)		0.500***	0.55***	0.64***	0.34**	0.52***	0.45***
Innovation performance <--- Tie strength(H2)	0.478***	0.257***	0.41*	0.10	0.36**	0.38***	0.17
Innovation performance <--- Absorptive capacity (H3)		0.444***	0.34**	0.59***	0.39***	0.32***	0.46***
Fit indices							
χ^2	40.472	74.07	74.926	70.68	69.424	74.159	69.867
p-value	0.119	0.076	0.056	0.123	0.145	0.075	0.137
GFI	0.973	0.962	0.837	0.927	0.905	0.915	0.941
CFI	0.995	0.994	0.971	0.989	0.986	0.986	0.992
RMSEA	0.033	0.032	0.078	0.041	0.047	0.049	0.036

*Notes: All path coefficients are standardized path coefficients. ***p<0.01, **p<0.05, *p<0.1*

From Table 4, it is suggested that the results of the empirical model will change with the firm's specific ownership and industry. When adding the ownership variable into the model, the results of Model 3 indicated that for state-owned firms and foreign-invested firms, we found support for all three hypotheses. However, in the private sector, Hypothesis 2 is not supported by the data, which implies the relationship between tie strength and firm innovation performance is not significant. But the path between tie strength and ACAP is significant and positive, so is that between ACAP and innovation performance. Thus, tie strength can indirectly influence innovation performance through the mediating role of ACAP and the indirect impact effect is 0.64*0.59=0.38, which is greatly lower than the effect values in state-owned (0.60) and foreign-invested companies (0.49).

After taking the industry variable into our model, the results of Model 4 show that Hypothesis 1-3 are all supported by the data of high-tech manufacturing firms and the impact effect of tie strength on innovation performance is 0.38+0.52*0.32=0.546. Nevertheless, when the sub-sample firms were all from traditional manufacturing industries, we did not find support for Hypothesis 2 while Hypothesis 1 and 3 could be supported. As the case in private sector, for traditional manufacturing companies, tie strength only has an indirect impact on innovation performance and absorptive capacity is an important mediating variable between them, with the indirect impact effect being 0.45*0.46=0.21. Therefore, in traditional manufacturing, strength of ties has a much weaker influence on innovation performance than in high-tech manufacturing.

CONCLUSIONS

In this paper, the relationship between tie strength, absorptive capacity and firm innovation performance in Chinese context was empirically examined, and interesting findings have revealed themselves from the estimated results.

First, strong ties with other innovation partners could improve the firm's absorptive capacity. There are at least two possible rationales for it: (1) in the Chinese social context, the contracts are usually incomplete and the Chinese strongly rely on the relationship (Guanxi), so companies communicate and link with other organizations mainly through informal relationships, such as family bonds, friendships, and geographic clusters. There are far more informal communications than formal communications and Chinese companies tend to obtain more useful knowledge and resources from informal ties. In China, innovation networks are commonly built with informal ties and there exist no formal contracts in terms of innovation. Moreover, members of the Chinese innovation networks tend to assume that knowledge sharing is based on strong ties (formal or informal) from the perspective of Guanxi. Therefore, the stronger the ties are, the stronger the absorptive capacity is. (2) Since the sample companies are all from manufacturing and their supply chains are relatively complicated, long-term and strong cooperative relationships will be beneficial to new knowledge acquiring and sharing.

Second, both tie strength and absorptive capacity show a positive impact on firm innovation performance and our results also pointed out the mediating effect of absorptive capacity on the relationship between tie strength and firm innovation performance. Cohen and

Levinthal (1990) emphasized that exposure to external knowledge flows cannot promote innovation performance and companies can benefit from these flows only through absorptive capacity. Our findings only partly supported this notion. It indicated that strong ties might enhance the firm's innovation not only because of knowledge learning and absorbing, but also owing to some other direct factors mentioned in Section 2. However, this does not imply that absorptive capacity is not or less crucial in that we found that the indirect impact brought by ACAP is just equally strong as the direct impact. Hence, for the improvement of innovation, firm's internal ACAP and external strong ties with partners are equally significant. Companies are supposed to strengthen innovation cooperation and simultaneously improve their absorptive capacity, building innovative capacity from both outside and inside.

Third, we found that Chinese private firms could not benefit from strong ties directly, so in the Chinese private sector the mediating role of ACAP is especially important for the impact of tie strength on innovation performance. One possible explanation for the lack of direct effect may be that Chinese private companies tend to build relationships with higher prices than state-owned companies and foreign companies (Nee, 1992), and consequently have insufficient funds or resources to fully utilize the network. Moreover, it is a common case that firms with the similar ownership structure are more likely to be networking together. Most Chinese private firms have relatively undeveloped capacity and weak strength, thus constraining the possibility of sharing risks or complementing competences. We think that this conclusion is the reflection of a potential problem lying in Chinese private businesses. Although some private firms have established good relationships with other innovative partners, few of them could turn it into practical outcomes because they usually ignore the development of absorptive capacity.

Fourth, the results also reveals that in traditional manufacturing industries tie strength has no direct impact on innovation performance, although absorptive capacity can mediate the relationship between them. Compared to high-tech industries, the wide application of standardization and the established habits and attitudes in traditional industries are prone to cause great resistance to innovation. From this perspective, strong ties in innovation network would perform practically no function because of the member's unwillingness to innovate. However, strong ties can still enhance absorptive capacity of traditional firms, thus enabling the firms to identify new opportunities by osmosis.

Overall, the present findings suggest that strong ties with innovative partners promote both adsorptive capacity and innovation performance. Firms should actively build innovation networks based on a wide range of inter-firm cooperation and close contacts, in order to fully utilize synergy of the network. The government should formulate policies that encourage cooperative innovation and set up an environment allowing for the development of innovation network. At the same time, another important finding is that absorptive capacity is a very significant mediating factor between tie strength and innovation performance, especially for private firms and traditional manufacturers. Therefore, we suggest Chinese companies raise absorptive capacity to the strategic level and establish knowledge management system to consciously improve their ability to acquire, assimilate and exploit knowledge. Despite the special role of Guanxi in Chinese culture, the development of Guanxi

and absorptive capacity are equally useful with respect to innovation promotion.

Implications notwithstanding, there are also some limitations that should be taken into account. First, the present work only focuses on three variables (tie strength, absorptive capacity and innovation performance), and it may be somewhat simple. Adding some other network variables (such as network position) to the model may get more stimulating conclusions. Second, the strength of ties with different organizations may be quite dissimilar, thus the results may vary greatly when analyzing specific ties. Further researches can compare different ties and their relationships with absorptive capacity and innovation performance to bring the present study from general to specific.

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EFFECT OF SUPPLY CHAIN INNOVATION COLLABORATION ON ORGANIZATIONAL PERFORMANCE: AN EMPIRICAL STUDY ON CHINESE MANUFACTURING FIRMS

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ABSTRACT
Manufacturing industry plays a very important role in China's economy. With the increasing globalization and internationalization, more and more Chinese manufacturing firms are aware of the importance of innovation collaboration in supply chain. In the past three decades, many Chinese manufacturing firms have made effort to collaborate with other firms in order to contribute to innovation. Some companies have achieved success, but some failed, and many are looking forward to collaborate with other firms. In this scenario, this research is conducted to know the impact of supply chain innovation collaboration on organizational performance.
Using data from 129 Chinese manufacturing firms, this study examines the effect of innovation resources (IR), innovation consciousness (IC) and interaction with innovation partner (IWIP) on organizational performance (OP).
The results reveal that supply chain innovation collaboration in terms of innovation resources, innovation consciousness and interaction with innovation partner, has impregnable effect on organizational performance. They are all important antecedents for organizational performance enhancement. Our findings contribute to devise an inclusive and empirically validated framework for supply chain innovation collaboration scholars and practitioners, which would help to increase their chance of success in achieving their innovation collaboration intentions.

Keywords: Supply chain, Innovation collaboration, Organizational performance, Manufacturing firms

INTRODUCTION

Manufacturing firms today's businesses operate in a global and competitive business environment. Many manufacturing firms have opted for apply different techniques to improve their business processes to respond to the challenges in the business environment. However, the collaboration in supply chain has experienced a tremendous increase in the last decade and has

drawn a lot of attention from academic researchers and practitioners. Nowadays, manufacturing firms strive to make smooth operation of supply chain in order to survive in competitive business environment and therefore they prefer to develop collaborative relationship. Manufacturing firms get the advantage of collaboration between innovation and SCM process in the favor of cost and time reduction in product development (Lewis, 1990; Parker 2000; Horvath 2001; McLaren et al., 2000, McCarthy and Golocic, 2002) Supply chain innovation collaboration helps to achieve economies of scales in production and a higher control of the new product development process. (Parker H., 2000).

Traditionally, supply chain process innovation and product innovation are considered as separate activities. (Swink, 2006). In today's highly competitive environment the phenomena are moving towards in this scenario, whether the organizational structure and culture is strong enough to collaborate inter-functionally, inter-divisionally or with external partner. In manufacturing firms internal cross-functional collaboration is the phenomena of engineering approach. For the new product development different competencies are required such as involving downstream function and firms may look forward to potential conflicts that will require for necessary changes of the project. When we have a look from external partner perspective, through collaboration organizations can add more valuable knowledge to its innovation process (Zamboni, 2011). As Wynstra et al., (2001) suggests that the boost collaboration with the supplier is the key of success in industry. Besides these results, the study by Hartley and Biron (1994) demonstrated that external suppliers are not helpful spontaneously to improve innovation process. Neither they were able to reduce the cost nor better product or shorter time-to-market. Perhaps, these complications occur due to lack of knowledge or experience about new project or the selection criteria of supplier based on price instead of innovativeness and collaboration with too many suppliers at the same time (Zamboni, 2011). More contemporary studies depicted that collaborative developments still have been facing numerous obstructions such as: organizational and hierarchical obstruction, relational obstruction and knowledge obstruction etc. (Swink, 2006). These obstructions may be occurred because sometime manufacturer considers collaboration with supplier as risk rather than opportunity.

The crucial problem is that many firms don't know how to deal with the process of collaborative innovation. This process could be started to identify the elementary relationship between the activities each functional area performs which is concerned with innovation consciousness; whether the organization has good culture or mechanism to perform such activities, as well as firms need to understand the vision that constructs interactions and interdependencies among development activities. The resources and level of commitment are required to recognize this vision. In this scenario, we consider resources as innovation resources and higher level of commitment as interaction with innovation partner.

LITERATURE REVIEWS AND HYPOTHESE DEVELOPMENT

To explore the effect of innovation resources, innovation consciousness and interaction with innovation partner on organizational performance, we developed our hypotheses according to comprehensive literature review in this field and constructed research model as shown in Fig.1.

Innovation Resources

Resource Based View (RBV) theory presumes that firm's capability is the basic component for competitive advantage and resources are used to enhance the firm's capabilities (Barney, 1991; Wernerfelt, 1984). According to Grant (1991) organizational resources include individuals' skills, patents, capital equipment, physical resources, financial resources, technological resources or organizational resources. But technological resources and financial resources have received much theoretical attention over the last few years. However, despite fruitful research results have been achieved by the academic community regarding organizational resources, many enterprises still struggle to obtain a clear view of utilizing their innovation resources. In this research, we consider professional technical talents, market information, technical knowledge and financial support as innovation resources in supply chain and we found that very little literature is available in this regard.

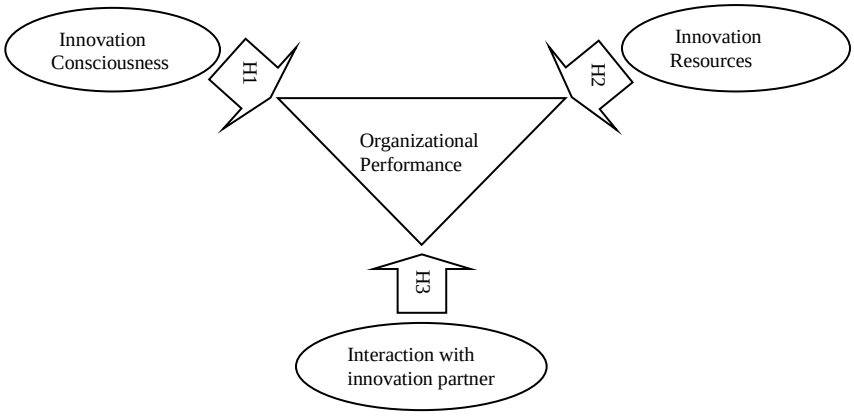

Fig.1 Research Theoretical Model

The research on technical information has raised awareness of an effective and efficient supply chain. Collaboration through technical information sharing is believed to be able to reduce supply chain uncertainty and handle the complexity. Previous studies on information in supply chain were related to upstream flow of demand information which has impact on material flows. For example, the study by Min and Mentzer (2004); Chen and Paulraj (2004); Tracey et al., (2004) and Burgess et al.,(2006) only examined the fundamental concepts in supply chain management but did not consider any construct related to information technology flow. Perhaps, due to this fact that in many cases technical information flow is related to order information and gives vague boundaries to each other. Thus, we fill the gap that through technical information sharing among partners that is based on technologies both partners can gain a lot of technical knowledge.

In manufacturing industries, the integration of suppliers in the new product development process (Burt and Soukup, 1985; Clark and Fujimoto, 1991; Helper, 1991; Hakansson and Eriksson, 1993; Lamming, 1993; Hines, 1994; Swink, 1999; Shin et al., 2000) is also considered as the source innovation collaboration, A considerable research has been conducted in this regard such as Wynstra and ten Pierick, (2000) proposed that the integration of supplier can be like that, giving minor design suggestions to being responsible for the complete development, design and engineering of a specific part of assembly. Moreover, the engagement of the suppliers is

constructive in crucial project and planning processes (Ragatz et al., 1997; Swink, 1999; Shin et al., 2000; Croom, 2001). However, such types of integration contribute to financial support. On the basis of above literature we proposed that the involvement of supplier in new product development is also a resource of financial support.

Along with the rapid development of trends in supply chain, a considerable research stream has emerged on integration and collaboration among supply chain member in order to improve co-operation and co-ordination (Smith et al., 1995) and as well accelerate their efficiency from co-development and co-production (Ragatz et al., 2002), By developing collaboration among supply chain members, all the members can get potential benefit like cost reduction (Niezen et al., 2007) and higher level of information sharing (Lee et al, 2000). As study by Christopher & Peck (2004) has lent support to this argument that higher level of collaboration leads to more adaptability and resilience across the supply chain. Better collaboration also enhances organizational competitive capability that is based on speed, quality and flexibility (Niezen et al., 2007). This development in supply chain management has extensive implication for human resources perspective. As Goll et al. (2005) argued that "human resources are the primary resource input to information system planning". Supply chain researchers are observing continuously about conventional jobs, roles, skill requirements and responsibilities within and between functional areas including, logistics, marketing operations, procurement, and well as relationship between firms (Mentzer et al., 2008). We propose that professional technical talent can manage under human resource management and by sharing this professional technical talent with other partners of supply chain; firms can gain many professional technical talents. Although limited research has been conducted relating to the contribution of professional technical talent in supply chain innovation collaboration and we consider that HR systems are particularly useful lens for examining this gap.

Parallel research has been conducted in supply chain management which emphasize on the importance of market orientation (Kohli & Jaworski, 1990; Narver & Slater, 1990). In the early 2000s, supply chain management and marketing synergy has been recognized (Juttner, Christopher, & Baker, 2007). The results depict that firms could be able to get market information on the basis of current and potential customer needs. By using this current information they can easily respond effectively and as the result they would get higher profit and customer satisfaction. Hence, we propose that through collaboration in supply chain, both firms can gain a lot of markets information as compared to individual firm.

Organizational Performance

Several researchers analyzed the relevant organizational performance literature about supply chain and provided clear guidance for defining objectives. Financial metrics are used as tool to measure organizational performance (Holmberg, 2000) Many studies have been measured organizational performance from both financial and market perspectives like return on investment (RIO), the growth of ROI, market share, growth of market share and profit margin on sales (Vickery et al., 1999; Stock GN et al., 2000; Zhang QY, 2001). Although in different studies organizational performance has been measured on different metrics. According to Lee and Billington (1992) "There were no performance measures for the complete supply chain. Many companies have this problem. Those that do have such metrics often do not monitor them regularly". In this research, for perceptual measure of organizational performance, 22 items have

been taken to measure organizational performance. These items directly measure five different dimensions of financial and market perspectives like profit, cost, quality, flexibility and efficiency. Thus, from the previous literature we conclude that there is a lack of comprehensive framework, which covers innovation resources from technical knowledge, financial support, professional technical talent and market information perspective and as well organizational performance from quality, flexibility and efficiency perspective, although these are the important antecedent for effective supply chain innovation collaboration. Hence, we postulate our hypothesis on the basis of literature reviews as under:

H_1: More innovation resources have influence on better organizational performance.

Innovation Consciousness

Innovation consciousness is concerned about the evaluation or assessment of the firms and innovation partners' relationship in order to get win-win partnership, and well as organizational culture which refers to whether the organization has good mechanism and culture to encourage innovation.

Many firms and academics have suggested that collaborative buyer-supplier relationships refer to successful partnership in order to get numerous benefits such as better quality, reduced costs, inventory reduction, improved delivery, higher flexibility, compressed lead times, increased in market share, faster product-to-market cycle times, increased responsiveness to market demands and customer service (Anderson and Lee, 1999; Corbett et al., 1999; Mentzer et al., 2000a, b; McLaren et al., 2002). Additionally, Successful collaboration among the partners may provides more opportunities for the creation of competitive advantage and extraordinary financial performance (Jap, 1999, 2001). This perspective has been supported with empirical evidence for example, high levels of collaboration, both with suppliers and buyers lead to significant overall performance improvements (Vereecke et al., 2006) but some other researchers like Christopher, (1999); Frohlich and Westbrook, (2002) believed that some organizations are not able to manage supply chain collaboration activities effectively. In accordance with this standpoint, we observe that all collaborations are not successful. The reason is that organizations need to assess or evaluate their organization and the main innovation partners' relationship to know that whether their cooperation and communication with innovation partners make them feel the technology innovation or urgency of introducing new product. Hence, the evaluation of cooperation and communication is very important

On the other hand, innovation consciousness also refers to organizational culture, whether organization has flexible structure to contribute to innovation. Today, companies are facing increasingly keen competition in the marketplace and their survivals are under challenge, therefore more and more companies are striving to introduce advanced management to support organizational innovation. However, organizational flexibility is most important for the successful supply chains which promotes to more innovation activities such as Anderson and Tushman (2001) suggest that firm's ability to cope with uncertainty is a key determinant of its survival. Hence, the organizational structure should be flexible to deal with uncertainty.

Many researchers have been taken an overview from multidimensional perspective of organizational culture like Barringer and Harrison (2000) proposed that all inter-organizational

relationships are difficult to manage due to the lack of aligned corporate cultures and they also argued that one cause of relationship failure is the inability to align cultures. Moreover, Fawcett et al. (2008) proposed that misalignment of culture is a crucial barrier to success in a supply chain management. According to inter-organizational perspective, culture is concerned about congruent of two integrating firms' cultures (Cartwright and Cooper, 1993). Some others researchers also intended that incongruent culture among the integrating organizations lead to lower relationship satisfaction, lower financial performance outcomes, higher levels of conflict and lower productivity (Cartwright and Cooper, 1993; Pothukuchi et al., 2002; Weber and Camerer, 2003). According to the existing studies, the organizational culture (i-e compatible values, beliefs and behaviors) has significant influence on supply chain performance (McAfee et al., 2002; Mello and Stank, 2005). For example, Bates et al., (1995) contend a significant relationship between manufacturing strategy and organizational culture. Similarly, study by Mello and Stank (2005) also builds up a constructive theoretical framework regarding the impact of cultural incongruent on supply chain performance. In addition, Castrogiovanni (1991) find that there are five levels at which environment or culture can be assessed such as resources pool, sub-environment, task environment, aggregation environment and macro environment. Hence, the environment munificence can be enhanced by assessing multilevel environmental analysis.

In keeping with the extent literature; we need to investigate cultural behavior of firms which contribute to creativity and innovation. In other words, we can say that when the members of an organization are conscious of the organizational climate of innovation, they perceive the organizational support for innovation. Such consciousness influences the occurrence of innovation behavior (Scott and Bruce, 1994). Hence, we propose our hypothesis as under:

H_2: There is a positive relationship between higher innovation consciousness and organizational performance.

Interaction with innovation partner

Interaction with innovation partner is another segment of supply chain management which is based on trust and commitment (Lee and Billington, 1992). It is considered that trust contributes substantially to the long-term stability of an organization (Heide and John, 1990). In general, trust is a simple belief of a firm that its supply chain partners will act in a stable manner and accept everything which contributes to long-term relationship. In this sense, self- serving behavior is concerned with intentions and expectation among the member of supply chain (Nooteboom et al., 1997). Commitment is the belief that all the members of supply chain should be agreed to devote their energy to maintain this relationship (Dion et al., 1992). Hence, strong commitments among the supply chain partners contribute to sustain and further goal of the supply chain. But at the higher level of commitments, it seems more difficult for partners to act in ways that could be affected negatively to the overall performance of supply chain. The integration among the trading partners in supply chain regarding their major customers' processes is mostly successful and has strong influence on organizational performance such as supply chain partners can share information of design, competitive forces and R&D activities (Spekman et al., 1998). On the basis of long-term relationship all the members in supply chain can enjoy those benefits which are essential for continued success.

Previous review of the conceptual literature has provided an extensive conceptual background of supply chain partnership and revealed some of the expected benefits of supply chain partnership. Despite this wealth of conceptual literature, there is need to measure the strength of relationship among partners. As can be seen from the above literature, there has been very little evidence which focus on "strength of relationship" among the partners in supply chain.

In this research, we measure the strength of relationship between firms and innovation partners, 9 items are taken under the four dimensions of relationships namely: contact time, resources investment, the scope of corporation and reciprocity. First, contact time refers to immediate proximity or association among the members in supply chain and it endorses to develop trust and reduce corporation risk. Second, resources investment comprises human resources, financial & equipment and social capital. It gauges how the firms utilize their different resources into innovative activities with other partners. Third, the scope of corporation which measures the level of corporation among the partners, it shows that how much coordination they have among themselves. The last one is reciprocity; we consider that reciprocity contributes to develop strong level of trust which leads to build win-win relationship and as well to avoid from those conflictions which are harmful for their interests or objectives. Thus, throughout the previous literature we reach at this conclusion that interaction with innovation partner is a crucial element for new product development because through higher level of collaboration among organizations, they can get new ideas and knowledge about product that is useful for innovation. Hence, we propose:

H_3: More interactions with innovation partner have influence on better organizational performance.

METHODOLGY

Data Description

We collected data for this research from Chinese manufactures and this research was initiated by Chinese University of Hong Kong, Wuhan University and Tianjin University in 2012. We identified sample firms from manufacturer a database of Chinese Financial & Economics 2008 provided by Guotaian Data Service Centre (CSMAR®) in random selection. Sample industries incorporate Textile and Garment Industry, Household Appliance, Motor Vehicle assemblers, and IT & Electronic in China. The population was chosen to concentrate the geographical environment in a national territory, ensuring a homogeneous economic, politic, socio cultural, technological and legal framework for all firms in the study.

We collected the data by questionnaire in three stages. During the first stage, we conducted a pilot test with several senior managers, experts and scholars to ensure whether the questionnaire can be totally understand by the responds and can measure variables accurately, as well as to examine the convenience to informants. After ensuring the quality and feasibility of the questionnaire, we began to deliver questionnaire in a large scale. Senior manager is our main investigation object because they have an integrative knowledge about a company's resource, management and the development. They can access to strategic information, and familiarity with the environment of the firms (Aguilar, 1967), which suggests them to be the most suitable

responds. Before mailed the questionnaire, we told the senior manager and intention of our study and gained their acceptance for our investigation. In the last stage, we implemented a feedback investigation to ensure the authenticity of their responses and ask for some suggestions. A total of 3088 individuals randomly selected firms were mailed with questionnaire and 129 usable responses we received, leading to an acceptable response rate of 21.5%.

Measures

In our study all of the items were measured with seven-point Likert-type scale ranging from "1'' (strongly disagree) to ''7'' (strongly agree) unless the basic information such as size, nature, industry and sales volume.

Variables

Independent Variables:

Innovation resources: are the basic elements for innovation capability, which creates performance for a company. According to Barney's resource-based view (RBV), innovation resources can be a kind of rare resource that not so easy to imitate and mobile, and results in continuous competitive advantages. In this study, we developed a four-item scale to measure a company's innovation resources, including technical knowledge, financial support, professional and technical personnel and market information.

Innovation consciousness: refers to whether a company has already recognized the pressure or the urgent call to innovate, as well as an organizational environment for company to innovate. We use four items covering a company's sense of pressure, urgent call, confidence in technology or product innovation and culture or mechanism to stimulate innovation. All these can effectively promote a company commitment to innovation.

Interaction with innovative partners: another important variable as an antecedent of innovation performance is interaction with innovative partners. This variable mainly measured a company's relationship intensity with innovative partners regarding to how long, what resources invested, the range of partnering and reciprocity of their interaction. Thus, we also developed such a four-item scale to investigate a firm's innovative interaction activities with universities, scientific research institutions, government, intermediary, financial institutions, suppliers and customers, and even competitors. 50 questions involved in these four items.

Dependent variable

Organizational performance

Since organizational performance always incorporates financial performance, operational performance representing short-term performance and various development capabilities for long-term performance, we combined the measurement for short-term and long-term performance that

associated with innovation. In this study we used 22 items in total to measure the average value for organizational performance.

Control variables

We also control for several important variables. Industry sector is the first factor may affect innovation performance and organizational performance for different industries usually have different performance results. We here incorporated four different sectors in our usable samples, thus we created three coding dummy variables for industry sector groups (i.e., number of code variables=Groups-1). We did this just because we want to analysis the effects of different sectors in detail. According to the rules of coding dummy variables, we used industry sectors other than Textile and Garment Industry, Household Appliance, and IT & Electronic. Code variables refer to these groups that will be considered in the regression analysis later. For we coded "0" or "1" representing yes or no (for example, when industry= Textile and Garment, our variable Textile and Garment^{b}=1, otherwise, Textile and Garment^{b}=0). The second variable we controlled is ownership type. For each type of ownership, we use the same criterion. Thus, since the total number of ownership type is six, we create five code dummies for ownership type, including ownership types other than state-owned or state holding, collective, private, wholly foreign-owned and sino-foreign joint venture. The last control variable is firm size. Number of full-time employees in the questionnaire is to represent firm size. We use "one" to "seven" reflecting seven different levels of firm size in ascending from "less than 100 employees" to "more than 3000 employees".

Reliability and validity

To ensure the reliability of the scale, we conduct reliability analysis for each construct. A series of Cronbach's alpha results are providing: 0.953 for organizational performance, 0.977 for interaction with innovative partners, 0.865 for innovation resources, and 0.811 for innovation consciousness, all exceeding the recommended level of 0.7, which suggests that the scale reliability is confirmed as shown in table1. Regarding to the validity, we have two ways to advance the level of validity. One is pretest and pilot before deliver the questionnaire in large scale. Minor improvements and modifications were performed after pretest and pilot according to the experts and respondents. The other is the statistical test for the constructs validity. Confirmatory factor analysis (CFA) was conducted to examine the validity for each construct. All factors received loadings over 0.5 and appropriate χ^2 with a significant level, leading to a good validity for each scale.

RESULTS

Before testing the proposed hypotheses, we provide the descriptive statistics for each variables and correlation coefficients between them in Table 2. We found that there are no much significant relations between control variables, independent variables and dependent variables.

Table 3 reveals the results of Model 1, Model 2, Model 3 and Model 4. First, we entered control variables only and then we included control variable plus the direct effect of innovation resources, innovation consciousness and interaction with innovation partner on organizational performance respectively. Model 2, 3, 4 indicate that there are significant positive links for

Table 1 Summary of study variables (with cronbach's alpha for construct)

Variables and construct items		α
Main Variables		
Innovation Resources		0.865
	Technical knowledge,	
	Financial support	
	Professional and technical personnel	
	Market information	
Innovation Consciousness		0.811
	Evaluation of firms and innovation partner	
	Organizational Cultural	
Partnership relationship		0.977
	Contact time	
	Resources investment	
	The scope of cooperation	
	Reciprocity	
Organizational performance		0.953
	Profit	
	Cost	
	Market flexibility	
	Market efficiency	
Control Variables		
Industry sector	Textile and garment, household appliance, IT and electronics and automobile motor vehicle	
Ownership	State-owned, collective, private, wholly, foreign-owned and Sino-foreign joint	
Size	Number of full-time employees	

Table No 2 Descriptive Statistics and correlations

Variables	Mean	S.D	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Industry= Textile & Garment [b]	0.34	0.48	1												
2 Industry= Household Appliance [b]	0.09	0.29	-.230**	1											
3 Industry= IT & Electronics [b]	0.46	0.50	-.661**	-.294**	1										
4 Ownership= State-Owned [c]	0.09	0.29	-.118	-.103	.188*	1									
5 Ownership= Collective **c**	0.03	0.17	-.034	.097	-.074	-.057	1								
6 Ownership= Private **c**	0.48	0.50	.224*	.012	-.167	-.308**	-.172	1							
7 Ownership= Foreign- Owned **c**	0.26	0.44	-.133	-.010	.157	-.192*	-.107	-.575**	1						
8 Ownership= Joint Venture **c**	0.09	0.29	-0.05	-.103	-.080	-.103	-.057	-.308**	-1.92*	1					
9 Size	3.53	2.22	-.204*	.067	.172	.188*	-.144	-.387**	.261**	.043	1				
10 IR [a]	5.04	1.27	-.233**	.043	.212*	.170	-.041	-.100	-.032	.043	.063	1			
11 IC [a]	5.06	1.22	-.255**	.061	.163	.122	.010	-.153	.155	-.054	.272**	.444**	1		
12 IWIP [a]	4.49	1.16	-.145	.006	.179*	.235**	.095	-.150	.003	-.052	.141	.654**	.396**	1	
13 OP [a]	5.19	0.83	.027	.132	.003	.131	-.045	-.123	.079	.043	.061	.315**	.403**	.326**	1

Notes: N=129; Level of Significance: ** =1%, * =5% all two tailed.

[a] Value of variable ranging from 1 to 7

c Base group is the other ownership of firm than State-Owned, Collective, Private, Foreign-Owned and joint venture.

Table No 3 Results of linear regression analysis predicting organizational performance

Variables	Model 1		Model 2		Model 3		Model 4	
	B	t-value	B	t-value	B	t-value	B	t-value
1 Industry= Textile & Garment [b]	0.53	2.08**	0.59	2.41**	0.72	3.07***	0.51	2.11**
2 Industry= Household Appliance [b]	0.95	2.84***	0.87	2.73***	0.96	3.17***	0.89	2.80***
3 Industry= IT & Electronics [b]	0.42	1.70*	0.34	1.43	0.47	2.09**	0.33	1.39
4 Ownership= State-Owned **c**	0.93	2.08**	0.86	2.02**	0.63	1.55	0.76	1.78
5 Ownership= Collective **c**	0.31	0.55	0.42	0.78	0.02	0.04	0.14	0.25
6 Ownership= Private **c**	0.40	1.00	0.46	1.21	0.18	0.48	0.42	1.11
7 Ownership= Foreign-Owned **c**	0.65	1.62	0.72	1.89*	0.37	1.03	0.66	1.74*
8 Ownership=Joint venture **c**	0.79	1.74*	0.78	1.81*	0.64	1.56	0.81	1.89*
9 Size	-0.00	-0.05	0.00	0.05	-0.04	-1.19	-0.01	-0.34
10 Innovation Resources			0.21	3.66***				
11 Innovation Consciousness					0.30	5.20***		
12 Interaction with Innovation partner							0.23	3.70***
13 R^2	0.10		0.19		0.27		0.20	
14 Adjusted R^2	0.04		0.13		0.21		0.13	
15 F	1.52		2.84***		4.37***		2.88**	
16 Dubin-Watson	1.90		1.97		2.10		1.88	

Notes: N=129; Level of Significance: *** =1%, ** =5%, *=10% all two tailed.

[b] Base group is other sectors than Textile& Garment, Household Appliance, IT & Electronics.

c Base group is the other ownership of firm than State-Owned, Collective, Private, Foreign-Owned and Joint Venture.

innovation resources (t=3.66, p<0.01), innovation consciousness (t=5.20, P<0.01) and interaction with innovative partners (t=3.70, P<0.01) with organizational performance respectively. Hence, for hypothesis 1, 2, and 3, we predicted that innovation resources, innovation consciousness, and interaction with innovative partners all positively associated with organizational performance. Thus, it is empirically confirmed that supply chain innovation collaboration helps organizations to reduce production costs and constantly improve the process and product which is expected to result in improved organizational performance.

DISCUSSION AND CONTRIBUTION

In order to understand the reason that manufacturing companies utilize supply chain management to reduce cost and increase effectiveness and efficiency through innovation, it is necessary to analyze numerous dimensions of innovation collaboration that how they affect organizational performance. As Soosay et al. (2008) suggested that collaboration in supply chain is essential for innovation as partners get the several benefits of innovation such as lower costs, high quality more timely delivery, effective coordination and efficient operations. However, it is important to consider for manufacturing firms that how quickly a new product becomes available to the market. Thus, to secure the right thing, in the right place and at the right time for supply chain activities in the manufacturing firms, innovation collaboration plays a vital role in providing information for the expected benefits and costs.

Creativity is the soul of manufacturing industry. For adapting the needs of improving manufacturing industry, China has always been, in recent years, speeding up the growth of new

product development. Due to the labor cost advantage, it has become the world production center. With more and more Chinese manufacturing companies trying to achieving successful business, the urge of understanding innovation collaboration in supply chain becomes more and more critical. Thus, this research has been explored the impact of supply chain innovation collaboration on organizational performance.

This research provides a significant contribution to the existing body of knowledge in SCM research by analyzing the effect of innovation collaboration on organizational performance. Overall, the empirical results of this research reveal that innovation collaboration has strong impact on organizational performance. In terms of practical implication this study would eventually lead to an inclusive, empirically validated framework and measurement for supply chain innovation collaboration scholars and practitioners, which would help to increase their chance of success in achieving their innovation collaboration intentions. This study has achieved three important findings. First, firms need to understand the culture and focus on the practices that are more effective under that culture because good culture and mechanism are the most essential attributes for firms to create added value. So firms must think carefully about how to develop these mechanisms. Second, in corporative relationship, higher levels of commitments are required. Both parties need to understand their responsibilities regarding any project. Thirdly, it shows that cooperation and communication with innovation partner in terms of innovation resources such as technical knowledge, financial support, professional technical talent and market information, firms can get several ways to improve performance.

DIRECTION FOR FUTURE RESEARCH

Like any empirical study, this research has also certain limitations. First, the sample size is not good enough to provide robust results. Sample size can be expanded in order to get the results more reasonable. Second, the proposed model did not examine any kind of moderate effect. Future studies may explore moderators such as firm size and firm ownership etc. Third, this research is only based on data from Chinese manufacturing firms and the results may not be able to be applied on other countries because results vary from country to country. Thus, further research is needed to further evaluate the robustness of results. Lastly, further studies should investigate how other dimensions of innovation collaboration contribute to organizational performance.

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COST SHARING DECISION FOR COMPLEX PRODUCT CO-DEVELOPMENT IN SUPPLY CHAIN

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ABSTRACT: A new type of collaborative chain model containing one system integrator and some suppliers for product co-development was constructed and the cost sharing decision among them was discussed in this paper. This paper is to study the system integrator how to motivate the suppliers to increase the labor effect and the level of R&D innovation and shorten development time through R&D cost sharing, and analyze the system integrator's cost-sharing rate with Game theory. The result shows that the suitable R&D cost sharing policy could inspire the suppliers' effort and reduce development time to obtain profit optimization. It provides a theoretical reference and quantitative guidelines to implement cooperative research and development for innovation.

Keywords: Product Development, Cost-sharing, Game theory, Supply chain, Cooperation

1. INTRODUCTION

Complex product refers to the product that containing many parts. It is well recognized that the chance of innovation success of complex product is very low because of the nature of R&D activities. It is hard for one firm to develop this kind of products independently. With shrinking product lifetimes, increasing technical complexity, and daunting odds of success, firms are forced to invest continually to maintain their competitive edge. In response, some firms have looked beyond their four walls to manage the costs and risks of development of new product or some components (Nuri Mehmet Gokhan, etc., 2010).

The increasing uncertainty, complexity of knowhow, and costs of product development and distribution require firms to pool their resources and enter into collaborative development contracts involving outsource of development of some key components and the sharing of product revenues, development costs, and research and development (R&D) effort between industrial customers and suppliers.

There are three primary benefits from cooperation in R&D. First, a fully inclusive cooperative agreement eliminates or alleviate uncertainty and risks. Second, cooperation may increase the efficiency of R&D investments through the elimination of duplication of efforts and the exploitation of cooperation in R&D. Third, the externalities created by technological spillovers are internalized through cooperation. However, the partners involving in product co-development are different interest subjects, and seek to maximize their self-interest in R&D investments and profit. Therefore, the suppliers often can't offer R&D results or can't reach the excepted innovation level.

R&D activities are often sponsored by governments, firms, nonprofit organizations. The sponsor often select more than one participant to undertake a same R&D task at the same time competitively for higher chance of success, and would pay part of the R&D expenses to all of them or promise a reward (usually production orders as reward for factory participant and

case reward for individual participant) for the winner of the R&D competition. For centuries, R&D inducement rewards have inspired various scientific and technological breakthroughs. Besides posting production orders as an inducement prize, the sponsor often assists factory participant financially to improve their competence. for an example, the U.S. Department of Defense (DoD) has conventionally assisted numerous suppliers in defense technology development.

While reward (production orders or cash) inspires suppliers to exert more effort, a subsidy has much more subtler effects. First, it has a positive effect: it upgrades the suppliers' R&D innovation capacity, accelerate product development, and shorten the time of launch-to-market and increase sales, thus increasing profits. Second, a subsidy has a negative effect, as it alters suppliers' incentives to take part in R&D and maybe reduce effort because of another supplier's subsidy. Third, the subsidy will increase the system integrators' cost and reduce one part of the integrators' profit. Therefore, there is a conflict among these effects. The overall effect of subsidy is ambiguous.

The complexity resulted from the subsidies compels us to explore how much (Cost Sharing ratio between integrator and supplier) and how to (subsidy distribution ratio between two suppliers) a sponsor should pay subsidies to the suppliers.

This paper focuses on a product development project of one system integrator and two suppliers. Among them, the system integrator provide R&D subsidy to develop a new product (or subsystem), require the two suppliers to compete on the quality of their results (technical solution, design scheme, prototype, etc.), and the supplier that turn over the best results will win production orders (Purchase commitment) as a reward.

In terms of Their high autonomy, one quantitative model based on Game theory was used in this paper to calculate the optimum R&D Cost-Sharing rate and realize the max total profit of supply chain.

2. RELEVANT LITERATURE

New product development has been a topic of significant research interest in the operations literature in recent years, but most of the literature on product development is single-firm-centric with its focus at the level of a project or, at best, a product line. More recently, there has been an emerging stream of work on the interactions between product and supply chain design decisions (Alex Hill, etc., 2012).

Articles trace HP's development of its highly profitable printer business to joint work with suppliers during different phases of its business (Cohen, C., etc., 2008). Even companies with a strong patent portfolio and research budgets such as IBM have begun forging joint-development agreements to meet the challenges of contemporary products and markets.

Sreekumar R (2009) conceptualize and formulate the joint development of products involving one sponsor and only one supplier, and shows that investment sharing is more attractive for new-to-the-world product projects with significant timing uncertainty, innovation sharing plays an important role in environments where projects experience product quality uncertainty.

Cohen (2008) pointed out that reward and subsidies have different functions, Specifically, when the development process involves a higher level of difficulty or uncertainty, the optimal R&D contest provides more subsidies and less reward (Cohen, C., etc., 2008).

The operational challenges of joint development are equally complex but relatively understudied (Kenneth J. Petersen, etc., 2005). Unlike manufacturing and assembly, where activities can sometimes be outsourced in an arms-length transfer of prices and quantities,

product development is an uncertain and long-lead-time activity with advance investments and joint work between firms that requires coordination about product features and qualities.

These above articles researched on cost-sharing and investment sharing mechanism of policy between suppliers and manufacturers and their effectiveness on R&D performance and supply chain efficiency, but most of them did not give quantitative proportion of apportionment or sharing, and were not involved in the competition between suppliers.

This paper, focused on collaborative product innovation involving one sponsor and two suppliers, borrows some model elements from this stream, but differs significantly in these following aspects: first, this paper expand R&D management from single-firm-centric management to multi-supplier collaborative R&D Management; second, it extended from qualitative analysis to quantitative model, to enable us to understand the interaction between the two suppliers and between suppliers and integrator in a complete model; third, it extended from a static model to a time-based dynamics interactive model, and explain the dynamic Games and gain the accurate conclusions.

3. Model

3.1 Basic assumptions

A sponsor (integrator), who is interested in an innovative product, but one new component in this product is difficult for development, therefore, it invites two R&D suppliers to carry out the development of this component in order to improve the success rate of R&D and gain more achievements by combining suppliers' results on time. The two suppliers, indexed by i=1, 2, develop and submit design results to the sponsor. The supplier that develops a higher-quality component (or subsystem) will win the R&D competition and then get the production orders with price of P_1 from the integrator. The integrator's goal is to maximize the expected quality and gain the maximum sale profit.

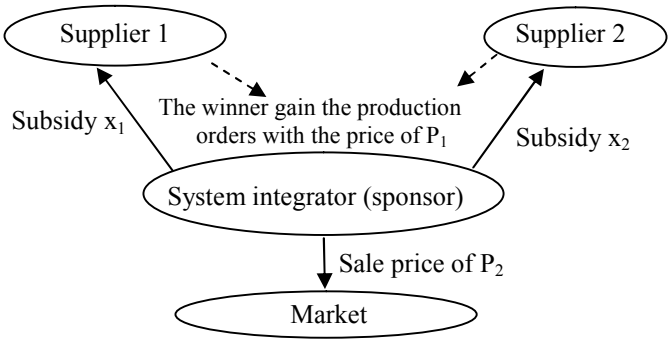

Figure 1. THE COLLABORATIVE CHAIN FOR R&D COST-SHARING PLAN

The integrator acts as the R&D sponsor and knows the suppliers well and can cooperate with them if a suitable mechanism of cooperative R&D was established. The two suppliers would not cooperate with each other because they compete with each other and the loser will lose the subsequent production orders, but they are influenced by each other's behavior.

Other assumptions include:

(1) Suppliers are responsible for research and development of the same one component, so R&D cost of components is borne by the suppliers.

(2) The R&D cost of components constructs the R&D cost of product.

(3) The system integrator sells the product in market with the price of P_2.

(4) The sale of the product is time-sensitive.

The dilemmas and tradeoffs faced by the integrator includes as follows:

(1) If the integrator pay much more subsidy to its suppliers, the integrator's R&D cost burden will be increased; but if pay less, its suppliers will delay the time-to-market because the suppliers will be lack of R&D input and innovation capability. the integrator have to explore the optimization of the cost-sharing ratio between integrator and suppliers for the maximum profit of supply chain.

(2) The two suppliers are not the same in innovation capability. If the integrator give much more subsidy to the supplier who is strong in innovation capability, the weak supplier will give up the R&D competition since the competition is hopeless for it, and then the strong supplier has no need to do its best since there is not competition; but if the integrator give much more subsidy to the weak supplier, the subsidy given to the weak supplier may be wasted, as the old saying "use the best steel to make the knife's edge". the integrator have to explore the optimization of the cost-sharing ratio between the two suppliers to inspire them effectively.

For the resolution of these tradeoffs, some dynamic parameters such as R&D cost, market capacity, demand, product sale, and some decision parameters such as time-to-market, product pricing, degree of product innovation , cost-sharing ratio are considered in the model.

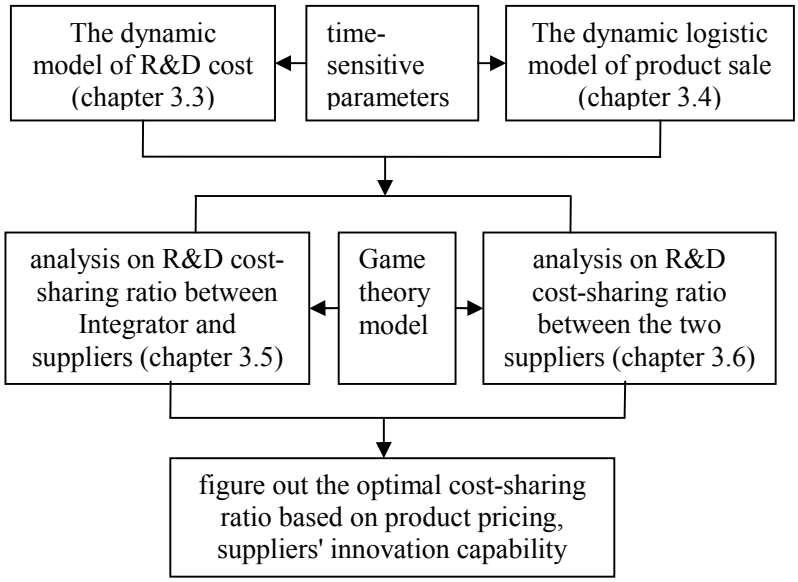

Figure 2. THE ANALYSIS PROCESS OF THIS PAPER

3.2 Notations

Table 1. NOTATIONS AND DEFINITIONS

Notation	Definition
E_i	the labor effort of supplier i in carrying out R&D
x_i	The R&D subsidy that supplier i gains from integrator;
a_i	The R&D innovation capability of supplier i.
R_1	R&D cost-sharing rate between integrator and supplier; R_1 = R&D cost shared by integrator / the total R & D cost

R_2	R&D subsidy -distribution rate between the two suppliers. R_2 = the subsidy that the first supplier got/ the subsidy that the second supplier got
A	A parameter in Logistic Equation. It means the number of the existing market demand for the product. A>= 0.
B	The demand elasticity of the level of research and innovation. B>= 0.
G	The demand elasticity of time-to-market. G>= 0.
I	The cost elasticity of the level of R&D innovation. I>= 0.
J	The cost elasticity of development time. J>= 0.
θ	The level of product innovation determined by the proportion of new functions and new technology in the product. 0<=θ<=1.
T	The development time in contract determined by supplier and Industry practices.
T_{end}	The time delisting in the market
D	The R&D time Corresponding to the lowest cost
P_1	The price of unit product sold to integrator from supplier winner.
P_2	The price of unit product sold in the market by integrator.
c	The total R&D cost of the component borne by the suppliers.

3.3 The dynamic model of R&D cost

Typically, while developing a new product, a company will work with customers to determine their desired level of innovation θ, which is relevant to R&D fixed cost and variable cost based on time. R&D fixed cost is the investment which start with the beginning of R&D process. It is a function of the level of innovation θ. It was assumed that R&D fixed cost function in the form of θ^{ρ} (ρ> 1) (Sreekumar R, etc., 2009). The formula "ρ> 1" means that increasing of the innovation level will lead to growing up of R&D fixed costs exponentially. From the viewpoint of Zenger (1994), assuming ρ = 2. The function of fixed R&D cost denoted as $I\theta^2$.

In addition to R&D fixed cost such as R&D equipment, companies will invest other resources such as designers' wages to promote R&D process, resulting in costs that changes with development time, namely, variable costs. The variable costs usually reach a minimum at the point D which means the suitable constant of product development time.

Typically, the shorter the product development time is, the less the variable costs will be. But if the product development time is shorter than T, enterprise resources such as new technology or equipment or exterior resource they need will increase at a rapid rate, and the R&D cost will be more instead of less.

Therefore, the variable cost shows a parabola nonlinear relationship with the development time shown in Fig. 2. For a parabola formula, the variable cost function can be denoted as $J(T-D)^2$.

At this point, we can get the total R&D cost including variable cost and fixed cost:

$$c = J(T-D)^2 + I\theta^2 \quad (1)$$

Note: I and J are constants being greater than zero.

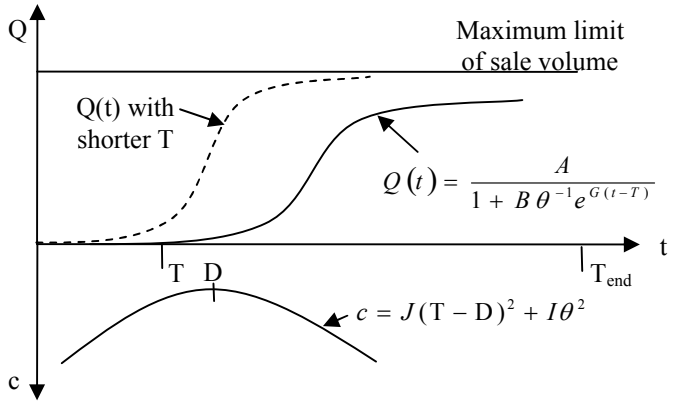

Figure 3. THE LOGISTIC EQUATION OF SALE VOLUME AND THE R&D COST CURVE

New product development time is constituted by the system integration time and the components development time. Since this paper study on how systems integrator to get the components on time and with good quality, so the system integrator's system integration time is no longer considered. At this point, new product development time depends on the development time of the components. The level of development time is related to supplier's R&D investment closely.

3.4 The dynamic logistic model of product sale

The logistic model has its roots in ecology in modelling population growth. Going beyond its roots in ecology, the logistic function has found applications in the diffusion of technologies and products. According to logistic growth functions:

$$Q(t) = \frac{A}{1 + B\theta^{-1}e^{Gt}} \tag{2}$$

Note: Q(t) represents sale volume in the time of t, A represents the maximum size of sale volume that the environment could support. B and G are constants in this equation and Q changes with time to produce a sigmoid or S-shaped curve, which was shown in Fig.3.

The level of innovation and development time will affect the market performance of the product. It was well known that under a certain price, the sooner to market and the greater level of innovation, the greater market share and the more the profits would be gained. At the end of the life cycle of the product (T_{end}), there will be great difference in accumulative sale volume if the T changes (the change of T_{end} was not considered in this paper).

Suppose the level of demand is impacted by the product innovation and the development time. The higher level of product innovation, the demand will increase. At the other hand, the sooner into market (left shift of T in fig.3), longer the sales cycle will be, and also higher the company's market share will be.

Concerning that the equation starts at the point of the product development time T, thus, the Logistic Equation was changed into:

$$Q = \int_{T}^{T_{end}} \frac{A}{1 + B\theta^{-1}e^{G(t-T)}} dt \tag{3}$$

Note: Q represents accumulative sale volume in the whole lifecycle time of this new product.

From the formula (3), we can see that the optimal development time should be less than D because the total profit will be more even though R&D cost increase.

3.5 Cost sharing ratio between suppliers and integrator

It is assumed that the suppliers and integrator have full information of each other's sales, demand function and cost structure. The order of decision-making is: first, integrator decides the share ratio, and then suppliers decide how much effort to R&D. Therefore, the Game between the suppliers and integrator is cooperative dynamic Game of complete information.

In order to motivate supplier to increase their R&D investment to reduce the development time T and gain more profit, system integrator often use R&D cost-sharing strategy, in which the system integrator bearing a part of suppliers' R&D costs, so that suppliers' R&D decisions tend to maximize the overall profit. This behavior reflects the principles of shared interests of both sides and risk-sharing. The following will analyze the optimal R&D cost-sharing ratio between the system integrator and the supplier and subsidy-distribution rate between the two suppliers.

The suppliers bear the R&D cost x_i (i=1,2) ,assuming $x = x_1+x_2$. x represents the total R&D cost that the two suppliers bear. Then, the system integrator bears the R&D cost c-x.

Then the supplier's profit function is presented:

Max (profit $_{\text{supplier}}$) =

$$Qp_1 - x = \int_T^{T_{end}} \frac{A}{1+B\theta^{-1}e^{G(t-T)}}dt - R_1 c$$

$$= \int_T^{T_{end}} \frac{A}{1+B\theta^{-1}e^{G(t-T)}}dt - R_1(J(T-D)^2 + I\theta^2) \tag{4}$$

The profit function of integrator is presented:

Max (profit $_{\text{integrator}}$)

$$= Q(p_2 - p_1) - c = \int_T^{T_{end}} \frac{A(p_2 - p_1)}{1+B\theta^{-1}e^{G(t-T)}}dt - (1-R_1)(J(T-D)^2 + I\theta^2) \tag{5}$$

When the supplier's R&D cost sharing ratio is R*, the relational group's interest is balanced. At that point, the supplier is lack of innovation motivation if increasing R, and integrator can not accept the scheme if decreasing R. in the mechanism of optimal R&D cost sharing ratio R*, the supplier would pay more effort to improve its innovation ability and shorten the development time T. As discussed above, the development time T play a key role in determining the sale volume and profit. In order to make out the optimal T to the maximum profit, the derivations of T according to (4) and (5) are shown below:

$$\frac{dprofit_{\ \text{sup}\ plier}(T)}{dT} = \frac{-Ap_1}{1+B\theta^{-1}e^{GT_{end}}} - 2R_1J(T-D) = 0 \tag{6}$$

$$\frac{dprofit_{\ \text{int}\ egrator}(T)}{dT} = \frac{-A(p_2-p_1)}{1+B\theta^{-1}e^{GT_{end}}} - 2(1-R_1)J(T-D) = 0 \tag{7}$$

The intersection point of curve (6) and (7) is the point of Nash Equilibrium. At this point of Nash Equilibrium, the supplier and the integrator adopt the development time T. Use equation (6) to divide equation (7) at both sides of the equations, and this equation was resulted:

$$\frac{R_1^*}{1-R_1^*} = \frac{P_1}{p_2 - p_1} \tag{8}$$

Therefore,

$$R_1^* = \frac{P_1}{P_2} \tag{9}$$

From (9), the supplier's optimal cost-sharing ratio is P_1/P_2. That means system integrator could use the size of the bear rate to influence the supplier's R&D innovation effort and development decisions, and the integrator and supplier gains respective satisfying profits.

3.6 Profit Analysis based on Game between two suppliers

It is assumed that the two suppliers do not have full information of each other, and do not know how much effort another supplier will pay on this R&D race. Therefore, the Game between the two suppliers is non-cooperative static Game of incomplete information.

The R&D output quality function $F(a_i, x_i, E_i)$ measures quality of R&D output of the supplier i. a_i reflects the supplier's R&D innovation ability, which is determined by its physical and human capital stock, e.g. the equipment and the knowledge or experience of the designers; x_i represents the R&D subsidy that supplier i gain; E_i represents the effort of supplier i in carrying out R&D, it could include time, energy and opportunities that were sacrificed to pursue this project.

The integrator divides her budget into three parts: direct subsidies to the two suppliers (x_i, i=1, 2) and an inducement winning prize (production order with price of P_1), with $x_1, x_2, P_1 \geq 0$. The integrator chooses the portfolio (x_1, x_2) to maximize the expected quality of the R&D output and the total profit brought from the product.

The quality of a supplier's product is determined by $F(a_i, x_i, E_i)$. Higher output quality lead to the supplier's success in winning the R&D competition. The supplier's effort (E_i) is a critical subjective factor, and it can make the objective factors including its research capacity (a_i) and the subsidy (x_i) to give full play in R&D activities, thus, the quality function $F(a_i, x_i, E_i)$ takes a multiplicative form:

$$F(a_i, x_i, E_i) = E_i \times (a_i \times x_i) \tag{10}$$

It means that the success of R&D depends on the supplier's subjective effort, its research and innovation capacity, and the subsidy from sponsor.

A higher R&D effort E_i implies that a higher quality is more likely to be realized, and that the supplier is more likely to leapfrog its rival. An intuitive interpretation of this family of models can be seen in Baye and Hoppe (2003).

The supplier i wins if and only if the quality of its design is better. The probability of the event was then given by:

$$P(F_i > F_j) = \frac{E_i(a_i \times x_i)}{E_i(a_i \times x_i) + E_j(a_j \times x_j)} \tag{11}$$

Each supplier i chooses its R&D effort Ei to maximize its profit by provide suitable design quality and R&D effort. For the sake of simple description, the gross profit brought by the winner's production orders is the sales volume ($Q \times P_1$) , and its input is E_1. Therefore, the Successful supplier's profit is ($Q \times P_1$-E_1).

The proposal of Supplier 1 is presented:

$$\text{Max} \quad (\text{profit}_1) = \frac{E_1(a_1 \times x_1)(QP_1 - E_1)}{E_1(a_1 \times x_1) + E_2(a_2 \times x_2)} \tag{12}$$

That of Supplier 2:

$$\text{Max}\ (\text{profit}_2) = \frac{E_2(a_2 \times x_2)(QP_1 - E_2)}{E_1(a_1 \times x_1) + E_2(a_2 \times x_2)} \quad (13)$$

In order to make out the optimal effort to the maximum profit, the derivations of E according to (12) and (13) are shown below:

$$\frac{d\text{profit}_1}{dE_1} = \frac{(a_1 \times x_1)(QP_1 - 2E_1)[E_1(a_1 \times x_1) + E_2(a_2 \times x_2)] - E_1(a_1 \times x_1)^2(QP_1 - E_1)}{[E_1(a_1 \times x_1) + E_2(a_2 \times x_2)]^2} = 0 \quad (14)$$

$$\frac{d\text{profit}_2}{dE_2} = \frac{(a_2 + x_2)(QP_1 - 2E_2)[E_1(a_1 \times x_1) + E_2(a_2 \times x_2)] - E_2(a_2 \times x_2)^2(QP_1 - E_2)}{[E_1(a_1 \times x_1) + E_2(a_2 \times x_2)]^2} = 0 \quad (15)$$

For respective maximum profit, the supplier reacts aiming at another supplier's R&D effort and offers effort as little as possible to win the competition. Based on (14), the reaction function of E_1 to E_2:

$$E_1^2(a_1 \times x_1) + 2E_1E_2(a_2 \times x_2) - QP_1E_2(a_2 \times x_2) = 0 \quad (16)$$

Based on (15), the reaction function of E_2 to E_1:

$$E_2^2(a_2 \times x_2) + 2E_1E_2(a_1 \times x_1) - QP_1E_1(a_1 \times x_1) = 0 \quad (17)$$

The intersection point of curve (16) and (17) is the point of Nash Equilibrium. At this point of Nash Equilibrium, each supplier exerts an optimal R&D effort:

$$E^* = \frac{[(a_1 \times x_1)(a_2 \times x_2)]QP_1}{[(a_1 \times x_1) + (a_2 \times x_2)]^2} \quad (18)$$

In this formula (18), we can see that E* will be smaller if there are much difference between $(a_1 \times x_1)$ and $(a_2 \times x_2)$, which means that one supplier is more powerful than another. Because the much more powerful supplier have no need to work hard to win the R&D competition to get the production orders, at the same time, the weak supplier will give up the competition and waste the subsidy. When $a_1 \times x_1 = a_2 \times x_2$, E* reach the maximum. Therefore, the optimal subsidy (x) should realize the equation:

$$a_1 \times x_1 = a_2 \times x_2 \quad (19)$$

$$R_2^* = \frac{x_1}{x_2} = \frac{a_2}{a_1} \quad (20)$$

At this time, the two suppliers will exert a maximum R&D effort which is the sponsor's expectation.

The conclusion by Game Theory are: There are two situations: if the two suppliers are the same powerful, then the sponsor should give them the equivalent subsidy; otherwise, give the weak supplier more subsidies, in order to stimulate suppliers to invest maximum efforts to obtain the victory of R&D competition; If R & D expenses are paid evenly (R_2=1), the vendor with strong R & D capability will lost enthusiasm of investment, because he is sure of the victory of R&D competition.

4. CONCLUSION

(1) Production and subsidy are dependent inspirit measures; if the R&D task is difficult, the subsidy should be given more; the weak vendor should be given more subsidy to balance the R&D race;

(2) The supplier's optimal cost-sharing ratio is P_1 / P_2, with which the integrator and supplier gains respective satisfying profits;

(3) In time of more and more significant new competitive economic environment, those enterprises which can be faster than its competitors sending new products to the market are more likely to succeed. Therefore, taking the time factor into account becomes necessary.

Care must be taken, however, in taking these conclusions to the extreme. First, if with more vendors, the situation will be much more complex and go beyond the scope of this paper. Some vendors are likely to be less active. The integrator can eliminate less active vendors with less subsidy plan, or pay more subsidies to activate the less active vendors.

Analytical tractability and expositional efficiency have limited our analysis to a stylized two-firm R&D tournament model. However, our main results would continue to hold in a more extensive setting, e.g., where more than two firms compete. However, the analysis for such a scenario is beyond the scope of the current paper. When more than two heterogenous firms compete, and a subset of firms are excessively disadvantaged against the favorites, they may stay inactive (i.e., exert zero effort) in the equilibrium. This possibility would greatly complicate the analysis, because the sponsor's budget allocation problem becomes discontinuous.

Second, firms tend not to trust one another. Thus, firms may feel that in a joint venture they will be giving away too many of their secrets, and prefer to stay at arms length. Similarly, cost sharing without a joint venture may require that each firm monitor the accounting books of the other firm—a clear intrusion into their private matters. Each firm has a clear incentive to agree on a high level of investment, and then spend less.

The result suggests that cost sharing usually leads to increased investment and profits compared with a fully competitive R&D market. However, cost sharing is not always the most profitable form of cooperation.

In this paper, we have assumed Logistic demand functions, R&D cost curve and some special model. However, the valuation framework we have developed and the numerical solutions we have implemented are quite general. We could allow for any reasonable demand function and joint stochastic processes describing the conditional expected cost to completion and quality of the R&D output. More R&D phases can also be considered without much complication.

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Applying the Two Stages Least Square to Explore the Impact of Income on Health

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Abstract

This study using the 2005 National Health Interview Survey obtained from the National Health Research Institutes and Bureau of Health promotion. Appling Yitzhaki Index and a two-stage least squares (2SLS) with two-equation simultaneous model to investigate the association of relative deprivation with health status and negative health behaviors. The empirical results indicate that the relative deprivation is an important factor in health status after controlling the socio-demographic characteristics and supports the relative deprivation hypothesis, implying that the higher relative deprivation accompanied with the poorer health status. And the results also support the higher relative deprivation increasing the probability of being a smoker, drinker or betel nut chewer, which indicates that the negative health behaviors plays an important transmission on the relationship between relative deprivation and health status. If the Government is aware of the relative deprivation as a result of unequal distribution of income and lead to worse health, the government not only provides better medical resources to improve individual's health, but also should pay attention to the income inequality, especially avoiding the widened gaps between the rich and the poor.

Keywords: relative deprivation, income distribution, Yitzhaki Index, two stages least square

Introduction

Some literatures had confirmed that income is closely associated with health. Feinstein (1993) pointed out that income and socio-economic status are significant negative with health status (mortality). Chiang (1999) explored the effects of household absolute income on mortality in the Taiwan and found there had significant negative relationship between them. Yang (2001) indicated that economic recession might lead to a decline in wages and income, tax revenue shortfalls, and government spending reduction, which cause the health situation worsen. However, when per capita income up to a certain level, some studies found relative income will replace the absolute income as an important factors influencing health status (Kaplan et al., 1996; Kennedy et al., 1996; Lynch et al., 1998; Rodgers, 1979; Waldman, 1992; Wilkinson, 1992a & 1992b).

The social economists had analyzed the social negative impacts caused by the unequal income distribution. Rodgers (1979) was the first study to investigate the impact of income distribution (Gini coefficient) on health (life expectancy, infant mortality rate) between cross-country comparison of the 56 countries. He found that the impact of unequal income distribution on health has a significant negative correlation. Thereafter, although the findings relating to the effect of income on health is controversial, most studies support income inequality have negative effects on health (Babones, 2008). Wilkinson (1992a) pointed out that when a country's economy develops to a certain extent, the degree of effect of absolute income on health will sharply reduced, on the contrary, relative income will play a major role on population health. While economic development has made a lot of people out of absolute poverty, the people with lower income feel deprived compared to the higher income peers. Being relatively deprived caused frustration, stress, shame, and might increase the probability of engaging in tobacco, alcohol or other risk behaviors,

which have negative impacts on health.

The concept of relative deprivation was derived from Stouffer et al. in 1949. The "social comparison theory" proposed by Festinger (1954) also supports the relative deprivation. Both of them think that people assess their status through comparing with others. Runciman (1966) articulated the sense of relative deprivation, positing that a person is relatively deprived if (i) he does not have X, (ii) he sees the other or others who have X, (iii) he wants X, and (iv) he sees it as feasible that he should have X. That is, someone feels relatively deprived if others possess something that he does not. By this definition, Yitzhaki (1979) developed a mathematical formulation, called “Yitzhaki Index” for relative deprivation in income, which is $RD_i = \frac{1}{N}\sum_j (y_j - y_i) \quad \forall y_j > y_i$. In brief, relative deprivation for each individual is the sum of shortfall in income between that individual and everyone else with higher incomes and divided by the total number of people in the reference group.

There have been some studies to investigate the impact of relative deprivation on health status. Eibner et al.(2004) used the individual level data and applied Yitzhaki Index” to test whether an individual’s income affects mental health outcomes. Their findings supported the hypothesis of relative deprivation which indicated that those with lower relative income have a higher risk of suffering from mental illness, including depressive and anxiety disorders. In 2005, the study of Eibner & Evans (2005) also consisted with relative deprivation. They pointed out higher relative deprivation in the sense of Yitzhaki is associated with poor self-rated health, higher probability of death, worse activity restrictions, higher body mass index and higher risk behaviors. Kondo et al. (2008) also gained the conclusion that elative deprivation is highly correlated with poor self-reported health. In addition, Kondo et al. (2009) tested the relationship between relative deprivation and the incidence of disability among Japanese elderly and confirmed the positive correlation

between them. Furthermore, Subramanyam et al.(2009) and Mangyo & Park(2011) also verified that relative deprivation was associated with poor self-rated health.

However, there still have some empirical studies with unsupportive findings for the hypothesis of relative deprivation. Lorgelly & Lindley (2008) explored the impact of absolute income and relative income on self-reported health, the finding is no support for the relative income hypothesis, but support for the absolute income hypothesis. Applying the same British Household Panel Survey data, Jones & Wildman(2008) pointed out no strong evidence for the impact of relative deprivation on the self-reported measures of health. Similarly, Gravelle & Sutton(2009) provided very week support for the relative deprivation hypothesis.

In spite of the controversial results among the different empirical studies, most of the literatures attempted to use the individual-level data rather than aggregate-level data to test relative deprivation hypothesis as this requires measures of each individual's income and everyone else with higher incomes in the reference group (Gravelle & Sutton, 2009). The self-rated health are often viewed as the outcome of interest (Eibner & Evans, 2005; Gravelle & Sutton, 2009; Jones & Wildman, 2008; Kondo et al., 2008; Lorgelly & Lindley, 2008; Subramanyam et al., 2009). The possible reason for different results among these studies is probably stemmed from the different categories for self-rated health status. Kondo et al. (2008) created a dichotomous outcome measure for self-rated health, good and poor. Lorgelly & Lindley(2008) divided self-rated health into four categories, such as excellent, good, regular, and poor. In addition, applying the different regression model and controlled variables may be another cause of different empirical results.

As the medical technology, what is meant by "health" have different interpretations. The World Health Organization (WHO) pointed out that "Health is a state of complete physical, mental and social well-being and not merely the absence

of disease or infirmity (Breslow, 1972). Therefore, health is no longer defined simply in physical terms, as the absence of disease or disability, but now includes mental and social dimensions. The 36-Item Short-Form Health Survey (SF-36) is a measure of health status containing 36 items which evaluates health on eight dimensions covering physical, psychological and social dimension of health. The SF-36 is a questionnaire commonly used to measure health status in general owing to its good reliability and validity of health assessment (Ware et al., 1993). In this study, we apply SF-36 rather than only self-rated health as the dependent variable for the empirical analysis.

Prior studies have found that lower relative income accompanied higher relative deprivation will contribute to socioeconomic disparities in mental health (Eibner et al., 2004). Alternatively, those who are relatively deprived, leading to stress or frustration will further via unhealthy behaviors, including smoking, drinking, betel nut chewing, etc to endanger health (Adjaye-Gbewonyo & Kawachi, 2012; Eibner & Evans, 2005; Eibner et al., 2004; Siahpush et al., 2006). Therefore, relatively deprivation affects health through risky behaviors. However, there is no study to estimate the impact of relative deprivation on health status and negative health behaviors with two-equation simultaneous model which take the endogeneity under consideration.

Differing from previous literatures, the objective of this study is to investigate the association of relative deprivation with health status and negative health behaviors constructing two-equation simultaneous model to avoid the problem of endogeneity. By utilizing the 2005 National Health Interview Survey, which is a nationwide population-based data to explore the relationships.

Methods

Database and Study Sample

This study using the 2005 National Health Interview Survey (NHIS) obtained from the National Health Research Institutes (NHRI) and Bureau of Health promotion (BHP). This survey provide nationwide population estimates within Taiwan's 23 administrative districts using face-to-face interviews and multi-stage stratified systematic sampling design methods. There were 30,680 interviewees and 24,726 of them completed the interview, including three kinds of questionnairs for three groups: age below 12, 12-64, and above 65. The numbers of completed interviews for the three age groups were 3,900, 18,099, and 2,727 respectively. The database provide detailed information including individual demographic and socioeconomic characteristics (gender, age, marriage situation, highest education and income, ethnic group and place of residence), personal health status (SF-36 measurement, history of chronic diseases, history of family diseases and limitations in activities of daily living, ADLs), utilization of medical and preventive care services (outpatient, inpatient, emergency services and awareness of preventive care services), personal health behaviors (smoking, drinking, betel nut chewing, exercise, eating behavior and awareness of betel nut chewing), long-term care, mini-mental status exmnation (MMSE), and health status.

This study focuses on the questionnaire for the group aged between 12-64 since only the 12-64 interviewees were asked the SF-36 measurement, and those people aged below 18 are forbidden for smoking, drinking and betel nut chewing in Taiwan. In addition, the person aged between 18-24 are often still a student not in employment, and remain dependent on family for economics, as a result, it is not enough to calculate the personal relative deprivation. Therefore, we consider the individuals aged 25-64, excluding students and housewives who are more likely to be

dependent economically in the following analysis. After discarding observations below the age of 24, missing or incomplete data, we total of 12,806 individuals for inclusion in this study.

Analytical methodology

Previous literatures pointed out the impact of relative deprivation on health status via risky behaviors owing to the stress, low self-esteem and depressed caused by relative deprivation. The relative deprivation is also an important determinant of whether an individual to engage some negative health behaviors. The negative health behaviors, no doubt, affected by other factors and were not suitable to be treated as an independent variable in the estimation. In order to controlling for endogeneity of negative health behaviors, we treat both health status and negative health behaviors as two dependent variables and a two-stage least squares (2SLS) with two-equation simultaneous model being applied to solve the endogenous variable exist in the estimation. The two-equation empirical model can be expressed as follows:

$$\text{Health} = \alpha_0 + \alpha_1 \text{Badbehavior} + \alpha_2 \text{RD} + \alpha_3 \text{X} + \varepsilon \quad (1)$$

$$\text{Badbehavior} = \beta_0 + \beta_1 \text{RD} + \beta_2 \text{Aware} + \beta_3 \text{X} + \mu \quad (2)$$

Where “Health” is the sum of scores for SF-36 about repondent’s health status, and “Badbehavior” is a composite score about the negative health behaviors (whether the respondent is being a smoker, drinker or betel nut chewer). “RD” is the relative deprivation symptoms calculated from Yitzhaki Index. “Aware” was determined through two questions about the awareness associated with betel nut chewing. “X” represents the control variables which are seen as influencing the estimation of health status and negative health behaviors. α_0 , β_0 are constants; α_1, α_2, α_3, β_1, β_2, β_3 are the coefficients; and ε, μ are the residuals.

Principal variables

The dependent variable, defined as health status, is measured from the 36-Item Short-Form Health Survey (SF-36). The SF-36 as measures 36 items of physical and mental health constructs, including multi-item scale that assesses eight health concepts: (i) physical functioning (PF, 10 items) (ii) role limitations due to physical health problems (RP, 4 items) (iii) bodily pain (BP, 2 items) (iv) general health perceptions (GH, 5 items) (v) vitality (VT, 4 items) (vi) social functioning (SF, 2 items) (vii) role limitations due to emotional problems (RE, 3 items) and (viii) general mental health (MH, 5 items). It also includes a single item that provides an indication of health transition (HT). The health status is based on a composite score obtained by calculating the SF-36 excluding the item of health transition (HT)[1]. The higher scores indicate better health status. More details on the health status indicator composition can be found in Appendix A.

The variable of negative health behavior is a composite score obtained by calculating whether the respondent is being a smoker, drinker or betel nut chewer. We regarded an individual is a smoker if he smoked at least 5 bags (100 cigarettes) from past to present and has ever smoked during the past month. For drinking, the respondent regarded as a drinker if he drinks at least once 2-3 days. We regarded an individual as a betel nut chewer if he has ever chewed betel nut during the past six months. For those who regarded as a smoker, drinker or betel nut chewer with a score of 1, otherwise 0. The higher scores indicate the higher likelihood of being a smoker, drinker or betel nut chewer.

The key independent variable of interest to this study was the relative deprivation in income which is a mathematical formulation calculated from Yitzhaki

[1] This item is not included in the eight dimensions nor is it scored.

Index which derived from Runciman's theory, that is $RD_i = \frac{1}{N}\sum_j (y_j - y_i) \quad \forall\, y_j > y_i$.

It indicates that relative deprivation for individual i is based on the differences in incomes between individual i and the j individuals who have incomes higher than individual i, divided by the total number of people in the reference group (N). We assume a individual compares himself to others in his reference group based on his own income. The individual's income measure used to calculate relative deprivation is set at the midpoint of the income interval from the 2005 NHIS, for example, for the 0-5,000 interval, income is set at 2,500 (Eibner & Evans, 2005). Until now, it is difficult to define reference group specifically according to similarity. Literatures found that individuals may compare themselves with others of similar socio-demopraphic backgrounds, such as sex, age, education and geographical location. Unlike Europe and America, the territory of Taiwan is small. To avoid too few samples in the comparison group, we construct references groups based on socio-demopraphic characteristics such as sex, age, education. We also created references groups defined by the combinations of these variables. In this study, the reference groups are defined in eight different ways, including all study samples, Gender, Age, Education, Gender + Age, Gender + Education, Age + Education and Gender + Age + Education.

A variety of socio- demographic variables are also controlled in this analysis. They are respondent's average monthly income (including salaries, rental and investment incomes and pension benefits), gender, age, marital status, education level, father's ethnicity and residential locations. The instrument variable used in this study is awareness of betel nut chewing summed for 2 questions about the awareness associated with betel nut chewing. The higher scores indicate better Awareness of betel nut chewing. Full detailed definitions of dependent and independent variables are provided in Table 1.

Table 1：Definitions of Dependent and Independent Variables

Variables	Definition
Dependent Variables	
Health Status	Sum of scores for SF-36 about respondent's health Status including multi-item scale that assesses eight health concepts. The higher scores indicate better health status.
Negative Health Behaviors	A composite score obtained by calculating whether the respondent is being a smoker, drinker or betel nut chewer. The higher scores indicate the higher likelihood of being a smoker, drinker or chewing betel nuts.
Independent Variables	
Relative Deprivation	A mathematical formulation calculated from Yitzhaki Index (1979), the reference groups are defined by 8 types, including: all study samples, Gender, Age, Education, Gender+Age, Gender+Education, Age+Education and Gender+Age+Education.
Control Variables	
Absolute Income	respondent's average monthly income (including salaries, rental and investment incomes and pension benefits)
0	respondent's income is 0 is the reference category
1-19999	Dummy variable=1 if respondent's income is in this range, otherwise=0
20000-39999	Dummy variable=1 if respondent's income is in this range, otherwise=0
40000-59999	Dummy variable=1 if respondent's income is in this range, otherwise=0
60000 and above	Dummy variable=1 if respondent's income is in this range, otherwise=0
Gender	Dummy variable=1 if respondent is male, otherwise = 0
Age	
25–34	Dummy variable=1 if respondent's age is in this range, otherwise=0
35–44	Dummy variable=1 if respondent's age is in this range, otherwise=0
45–54	Dummy variable=1 if respondent's age is in this range, otherwise=0
55–64	respondent's age in this range is the reference category
Marital Status	Dummy variable=1 if respondent has a spouse, otherwise=0
Education Level	
Primary school and below	respondent finished Primary school and below is the reference category
Junior high	Dummy variable=1 if respondent finished Junior high school, otherwise=0
Senior high	Dummy variable=1 if respondent finished Senior high school, otherwise=0
College and above	Dummy variable=1 if respondent finished College and above, otherwise=0
Father's Ethnicity	
Hokkien	respondent's father is Hokkien is the reference category
Hakka	Dummy variable=1 If respondent's father is Hakka, otherwise = 0
Mainlander	Dummy variable=1 If respondent's father is Mainlander, otherwise = 0
Other	Dummy variable=1 If respondent's father is a aborigine or a foreigner, otherwise = 0
Residential Locations	
Northern area	If the individual is resident in Taipei city, Keelung city, Hsinchu city, Taipei county, Taoyuan county, Hsinchu county, Miaoli county, or Ilan county; yes = 1, otherwise = 0 (reference category)
Central area	If the individual is resident in Taichung city, Taichung county, Changhua county, Nantou county, or Yunlin county; yes = 1, otherwise = 0
Southern area	If the individual is resident in Kaohsiung city, Tainan city, Chiayi city, Kaohsiung county, Tainan county, Chiayi county, or Pingtung county; yes = 1, otherwise = 0
Eastern area	If the individual is resident in Taitung county, Hualien county, or Penghu county; yes = 1, otherwise = 0
Instrument Variable	
Awareness	Sum of scores for 2 questions about the awareness associated with betel nut chewing. The higher scores indicate better Awareness of betel nut chewing.

Results

Descriptive statistics

As shown in Table 2, the health status measured by the SF-36, ranging from 35 (the worst health) to 145 (the best health), the mean of the health status variable in this sample was about 121.08. The mean score of the negative health behaviors is 0.51, ranging from 0 (the slightest) to 3 (the heaviest). The variable of awareness of betel nut chewing was ranged from 0 (full misinformation) to 2 (full information) and the mean was 1.36. Table 2 showed that the measures of relative deprivation derived from Yitzhaki Index varied from 1.03 to 1.31, depending on the type of references group that was fitted.

The individual's average monthly income (including salaries, rental and investment incomes and pension benefits) was divided into five groups. The largest group consisted of those whose average monthly income was NTD 20,000-39,999 and accounted for about 34%. The reference group of those whose monthly income was 0 and they accounted for 15% of the overall sample. The respondents with monthly income of 60,000 and above accounted about for 10% of the interviewees. In the overall sample, approximately 50% of the observations were male. In terms of age, was divided into four groups, with 55-64 as the reference group, and around 16% of them were in the 55-64 age range, the smallest group of the sample. Respondents were in the 25-34, 35-44 and 45-54 age range were roughly the same proportion of about 26-29%. Over 70% of the respondents had partner living together regardless of whether they were married or not. Approximately 32% of the participants had graduated from senior high school, college or above (30%). Almost 17% of the participants had no more than an elementary school education. More than three-quarters of respondents reported that their father's ethnicity was Hokkien. As for the geographical distribution of our samples, 46% of the participants were located

in the northern area of Taiwan, 20% were in the central area, 26% were in the southern area, and 8% were in the eastern area.

Table 2：Descriptive statistics of the variables

Variables	Mean	Standard Deviation	Minimum	Maximum
Dependent Variables				
Health Status	121.082	16.399	35	145
Negative Health Behaviors	0.507	0.824	0	3
Independent Variables				
Relative Deprivation				
All study samples	1.311	0.983	0	2.981
Gender	1.231	0.957	0	3.753
Age	1.242	0.955	0	3.435
Education	1.143	0.961	0	4.374
Gender + Age	1.156	0.928	0	4.347
Gender + Education	1.193	1.010	0	4.994
Age + Education	1.098	1.006	0	5.503
Gender + Age + Education	1.029	0.970	0	6.182
Control Variables				
Absolute Income				
0	0.150	0.357	0	1
1-19999	0.241	0.428	0	1
20000-39999	0.343	0.475	0	1
40000-59999	0.169	0.375	0	1
60000 and above	0.097	0.296	0	1
Gender				
Male	0.505	0.500	0	1
Female	0.495	0.500	0	1
Age				
25–34	0.284	0.451	0	1
35–44	0.294	0.455	0	1
45–54	0.264	0.441	0	1
55–64	0.158	0.365	0	1
Marital Status				
spouse	0.722	0.448	0	1
Education Level				
Primary school and below	0.211	0.408	0	1
Junior high	0.173	0.378	0	1
Senior high	0.317	0.465	0	1
College and above	0.299	0.458	0	1
Father’s Ethnicity				
Hokkien	0.754	0.431	0	1
Hakka	0.126	0.332	0	1
Mainlander	0.095	0.294	0	1
Other	0.025	0.156	0	1
Residential Locations				
Northern area	0.463	0.499	0	1
Central area	0.201	0.400	0	1
Southern area	0.258	0.438	0	1
Eastern area	0.078	0.268	0	1
Instrument Variable				
Awareness	1.356	0.657	0	2

Regression results

Table 3 and 4 present the results estimating the system of equations using 2SLS method. According to Table 3, after controlling the negative health behaviors, absolute income, gender, age, marital status, educational attainment, father's ethnicity and region of residence, individuals who had higher relative deprivation had significant poorer health except the comparison groups are defined as education and gender + education. Table 3 reveals that the individuals have significant worse health status when they have higher degree of negative health behaviors. The results also show that the relationship between absolute income and health status are significant positive gradient except the reference groups are defined as gender and age. Male's health status has also shown significantly better than women. The interviewees who were under the age of 55 had a significantly better health status compared to those who were aged 55-64. As compared to the individuals who graduated from elementary school or below, those who had junior high school attainment had a significantly positive health status. While individuals graduated from senior high school, college and above had negative health status compared to those graduated from elementary school or below. As compared to the northern area of Taiwan, individuals located in the southern and eastern areas were found to have a significantly positive health status.

Table 4 shows the estimation results of the effect of relative deprivation on negative health behaviors. It shows that the greater of relative deprivation, the higher likelihood of being smokers, drinkers or chewing betel nuts. The awareness of betel nut chewing significantly decreased the likelihood of having negative health behaviors. We also found that male, higher average monthly income, younger, lower education attainment and located in no-northern areas are significantly higher likelihood of being smokers, drinkers or chewing betel nuts.

Table 3：Regression analysis of health status

Independent Variables								
Relative Deprivation								
All study samples	-7.15***							
Gender		-3.39***						
Age			-4.77***					
Education				2.32**				
Gender + Age					-1.14*			
Gender + Education						2.46**		
Age + Education							-3.02***	
Gender + Age + Education								-2.66***
Negative Health Behaviors	-33.49***	-33.47***	-34.11***	-34.22***	-33.96***	-34.54***	-33.98***	-34.29***
Control Variables								
Absolute Income								
0	reference category							
1-19999	2.43^{+}	1.42	0.04	6.26***	3.32**	6.14***	7.03***	6.24***
20000-39999	5.58*	2.75	0.35	13.93***	7.21***	13.85***	15.86***	14.25***
40000-59999	8.33*	1.60	2.00	16.60***	7.47**	16.82***	19.04***	17.22***
60000 以上	10.59**	0.14	3.66	17.18***	6.55*	17.78***	20.27***	18.25***
Gender								
Male	28.31***	31.43***	28.81***	28.82***	29.74***	26.59***	28.54***	26.84***
Age								
25–34	9.16***	9.22***	12.48***	9.76***	10.33***	9.98***	10.71***	10.47***
35–44	8.89***	8.95***	13.71***	9.53***	10.38***	9.74***	8.73***	8.90***
45–54	4.04***	4.13***	7.98***	4.45***	5.26***	4.58***	3.20***	3.48***
55–64	reference category							
Marital Status								
spouse	0.73	0.64	0.83	0.82	0.80	0.94	0.68	0.78
Education Level								
Primary school and below	reference category							
Junior high	5.69***	6.01***	6.35***	4.39***	6.22***	3.27**	3.54***	4.67***
Senior high	-0.83	-0.50	-0.29	-3.17*	-0.37	-2.92^{+}	-4.63**	-3.37*
College and above	-13.09***	-12.65***	-12.86***	-17.51***	-12.83***	-17.49***	-19.64***	-18.04***
Father's Ethnicity								
Hokkien	reference category							
Hakka	0.74	0.70	0.66	0.66	0.65	0.68	0.70	0.65
Mainlander	0.32	0.30	0.38	0.34	0.32	0.34	0.14	0.19
Other	11.73***	11.50***	12.10***	11.82***	11.79***	12.00***	11.43***	11.66***
Residential Locations								
Northern area	reference category							
Central area	1.19^{+}	1.17^{+}	1.17	1.15	1.16	1.15	1.14	1.14
Southern area	2.24***	2.21***	2.23***	2.22***	2.21***	2.22***	2.21***	2.19***
Eastern area	4.25***	4.27***	4.42***	4.39***	4.35***	4.43***	4.29***	4.35***

*** p<0.001，** p<0.01，* p<0.05，+ p<0.1

Table 4：Regression analysis of Negative Health Behaviors

Independent Variables								
Relative Deprivation								
All study samples	0.02*							
Gender		0.09***						
Age			0.03*					
Education				0.08***				
Gender + Age					0.09***			
Gender + Education						0.12***		
Age + Education							0.12***	
Gender + Age + Education								0.13***
Instrument Variable								
Awareness	-0.09***	-0.09***	-0.09***	-0.09***	-0.09***	-0.09***	-0.09***	-0.09***
Control Variables								
Absolute Income								
0	reference category							
1-19999	0.05	0.10***	0.00	0.10***	0.09***	0.12***	0.13***	0.13***
20000-39999	0.12^{+}	0.25***	0.02	0.23***	0.24***	0.29***	0.30***	0.31***
40000-59999	0.16*	0.35***	0.04	0.32***	0.33***	0.42***	0.41***	0.44***
60000 and above	0.14	0.36***	0.01	0.34***	0.34***	0.47***	0.45***	0.49***
Gender								
Male	0.80***	0.71***	0.80***	0.79***	0.72***	0.67***	0.79***	0.69***
Age								
25–34	0.24***	0.25***	0.26***	0.24***	0.20***	0.25***	0.28***	0.27***
35–44	0.25***	0.26***	0.27***	0.25***	0.18***	0.25***	0.22***	0.21***
45–54	0.10***	0.11***	0.12***	0.10***	0.04^{+}	0.10***	0.05**	0.05*
55–64	reference category							
Marital Status								
Spouse	-0.08***	-0.07***	-0.08***	-0.08***	-0.08***	-0.07***	-0.08***	-0.08***
Education Level								
Primary school and below	reference category							
Junior high	0.09***	0.09***	0.09***	0.03	0.08***	-0.05^{+}	0.00	0.02
Senior high	-0.12***	-0.12***	-0.12***	-0.21***	-0.13***	-0.23***	-0.26***	-0.26***
College and above	-0.47***	-0.47***	-0.47***	-0.62***	-0.48***	-0.68***	-0.70***	-0.71***
Father's Ethnicity								
Hokkien	reference category							
Hakka	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mainlander	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*
Other	0.38***	0.38***	0.38***	0.38***	0.38***	0.38***	0.37***	0.37***
Residential locations								
Northern area	reference category							
Central area	0.04**	0.04**	0.04**	0.04**	0.04**	0.04**	0.04**	0.04**
Southern area	0.05**	0.05**	0.05**	0.05**	0.05**	0.05**	0.05**	0.05**
Eastern area	0.14***	0.14***	0.14***	0.14***	0.14***	0.14***	0.14***	0.14***

*** p<0.001，** p<0.01，* p<0.05，+ p<0.1

Discussion

As the socio-economic development and per capita income rising, the interplay between relative deprivation stemmed from income inequality and health has become an important topic. In Taiwan, the situation of unequal income distribution appears to have been more severe, the inequality of the income distribution among the five equal divisions of households rises from 4.17 times in 1980 to 6.17 times in 2011. It is important to pay attention to whether the income inequality has a negative impact on individual health in Taiwan.

A variety of literatures measure of income-based relative deprivation is based on Runciman's definition (1966) and subsequent Yitzhaki Index developed by Yitzhaki (1979). In this study, still applying Yitzhaki Index to define individual's RD, which calculated the cumulative difference between the income of an individual and all those with greater income within a reference group. While large of studies have examined the impact of relative deprivation on health, whether or not income inequality is a determinant of population health remains a controversial issue. Almost three-quarters of all empirical studies were classified as either wholly or partially supportive the RD hypothesis, the explanations for the unsupported RD hypothesis reported by a minority of studies is the analysed data for areas used to measure inequality is too small to reflect the differences between different individual (Wilkinson & Pickett, 2006). Wilkinson & Pickett (2006) indicated the different measure for health status variable is another factor for the distinct findings.

This is the first study to viewed health status as summed of scores for SF-36, which including physical, psychological and social dimension of health, not merely only the physical or psychological dimension. In addition, relative deprivation is a crucial factor in the negative health behaviors and we treated the negative health behaviors as a dependent variable. Therefore, this is the first one to apply 3SLS with

two-equation simultaneous model and use instrumental variable with the consideration for endogeneity to estimate the impact of relative deprivation on health behavior and health status.

The specific choice of reference group is still a difficult problem in the empirical test. Most studies assume that individuals compare their income with those who are similar to them with regard to the similar gender, age, education status, region of residence, etc. In this study, the reference groups are constructed by gender, age, education, and the combinations such as gender and age, gender and education, age and education, gender and age and education. In order to prevent the number of samples too small to reflect the differences between individuals, the region of residence excluded from the reference group because of the small territory of Taiwan.

The empirical results indicate that the relative deprivation is an important factor in health status after controlling the socio-demographic characteristics (including average income, gender, age, marital status, education level, father's ethnicity and residential locations). In general, the finding of this study supports the relative deprivation hypothesis, implying that the higher relative deprivation accompanied with the poorer health status and the same as the studies of Eibner et al. (2004), Eibner&Evans (2005), Kondo et al. (2008), Kondo et al. (2009), Subramanyam et al. (2009) and Mangyo&Park (2011). However, when the comparison groups are defined as education and gender + education, the associations between RD and health status are significant positive, suggesting those with similar education attainment, the same gender and education level, the relative lower income individuals have better health status. This is probably because the SF-36 measurement covers personal physical, psychological and the social field of health, although higher education accompanied with higher income, whether due to a heavier responsibility to cause

stress, anxiety, depression, fatigue and exhaustion phenomena, resulted in poor health estimation results.

It is worthwhile to note that the meaning of education level is different with age, For example, 60 and 30 years of age as a college degree, or 60 and 30 years of age and the same gender as a college degree, both of them have age difference with 30 years, represented the social status of very different significance. Therefore, take age into account for reference group is more reasonable. When there is inclusion the factor of age in the comparison groups, regardless of age, gender + age, age + education, gender + age + education, health status with higher relative deprivation significantly poorer results, consistent with the hypothesis of relative deprivation.

On the estimation of negative health behaviors, regardless of the reference group, the higher relative deprivation increasing the probability of being a smoker, drinker or betel nut chewer. This result supports the relevant literatures found that the higher relatively deprived, through cigarettes, alcohol and betel nuts to alleviate psychological emotions such as anger, frustration and stress (Conway et al., 1981; Gorman, 1988; Horwitz & Davies, 1994; Wilkinson, 1996; Kristenson et al., 1999; Jensen & Richter, 2004). Comparing Tables 3 and Table 4, the effect of relative deprivation on negative health behaviors is more consistent than on health status, which indicates that the negative health behaviors plays an important transmission on the relationship between relative deprivation and health status.

As expected, the negative health behaviors had negative significant effect on health status. Those with higher cognition on chewing betel nuts, the risk of smoking, drinking or chewing betel nuts often significantly lower. On the other control variables, Table 3 shows the higher absolute income, male and younger individuals have better health status. Compared to the primary school and below, graduated from junior high school have better health status, but graduated from senior high school

have worse health status. Whether it means the social responsibility for those with higher education due to pressure, anxiety, depression, fatigue and exhaustion, as a result, lead to poorer health outcomes and this is worthy for further exploration.

Furthermore, compared to northern residents, living in the southern and eastern regions have significantly better health. In the northern region, there are more plentiful resources, higher degree of economic development and urbanization, however high population densities causing the crowded and under the pressure of high commodity prices, the individuals resided in northern region are reported poorer health status than the southern and eastern areas.

As shown in table 4, the effect of absolute income on negative health behaviors is positive. This finding implies that the cigarettes, alcohol and betel nuts are normal goods, thus higher income individuals would increase consumption of cigarettes, alcohol and betel nuts. As expectation, those people who are male, younger and no spouse have positive significant effect on negative health behavior. Compared to the primary school and below, residents recorded of junior high school, college and above attainment have significant lower probability of having negative health behaviors. This indicates higher educated individuals tend to be more health conscious and had greater awareness of the damage of smoking, drinking and chewing betel nuts and would have less incentive to engage in such behaviors.

This study uses the individual's average monthly income to calculate the relative deprivation arising from income inequality, because individuals often compare their income with others, regardless of the distribution of household income (Subramanyam et al., 2009). The study samples excluding those who are students and housewives because of a lack of personal income information to calculate the relative deprivation. The personal average monthly income from 2005 NHIS is an ordinal number type, not the real income of individuals. Confining to the dataset, this

study set the midpoint of the income interval as the personal income. In consequence, the relative deprivation calculated in this study may be inconsistent with the reality, and this is the inherent limitation of this study.

Secondly, the sense of relative deprivation is a subjective experience, whereas the Yitzhaki Index caused by unequal distribution of income is an objective norm. Owing to personal subjective experience cannot be provided from the data, along with previous studies, this study assumes that individual subjective experience is similar to Yitzhaki Index calculated from the objective norm. Another limitation of this study is that the Yitzhaki Index calculated under the assumption that everyone knows the real income of others, but in fact, individuals may not know everyone else's actual income. Finally, the 2005 NHIS database used in this research is a cross section, so that it provides information in 2005. Thus, we are unable to analyze the effect of negative health behaviors for a long term. In general, once a person engages in smoking, drinking and betel nut chewing, it is difficult to quit these habits. Although only one year of data is being used, the empirical results also provide us the valuable information.

Notwithstanding these limitations, this article verify the relative deprivation of income inequality will through psychological resentment, anger, stress and other emotions, transfer for the consumption of tobacco, alcohol and betel nuts, which are hazardous to health. How to improve physical and mental health of the people appears to be the responsibility for health agencies, nevertheless to improve the income distribution inequality is the obligation for the Bureau of finance authorities. If the Government is aware of the relative deprivation as a result of unequal distribution of income and lead to worse health, the government not only provides better medical resources to improve individual’s health, but also should pay attention

to the income inequality, especially avoiding the widened gaps between the rich and the poor.

In addition, government also developed related policies to prevent people from smoking and drinking. The Tobacco Hazards Prevention Control Act has been implemented since September 1997, and a health and welfare surcharge has been applied to tobacco products since 2002, moreover, government has made efforts to amend laws to deter drunk driving accidents since April 1999. Although legislation to curb tobacco and alcohol consumption, if income inequality cannot be improved, individuals may turn to other negative health behaviors to reduce psychological resentment as a result of relatively deprivation, this is should be under consideration for government authorities.

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APPLIED ANALYTICS IN MANUFACTURING: A CASE STUDY IN THE AUTOMOTIVE INDUSTRY

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ABSTRACT
The automobile industry has become more and more complex, involving a variety of sub-sectors across the supply chain. The pressure on the production business is continually increasing. Many manufacturing enterprises are facing challenges to generating good demand forecast, effectively managing inventory, and diagnosing the root causes of defects. In this study, a case is conducted for how analytics can help automotive industry leaders tackle those challenges and pressures and make better strategic decision. By validating this framework with several scenarios in an automobile manufacturing company in Thailand, the results demonstrate the practical validity of our approach.

Keywords: Analytics, Manufacturing, Data Mining

INTRODUCTION

The automobile industry has become more and more complex, involving a variety of sub-sectors across the supply chain. Drastic changes in the automobile markets over the last decades have increased the pressure on the production business. The first challenge is to speed up the new products to the market; thus, generating good demand forecasts is critical (Aburto & Weber, 2007; Carbonneau, Laframboise, & Vahidov, 2008; Chase Jr, 2009; Rey & Kauhl, 2013). Many organizations are also facing difficulty in diagnosing the root causes of defects, especially in high-tech manufacturing industries (Chien, Wang, & Cheng, 2007; çiflikli & Kahya-Özyirmidokuz, 2010). Another challenge is how to effectively manage inventory and how much of each product should be stored, ordered, or manufactured in order to achieve the highest level of customer satisfaction while also minimizing total inventory (Dhond, Gupta, & Vadhavkar, 2000; Yin, Kaku, Tang, & Zhu, 2011).

Although a huge amount of data on customer purchasing history, WIPs and finished product inventory, and process and equipment information from the shop-floor operations is automatically or semi-automatically recorded and accumulated in a database, the key question is how to enable organizations to understand and utilize the ample data. Thus, companies must find ways to leverage the data collected at each function in their manufacturing enterprises into actionable strategies to tackle their challenges and pressures.

In this study, a framework is proposed for how analytics can help automotive industry leaders make better strategic decisions in the age of big data. Three common scenarios involving forecast analytics, failure analysis, and inventory management are presented. The main purpose is to describe how to get the most value from enterprise data and utilize

analytics techniques such as Decision Trees, Neural Networks, regression models, cluster analysis, and association rules to improve operations, reduce costs, and stay competitive.

This paper is organized as follows. First, related literature on business analytics in manufacturing is briefly reviewed. A case study of automotive enterprises utilizing analytics is then presented to solve operational issues. The research methodology along with data description and predictive models are described. After the results and discussion, the last section contains the conclusion and directions for future research.

LITERATURE REVIEW

Advanced analytics through data mining approaches has been used successfully to identify and interpret intrinsic patterns in data into useful information within a particular context. Data mining incorporates both statistical and analytical techniques to effectively and efficiently understand and use data (Jackson, 2002; Turban, Sharda, & Delen, 2011).

Business analytics has been applied in many fields across all industries, from customer relationship management, behavioral profiling, healthcare, and genome analysis to supply chains (Davenport, 2006; Kusiak, 2006). Many high-technology companies such as Toshiba and Dell take an integrated approach to analytics in their business to improve yield management and to ensure that the right products are being manufactured at the right time (Davenport & Harris, 2007). Specifically in manufacturing, data mining has been used extensively to improve demand forecasts, classify product groups based on specific characteristics, enhance productivity, tailor special offers to customers, and improve operations performance. For instance, many studies propose new forecasting techniques such as hybrid intelligent systems, applied machine learning techniques, or time-series based data mining approaches to improve forecasting accuracy in the supply chain (Aburto & Weber, 2007; Carbonneau, et al., 2008; Rey & Kauhl, 2013). Chase (2009) provides an overview of demand-driven concepts including forecasting methods and performance measures. Using advanced analytics through predictive modeling, companies can not only analyze data for timely decision making but also uncover patterns in customer purchasing behavior and evaluate their marketing campaign accordingly (Chase, 2009).

Inventory management is another area that has a great impact on any manufacturing enterprise. Inefficient inventory policies can be a leading cause of excess inventory levels, out-of-stock problems, lost sales, product obsolescence, or inadequate safety stock levels (Anderson, 2004). Many data mining techniques have been applied to improve inventory policy. For instance, Dhond et al., (2000) present two case studies where the Neural Network technique is used for inventory optimization. The results show that the total level of inventory is reduced by 50% while maintaining the same level of customer demand (Dhond, et al., 2000). Association rule is another data mining technique, widely used to discover the association relationships among items. Such association rules can help enterprises develop business strategies for managing inventory (Yin, et al., 2011).

Wang (2007) also outlines the application of data mining in other areas in advanced manufacturing such as process and quality control, optimization of manufacturing yield, assembly selection, material requirement planning, and preventive machine maintenance (Wang, 2007). ÇiflikIi and Kahya-Özyirmidokuz (2010) develop a data mining solution for enhancing carpet manufacturing productivity that employs attribute relevance analysis, Decision Trees, and rule-based induction. The results indicate the isolate machine breakdowns in the production process and the proposed Decision Tree model produce a significant improvement (72.8%) in the accuracy ratio (Çiflikli & Kahya-Özyirmidokuz, 2010).

Narasimhan et al. (2005) apply cluster analysis to aid in examining the relationships between manufacturing practices and plant performances, including new product development, flexibility, efficiency, and market-based performance (Narasimhan, Swink, & Kim, 2005). Chien et al. (2007) present a framework for improving the yield of fabricated wafers in semiconductor manufacturing. Their study shows that data mining and knowledge discovery through the Kruskal-Wallis test, *k*-Means clustering, and variance reduction splitting criteria help in defect diagnosis, identifying the possible causes of faults and manufacturing process variation (Chien et al., 2007).

These studies are just examples of efforts to realize the benefit of analytics and data mining approaches in the manufacturing setting. This study is different from the others by providing several scenarios in which analytics can be integrated in each function in the manufacturing enterprise starting from analyzing customer demands and managing inventory to diagnosing the root causes of defects. The research methodology and scenarios are presented in the next section.

METHODOLOGY

This study follows the CRISP-DM (Cross Industry Standard Process for Data Mining) model, a popular data mining method, as a complete blueprint for this study (Shearer, 2000). CRISP-DM breaks down this data mining project into six phases: business understanding, data understanding, data preparation, modeling, evaluation, and development.

The data sets are collected from one of the leading automobile industry companies in Thailand. Operating on a quarterly timeframe, the company provides speedometers; fuel, temperature, and RPM gauges; and LED decorative lights to support both the automobile and motorcycle industries. Figure 1 presents the operational flow of the production system once the company receives demand forecasts or purchase orders from its customers. The medium- and long-term planning for the entire operation, such as master scheduling, capacity planning, or resource allocation, takes place at the higher planning levels before detailed production scheduling tasks at the shop-floor level begin. The finished products are moved to warehouses and distribution centers before being delivered to the customers within 1 to 5 days. Figure 2 presents the research framework of this study. Currently, the company is facing the following three main challenges.

- *Scenario #1 – Forecasting Analytics*: The Company currently employs only multiple regression techniques to predict customer demands for each product line. This standard technique is considered a "one equation fits all" for all customers purchasing a particular product type. Consequently, there is a big discrepancy between the forecasts and actual purchase orders, resulting in inefficient production planning, material and capacity planning, resource allocation, or shop-floor scheduling at the operational level.
  Research Question #1 – What factors drive demand and how do these factors vary across different product lines?
- *Scenario #2 – Failure Analysis*: In the shop-floor operations, when defects occur, engineers identify possible root causes and whether the problems are related to specific processes or machines. However, failure analysis is quite complicated and only simple descriptive statistics and Pareto analyses are currently employed to rank the most common causes of defects. As a result, the company is still experiencing high rework rates.
  Research Question #2 – What are the most important factors to be included in the failure analysis to reduce the incidence of defects in the shop-floor operations?

- *Scenario #3 – Inventory Management:* Managing a multi-item inventory is challenging. Only an ABC classification is currently employed for the purpose of selective inventory control. However, work orders are released to the shop-floor operations from both confirmed purchase orders and demand forecasts to utilize its capacity and to avoid tight scheduling at the end of the quarter. As a result, the company ends up carrying excess inventory for certain models.
  Research Question #3 – Which products or models should receive close attention and tight control?

Data description

The application data set contains the following key information: (1) customer, sales, and revenue information the data marketing department uses to keep track of its customers' purchasing activities, (2) purchasing, supplier, and inventory data used to support procurement processes, and (3) production data tracking of all shop-floor operations. The data are extracted, combined, and used accordingly to address each challenge. The number of observations and related variables are explained as follows:

- *Scenario #1 – Forecasting Analytics*: The complete dataset consists of 9,645 records with twelve predictor variables related to types of customers, customer information, sales coverage areas, product, product type, product groups, delivery period (referring to any specific seasonality or holiday etc.), and forecasts received prior to the actual purchase orders for 1-month, 2-month, and 3-month periods. The target dependent variable is the actual purchase orders received from January 2006 to February 2013.
- *Scenario #2 – Failure Analysis*: The complete dataset consists of 13,000 records with thirteen predictor variables related to sub-processes, machines, lot size, and other defect-related factors. Any factors that are the leading causes of delay in production are also captured in this analysis, as they are potentially important indicators for defective items as well.
- *Scenario #3 – Inventory Management:* The complete dataset consists of 50,000 transaction records related to the focus of this study: the automobile/motorcycle decorative accessories such as LED decorative lights, decorative lamps, LED antennas, and fuel tank covers. The data were collected from May 2006 to September 2013.

Data preparation

Frequency distribution, descriptive statistics, and cross-tab analyses are performed to examine the quality of the data before the model is developed. Any inconsistencies, errors, and outliers are removed accordingly. The next step is to assess whether the data are complete and which variables are to be included in the model. Because including variables with a high number of missing values can lower the quality of the findings, even after applying a missing value imputation method, an assumption is that the model excludes variables with over 50% of the information missing. For each scenario, the dataset is partitioned into 50% for training and 50% for testing dataset before the prediction models are built.

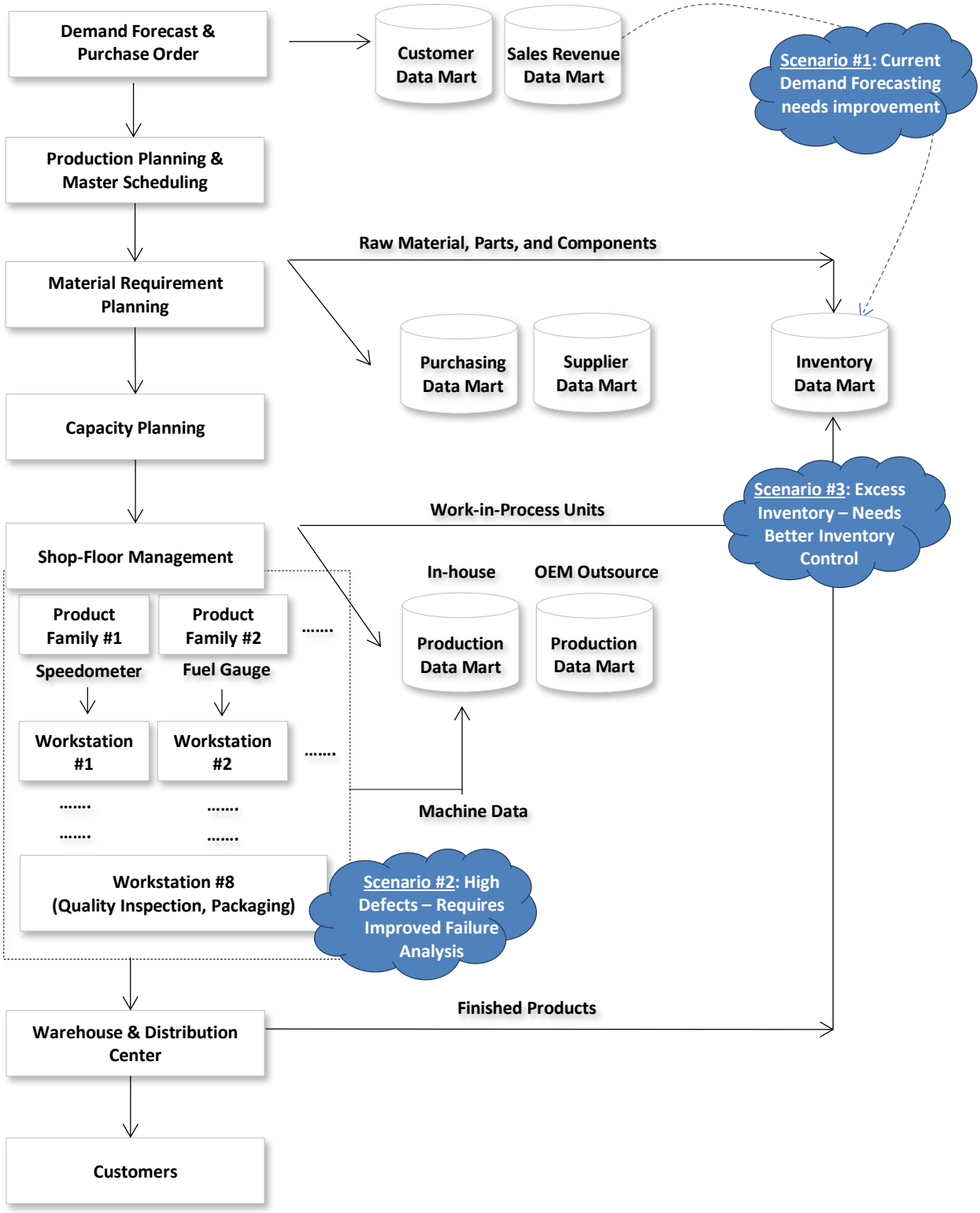

Figure 1: Process Flow

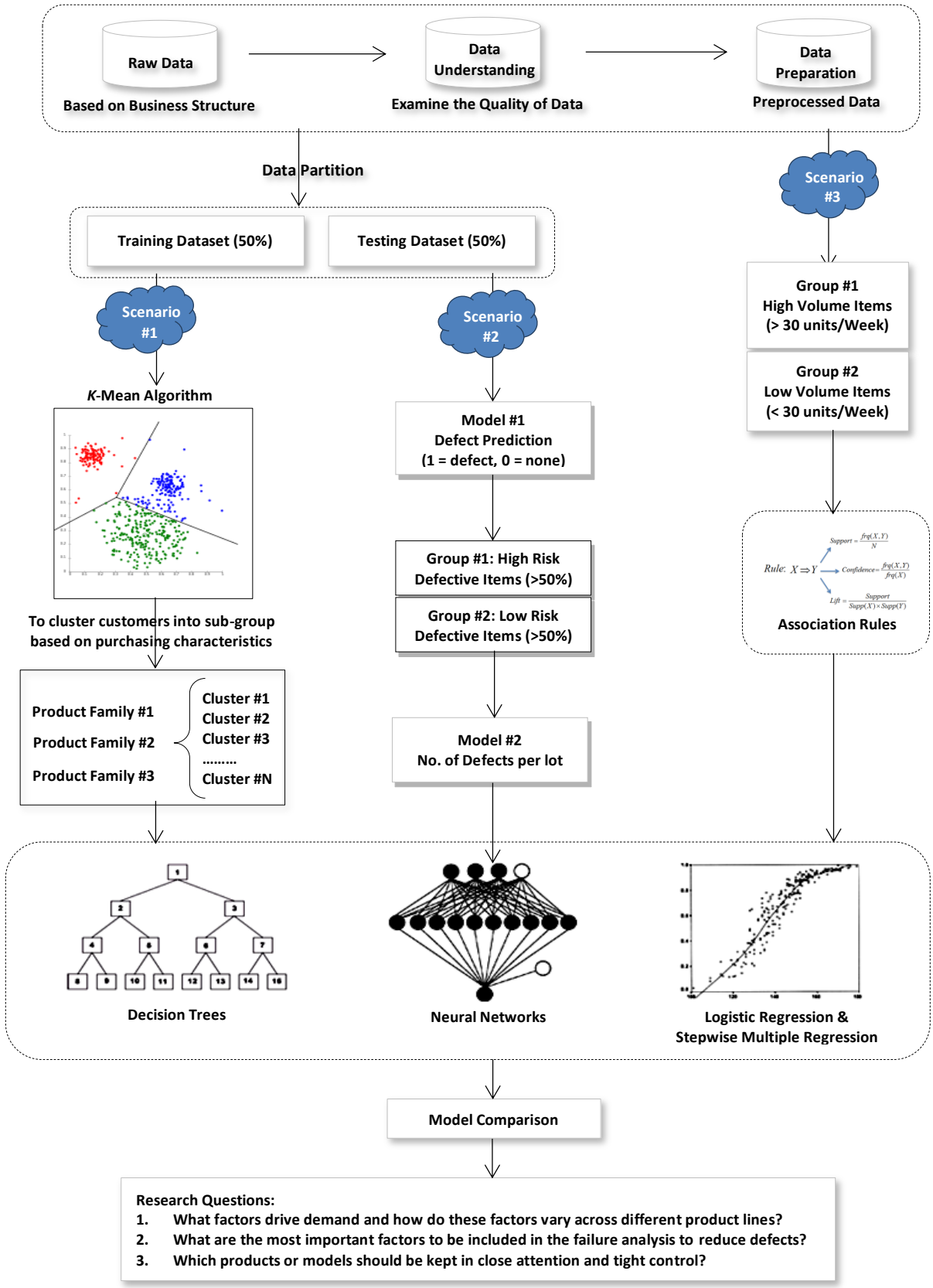

Figure 2: Research Framework

Prediction models

A variety of data mining techniques is available in predictive analytics (Wang, 2007). However, only four popular models are used to analyze data sets with multiple predictor variables in this study: logistic regression, stepwise multiple regression, Decision Trees, and Artificial Neural Network (ANN). For a technical summary, including both algorithms and their applications for each method see Delen (2010); Delen, Oztekin, and Kong (2010); Delen, Walker, and Kadam (2005); Jackson (2002); and Turban, et al. (2011).

Performance measures

Two popular criteria (misclassification rate and average squared error) are used to select the best model from the testing dataset. The proportion of incidents of misclassified data is very common in predictive modeling when the target variable is binary. However, the observed misclassification rate should be relatively low for model justification. For the interval target variable, the average squared error is evaluated among the three models built on the testing dataset. The lower the average squared error, the better the model.

RESULTS AND DISCUSSION

Statistical analyses are performed using SAS Enterprise Guide 6.1 for data preparation and SAS Enterprise Miner 12.1 for model development and comparison.

Scenario #1 – forecasting analytics

Our goal is to develop a demand prediction process for each product family group based on the customer segmentation profile rather than on "one equation" or "one solution" fits all. For instance, all customers of speedometer products (Product Family #1 as presented in Figure 2) are segmented into sub-groups that share similar characteristics. The *k*-Means algorithm is deployed in this clustering process. See Collica (2011), for the details on customer segmentation and clustering using SAS Enterprise Miner.

Without customer segmentation, the conclusion is that the demand for speedometer products is driven by high-volume deals with a few customers who have negotiated long-term contracts with the company. However, because of the seasonal demand patterns, or volatilities in demand, this generic conclusion may not always represent the characteristic of speedometer customers. In fact, a better view of the demand pattern can be seen after applying cluster and predictive analytics.

As presented in Figure 3, customers can be divided into two groups. For the first group of customers, the characteristics of demand remain the same as our baseline understanding (high-volume and long-term contracts). The interesting finding, however, is for the second group of customers, whose demands are based on ongoing sales and new less-than-3-months customers. The number of customers in the second group is quite small, and the negotiated contracts offered to this group are in the lower-volume deal. The key finding is that, once realizing what factors drive demand in each product line, the company understands how these factors impact demand and overall production processes and can properly monitor these factors over time.

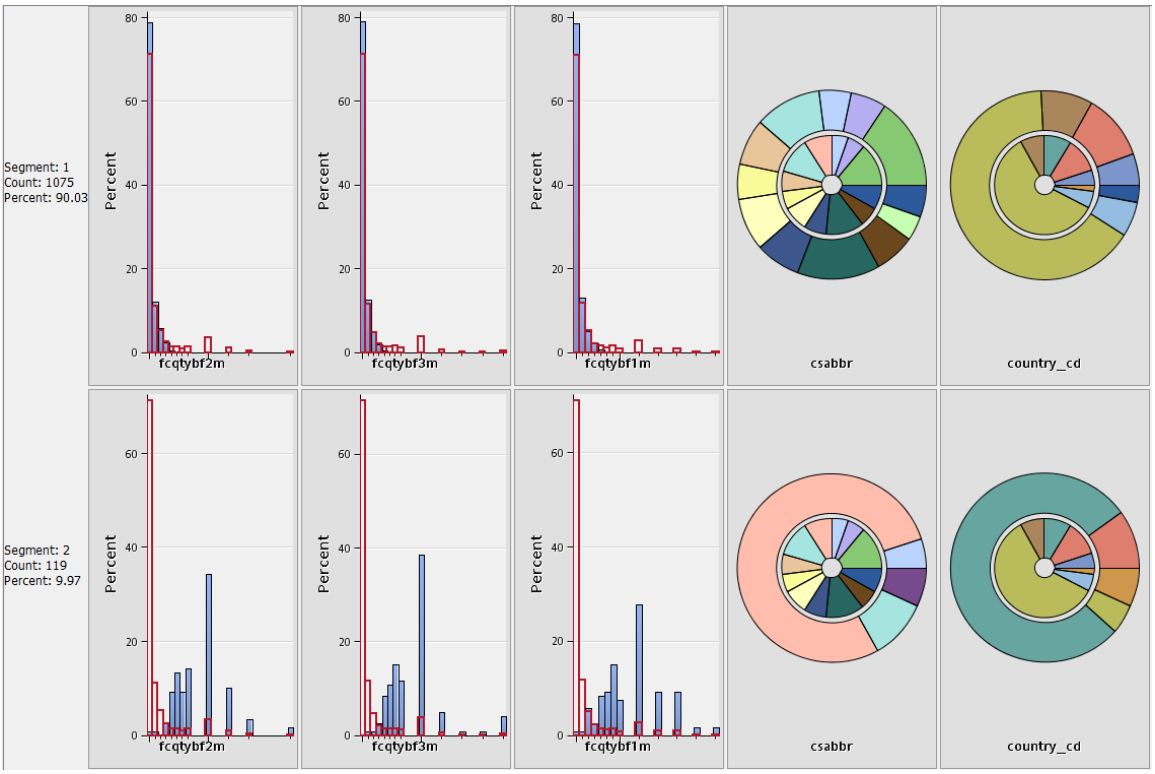

Figure 3: Cluster Analysis for Customers of Speedometer Products

Scenario #2 – failure analysis

When defects occur, engineers follow trouble-shooting instructions step by step to diagnose the causes of the problem and pay closer attention to historical data of specific types of defects and corrective action is then performed. However, this traditional process takes time. To push advanced analytics to aid in reducing defects, the model to predict the probability of the incidence of defects is built. Although the Neural Network Model shows better results in predicting the target variable, the misclassification rate is just slightly lower than that from Decision Tree model. Thus, the Decision Tree model is selected for better explanation. The following example illustrates a rule-based prediction (see Figure 4 for a part of the Decision Tree diagram of this study):

> "IF a WIP is in [FND, PT6, FNM …] process and gets through [M/C FNC SELECTIV...] section, THEN the probability of defective occurrence is 80%"
> "IF a WIP is in [FND, PT6, FNM …] process and gets through [MODEL CHANGE, VARIA...] section, THEN the probability of defective occurrence is 1.3%"

The next step is to classify the group of defective items into high risk and low risk groups based on the predictive results in the first step.

- According to the results of the stepwise regression model for the group with the chance of defective occurrence over 50% as presented in Figure 5, defects increase significantly in the M3 and M4 process stages and when the following machines (M/C-1, Selective M/C no. 1 and 2, and Splay Flux No. 2 M/C) break down.
- For the low risk group with the chance of defective occurrence below 50%, M/C-1, Selective M/C no. 2, and EDP machine are the leading causes of defectives.

The key finding for both groups is noted so that any preventive maintenance on those processes and machines can be regularly evaluated and monitored, helping reduce the defect rate in the long run.

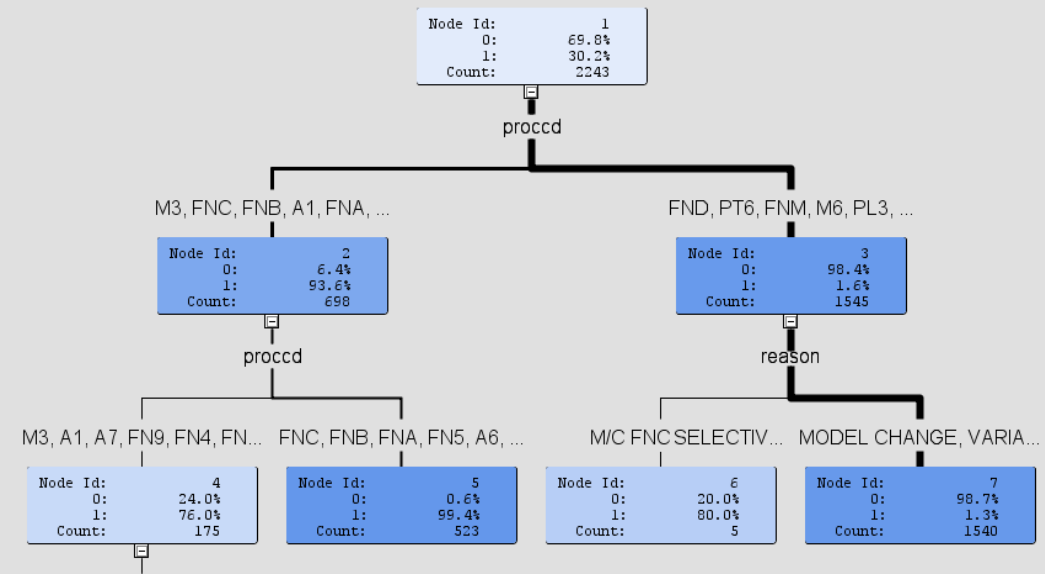

Figure 4: Decision Tree Model

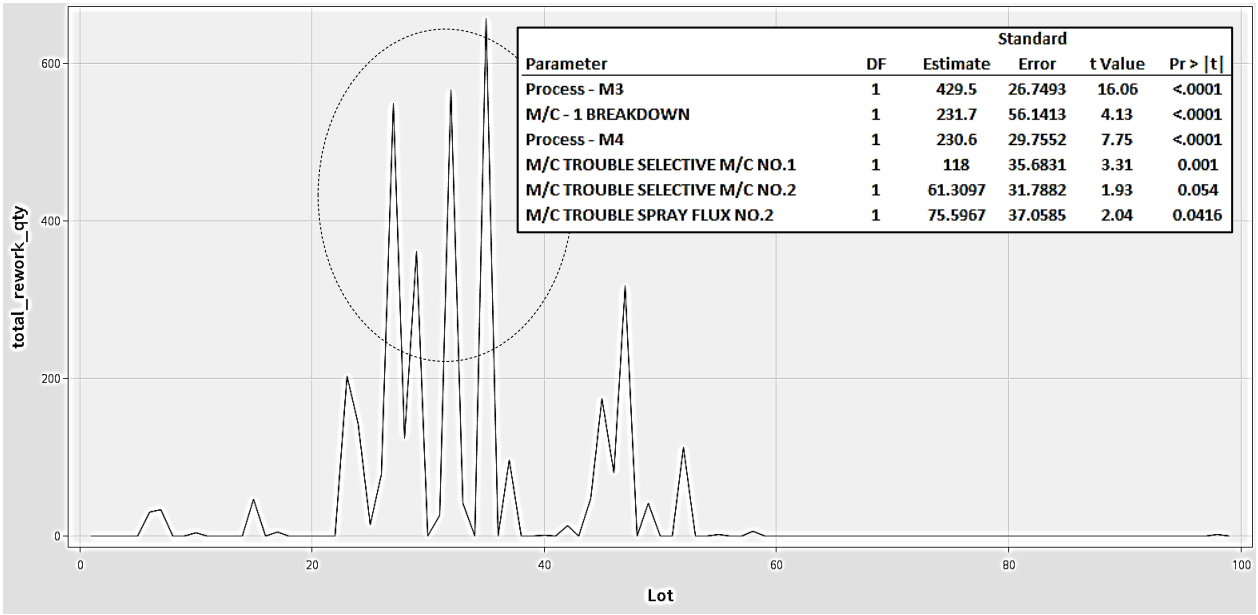

Figure 5: The Scatter Plot of No. of Defects for Speedometer Products

Scenario #3 – inventory management

The association rule mining method is employed to discover the relationships among automobile and motorcycle decorative products in the transaction databases. For greater detail about association rule mining, see Kotsiantis & Kanellopoulos (2006) and Yin, et al. (2011). The first task is to classify products into two groups: 1) high volume items that sell greater than 30 units per week and 2) low volume items that sell fewer than 30 units per week. With this classification, the shop-floor resources are prioritized so that the machine capacity and common raw materials, parts, and components can be allocated to the high-volume sale items. Additionally, work orders released to the shop-floor operations for the low-volume items can be based on confirmed purchase orders rather than on demand forecasts, significantly reducing potentially excessive inventory. Table 1 presents the association rules for the high volume items, where the values of support (the proportion of events where the rule is true), confidence (measuring how often the right side of the rule holds, given the left side), and lift (measuring how much better the rule is for prediction than a random guess) are acceptable. For one two-item relationship, the results show that customers who order Red LED Light Model 2256 (Red), are frequently to purchase M 3556 Lamps with the values of support, confidence, and lift of 1.3%, 33.1%, and 2.3%, respectively. Another interesting two-item relationship is that customers who purchase LED Model 2000 tend to purchase the M 3500 Set Lamp. A three-item relationship is also presented: Red LED Light Model 2256, C3331 Antenna, and LED Light 3100 are frequently purchased together.

Traditionally, the Company follows an ABC inventory classification policy before releasing work orders to shop-floor operations, meaning that only items in "A" category receive a closer check. Applying knowledge of customers' purchasing behavior like those presented in Table 1 can result in a better production planning and inventory control policy.

Table 1: Association Rules for High Volume Items

Relations	Expected Confidence (%)	Confidence (%)	Support (%)	Lift	Transaction Count	Rule
2	14.7	33.1	1.3	2.3	2,635	Red LED Light Model 2256 (Red) ==> M 3556 Lamp
2	16.1	30.2	1.3	1.8	2,630	LED Model 2000 ==> M 3500 Set Lamp
3	24.1	34.5	1.4	1.4	2,744	Red LED Light Model 2256 (Red) & C331 Antenna ==> LED Light 3100 (Motorcycle)

Additionally, we can further analyze the characteristics of customers whose purchasing patterns follow the association rules presented in Table 1. For instance, for those customers, who tend to purchase LED Model 2000 and the M 3500 Set Lamp together (Rule #2), the company can predict the probability that customers will likely to purchasing those two items together (the dependent variable) based on the following independent variables: type of customers, customer information, or sales coverage area. By building a stepwise regression model, the results show that a customer who has a long-term contract with the company and is based in Asia is more likely to purchase those two items together than a customer who has a short-term contract with the company and is located in Europe.

CONCLUSION

The need for predictive analytics at both strategic and operational levels to analyze ample data for timely decision making is apparent. In this study, a knowledge-based analytics application for demand forecasting, failure analysis, and inventory management is proposed. Using data collected from an automobile manufacturing firm in Thailand, cluster analysis is employed to segment customers of each product line into a small number of groups before building predictive models to improve demand forecasts. The Decision Tree model is developed to classify defects into high risk and low risk groups so that shop-floor engineers can have a better view of the causes of defects in each group. Lastly, association rules are applied for both high-volume and low-volume items in our inventory database. By recognizing these key association rules, the company can gain insight into which products are frequently ordered together and develop better production planning and inventory control strategies. Once analytics is integrated into each function in manufacturing, the next step is to ensure that the enterprise not only realizes the operational improvements but continues providing support and awareness of the value of applying data analytics in the long run. Further experimentation with business analytics in other areas such as machine utilization, process control, machine maintenance, and safety evaluation remains to be done.

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Trilogy of Start-up, Being Mergence and Acquisition, Go into Bankruptcy: The Case of a Start-up High-tech Company Broken-hearted to Insolvency

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Abstract

The management of a start-up high-tech business will essentially be facing operating risks of high-tech industries and start-up business. Purpose of this study is based on theoretical basis and tries to analyze the life course of a start-up high-tech company (alias company A). By means of in-depth interviews and counseling process, this study explore about Dr. Yan (alias), the head of A company, discussing following topics he faced and what manners he taken when he managing company A:

1. What operational risks are there in a high-tech industry? How can a successful high-tech industry doing to respond? What manners should be taken by company A and Dr. Yan?
2. What operational risks are there in a start-up business? How can a successful start-up business doing to respond? What manners should be taken by company A and Dr. Yan?
3. The requirements for the high-tech industry start-up phase have basic management systems, internal controls and accounting systems, and how about financing for pipeline? Whether company A take attention and do it?
4. When the corporate mergers and acquisitions, what factors may be taken into account by acquirers? Whether company A has acquired conditions?
5. Poor management, fail to mergers and acquisitions, companies to enter liquidation bankruptcy phase, how about the statutory liquidation bankruptcy procedure? How about legal liability of the head of company? When the physical liquidation of company A, what problem occurred? After clearing in bankruptcy, which liable for real by Dr. Yan?

Oriented to in-depth analysis through management, accounting, financial, legal and other business practices, the results of this study show:

1. An outstanding inventor is essential to the success of high-tech industries but not a sufficient condition. Only is a brilliant inventor, not enough to be a successful operator.
2. Characteristics of high risk inherent in the high-tech industry and new career, need more backed up by good management systems. The importance of a strong management team that cannot be ignored, the operator must also personally involve in putting.
3. Business related legal issues involved in a wide range, if technology could not understood when starting preventive control, once caught up in the action, when you have to pay a high price, it was too late.

1. Purpose

The management of a start-up high-tech business will essentially be facing operating risks of high-tech industries and start-up business. This study in-depth discussion with the head (alias Dr. Yan) and the company officials about the course from entrepreneurship to failure about his high-tech company in Taiwan (based on confidential requires of case company, alias company A mentioned hereafter), and by which inquiry conclude out some argument has important meaning culvert, worth as high-tech new invasive career to operating.

Purpose of this study is based on theoretical basis and tries to analyze the life course of a start-up high-tech company (alias company A). By means of in-depth interviews and counseling process, this study explore about Dr. Yan (alias), the head of A company, discussing following topics he faced and what manners he taken when he managing company A:

(1) What operational risks are there in a high-tech industry? How can a successful high-tech industry doing to respond? What manners should be taken by company A and Dr. Yan?

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(3) The requirements for the high-tech industry start-up phase have basic management systems, internal controls, accounting systems, and how about financing for pipeline? Whether Company A take attention and do it?

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(5) Poor management, fail to mergers and acquisitions, companies to enter liquidation bankruptcy phase, how about the statutory liquidation bankruptcy procedure? How about legal liability of the head of company? When the physical liquidation of company A, what problem occurred? After clearing in bankruptcy, which liable for real by Dr. Yan?

2. Background

Since its inception in 1980 in Hsinchu Science Park, high-tech industry has been a focus on the development of industries in the Republic of China. In the past 31 years, only Silicon Valley of Taiwan Science and technology: the Hsinchu Science Park, have been active since the introduction of the 509 companies; annually create more than trillion NT dollars for national output as well as the most patents (Zhong, 2011). In 2013, HSP, CTSP and STSP, these three science park's production value climb up to NT$2,187,000,000,000. (Shen, 2014), about 15% of total national GDP of R.O.C. .

To many entrepreneurs, High-tech industry's high profits and high pay have fatal attraction. But behind the deadly entrepreneurship, markets are often outgoing being mergence events. Except bright of high profit

and high paid, hi-tech industry have more hidden factors with high risk of operating environment, such as industry competition increasingly fierce, products life cycle increasingly shortened, market preferences vagaries, industry standard ascendant, research team often was dug corner, patent litigation cases endless, continued development products and quickly commercialization and volume produced of pressure heavy, even technology industry of high investment real-time recycling of urgency, are has may became pressure collapsed enterprise of last a root straw. Therefore, don't you see as a rising star has disappeared from the company only sold, or transfers or mergers and acquisitions?

The 2013 Taiwan SME White Paper points out that, from 2009 to 2012 in each year, SMEs operating for less than one year that closed up to 7% per cent of SMEs in all of them. Commercial Weekly has track 283 youth venture model between 1978-2005 years, found this group had for Taiwan most outstanding of venture by operating of enterprise, up to 74 Enterprise jumped votes, restructuring, collapsed, other 25 venture was prosecutors banned or sentenced due to involves wrongful, which amounted up to 35% of venture in the scars-laden in Red Sea of venture, contains floating contains sank, or drowned. It is very difficult to start an undertaking, which is a serious issue for all entrepreneurs to face.

3. Literature Review

In the high-tech industry, technology is the core of the new career, but to have a complete technical capacity, not one person could accomplish, necessity has its venture team. Gong (1999), Li (1998), Chen (2001) pointed out that one of the success factors for entrepreneurship is "Total management" which including production, marketing, research, personnel, finance and material. It is necessary, for a business from planning phase to mature into a long term, to consider about.

Cai and Guo (1998) found that one of the trait a start-up high-tech business for venture team is incomplete, lack of management capabilities besides research technology. Bruno and Tyebjee (1985) also found that one of the common traits of the United States Silicon Valley high-tech companies' venture team is that entrepreneurial teams in some of the most important functions of the serious lack of experience on the field, particularly in the lack of the finance function is most evident, the same discovery also appears in the study of Zeng (1987).

Zhuang (2000) has found that the high-tech industry entrepreneurs think that the establishment of accounting system are not very helpful for success, however, venture capital operators believe that the accounting system are important considerations when venture capital investments. Successful business entrepreneurs, only if through the initial period of funding needs, profits come after and then no financial worries. Maybe due to their lack of relevant experience in management, finance and accounting, therefore they don't believe that the accounting system should help entrepreneurs succeed. But Wu (2001) has found that investment commitments often fail due to changes in the political and economic environment, entrepreneurs should therefore renounce the myth of control, thinking how to raise funds for a rainy day. Because once when external funding is needed, funding provider is bound to require enterprises to provide

credible financial statements with a complete accounting system, as a basis for evaluation. If not for the early establishment of accounting system, enhancing the capacity of management and finance, investors naturally discourage, in case that funding was not in place in time, potentially rising stars may became something of the past.

"Success is only one reason, failure there are innumerable reasons." to learn from the success of its experience is necessity, how to avoid failure fate however is another study. But in the matter of entrepreneurial success in numerous documents show, numerous success-oriented literature, focusing on literature rarely startups fail. By National Central Library thesis index search, as till 2013 , PhD & Master thesis of Taiwan topics involves "venture success" of research has 71 articles, involves "venture failed" of research only 6 articles, perhaps due to success was exciting, failed was frustrated, perhaps due to failed of causes countless and effects degree ranged, perhaps due to failed of enterprise has market eliminated, less related information can for research, but saying "first is lost, again is win", if can synchronization squarely and cognitive failed and the success of reason, more may have lucky and avoided disaster and then access to ultimate success.

4. Company A

High-tech start-up business has the characteristics of high risk and high expected remuneration, entrepreneurs usually have excellent product development capabilities, leads of this study case Dr. Yan, is the best example. Dr. Yan obtain photoelectric science PhD in the United States, after returning to Taiwan, he teach at a National University in Hsinchu, guiding the Graduate Research Assistant , who specializes in optical system design, with excellent research energy, has patents such as LED luminaire with feedback control, Solar energy collector and array of the same, Beam shaping apparatus. Later, Dr. Yan was snare as a conglomerate of the high-tech company (alias company B) under one of the Hsinchu Science Park (alias Empire Group), Yan then led his research team in responsible for the technical development of the company B.

Chairman and General Manager of the company B (alias Mr. Kim)was the youngest leader in the Taiwan semiconductor industry's six-inch and eight-inch wafer plant, youth and activities, phase by the Chairman of Empire Group, established B company, Empire Group is the largest shareholders, holding 50%. Company B was Taiwan's first semiconductor and TFT-LCD equipment OEM vendor; it was also the representatives of the Empire Group into the semiconductor industry. Follow-up by company B and other company of the Empire Group, intends to produce its own brand of intelligent and energy-efficient LED lighting system of the Empire Group. Company B had a brilliant time, stock prices up to more than NT$300 per share, but fell short of expectations to passed the certain technical bottleneck breakthrough products, and part of the research team members poached by competitors, the share price had fallen to only one-tenth of the highest priced. Kin finally resigned from the company B.

2008 when Mr. Kim served as the Chairman of company B, established the technology development

branch, and Dr. Yan served as Director, spent tens of millions of dollars in financial, human resources and equipment, fully develop LED technology. Two years later, Mr. Kim established company A in another technology park, gradually moved internal technology from company B to company A. Finally, with the loss by, Mr. Kim close technology development department of company B, put Department within more than 10 employees dug to work for company A, by Dr. Yan served as Chairman of company A, Dr. Yan also invest his savings for several years to company A, Mr. Kim is financier for company A in behind.

Because many personnel of company A come from company B, equipment almost identical as technology development department of company B, Qiren puzzle, if technology development department of company B really close due to losses, there was no reason that whole batch people went to operation for another company in same conditions. In this case, shareholders of company B to seized adjustable units Prosecutor have, suspected Mr. Kin and company A intends to cut empty company B. In addition, when company A is set up, even if there are not numbers of new research results, nor easy identification is solely vested in the company of all, which is not against the interests of company B.

Company A have an inventor with a number of patents as business leader, but have no any background in management, finance or accounting. Its development potential is certainly, but lack of management systems, internal controls, accounting systems and financial management capability. In a short term of two years, enterprise experience those things that hi-tech industry and the new invasive career operating common meet such as: life cycle of products increasingly shortened, market preferences quickly changes, industry standard varies, results of research progress worse than expected, patent litigation cases ridden. Furthermore, poor management, poor internal control, no complete accounting system, bad controlled of funds tube, so that did not produces profit as expected. When funds gradually constraints, those funds that Mr. Kin commitment of is not in place, and due to has no conditions for merger, other investors unwilling to joined or get into, no way to selling. Just only two years, drunk into the bankruptcy and liquidation procedures and had to close down, summarized under Dr. Yan, debts, lawsuits.

5. Analysis

This study showed that the success of a new venture, does not only depend on research and development capabilities, and after start-up, management capabilities include system requirements with the attendant. Company A is set up, although Dr. Yan is appointed as the Chairman, but don't have work experience of other field besides the research and development, his major work is still in leading new development team focused on the development of research and development. He is not deeply involved in corporate management functions other than many management flaws occur one after another. Such as Mr. Kim as the single biggest financier, cause otherwise, individual company A therefore does not adhere to enterprise, against other sharing company that Mr. Kim will have some resources, but is not a reasonable cost-sharing, resulting in accelerated depletion of funds. Appointment to managerial staff, lack of management experience, not with an enterprise Omni-directional vision, the units operate the lack of lateral and longitudinal links

between communication and coordination, internal controls are lacking. All these phenomena Dr. Yan didn't seem to mind.

Overall, Dr. Yan did not familiar with management, law and industry, putting himself and company A under risk. Although is Mr. Kin will moved technology and the personnel from company B to company A, but heads title of company A is Dr. Yan, largest shareholders of company B, Empire Group, impossible give company A good strike, Dr. Yan perfectly brunt! Anyone who dares to give aid hand be merger? Because internal management is poor, sources is not dispersed and funds fast loss, company A cannot have enough valuable time, to survive from early time and funds dilemma of new invasive hi-tech industry. Company A postnatal imbalance of naturally poor business conditions, apparently meaningless research scholar business previously unimaginable. Case studies of the company A are enough to be the reference of those who embrace ideals and dreams, and development entrepreneurs to learn from.

6. Conclusion

Through deep interviews with company officials, to gather and analyze about information of print media and electronic media, this study finishing out of Dr. Yan's background information, company formation, business conditions and the various controls in the management accounting and finance issues and influence, as well as the cost of Dr. Yan pay when entrepreneurial dreams crushed. Oriented to in-depth analysis through management, accounting, financial and other business practices, the results of this study show:

(1) An outstanding inventor is essential to the success of high-tech industries but not a sufficient condition. Only is a brilliant inventor, not enough to be a successful operator.

(2) Characteristics of high risk inherent in the high-tech industry and new career, need more backed up by good management systems. The importance of a strong management team that cannot be ignored, the operator must also personally involve in putting.

(3) Business related legal issues involved in a wide range, if technology could not understood when starting preventive control, once caught up in the action, when you have to pay a high price, it was too late.

Through deeper into a failed high-tech start-up business venture, this research undulating course of summarizing some important discoveries, with practical management implications, these findings can be used as a reference to aspire to high-tech entrepreneurs to learn from. At the same time, this study's findings may also complement the lack of relevant literature about new career in the field of management, finance and accounting provides some new arguments, new academic theory of career management and let it more complete.

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REUSABLE LUGGAGE TAG FOR MOBILE TRACKING AND SUSTAINABILITY DEVELOPMENT

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ABSTRACT

With more than two billions passengers travelling by air in the world each year, the vast number of lost luggage and disposable paper adhesive luggage tags after each travel is pushing the aviation industry to think of methods to improve luggage tracking and reduce the printed one-off adhesive luggage tags. This paper reviews the current application of Radio Frequency Identification (RFID) in the luggage handling system and proposes the development of one reusable luggage tag to facilitate the aviation luggage handling and tracking process. A framework and components of the RFID for the proposed reusable tag are presented. A database management system and a mobile app on Smartphone device for luggage tracking are proposed. This paper further suggests an initial framework of the integrated reusable luggage tag as future development. Future studies will cover the methodology of integrating the retail system, luggage tag, airport check-in counter, luggage handling system, aircraft, and the destination airport through the use of the tag, readers, antenna, and mobile devices.

Keywords: RFID, luggage tag, aviation, mobile tracking, sustainability

1. INTRODUCTION

The airline industry handles more than two billion passengers annually. With the huge number of luggage being handled, there are considerable luggage lost and mis-handling in the airports worldwide each year. World airlines have a loss of 25 million pieces of passenger luggage in 2009 (Carmichael, 2009). There are 26 million pieces of checked luggage went astray on international flights in 2011 (Peterson, 2012). In U.S. airlines, about 1.8 million pieces of luggage were reported lost, stolen or damaged in domestic flights (Yogerst, 2013). There is luggage found within several hours after track and trace. Some luggages are reported permanently lost. Huge amount of resources and costs are pulled in the airport and airlines to trace and return the lost luggage to passengers. Swedberg (2010) indicated an estimated annual cost of US750 million used to track and deliver lost luggage to its owner, through airline, airport, and courier.

The use of Radio Frequency Identification (RFID) in aviation luggage tracking has come to solve the problem. The RFID has been evaluated and implemented in some airports over the world to facilitate the monitoring of luggage flow, minimise luggage mis-handling, and assist

to identify lost luggage. Al-Ali et al. (2007) assessed the feasibility of using RFID technology for baggage handling in airports. DeVries (2008) evaluated the state of RFID to solve the tracking of luggage in airports and airlines. The study reviewed the benefits and drawback on the use of RFID. DeVries reflected the importance of the development of the RFID infrastructure in order to achieve a successful track and trace of luggage. Wyld et al. (2005) investigated the application of RFID in baggage handling and security. The study provided the testing and development of RFID in baggage handling of Delta Airlines in U.S. Zhang (2008) discussed the International Air Transport Association (IATA) protocol used as a standard to recognize baggage tags and the application of the RFID-based baggage tracking in the Beijing Capital International Airport (BCIA). Medeiros (2011) presented the use of passive Ultra High Frequency (UHF) tag for suitcase identification and tracking in airport. The study concluded that RFID is superior to barcodes considering the identification, average read rate, network, and labor costs involved. Other similar studies include Jacinto et al. (2009) and Ouyang et al. (2008).

With the use of RFID in luggage tracking, the display and interaction between human and tracking data could be made use of mobile app. Mobile tracking allows users to track and trace the position of luggage anytime anywhere. The mobile app could further display the real-time flight information and assist the check-in process. It could also act as a platform for the communication between traveler and airline before departure. Airline shopping with business transaction could provide add-on service and customer retention. One of the recent researches on mobile tracking is the use of interactive RFID-based bracelet (Sennou et al., 2013). The paper suggested the use of the bracelet to be worn around the passenger's arm. It is provided to the passengers in the check-in process. The database application processes the RFID signals and sends the messages to the bracelet whenever the luggage moves from a station to another.

In terms of the importance of environmental protection and sustainability, can luggage tags be reused to reduce the use of paper adhesive luggage tags? With two billion passengers travelling by air each year, huge amount of adhesive luggage tags are printed for the trip and disposed of after used. This phenomenon creates environmental unfriendly wastage. IATA estimated in 2013 that airlines print 2.95 billion adhesive luggage tags each year. It has initiated airlines to develop permanent digital luggage tags. British Airways announced in November 2013 to roll out digital tags to frequent fliers who can check-in for a flight with their own smartphones over the personalized digital tag. The tag uses the Near Field Communication (NFC), short-range wireless technology and electronic ink to display and pass the barcode information to the reader device. This method has reduced the use of adhesive paper luggage tags. Qantas Airways also introduced QBag Tag, which is a permanent electronic tag, in domestic flights with the use of RFID instead of NFC in transmitting the flight details into the tag. Aircraft manufacturing Airbus is also investigating a digitally enabled suitcase with electronic tagging and GPS real-time tracking (Baskas, 2013).

This paper proposes the development of integrated reusable luggage tag, from the time when the luggage with RFID tag being purchased in the retail store to the airport check-in counter, luggage handling system, aircraft, destination airport, and the hotel. This paper presents the framework and components of the RFID for the reusable tag. A database management system (DMS) is suggested for the development. A mobile tracking device is proposed and developed.

This paper also suggests an initial framework for the integrated reusable luggage tag. Further development and investigation will cover the methodology of integrating the retail system, luggage tag, airport check-in counter, luggage handling system, aircraft, and the destination airport through the use of the tag, readers, antenna, and the mobile devices.

2. FRAMEWORK AND COMPONENTS

The integrated model involves several parties including the tag company, customer mobile apps, airline, airport check-in counters, and luggage handling system. The devices, components, and the system are made up of RFID passive cards that transmit radio frequency data collected by the RFID reader in the retail store, airport, airline, and hotel. The retail store, with the Point-of-Sales (POS) systems and RFID readers installed, keeps the sales record of the luggage product including the RFID tag. The tag will be registered at the time of the product being sold. The RFID tag, with its unique identification number, is of UHF with 862-900 MHz. The RFID antenna is used to identify the tag and receive the transmitted signal from the tag. The reader transmits the data to a DMS via the network. The DMS then processes the data and sends it to the mobile app application. The DMS also integrates the data received from the airline, airport terminal, and the mobile app application. The mobile apps application is installed in a smartphone mobile device with Android operating system enables the travelers to track their luggage with the mobile tracking functions developed in the apps.

Table 1 – RFID components

RFID components	Description
Tag (Transponders)	UHF-band (862-900 MHz), wireless, passive, and unique identification number
Readers	Stand-alone, hand-held, and shelf readers
Antenna	UHF, vulnerable, and able to identify tag and receive transmitted signal
Printers	Baggage Printer
Information Systems	Enterprise Resource Planning systems and DMS
Mobile devices	Smartphone with Android operating system
POS with RFID readers	POS system integrated with the DMS and RFID tag readers

3. DATABASE MANAGEMENT SYSTEM AND MOBILE TRACKING

A DMS and a mobile tracking device are developed to model the luggage tracking system. The DMS is developed using the Microsoft Access. Nine tables are created, namely tag information, customers table, flight information table, stocks table, retail shop table, baggage history, baggage location, hotel table, and airline table. Most of the tables are connected to one another with the use of primary and foreign keys. The relationship starts from the retail shop in selling the luggage with RFID tag and reflecting in the POS, along to the traveler bringing the luggage to the airport during the flight trip. The relationship between a customer and luggage is one-to-many relationship as a baggage can be owned by only one customer while a customer can have more than one baggage. The relationship among the tag

information, retail shop for tag, customer details, luggage location, hotel, and airline are shown in Figure 1.

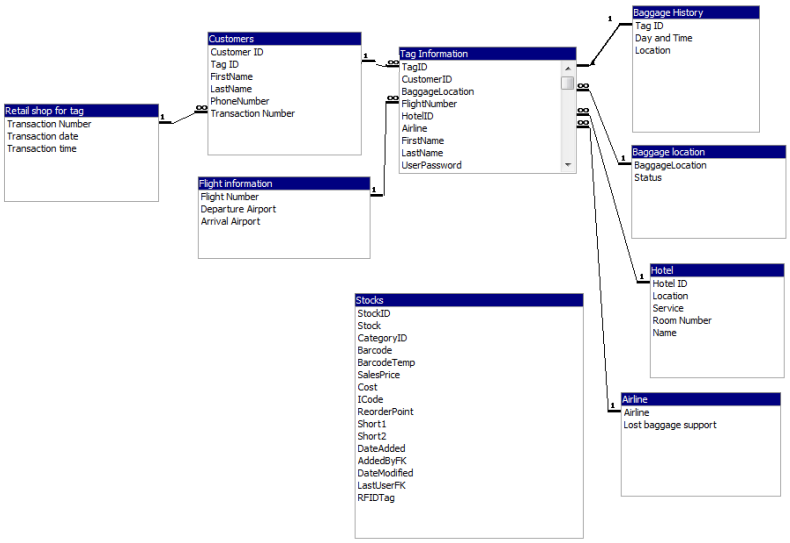

Figure 1 – The relationship diagram of the database management system

The mobile app is developed with the use of MIT App Inventor 2, which is a cloud-based tool. The luggage tracking, history log display, and login features of the mobile app are developed with the use of the app inventor block editor. An initial user interface is developed for the mobile app development as shown in Figure 2. Further investigation will be on the integration of end-to-end process, from the luggage, including the tag, being sold and recorded in the POS system to the luggage being brought during the travelling by air.

Figure 2 – The user interface of mobile tracking apps

Trials and implementations of RFID on luggage handling have been carried out in the airlines and airports in the recent years. The use of RFID in the airports is first deployed in 2005 at Hong Kong, Milan Malpensa and Las Vegas McCarran airports (Airport Business, 2009). The implementation results show has a read rate of over 97% compared with around 80% for conventional bar codes. RFID is estimated to reduce 20% of mishandlings through more accurate tag reading and better visibility over the entire baggage operation. Trials are also

carried out in other airlines and airports, for example, British Airways at Heathrow, Japan Airlines in Kansai International Airport and Hong Kong International Airport, Kuala Lumpur International Airport, Korean airports, etc. The benefits of RFID on luggage handling are not only on eliminating the number of mishandlings and better visibility but also better tracking and reducing the use of paper adhesive luggage tags. The use of reusable luggage tag by adopting the RFID tag being installed in the luggage could reduce the disposal of billions of adhesive luggage tags each year. This brings a positive environmental impact through eliminating environmental unfriendly wastage. The use of mobile tracking on luggage handling further connects the luggage location and flights information to the passenger. With the developed DMS and the mobile tracking functionalities, further development will be the integration along the systems, including the POS, DMS, and mobile apps.

4. CONCLUSION

To address the huge amount of lost luggage and adhesive luggage tags being disposed after the travelling by air, a research has been initiated to develop a reusable luggage tag with the use of RFID. This paper reviewed the current application of RFID in the luggage handling system and proposed the development of reusable luggage tag to facilitate the aviation luggage tracking process. A framework and components of the RFID for the proposed reusable tag are presented. An initial framework of the integrated reusable luggage tag is discussed. A database management system and a mobile app on smartphone device are proposed, facilitating luggage track and trace anytime anywhere. Further development and investigation will cover the methodology of integrating the retail system, luggage tag, airport check-in counter, luggage handling system, aircraft, and the destination airport through the use of the tag, readers, antenna, and mobile devices.

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EFFECTS OF INTELLECTUAL CAPITAL AND SUPPLY CHAIN LEARNING ON SUPPLY CHAIN RESPONSIVENESS: AN EMPIRICAL STUDY IN CHINA

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ABSTRACT: Intellectual capital (IC) is critical to company performance in knowledge-based economy. It has been acknowledged that IC influences innovation and company performance. We argue that IC could influence supply chain responsiveness (SCR) in the supply chain context. Further, based on the knowledge-based view, supply chain learning (SCL) is expected to be impacted by IC, and contribute to SCR. A research model is proposed linking IC (human capital, organizational capital, and social capital), SCL (learning from supplier and learning from customer) and SCR. Our model is tested by using a dataset of 300 Chinese manufacturers in high-tech industries. The results show that both human capital and social capital affect organizational capital. Human capital and organizational capital also directly affect SCR, while social capital doesn't. Human capital and social capital positively

affect SCL, including learning from supplier and learning from customer. SCL also positively contributes to SCR. Generally, our study provides empirical evidences on the roles of IC in the supply chain context.

Keywords: intellectual capital, supply chain learning, supply chain responsiveness

I. INTRODUCTION

In today's volatile competitive environment, manufacturers have been forced to provide customized products to obtain a competitive advantage. Hence, responsive supply chain is much more effective than a lean supply chain, because a responsive supply chain emphasizes on responding to the supply changes and solving relative problems quickly，whereas lean supply chain mainly stress leveling production schedule（Qi，Zhao & Sheu, 2011）. There are also many manufacturers seeking their way to increase their supply chain responsiveness, such as Borche, Shangpin zhaipei. Thus, finding a way to increase supply chain responsiveness is of great interest to both scholars and practitioners.

In order to get a good performance in supply chain responsiveness, manufacturer should have the capability to obtain relative knowledge from its supply chain partners，such as its suppliers and customers and apply it. Previous studies found that supply chain partners' knowledge is of great significance to manufacturer, because it allows manufacturers to tackle the changes and quickly respond to them (Lai, et, al.2012). Meanwhile, under the current circumstance, learning from the partners in the supply chain is a feasible way to acquire that knowledge(Dayer & Singh,1998; Hernández-Espallardo, Rodríguez-Orejuela,& Sánchez-Pérez, 2010). Researchers have also suggested that learning from external partners is crucial to the firm's performance (Calantone, Cavusgil, & Zhao, 2002). Therefore, in the context of supply chain, supply chain learning (SCL)，which we mainly focuses on learning from supplier and learning from customer, should has an important effect on the firm outcomes, such as reducing the lead-time, increasing flexibility, quickly responding to the market changes, facilitating its supply chain responsiveness. Thus, it's important to examine how firms improve their SCR by supply chain learning.

Although firms can obtain knowledge and resources from outside (Song, Almeida, & Wu, 2003), the firm's ability to learning from the supply chain is also affected by the knowledge inside the firm. They need to have certain knowledge basis in order to form the capability of learning from supply chain and enhance its SCR. In the knowledge-based economy，knowledge has become the most strategically important resource of the firm (Grant, 1996). Intellectual capital（IC） is viewed as the sum of all knowledge firms utilize for competitive advantage, which is widely acknowledged as a key source of obtaining sustained competitive advantage (Dean & Kretschmer, 2007; Martín-de-Castro, Delgado-Verde, López-Sáez, & Navas- López, 2011). It's conceptually separated into three prominent aspects: human, organizational and social capital according to the differences on the accumulation and distributions of knowledge (Youndt, Subramaniam, & Snell, 2004). Previous research has

found that IC can significantly affect the firm's financial performance (Simonin, 1997). From the knowledge-based view(KBV), the firm's resource inputs, such as IC, may enable firms to enhance their knowledge acquisition，assimilation，utilization from external sources. This means that IC will influence the effectiveness of the learning, and contribute to SCR. However，we have limited knowledge on this. Thereby, we also investigate how intellectual may enhance supply chain learning.

In this study, we will extend the existing literature by examining the relationships among intellectual capital, supply chain learning, and supply chain responsiveness. The resources-capability-performance framework of this study is proposed based on the knowledge-based view and organizational learning theory. Our research framework focuses on two key supply chain partners-the supplier and the customer, as well as three types of intellectual capital-human capital, organizational capital and social capital. Based on prior literature, we propose a theoretical model of how three types of IC, and two dimensions of SCL influence SCR. In addition，firm size and R&D input may have an impact on the knowledge available inside the firms and the mechanisms of obtaining necessary external knowledge. We set the firm size and R&D input as control variables. The model is empirically tested by using a dataset of 300 manufacturers in China.

By developing and investigating the theoretical model that links the three types of IC, SCL (learning from supplier and learning from customer), and SCR, this paper seeks to make three important contributions. First, this study conceptually and empirically tests the relationships among IC, SCL, and SCR. The results will enrich the knowledge-based theory and organizational learning theory in the supply chain context. Second, it would be interesting to understand the comparative impact of different knowledge resources and the capability of learning from different external partners（the supplier and the customer）on SCR. Finally, we can also make some contributions to the research in China，provide managerial insights and guidelines for practitioners to improve their supply chain responsiveness through effectively managing and applying IC and SCL.

II. THEORETICAL BACKGROUND

We reviewed the multi-disciplinary literature related to IC, SCL and SCR, developing the conceptual framework shown in Fig.1. In the following sections, we will discuss each component and develop hypotheses about how they are related.

A. Conceptual basic

With the environment shifting into a knowledge-based competition, the importance of IC is emphasized increasingly. Following the previous literature，IC can be considered as the sum of all knowledge firms utilize for competitive advantage (Youndt, Subramaniam, & Snell, 2004). It's a primary means of creating sustainable competitive advantage. Most researchers agree that the framework of IC contains various levels rather than a uni-dimensional construct. Due to research subjects，previous scholars had their own classification. After synthesizing prior literature, we could find that most studies following the opinion of Youndt et al. (2004), Subramaniam & Youndt (2005). In their opinion, IC is categorized into three basic

dimensions，namely human capital，organizational capital and social capital according to the differences on the knowledge accumulation and distribution . Based on the definition of Subramaniam & Youndt(2005), Menor et al. (2007), human capital refers to the tacit knowledge embedded in the mind of the employees, such as the employee's skills, capabilities and knowledge, aptitudes, experience. Skilled, creative and intelligent employees may bring and create new knowledge. Organizational capital is the non-human knowledge storage that involves organizational routines, processes, and various intellectual properties (Chang, Chen, & Lai, 2008). It's the institutional knowledge and codified experience embedded in the firm's systems, processes, databases, structures, etc. The last aspect, social capital is defined as the knowledge embedded in the interrelationships among the employees. It comes from the norms of interaction, relationships and connections (Subramaniam & Youndt, 2005; Tsai & Ghoshal, 1998). Although these three aspects represent different knowledge inside the firm, and influence the firm's operation in different approaches, they may support each other to bring IC into full use (Hsu & Fang, 2009).

Argyris and Schön (1978) first described organizational learning as organizational change. As many types of knowledge required in achieving the firm's value may extend beyond the firm's boundaries, inter-organizational learning is emphasized as one of the most important approaches to cope with this problem, acquire knowledge as well as obtain competitive advantage. Hult et al. (2003) conceptualized organizational learning in the context of a supply management process, learning is viewed as "values and beliefs associated with the development of new knowledge that has the potential to influence behavior". Meanwhile, the manufacturer will have to interact with its upstream raw material suppliers and the downstream customers. In our study, we conceptualize supply chain learning as the degree to which manufacturers obtain and apply the knowledge from their suppliers and customers, including two dimensions, learning from supplier and learning from customer. From the supplier, firm can obtain information related to quantity, public relations, logistics, and so on, whereas，information on the market demand, and the product, etc, can be got from the customer (Tseng, 2009).

We would rather choose responsiveness to analyze the supply chain performance. It mainly focuses on the degree to which the manufacturers respond to the changes during supply chain, in other words, how well the firm reacts to the uncertainty of the supply chain (Beamon, 1999; Wu, Yeniyurt & Kim, 2006). Prior literatures choose few categories to represent the supply chain performance, including reliability, responsiveness, flexibility, cost and efficiency. However, in a business environment characterized by fast changing customer requirement，supply chain responsiveness should be of greater significance than others.

B. Framework and hypothesis

a) IC

As discussed earlier, IC is viewed as the sum of all knowledge firms utilize for competitive advantage, including three forms, human capital, organizational capital, and social capital. It's possible that the firms can develop these individual dimensions of intellectual capital respectively. However, it would be more effective if these three dimensions support and

complete each other. Human capital is the origin of all knowledge, and much knowledge is created through human capital, in this way, the building of institutionalized knowledge should rely on the human capital, the results of human capital are also stored within the organization through the organizational capital, such as the knowledge embedded in structures (Hsu & Sabherwal, 2011). Therefore, human capital may facilitate organizational capital. In addition, social capital emphasizes that greater knowledge is embedded in the relationship or interaction among individuals. It can lead more knowledge to being stored in organizational systems (Hsu & Sabherwal, 2011). The social capital theory holds the view that individual or group knowledge is disseminated through the firm's structure, routines. Thus, social capital may have an impact on the organizational capital. Different types of knowledge may depend upon the existence of common knowledge for their operation. Organizational capital captures institutionalized knowledge and codified experiences stored within and by organizations, which can be viewed as one type of common knowledge. That common knowledge permits other forms of knowledge fulfill their roles. Therefore, we posit both human capital and social capital to enable organizational capital.

H1a: Human capital is positively associated with organizational capital.

H1b: Social capital is positively associated with organizational capital.

b) IC and SCR

Prior studies showed that IC may improve the firm's innovation capability， new product development performance，financial performance，etc, because it can transform the knowledge into value (Hsu & Fang, 2009). The more IC the firm has, including human capital, organizational capital and social capital, the more competence to further improve its performance. In this study, we mainly focus on the responsiveness of supply chain. Besides, because the different dimension of IC is characterized by different attribute， they may not have the same impact on SCR. Thus, we may discuss them respectively. Individuals in the firm are the origin of knowledge, human capital makes reference to the knowledge employees possess, it's considered as a primary driver of competitiveness, prosperity and economic wealth. Hurwitz et al. argued that a firm's profit mainly comes from human capital (Hurwitz, Lines, Montgomery, & Schmidt, 2002).A firm with capable, skilled employees and managers may quickly respond to the supply chain changes because they can recognize opportunities and risks with their skills, capabilities. Then, they can quickly adapt to the change, respond to the supply chain easily, and improve the SCR. Organizational capital may give structure, routines and other institutional knowledge to the firm's activities and process in order to streamline the knowledge into steady outcomes (Subramaniam & Youndt, 2005). As to the supply chain is full of uncertainty，organizational capital can provide relative stable support to deal with these problems, so that the firm can smoothly adapt to the change and successfully make the best of the opportunity, thus promoting the SCR. It has been emphasized that organizations are social entities. Social capital has been found to contribute to the new knowledge creating and sharing in the practice. Social capital is expected to affect the communication among individuals, in this way, employees can easily get along and exchange different ideas on stubborn questions. Thus, social capital may also have a positive effect on the SCR. Based on the discussion above, we posit the following hypothesis.

H2a: Human capital is positively associated with supply chain responsiveness.

H2b: Organizational capital is positively associated with supply chain responsiveness.

H2c: Social capital is positively associated with supply chain responsiveness.

c) IC and SCL

Previous studies showed that IC is closely related to knowledge management or organizational learning (Hsu & Fang, 2009). Spekman et al. (2002) argued that learning is based on acquiring new knowledge that improves the firm's outcome. Firms can create and acquire new knowledge from organizational learning. Cohen and Levinthal (1990) first use absorptive capacity to describe the learning process. Here, we discuss the learning behavior from the supply chain context. SCL can capture the capability from supply chain partners by combining their unique knowledge assets. IC is the valuable knowledge base that is distributed in individuals, organizations, and the entire supply chain network. Further, internal prior knowledge can enable firms to identify and utilize new knowledge from supply chain partners. A firm's ability to learn from its supply chain partners also is affected by its capacity to harness the knowledge inside the firm（Spekman, Spear, & Kamauff, 2002）, Chang et al. (2008) found that intellectual capital enhances the learning capability in alliances, thus intellectual capital may influence the supply chain learning. Baker (1992) held the view that high-quality employees can increase organizational learning. Kogut and Zander (1992) found that organizational learning depends on the exchange among individuals. Hsu and Fang (2008) showed that structural capital positively affects organizational learning. Schulz (2001) indicated that common values and trust in a network can improve communication and coordination between network members. Thus, in the supply chain context, with rich intellectual capital, skilled employees, supportive structures and social capital, the firm can positively absorb new knowledge on the final market's current demands and dynamics from the downstream customers, and acquire the information about accessories, stock and so on from the upstream suppliers. IC may influence the SCL. Based on the discussion above, we posit the following hypothesis.

H3a: Human capital is positively associated with learning from supplier.

H3b: Human capital is positively associated with learning from customer.

H4a: Organizational capital is positively associated with learning from supplier.

H4b: Organizational capital is positively associated with learning from customer.

H5a: Social capital is positively associated with learning from supplier.

H5b: Social capital is positively associated with learning from customer.

d) SCL and SCR

Organizational learning is a very important and complicated resource, it can create competitive advantage. SCL is a valid approach to access the knowledge outside the firm's boundaries. Learning can develop and use new knowledge to improve organizational performance. The sustainable success not only connected to the technological network, but also to the relationships with the suppliers and customers (Gemunden, Ritter, & Heydebreck, 1996). In particular, buyer-supplier relationships have been considered as a governance structure improving knowledge sharing. The manufacturer is the customer of upstream suppliers, and the supplier of downstream customers as well. Grover and Davenport (2001)

indicated that the tacit knowledge which is generated from the conversations and interactions with suppliers and customers is the most significant knowledge. Thus, we may discuss the relationships among learning from supplier, learning from customer and SCR. Choy et al. (2007) assumed that discovering new knowledge from the supplier may enhance the product development, and reduce the time required for research. Tseng (2009) also noted that the suppliers' knowledge should be utilized to ensure the competitive advantage of a new product. Whereas，customer knowledge enables firms to restructure and create value, which is considered as an essential intangible asset for firms（Rowley, 2002）.Chen and Su (2006) found that product and customer knowledge are the most significant and intricate elements during the constituents of company knowledge. Tseng (2009) argued that customer knowledge and supplier knowledge are expected to have a positive influence on firm performance. Consequently， supplier knowledge leveraging can obtain knowledge on upstream supply chain, which may facilitate the manufacturers' supply chain responsiveness, such as reducing the manufacturers' inventory obsolescence, as a result, the firm becomes more responsive. Meanwhile, customer knowledge leveraging can acquire accurate demand information which may be treated as a reference to promoting and product design, firms can utilize the knowledge to detect and realize demand changes more quickly. Thus, supplier knowledge leveraging and customer knowledge leveraging may enable firms to be more responsive. Based on the discussion above, we posit the following hypothesis.

H6a: learning from supplier is positively associated with supply chain responsiveness.

H6b: learning from customer is positively associated with supply chain responsiveness.

According to the analysis earlier, the overall theoretical research model of the paper is summarized in Fig. 1.

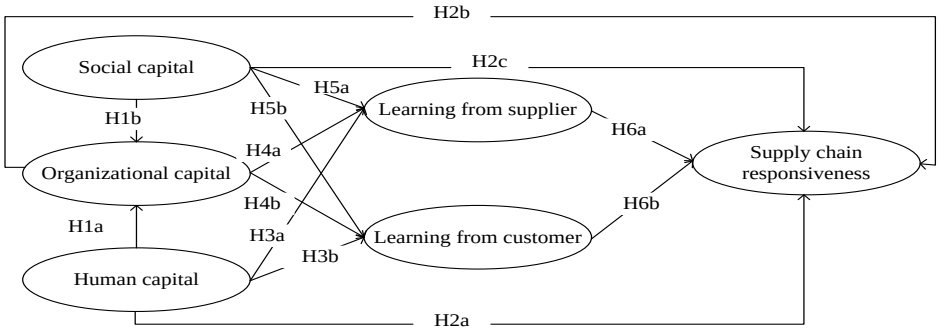

Figure1- Theoretical model

III. METHODS

A. Questionnaire Design

In order to ensure the reliability and validity of measures, the questionnaire was developed mainly from validity scales. We adopt the Chinese version questionnaire when collect data from China region. Because the original of partial measures are English version, a translation-back-translation procedure is used to ensure the comparability of the translated and original questionnaire. We also made some proper changes according to the purpose of this study. Before distributing the questionnaires, we also invited academic experts and

practitioners to check them, and made some relevant adjustments. Thus, the questionnaire has a good content validity. Seven-point Likert-scale ranging from "1" (strongly disagree) to "7" (strongly agree) is used to measure the following constructs of this study: the three types of IC (human capital, organizational capital and social capital), SCL (LS and LC), and SCR. A total of 23 items were used for all these constructs, as is shown in the appendix A.

IC: Here, we used the scales developed and validated by Subramaniam and Youndt (2005) to measure three types of IC (human capital, organizational capital and social capital). Human capital was measured by using a five-item scale, whereas organizational capital and social capital were each measured by using a four-item scale.

SCL: A 6-item measure was used for SCL, including 3 items measuring learning from supplier, and others measuring learning from customer. The scales were developed from the studies of Kale, Singh, & Perlmutter(2000), Hult, Ketchen, & Nichols(2003).

SCR: SCR was measured by using a four-item scale developed from Wu , Yeniyurt and Kim(2006)'s study.

Control variables: To support the theoretical model in this study, we also control firm size and R&D input because of their potential impact on the dependent variables, as suggested by the extant literature.

B. Samples and Data Collection

The dataset for this paper includes 300 manufacturing companies in China. In our study, we obtained the data on the constructs of this study through questionnaire survey. We randomly select the manufacturing companies of three regions from the list of National Bureau of Statistics. We first make telephone calls to these companies to find the most suitable informant (most knowledgeable about supply chain management) and get their permission to fill out the questionnaire before we send the questionnaire to them. Then, we use multiple informants in each company to avoid the common method bias and double check the validity of their responses. Based on our current knowledge, Chief Operating Officer (COO), general manager, vice president or directors of R&D, supply chain manager are likely to be the best informant. Thus, the questionnaire was mailed to them, stating the purpose and potential contribution of this study. A cover letter will highlight the objectives and value of the survey. Detailed explanations such as how to fill in the questionnaire were provided. After mailing the questionnaires, we also made follow-up phone calls to enhance response rate. Respondents will be encouraged to participate in the survey with an entitlement to a summary report and a small participation incentive. Finally, we collected a sample of 300 manufacturing companies. The sample of firms in this study is from diverse industries, shown in table 1. During the responding companies, the employee number 101-200: 67(22.3%); 201-300: 56(18.7%); 301-500: 69(23%); 501-1000: 52(17.3%); more than 1000: 56(18.7%). As to the ownership, state-owned: 96(32%); private-owned: 102(34%); joint venture: 46(15.3%); foreign investment: 56(18.7%).

Table 1- Industry distribution for the dataset

Industry type	Frequency	Percentage
Biology & Pharmaceuticals	18	6
Computer & Telecommunication equipment	34	11.3
Chemicals	51	17
Medical equipment	28	9.3
Electronics &electrical equipment	54	18
Industrial machinery	49	16.3
Transportation equipment	35	11.7
New materials	31	10.3

C. Assessment of Reliability and Validity

In this study, we developed a total of 23 items to measure the constructs. We conducted confirmatory factor analysis on these items with maximum likelihood estimates, using AMOS20.0. Item scores were standardized, and pairs of residuals for latent constructs were freed based on theory and modification indexes (MIs). Reflective measures were used, with the causal direction brought from constructs to items, and the items being highly interchangeable and correlated. The results of the test of this measurement model can be seen in the appendix A.

The reliability of measurement is assessed by Cronbach's α， the Cronbach's α of human capital, organizational capital，social capital，learning from supplier，learning from customer and SCR was 0.856, 0.847, 0.831, 0.832, 0.839, 0.842, values above 0.7 were acceptable. The internal consistent reliability of each construct was good, so that the reliability of the scales used by this study is good.

We used several indexes to assess the fit of the measurement model. The fit indexes for the measurement model are as follows: ratio of χ^2 to degrees of freedom=1.909, CFI=0.944, IFI= 0.944, TLI=0.934， RMR=0.061, RMSEA=0.052, standardized RMR=0.0464，all the fit indexes suggest good fit of the measurement model. Overall, this measurement model can be considered satisfactory.

The scales used in this study all are developed and validated by prior researchers, which indicates a good content validity for the focal constructs. As shown in the appendix, we found support for convergent validity for all six constructs. The average variance extracted for all six constructs was above 0.5. Except three items, all other items' standardized loadings exceeded 0.7. These results indicate good convergent validity for all the focal constructs. We used square root of average variance extracted for each construct included in the measurement model to assess the discriminant validity. As is shown in Tab.1, for each latent variable, the square root of average variance extracted for each construct exceeded that construct's correlation with all other constructs, which indicates good discriminant validity for the constructs.

IV. ANALYSIS AND RESULTS

Table 2 reports on descriptive statistics and bivariate correlations. The six constructs measured by questionnaire items (human capital, social capital, organizational capital, learning from supplier, learning from customer and supply chain responsiveness)are significantly and positively correlated with each other.

Table 2-Descriptive statistics and bivariate correlations for studied variables

Variables	1	2	3	4	5	6
Human capital	**0.745**					
Organizational capital	0.551**	**0.764**				
Social capital	0.442**	0.475**	**0.740**			
Learning from supplier	0.338**	0.351**	0.270**	**0.794**		
Learning from customer	0.392**	0.456**	0.318**	0.495**	**0.798**	
SCR	0.526**	0.477**	0.473**	0.422**	0.519**	**0.762**

**. P≤001.Square root of average variance extracted for each construct included in the model is given in bold along the diagonal in the table. The correlations among the variables (computed as means of the corresponding items) are given below the diagonal.

Data analysis was conducted by using a structural equation modeling approach. The Amos analysis started with the theoretical model, with two exogenous latent constructs (human capital and social capital) and four latent endogenous constructs (organizational capital, learning from supplier, learning from customer, SCR). The model performed well in terms of the fit indexes (χ^2 =493.100, degrees of freedom=252, ratio of χ^2 to degrees of freedom=1.957, IFI= 0.932, TLI=0.917, CFI=0.931, RMR=0.077, and RMSEA =0.057, standardized RMR=0.0574). However, during the hypothesized paths, the path from social capital to SCR (H2c), and the path from organizational capital to supplier knowledge leveraging (H4a) and customer knowledge leveraging (H4b), were not significant (p>0.10). Based on the analysis of the theoretical model, we obtained a modified theoretical model and the relationships among the variables after deleting non-significant relationships, as shown in Fig.2.

From the analysis results, we may discover the following relationships. First, social capital and human capital have a positive influence on organizational capital, the coefficient is 0.382 (p<0.001), 0.284 (p<0.001), respectively, which supports H1a and H1b. Second, human capital and organizational capital contribute to the firm's SCR, the coefficient is 0.260 (p<0.001), 0.232 (p<0.001), respectively. Third, human capital has a positive impact on learning from supplier, learning from customer, the coefficient is 0.198 (p<0.05), 0.177 (p<0.05), respectively. Social capital also positively affect learning from supplier, learning from customer, the coefficient is 0.281 (p<0.01), 0.408(p<0.001), respectively. However, organizational capital doesn't significantly influence the two dimensions of SCL. Thus, H3a, H3b, H5a, and H5b were supported, H4a, and H4b were not supported. Meanwhile, we may also found that the coefficients from social capital to learning from supplier, learning from

customer are larger and more significant than the ones from human capital to them. Fourth, learning from supplier and learning from customer also affect SCR positively, the coefficient is 0.15 ($p<0.01$), 0.298 ($p<0.001$), respectively. Based on the knowledge provided by intellectual capital, firms can obtain relative knowledge through learning from supplier and customer, which can contribute to the firm's knowledge storage, then, they can easily and quickly respond to the market changes and supply chain problems. Consequently, learning from supplier, learning from customer can stimulate SCR. The results support H6a and H6b. Moreover, the influence of learning from customer on SCR is larger and more significant than that of learning from supplier on SCR. At last, we also found that the control variable, firm size and R&D input didn't have significant influence on learning from supplier, learning from customer and SCR.

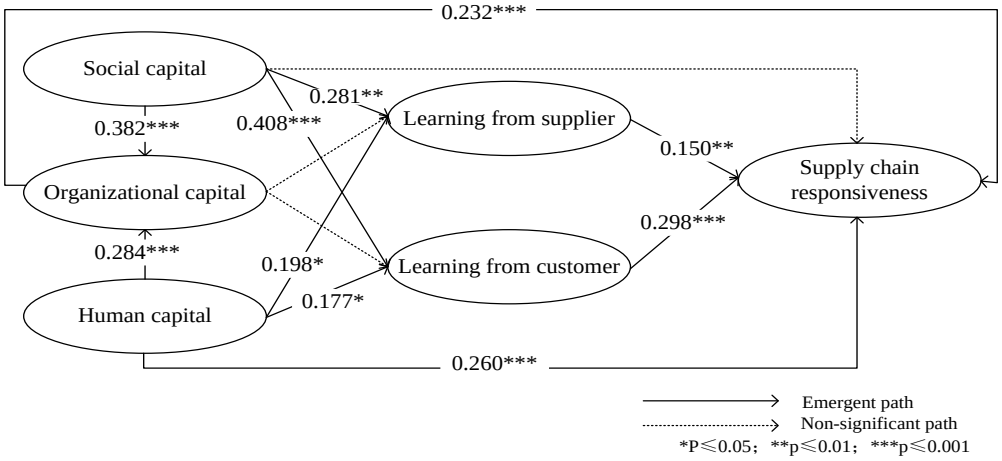

Figure 2-Results for the emergent model

V. DISCUSSION

A. Key Findings

Based on the previous literature, we found that the research focusing on relationships between IC, SCL and the firm's SCR, especially in the context of China is rare. Thus, proposed and empirically tested a comprehensive model which represents the relationships among intellectual capital of the firm, supply chain learning and supply chain responsiveness, based on the knowledge-based view and organizational learning theory. We tested the relationships by using a dataset of 300 Chinese manufacturers in high-tech industries.

The empirical results support the followings. The effects of human capital and social capital on organizational capital (H1a and H1b, respectively), the effect of human capital, organizational capital on SCR (H2a and H2b, respectively), the effect of human capital on supplier knowledge leveraging (H3a) and customer knowledge leveraging (H3b), the effect of social capital on supplier knowledge leveraging (H5a) and customer knowledge leveraging (H5b), the effect of supplier knowledge leveraging and customer knowledge leveraging to SCR (H6a and H6b, respectively) were supported. Hypothesized effects, such as the effect of

social capital on SCR (H2c), the effect of organizational capital on supplier knowledge leveraging and customer knowledge leveraging (H4a and H4b, respectively), were not supported. Table 3summarizes the results of hypothesis testing.

Table 3-Results of hypotheses testing

Hypotheses	Result
H1a: Human capital is positively associated with organizational capital.	Supported
H1b: Social capital is positively associated with organizational capital.	Supported
H2a: Human capital is positively associated with supply chain responsiveness.	Supported
H2b: Organizational capital is positively associated with supply chain responsiveness.	Supported
H2c: Social capital is positively associated with supply chain responsiveness.	Not Supported
H3a: Human capital is positively associated with learning from supplier.	Supported
H3b: Human capital is positively associated with learning from customer.	Supported
H4a: Organizational capital is positively associated with learning from supplier.	Not Supported
H4b: Organizational capital is positively associated with learning from customer.	Not Supported
H5a: Social capital is positively associated with learning from supplier.	Supported
H5b: Social capital is positively associated with learning from customer.	Supported
H6a: Learning from supplier is positively associated with supply chain responsiveness.	Supported
H6b: Learning from customer is positively associated with supply chain responsiveness.	Supported

First, a firm can significantly enhance its supply chain responsiveness through supply chain learning, including learning from supplier and learning from customer, especially learning from customer. Because learning from customer can transfer knowledge from market downstream. Through learning from customer, firms can obtain the direct information, in this way firms can respond to the market changes efficiently and flexibly (Jaber, Bonney, & Guiffrida, 2010).

Second, a firm's human and organizational capital can directly improve supply chain responsiveness, but social capital can't directly influence supply chain responsiveness. Nowadays，successfully responding to the supply chain changes relies on retaining employees with rich skills and knowledge. The routines, systems structures and processes can provide relative support to quickly respond to the changes and deal with problems. However, we also discovered that social capital doesn't significantly influence SCR, which may due to the efficiency of interactions inside the firm, interactions may time-consuming.

Third, a firm's human and social capital also can significantly improve supply chain responsiveness through learning from supplier and customer, but organizational capital does not have such significant indirect effect on supply chain responsiveness.

Last, a firm's human and social capital also has a significant positive effect on organizational capital, which is consistent with the study of Hsu and Fang (2009). Meanwhile,

social capital has a larger effect on organizational capital than human capital. The knowledge owned by employees and embedded in the interactions inside the firm can facilitate the institutionalized knowledge, human capital may establish a foundation of knowledge , whereas， social capital facilitates the diffusion and using of knowledge, thus, human capital and social capital can contribute to organizational capital. Social capital would do better on emphasizing knowledge from the firm's level than human capital, which leads to social capital influencing organizational capital more.

B. Managerial Implications

First, in order to improve supply chain responsiveness through the investment in intellectual capital, human capital seems to be the most important resources. Because knowledge and skills of employees enable the firm to acquire, assimilate, transform and apply knowledge from supplier and customer to help improve supply chain responsiveness. At the same time, the knowledge and skills can also help understand customer requirements, resolve problems, and make the needed changes to satisfy the changing customer requirements quickly. Therefore, human capital is the most important resource for improving supply chain responsiveness.

Second, social capital is also very important for improving the capability of learning from supplier and customer, which leads to higher supply chain responsiveness, but it doesn't significantly influence supply chain responsiveness directly. Trusting relationships among employees in different functions will enable open communication, frequent and reliable information exchange, which will enhance information acquisition from supplier and customer, and more effective dissemination, assimilation, application of the information for enhancement of supply chain responsiveness.

Third, organizational capital is important for improving supply chain responsiveness, because the institutional knowledge and codified experience embedded in the firm's systems, processes, databases, structures, etc, can be very useful in resolving supply chain problems, and adapt to market changes quickly. However, it is not very effective in facilitating learning from supplier and customer, because supply chain learning mainly involves the transfer of tacit knowledge, which requires intensive interaction and exchange between the firm and its supply chain partners.

In addition, to enhance organizational capital, firms needs to have the knowledge and expertise of its employees and have the culture and environment to enhance the knowledge and expertise sharing among employees, therefore both human and social capital can significant enhance organizational capital.

Last but not the least, this study indicates the relationships in a supply chain context, highlights the importance of learning from supply chain partners, such as suppliers and customers, absorbing the unique knowledge owned by supplier and customer, and acquiring external knowledge to increase the effectiveness of SCR. The customer's knowledge may be more useful than supplier's, thus firms should pay more attention on customer, seize the opportunities and quickly respond to them.

C. Contributions and Limitations

Prior literatures on IC mainly focus on the effects of IC on innovation, firm's financial performance，rarely explore the relationship between IC and supply chain performance，let alone supply chain responsiveness. What's more, the knowledge on the relationships among IC, learning and performance in supply chain context is limited, too. The study applies knowledge-based view and organizational learning theory to investigate the effects of intellectual capital on supply chain learning and subsequently on supply chain responsiveness (SCR). Our study has the following contributions. First, we contribute to the supply chain literature by specifying and empirically testing the relationship among three dimensions of intellectual capital, supply chain learning (learning from supplier and learning from customer), and supply chain responsiveness. Second, we discover that the three dimensions of intellectual capital influence supply chain responsiveness through different paths, thus enhance the understanding of the underlying mechanism among intellectual capital, supply chain learning and supply chain responsiveness. We also provide solid evidences on the impacts of intellectual capital in China. This may gives some insights into the practice of Chinese manufacturing.

This study also has some limitations, the knowledge also need to be explored by further researches. First, this study has only analyzed the data collected from China; future studies should test the validity of the proposed model using data from other countries, and compare the findings from different countries. Second, this study uses a cross-sectional data set which does not allow us to examine the longitudinal effects; future studies should investigate how intellectual capital and supply chain learning will influence SCR over time using a longitudinal data set. Third, this study has only investigated the effects of learning from supplier and customers. Learning from competitors, industry associations, universities may also play important role in enhancing SCR; future studies should examine the effects of learning from these organizations.

Appendix A. Measurement items (with factor loadings)

Measurements	Estimate	C.R.	Cronbach's α	AVE
Social capital		0.833	0.831	0.555
1. Employees from different departments feel comfortable calling each other when need	0.752			
2. People are quite accessible to each other in the company.	0.761			
3. We are able to discuss problems and tough issues openly in the company.	0.745			
4. Our employees apply knowledge from one area of the company to problems and opportunities that arise in another.	0.721			
Organizational capital		0.848	0.847	0.583
5. Standard operating procedures are in place.	0.795			
6. Much of this company's knowledge is contained in manuals, archives, or databases.	0.797			
7. We usually follow the sequence of written procedures and rules.	0.729			
8. Our company embeds much of its knowledge and information in structures, systems, and processes.	0.731			
Human capital		0.858	0.856	0.548
9. Employees in the company are highly skilled in their respective jobs.	0.790			
10. Employees in the company are considered among the best people in our industry.	0.767			
11. Employees in the company are experts in their particular jobs and functions.	0.764			
12. Every employee in the company has useful experience.	0.650			
13. Our employees always develop new ideas and knowledge.	0.721			
Supplier knowledge leveraging		0.835	0.832	0.630
1. We are able to obtain a tremendous amount of technical know-how from the supplier	0.799			
2. We rapidly respond to technological changes in our industry by applying what we know from the supplier.	0.869			
3. As soon as we acquire new knowledge from the supplier, we try to find applications for it.	0.705			
Customer knowledge leveraging		0.840	0.839	0.637
1. We are able to obtain a tremendous amount of our product knowledge from the customer.	0.757			
2. We rapidly respond to technological changes in our industry by applying what we know from the customer.	0.851			
3. As soon as we acquire new knowledge from the customer, we try to find applications for	0.784			
Supply chain responsiveness		0.845	0.842	0.580
1. We could quickly resolve the supply chain problems.	0.809			
2. Our supply chain could adapt to market change easily.	0.855			
3.We could easily acquire the raw materials for the new product.	0.692			
4. We could quickly conduct engineering change to adapt to customer's production line.	0.676			

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IDENTITY FRAUD: EMPOWERING INDIVIDUALS

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ABSTRACT

An increasing number of individuals are becoming victims of identity crime, yet few understand how to deal with the aftermath of the compromise of their personal information. Frequently, even the organisations that have inadvertently facilitated the crime are not able to offer constructive advice or assistance; victims are often given conflicting advice. This paper takes a victim centric approach to understanding experiences of identity theft and misuse of personal information in order to gain a clearer understanding of the type of education and support individuals require to prevent an instance of identity compromise and/or to cope with the effects of such an event. The findings of six focus groups and a household telephone and online survey, undertaken in New Zealand, indicate that people want to learn more about empowering themselves to cope with personal information compromise. Identity theft is considered to be of serious harm to the community. The results show that a support case management facility would assist in helping individuals to cope with identity crime; furthermore a standard code of practice through which government agencies, businesses and online merchants were accredited would give confidence and empower individuals.

Keywords: identity theft, personal information compromise, empowerment

BACKGROUND

Identity fraud is affecting a growing number of individuals but how much do those who have not experienced this silent and invidious crime know with regard to empowering themselves to preventing or overcoming its occurrence. Even those individuals who have endured the effects of having their identity used by another person may not have the knowledge or skill-

set to understand or deal with the implications of an appropriation of their personal information and integrity. In the next section we look at the literature on identity fraud, much of this literature is related to Australia and New Zealand, and for the purposes of this paper we are assuming that Australia and New Zealand are very similar in their cultural values and how they react to fraud.

Crimes involving identity have been defined variously (Australian Centre for Policing Research, 2006; Koops and Leenes, 2006; Lai, Li & Hsieh, 2012), however for the purpose of this article identity fraud is defined as 'the gaining of money, goods, services or other benefits through the use of a fabricated identity; a manipulated identity; or a stolen/assumed identity' (ACPR, 2006 p.15). As a false or fabricated identity may stem from a source other than identity theft it is necessary to note that identity theft is 'the theft or assumption of a pre-existing identity (or significant part thereof), with or without consent, and, whether, in the case of an individual, the person is living or deceased' (ACPR, 2006 p.15). Cybercrime occurs in many differing forms, it has been defined as 'any crime that is facilitated or committed using a computer, network, or hardware device' (Gordon & Ford, 2006), it includes misappropriation and misuse of identity in the cyber environment, cyber identity theft. Though the scope of these definitions is broad it is necessary to consider identity crimes that include both debit and credit card fraud, and the theft of personal information for the purposes of impersonation.

According to an Australian Bureau of Statistics (ABS) survey, undertaken in 2011, four percent of people over the age of 15 were victims of identity fraud in the 12 months prior to the survey being carried out, this equates to 702100 victims (Australian Bureau of Statistics, 2012). The 2006 New Zealand Crime and Safety Survey (NZCASS) reported that almost three percent of New Zealanders over the age of 15 in private households, equating to approximately 93000 people, had been affected by identity theft in the period of up to 18 months prior to the survey (Mayhew & Reilly, 2007). Following a further survey undertaken for the Australian Attorney-General's Department in 2012 it was reported that seven percent of respondents had experienced identity theft or misuse in the six months preceding the survey, furthermore 58 percent of those respondents thought that the compromise of their personal data had occurred through the use of the internet (Di Marzio Research, 2012). This research reported a significant variance between genders with a greater number of males reporting various types of cyber identity compromise than females, differences across age groups were also noted, the percentage of cyber identity theft occurrences reducing as age increased (Di Marzio Research, 2012). A lower level of risk of identity theft for those aged 60 or more was also found in the NZCASS survey (Mayhew & Reilly, 2007).

Taking into consideration the crime of identity fraud as a whole shows different correlations between the demographic characteristics of an individual and the likelihood of becoming a victim of identity fraud. Where identity fraud is not limited to the cyber environment, a higher level of income (Anderson, 2006; Office of the Australian Information

Commissioner [OAIC], 2013), being female (Anderson, 2006; ABS, 2012) or being a younger adult consumer (Anderson, 2006) renders an individual more likely to becoming a victim. Data from the ABS (2012) survey suggests that there is little difference within the age range of 25 to 44 years on the likelihood of falling prey to identity theft and misuse, and in a report based on data from an earlier ABS survey this commonality extends to those aged up to 54 years (Australian Institute of Criminology, 2008). Pratt, Holtfreter and Reisig (2010) suggest that the likelihood of becoming a victim of identity theft is increased for those who stay home and spend time and money in an online environment.

Research from the USA reported that individuals with lower levels of socio-economic status judged the risk of cyber fraud to be high but dissipated the risk by spending less time online and making fewer purchases (Reisig, Pratt & Holtfreter, 2009). Likewise individuals who had a tendency towards financial impulsivity perceived an increased risk of online credit card fraud; however they did not alter their behaviour to reduce the potential of becoming a victim of cyber fraud (Reisig, Pratt & Holtfreter, 2009).

In general Australians and New Zealanders are becoming increasingly concerned about identity theft and fraud (OAIC, 2013; Mayhew & Reilly, 2007). Though Australians have been found to hold consistent opinions in their attitudes to privacy (OAIC, 2013) there are some differences across the age range with regard to fear of identity compromise. Older people, those over 50, have expressed concerns over the use of their personal details (National Seniors Australia, 2011); in fact 'inappropriate access to financial details' (OAIC, 2013 p.19) was most concerning for those of 55 to 64 years of age (OAIC, 2013). Concern about identity fraud and theft was the greatest issue for those aged 25 to 54 years old, whereas the group that were least likely to hold any fears were aged under 24 (OAIC, 2013). In New Zealand those most concerned about identity theft through credit card misuse include women and young men (Mayhew & Reilly, 2007).

Cyber identity fraud brings with it the prospect of e-commerce and online banking being undermined worldwide, damaging public confidence and trust in government agencies (Jamieson et al., 2003) and business organisations. Research has reported that fear of identity theft and identity compromise is reducing consumer use of e-commerce opportunities (Eisenstein, 2008; Hille et al., 2011; Lynch, 2005; Reisig, Pratt & Holtfreter, 2009) and other online services (Gatto & Tak, 2008; National Seniors Australia, 2011). Such fear is increasing and equals or outstrips fear of traditional place-based crime (National Statistics, 2014; OAIC, 2013; Roberts, Indermaur & Spiranovic, 2013). Roberts, Indermaur and Spiranovic (2013) noted that their research reflected the fact that there was often a generalised fear and loss of personal confidence as individuals came into contact with new advances in technology and modes of communication. Their research suggested that there are two components that predict fear of internet related identity compromise, a general fear of crime and a component relating to the amount of internet exposure, where greater internet use increases fear (Roberts, Indermaur & Spiranovic, 2013), this may be due to a greater level of awareness of the

potential identity compromise opportunities (Miyazaki & Fernandez, 2001). Roberts, Indermaur and Spiranovic (2013) also noted that individuals accessing the internet at home, as compared to a work environment, have heightened levels of fear. The amount of time spent online at home and the belief that work environments will be protected by increased levels of internet security may influence this factor. Identity theft attacks trust, corroding faith in providers of goods and services (Australian Crime Commission, 2013), and diminishing confidence allowing fear to pervade the lives of victims (Anderson, 2006). However, fear of crime has been revealed to be disproportionate to the actual risk of becoming a victim (Chadee, Austen & Ditton, 2007; National Statistics, 2014; Roberts, Indermaur & Spiranovic, 2013; Wall, 2013).

It has been found that familiarity with a website, its navigation and with the e-vendor may allay fears that the user is being taken advantage of; indeed familiarity has been found to affect trust considerably (Gefen, 2000). Technical familiarity and amount of time spent online impact the privacy strategies an individual utilises (Park, 2011). In the case of a social media site, such as Facebook, young individuals who spend a greater amount of time on the site have been found to be more confident in utilising the site's privacy settings (Boyd & Hargittai, 2010).

The period of greatest fear arises when a communication channel is unfamiliar (Roberts, Indermaur & Spiranovic, 2013); trust is then instilled as users communicate online in a positive manner (Gordon & Ford, 2006). Reading web site privacy policies has generated a level of confidence for some users, (OAIC, 2013). As a group, older adults tend to lack confidence with computers and the internet (South Australian Government, 2012), however, as they increase their interaction with information and communication technologies they become more positive in their attitude toward the technology and achieve a greater level of self-confidence (Gatto & Tak, 2008; González, Ramírez, & Viadel, 2012). Though levels of trust are still low, Australians are increasingly trusting e-Commerce companies, however, in general, the level of trust in organisations reduces with increasing age (OAIC, 2013).

The accessibility of a targetable individual by cybercrime offenders is dependent on the individual's online activities; both in amount of time spent online and in the type of activity undertaken (van Wilsem, 2011). Estimating how many individuals are directly affected by cyber identity theft is not easy, this is partially due to the fact that most victims of identity theft are not aware of exactly how or when the original identity compromise occurred, including whether it was perpetrated online or in an offline situation (Roberts, Indermaur & Spiranovic, 2013). Furthermore in online situations, such as phishing, victims may be completely unaware of the deception (Wall, 2013).

It has been suggested that almost half of the Australian population believes that the greatest risk to their privacy comes from using online services and social media sites, and almost all take some measure to protect their personal information, however they do not routinely do everything (OAIC, 2013). The appropriate use of information security practices by end users

is the pivotal factor in successful information security (Rhee, Kim & Ryu, 2009). Research has shown that over one third of people using the internet always check the security of a website before giving personal details and some will provide false personal details in order to protect their true identity (OAIC, 2013). Though an increasing number of people do read website privacy policies over half do not, those that do suggest that it helps make them more confident and aware, and assists in the decision process on whether to use a website (OAIC, 2013). Such actions may help individuals to cope with their recognition of the risk of identity theft, indeed coping behaviours have been examined in this respect and both conventional coping and technological coping have been found to reduce occurrences of identity theft (Lai, Li & Hsieh, 2012). Conventional coping behaviour, self-efficacy, the perceived effectiveness of coping and social influence are the factors that contribute to technological coping behaviour (Lai, Li & Hsieh, 2012). Self-efficacy, the belief an individual has that he or she is able to perform and complete a course of action to attain a specific goal (Bandura, 1986), is a strong influence on technological coping, suggesting that individuals with greater technological competence are more likely to utilise technological methods such as anti-virus software, firewalls and system patching to combat cyber identity theft (Lai, Li & Hsieh, 2012; Rhee, Kim & Ryu, 2009).

Empowering individuals through improving their knowledge and coping behaviours offers a line of defence against identity fraud. One of the objectives of the Australian Government's cyber security policy launched in 2009 is making sure that all Australians are aware of cyber risks, use means to secure their computers and undertake procedures to protect their identity, their privacy and finances in online environments (Attorney-General's Department, 2009). The strategic policies to achieve the objectives include educating and empowering individuals with 'information, confidence and practical tools to protect themselves online' (Attorney-General's Department, 2009 p. vii). However instances of cyber identity compromise continue to affect a significant percentage of Australians and New Zealanders. Understanding experiences of identity theft and misuse of personal information may lead to clearer understanding of the type of education and support individuals require to prevent an instance of identity compromise and/or to cope with the effects of such an event.

METHODOLOGY

This study took a victim-centric approach; data was gathered by an external agency. The agency is a joint public-private sector not for profit organisation that has rigorous processes for ethics approval and ensures the anonymity of respondents.

Four primary methods of data collection were utilised throughout the study period in New Zealand, these included random household telephone and online surveys (n=1500), six focus groups and victim online surveys (n=51). Participants for the focus groups in New Zealand

were recruited through community groups, various official agencies and the website of the external agency.

For the household telephone and online survey females represented 65.7 percent of the sample (*n*=985) and males represented 34.3 percent (*n*=515). The largest group of respondents were in the 45 - 64 years old age bracket (41%), the next largest age bracket group were 65 years and older (37.1%), with the third largest age bracket group being 25 – 44 years (18.9%), and respondents under 24 years of age comprised the smallest age group in the survey (3%).

RESULTS

The focus group discussions revealed that whether the attendee had suffered the consequence of identity theft themselves or represented an individual or a business that had been impacted as a result of the theft of a person's identity the need for more knowledge was the motivation to attend the focus group. The majority wanted to learn of and from the experience of others and pick up 'tips on preventing things from happening going forward'. In the main, attendees had made the initial detection that their identity or that potentially their customers identities had been compromised, others (15%) were notified of the issue by their banking institution. Conversely, when the household telephone and online survey respondents were asked how they became aware that their personal information had been misused, 44.5 percent (*n*=53) of responses stated that the respondent had been notified or contacted by an agency or organisation, whereas 30.3 percent (*n*=36) had discovered the misuse event themselves (multiple responses were possible).

Though each identity theft experience is unique to itself the experience of approximately 31 percent of the focus group attendees was connected to credit card fraud where card details had been used to draw money from an account or fraudulent purchases had been made with the attendee's credit or debit card. Where more personal information such as birth certificate or passport information had been compromised individual consequences were more varied, with many attendees (46%) having ongoing issues to deal with and continuing to have concerns about 'what's coming next'.

Of the household telephone and online survey respondents, 42.9 percent (*n*=51) nominated credit/debit card information as being the personal information that was misused during their most serious occurrence of identity theft in the previous 12 month period, 22.7 percent (*n*=27) said their name was misused and another 16.8 percent (*n*=20) stated that bank account information was misused. Other types of personal information that were nominated were date of birth (10.1%, *n*=12); address, gender and computer username (9.2%, *n*=11); online account username (8.4%, *n*=10); place of birth and drivers licence information (3.4%, *n*=4); password and personal identification number (2.5%, *n*=3); passport information (1.7%, *n*=2), and inland revenue department number (0.8%, *n*=1), multiple responses were possible.

Typically, individuals whose identity has been compromised are not regarded as the primary victims of identity theft related fraud by law enforcement and legal agencies (Roberts, Indermaur & Spiranovic, 2013), however a number of focus group attendees (31%) went further and suggested that they were made to feel like 'the one who has committed the crime' by the organisations they had approached for assistance. Attendees related that organisations had given conflicting advice on what to do, passing individuals off from one organisation or department to another. One commented that 'everything is about prevention, there's nothing on how to respond'. In addition to this, and above and beyond the initial loss of money, 10.9 percent (*n*=13) of household and online survey respondents who experienced identity misuse incidents were also refused further credit, government benefit and/or other services, and just under seven percent required counselling or other treatment (multiple responses were possible) (table 1).

Table 1: Other negative impacts experienced as a result of personal information being misused.

	Frequency	%
I was refused government benefits	8	6.7%
I experienced mental or emotional distress requiring counselling or other treatment	8	6.7%
I was refused other services	4	3.4%
I was refused credit	1	0.8%
I experienced financial difficulties resulting in the repossession of a motor vehicle or other items	1	0.8%
Other	24	20.2%
I didn't experience any other consequences	83	69.7%

(multiple responses possible)

Focus group attendees spoke of the experience as being 'scary', of being 'less confident', of being 'not as trusting of people anymore', of questioning their use of the Internet and of changing their behaviour both online and offline.

With regard to harm to the community, the telephone and online surveys revealed that 93.9 percent (*n*=1392) of respondents considered the misuse of personal information to be very serious (63.3%, *n*=938) or somewhat serious (30.6%, *n*=454). Those considering it very serious nominated that they thought about it frequently and felt that action should be taken to minimise it. Though most respondents had not experienced identity theft or attempted identity theft in the preceding 12 month period, a significant percentage had (4.4%, *n*=66) with almost half of those (43.9%, *n*=29) being successful to some degree. This result suggests an approximately 50 percent increase in occurrence when compared to the 2006 NZCASS survey of those affected by identity theft (Mayhew & Reilly, 2007). Increasing the time period in which respondents had been affected by identity theft to five years, showed an increase in

occurrence with almost nine percent (8.7%, *n*=85) reporting attempted identity theft of which 38.8 percent (*n*=33) were successful to some degree.

Though some may consider that unsuccessful attempts to use another person's identity might not be significant it should be noted that an initial compromise of identity has still occurred and there may be more than one attempt at fraudulently using the compromised identity therefore there is a continued need to be vigilant. When respondents were asked how many unsuccessful attempts there had been to use their identity, 29.1 percent (*n*=16) nominated more than two attempts. Of those reporting actual misuse incidents 69.7 percent (*n*=23) stated that they had experienced one misuse incident and 15.2 percent (*n*=5) stated they had suffered two misuse incidents. However 12.1 percent (*n*=4) reported that there had been 10 or more incidents of misuse of their identity (figure 1). This may be affected by the time taken between the identity compromise event and its detection but may also reflect the type of identity theft, debit and credit card fraud or the theft of personal information for the purposes of impersonation.

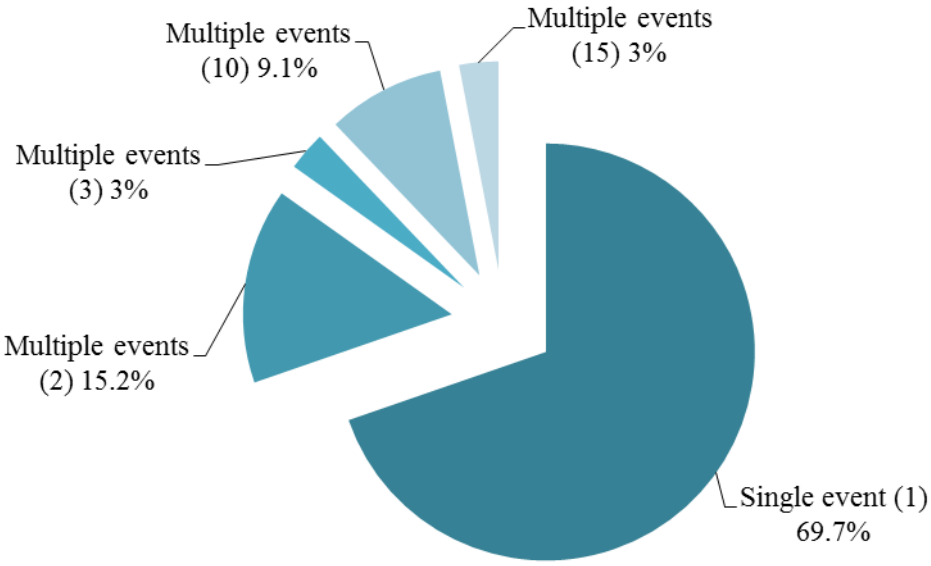

Figure 1: Number of actual misuse incidents.

Survey respondents were asked in which ways they believed their personal information was misused. Over 51 percent (*n*=61) of responses nominated reasons of financial gain, such as obtaining money from a bank account or purchasing something. A further 24.4 percent (*n*=29) of the reasons suggested involved the use of specific personal details for the purposes of impersonation (multiple responses were possible) (table 2).

Table 2: Ways in which respondents believe their personal information was misused.

	Frequency	%
To purchase something	33	27.7
To obtain money from a bank account (excluding superannuation)	28	23.5
To obtain a license or identity document (e.g. Drivers License, Birth Certificate, Passport etc.)	11	9.2
To apply for government benefits	9	7.6
To apply for a loan or obtain credit	4	3.4
To open an online account, such as Facebook, eBay	3	2.5
To apply for a job	2	1.7
Other	12	10.1
Don't know	27	22.7

(multiple responses possible)

Results from the household telephone and online survey suggest that most respondents (80.7%, *n*=96) do tell others when their personal information has been misused or there has been an attempt to do so. However whereas 65.6 percent (*n*=63) of respondents told a family member and 49 percent (*n*=47) of respondents told a friend, low percentages of respondents told anybody else with only 16.7 percent (*n*=16) informing the police (multiple responses were possible). The exception being banks or credit unions, credit/debit card companies or e-commerce providers such as PayPal, as one third (33.3%, *n*=32) of respondents did inform these organisations (table 3).

Table 3: Who respondents told that their personal information had been misused.

	Frequency	%
A family member	63	65.6
A friend	47	49.0
A bank or credit union, a credit/debit card company (e.g. Visa or MasterCard) or an e-commerce provider (e.g. PayPal)	32	33.3
The police	16	16.7
Department of Internal Affairs	4	4.2
A utility company (e.g. gas, electricity, water etc.)	4	4.2
A consumer protection agency (e.g. Consumer Affairs)	3	3.1
NZ Transport Agency	1	1.0
Insurance provider	1	1.0
Telecommunications carrier	1	1.0
Other	12	12.5

(multiple responses possible)

Of the reasons given for not reporting the misuse of their personal identity to the police or other authority, 19.6 percent (*n*=11) stated that it seemed too difficult to do anything about it, 10.7 percent (*n*=6) did not believe that the police would be able to do anything about it, 8.9 percent (*n*=5) were too embarrassed to report it, and 3.6 percent (*n*=2) did not know where to report the matter (multiple responses were possible) (table 4).

Table 4: Reasons why respondents did not report the misuse of their personal information to the police or other authority.

	Frequency	%
I did not think it was worth the effort to report / serious enough to report	19	33.9
I did not need to as the organisation(s) that informed me seemed to be responding well on my behalf	13	23.2
It seemed too difficult to do anything about it	11	19.6
I did not believe the police or other authority would be able to do anything	6	10.7
I was too embarrassed to report it	5	8.9
I did not believe it was a crime	3	5.4
I did not know how or where to report the matter	2	3.6
Other	5	8.9

(multiple responses possible)

Though most victims of identity theft are not aware of exactly how or when the original identity compromise occurred, including whether it was perpetrated online or in an offline situation (Roberts, Indermaur & Spiranovic, 2013), survey respondents were asked how they believed their personal information was obtained. Many respondents believed that the initial compromise of their personal information was likely to have occurred online, 32.8 percent (*n*=39) of responses nominated an online situation and 4.2 percent (*n*=5) of responses suggested a data breach where information was lost or stolen from a business or other organisation which may or may not have been through an online environment (multiple responses were possible). Approximately a quarter of responses (*n*=29, 24.4%) nominated a specific offline situation (table 5).

Table 5: How respondents believe their personal information was obtained.

	Frequency	%
From information you placed on a website (other than social media, e.g. online shopping)	16	13.4
By telephone (excluding SMS)	14	11.8
From theft or hacking of a computer or other computerised device (e.g. smartphone)	14	11.8
Break and enter of home or vehicle and theft of an identity document or other personal document	6	5.0
From information lost or stolen from a business or other organisation (i.e. a data breach)	5	4.2
In a face-to-face meeting (e.g. a job interview or a doorknock appeal)	4	3.4
By email	4	3.4
From an online banking transaction	4	3.4
From an ATM or EFTPOS transaction	4	3.4
Theft of your mail	1	0.8
From information you placed on social media (e. g. Facebook, Linked-in etc.)	1	0.8
Other	18	15.1
I don't know how my information was obtained	42	35.3

(multiple responses possible)

Survey respondents were asked how likely it would be that they would use a victim support case management centre set up to support victims of identity theft, 81.7 percent (*n*=120) stated that they would, possibly, probably or definitely use such a facility. The mean average of 2.10 on a five-point scale, where the lower score the better, supports the positive result overall (table 6). Respondents were also asked to what extent they agreed (or disagreed) that they would be more likely to interact with government agencies and businesses that were accredited by such a facility on their identity security and management standards of practice, 74.2 percent (*n*=120) of respondents agreed or strongly agreed that they would be more likely to interact with accredited organisations. Further respondents were asked if they agreed (or disagreed) that they would be more likely to purchase or use products and services online from merchants that had been accredited to an identity security and management standard Code of Practice set by such a not-for-profit facility, 65.2 percent (*n*=112) agreed or strongly agreed that this was likely to positively influence the online purchasing behaviour. Again the mean average results for both these questions (2.08 and 2.17 respectively) indicate overall positive responses (table 6). A focus group attendee commented ‘there is such a need out there’ for that type of support case management centre.

Table 6: Would respondents use a victim support case management centre and be assured by government and business accreditation to an identity security and management standard Code of Practice?

	Mean (std)
If you were a victim of identity theft and misuse, how likely would you be to use a victim support case management centre? (*n*=120)	2.10 (1.21)
To what extent do you agree or disagree with the statement, I would be more likely to interact with Government agencies and businesses who were accredited on their identity security and management standards of practice? (*n*=120)	2.08 (0.97)
To what extent do you agree or disagree with the statement, I would be more likely to purchase or use products and services on-line from merchants who had been accredited to an identity security and management standard or Code of Practice? (*n*=112)	2.17 (1.11)

(Five point scale where 1=Definitely/Strongly agree and 5=Definitely not/Strongly disagree.)

DISCUSSION AND IMPLICATIONS

This study sought to gain a clearer understanding of the incidence of identity crime and the needs of individuals affected by identity theft and the misuse of personal information in order that a better level of education and support could be developed and offered to empower those who had been victimised by the crime.

The findings reveal that though the greater percentage of identity theft and misuse can be attributed to credit and debit card fraud, which are generally dealt with quickly causing limited impact on the individual victim, it is the victims of events that relate to non-banking card services that have to deal with longer term difficulties. The consequences of these events may be particularly hard to deal with where there is limited or ineffective response from the organisations involved. Many victims are not receiving clear and constructive advice from the organisations that are themselves the facilitators of the identity theft in the first place, furthermore in some cases the victims are being made to feel like criminals such as where organisations require the victims to go to greater lengths to prove themselves.

There is evidence that identity crime may have a pronounced psychological impact on victims particularly where the situation has not been fully resolved, these findings support earlier research by Sharp et al. (2004). The results from this survey suggest that incidents of identity crime are increasing, yet it is often the victim who detects the crime, instigates the remedial action, may be required to prove their own identity and then lives with the continual concern of ‘what’s coming next’. Even unsuccessful attempted crimes have a residual effect in that the victim is not able to know whether a perpetrator will attempt to use the victim’s personal details on another occasion. Victims are not able to know how far their personal information has been spread. Furthermore victims are unsure of where to source useful guidance; lack of knowledge, difficulty of undertaking the action, lack of confidence in the

authorities and embarrassment were all nominated as barriers to informing pertinent authorities. As a result individuals are looking to learn from the experiences of others.

Focus group attendees openly spoke of a loss of confidence and trust, and of changing their online and offline behaviour, this correlates with other studies (Eisenstein, 2008; Gatto & Tak, 2008; Hille et al., 2011; Jamieson et al., 2003; Lynch, 2005; Reisig, Pratt & Holtfreter, 2009) and has a direct impact on commerce and banking, particularly in online situations. Even those who have not been victims of identity theft consider it to be a serious problem and think about it frequently, most believe that some action should be taken to minimise its occurrence.

One means of offering support and empowerment to victims is the establishment of a support case management centre that affords individuals access to independent free advice across a range of needs such as the steps to take in the event of a suspected or actual identity compromise. The findings suggest that individuals would make use of this type of facility both for specific actionable information in response to an identity theft incident and for reassurance of organisations that were accredited to a code of practice set out by this support facility.

There are a number of areas where future research will be undertaken. It is important to investigate the response small and micro businesses have to identity security and whether they employ adequate security measures and controls to eliminate the potential of data breaches and other forms of personal information compromise. Additionally, many victims attribute their initial identity compromise occurrence as having occurred in an online environment, ongoing research is being undertaken to examine cyber participation and the impact identity theft and misuse has on consumer confidence particularly amongst older individuals, and in rural and remote communities.

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DETERMINANTS OF SUCCESSFUL CORPORATE ENTREPRENEURSHIP: THE ROLE OF AUTONOMY, PROCEDURAL JUSTICE AND HARMONIOUS PASSION - THE CASE OF GOOGLE –

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ABSTRACT

Continual growth based on the innovation is very important for a company and it has big ripple effects. Therefore for this innovation and continuous growth we should pay attention to the corporate entrepreneurship. Until now there has been no analysis about the determinants of successful corporate entrepreneurship in the aspect of the organization and its members.

This paper studies the case of Google to find out the determinants of corporate Entrepreneurship. By understanding 5 characteristics of Google we deliver the exploratory study model for the determinant of corporate Entrepreneurship and propose 6 hypotheses by the classification of autonomy, procedural justice and harmonious passion which influence on corporate entrepreneurship.

Keywords: Corporate Entrepreneurship, Google, Innovation

1. BACKGROUND AND PURPOSE OF STUDY

The change from agricultural society to industrial one and object economy enters to the time of creative economy under new paradigm called “creative society”. In the aspect of the company the change and innovation is required for its survival and development. But the uncertainty and complexity for operation of company is much increased when compared to the past and offering innovative product and service become a very important management agenda especially in the time of creative economy. Bigger company has the tendency of low autonomy and innovation. That’s why it tries to avoid risks and stays in existing products and businesses with hampered creativeness of employees because of its big magnitude of organization. So the corporate entrepreneurship should be activated for companies to find out the way of growth as Covin & Slevin(1986) emphasized.

Like this there have been some in-depth studies about the importance of corporate entrepreneurship. The findings of them are 5 elements of the entrepreneurial orientation of corporate entrepreneurship and the point that corporate entrepreneurship can give positive influence on the innovative performance of a company. Though the study to find out the

parameters or control variables between corporate entrepreneurship and innovation has been performed there is no proper analysis about the determinant to inspire the corporate entrepreneurship in the relationship between company and its employees nor established mechanism to lead the innovative performance of companies. Therefore the aim of this study is to find out the determinant to realize the corporate entrepreneurship in the relationship between a company and its employees and to give theoretical and empirical implications to inspire the empirical in a company.

This study watches the case of Google, a company attracts attention all over the world and gives study models and hypotheses about determinants of the corporate entrepreneurship through it.

2. THEORETICAL STUDY

2.1 Theoretical study for corporate entrepreneurship

2.1.1 The concept of corporate entrepreneurship

The studies about the corporate entrepreneurship was about the person before but changed to the aspect of a company with the increase of uncertainty and complexity of company management. Above all the corporate entrepreneurship which can lead an innovation for a company or business is required seriously. Though the corporate entrepreneurship is expressed as corporate entrepreneurship, corporate venturing or internal entrepreneurship normally we use the word "corporate entrepreneurship" in this paper.

Covin & Slevin(1986, 1991) classified entrepreneurial posture, the elements of corporate entrepreneurship, into innovativeness, proactiveness and risk-taking and Lumpkin & Dess(1996) renamed the corporate entrepreneurship to entrepreneurial orientation and broadened its concept by adding the autonomy and competitive aggressiveness.

The corporate entrepreneurship can be defined as an entrepreneurial thinking and behavior through the process of strategic renewal for new business or organization, That is, the importance is how the constituents of an organization act as a business entrepreneur. Many studies define this corporate entrepreneurship differently but they have common characteristics of innovativeness, proactiveness, risk-taking and autonomy. Let's think of details of them.

2.1.2 The core variable of corporate entrepreneurship

The core variables of corporate entrepreneurship are as follows: innovativeness, proactiveness, risk-taking and autonomy. Miller(1983) explains the innovativeness as the efforts of a company to find out the new opportunity and solution, that is, the desire of a company to solve the faced challenges with bold and broad behaviors. The risk-taking means the act of driving new business opportunity with pushing new businesses though it has no certainty of success of the business (Lumpkin & Dess, 1996). So we can say the corporate entrepreneurship is a business management to make a decision or push new business though the risk is somewhat big and a concept to find out and push an opportunity without the limit of controlled resources. The proactiveness can be defined as a challenge to change the status in the industry or show its willingness for superb performance with proactive competition (Lumpkin & Dess, 1996). The autonomy is an entrepreneurial sense to give an idea or vision independently (Lumpkin & Dess, 1996) and can be defined as an entrepreneurial independence to propose new ideas from escaping the bureaucratism of the organization. The autonomy which can be a base for the risk-taking and innovativeness plays big role to make new ideas for new development of a product by giving self-reliant mood of the company.

2.1.3 Conventional studies of corporate entrepreneurship

The studies about corporate entrepreneurship can be classified into some categories. Firstly, there are some studies about the importance of the corporate entrepreneurship. These studies specify 5 elements of entrepreneurial orientation including the innovativeness which influences on the innovative performance of a company. According to Lassen et al(2006) the corporate entrepreneurship has characteristics of innovativeness, proactiveness, risk-taking, autonomy and rashness and the proactiveness and risk-taking influence more on radical innovation.

Secondly, there are some studies on the corporate entrepreneurship related to organizational system. Kaya(2006) approaches it with management dimension of human resource and insists that the immersion and concentrativeness of employees can be enhanced with it.

Conventional studies deliver results that the elements specification of entrepreneurial orientation and corporate entrepreneurship influence positively on innovativeness and labor immersion of employees. But still there is no in-depth study how the entrepreneurial orientation is formed and how the innovative performance is made with what procedures.

2.2 Theoretical study on self-determination

2.2.1 The concept of self-determination

The self-determination theory is a kind of motivation theory and it insists that by responding to the things occurred around us we can develop autonomic mental growth and development. The self-determination means we determine what to do for ourselves not enforced by external conditions.

In this study the motivation is classified into intrinsic motivation and external one. Whereas in the intrinsic motivation the source of any behavior comes from oneself it relies on the external conditions in the external motivation. Deci and Ryan give the concept of 'self-determinant' as the determinant of intrinsic motivation with regarding intrinsic and external motivation as the concept of continuity (Deci & Ryan, 1985). That is they insist we have somewhat self-determinant though there exists the intervention of external motivation including external compensation and it has form of coexistence of intrinsic and external motivation. As the table 1 shows the type of motivation can be classified into no, external and intrinsic motivation and the no motivation means the status of no willingness to behave with no self-determinant. Also about the regulation there are various types of it from no regulation to intrinsic regulation and a person can make harmony with other aspects of self-value or self-identity in case the regulation becomes intrinsic.

Table 1 – Type of motivations according to the continuity of self-determinant

Behavior	Non self - determined				Self - determined	
Type of Motivation	Amotivation	Extrinsic Motivation				Intrinsic Motivation
Type of Regulation	Non Regulation	External Regulation	Introjected Regulation	Identified Regulation	Integrated Regulation	Intrinsic Regulation
Locus of Causality		External	Somewhat External	Somewhat Internal	Internal	Internal

resource by Deci & Ryan (2000)

2.2.2 Components of self-determinant

The components of self-determinant are autonomy, competence and relatedness and mental satisfaction of these 3 components stimulates the intrinsic occurrence of motivation through the self-determinant (Deci & Ryan, 1985). The autonomy is to select the behavior of oneself and means the recognition that he or she is the entity of own behavior and has the power to do it (Ryan & Grolnick, 1986).

The competence is the belief that one can interact with the environment efficiently. That is, it is the desire to feel the satisfaction to broaden own performance (Deci & Ryan, 1985). People show the tendency to find proper challenges for own growth. This is the expression to show own competence to overcome surrounding environmental conditions.

The relatedness means the individuals are socially connected each other and make harmony with others (Baumeister & Leary, 1995). The satisfaction for the desire of relatedness plays big role to keep the intrinsic motivation of behavior. The discussion about the relatedness starts a bit lately than the autonomy and competence.

2.2.3 Conventional studies for self-determinant

Wilson, Rodgers & Fraser(2002) explain there is a relationship between the elements of mental satisfaction (e.g. autonomy, competence and relatedness) and self-determinant. In the aspect of an organization existing studies support that autonomic office environment enhances the internalization of intrinsic and external motivation by satisfying basic needs of constituents and draws positive results including work satisfaction, immersion of organization and psychological stability (Gagne & Deci, 2005).

In the relationship between self-determinant and corporate entrepreneurship Mudambi & Navarra(2007) interprets the self-determinant as a power succession and insists this self-determinant intensify the innovation. Through these studies we can say the motivation and self-determinant influence to the corporate entrepreneurship.

2.2.4 The theory of harmonious passion and self-determinant

The passion is the personality which people invest own time and energy for the valuable things he or she like. Vallerand(2003) establishes the dualistic model of passion which classifies the harmonious passion and the obsessive passion according to how the passionate behavior internalizes the person's identity.

The harmonious passion occurs when one's identity goes through the autonomic internalization of behaviors and autonomic internalization occurs when a person give the importance to any own behavior and performs it autonomically. That is, the harmonious passion is a motivation power to encourage one's willingness to participate.

In here we should pay attention to the relationship between the passion and the motivation. Vallerand(2006) explains the autonomous personality and the controlled personality determine the passion. Those personalities represent the intrinsic and external motivation which drives passion.

Through the study of the relation between passion and motivation the self-determination theory from Deci &Ryan and the dualistic model of passion from Vallerand can be established. Also Vallerand(1997) develops various conceptual models through the hierarchical model of intrinsic and extrinsic motivation in the aspect of self-determinant theory.

2.3 Theoretical study on the equity theory of an organization

2.3.1 The concept of the equity

The concept of equity bases on the theory of cognition dissonance from Festinger(1954) and the exchange theory from Homans(1961). In the theory of cognition dissonance disharmony/tension occurs when two kinds of cognition elements are disagree and a person

behaves to establish psychological balance by removing the cause which drives the tension. In the exchange theory the input is related to the output in human's social relationship. Also the studies about the equity can be classified into two categories: One approaches from the aspect of overall society with social ethos and macroscopic. The other with microscopic and from the organization inside can be thought as so called the aspect of equity so it is widely used at the field related to businesses.

The equity theory with microscopic and from the organization inside is widely used as the one which specifies the behavior patterns and motivation elements and especially it is about what action people take when they think they don't have proper compensation. When a person think his or her status is not fair compared to others the will to work is declined and not well motivated (Streers, 1979).

The organizational equity can be classified into the distributive justice and procedural justice. Whereas the former explains the fairness of the result the latter focuses on the procedural fairness to determine the distribution. At early times most studies centered to the distributive justice. But the focus moved to the procedural justice because there was some limit to explain all conditions of an organization with just distributive justice.

2.3.2 The procedural justice

Thibut, Walker & Lastour(1975) used the concept of procedural justice first and Folger & Konovsky(1989) insisted it influences to the employees more than the distributive justice does. Especially Leventhal(1976) explained the procedural justice is a precondition to secure and keep the distributive justice and proposed following six criteria to secure the procedural justice:

① consistency: Does the procedure have the consistency for the person or time?

② bias suppression: Is the procedure independent from the bias?

③ accuracy: Is the procedure based on correct information?

④ correctability: Does the procedure give the opportunity to revise the incorrect decision?

⑤ representative: Does the procedure consider the attention of all people?

⑥ ethicality: Does the procedure coincide with socially shared ethics?

One thing we should pay attention is the procedural justice can be a kind of external motivation like money in the aspect of the motivation for the constituent of an organization and Prooijen(2009) insists that the autonomy is influenced by the procedural justice.

3. CASE STUDY OF GOOGLE

3.1 Company overview

The reason we select Google to specify the determinant of corporate entrepreneurship in this paper is as follows: Firstly it is an innovative company which has got innovative 50 companies award for 3 years in a raw from Business magazine. Secondly it is the company which USA university students want to work for mostly. Thirdly it is the high-premium company which has world 2nd market cap and its price sales ratio is almost 6.

Google originated from a joint study of Larry Page and Sergey Brin at the Stanford University in 1996 and got the investment of $100,000 from Andy Bechtolsheim, a co-founder of Sun in 1998. Though the member of Google was just two co-founders and one employee now the number of its employee are about 39,000 all over the world.

The name "Google" came from the Math term "Googol" which means 100 squares of 10 and means the willingness to systematize the unlimited information on the Internet and to search for the countless web-pages. The word "Google" listed on the Oxford dictionary in 2006 with

meaning of “to browse” and it becomes a culture and influences on the society with various innovations.

4. RESEARCH MODEL AND PROPOSITION

4.1 Research model

As mentioned in the introduction, this study investigates what are determinants of successful corporate entrepreneurship. For this purpose, we have reviewed self -determination theory as well as equity theory regarding corporate entrepreneurship, and built a research model based on the analysis of Google case study, which is about how giving the autonomy within the organization influences entrepreneurship orientation, and what influence external and internal motivation in the relationship between the organization and employee have on the corporate entrepreneurship.

For the external motivation in the relationship between autonomy and corporate entrepreneurship, we will focus on the role of procedural justice, and for the internal motivation, the role of harmonious passion. According to this, the research model was set up in this study:

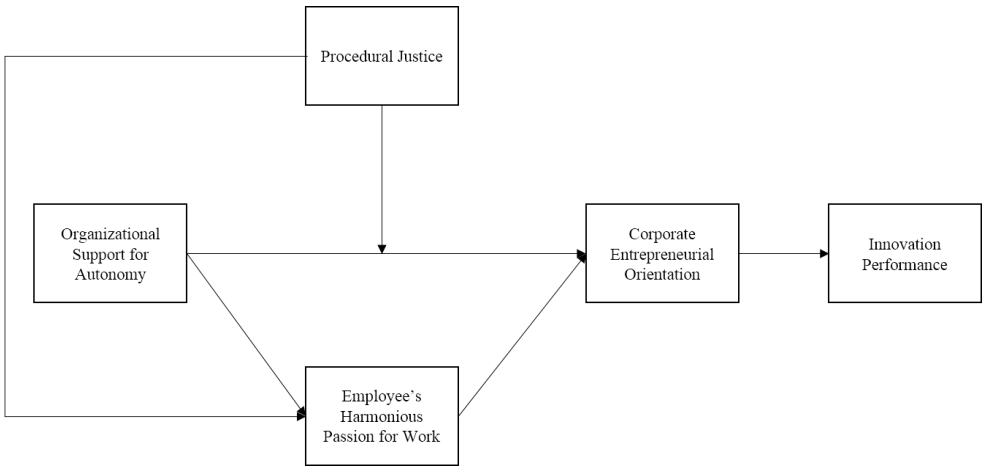

Figure 1 – Research model

4.2 Research proposition

4.2.1 The autonomy and corporate entrepreneurship

As discussed above among the elements “autonomy, competence and relatedness” to form the self-determinant the autonomy can represent the self-determinant very well. So we will observe the relationship between the autonomy and corporate entrepreneurship through the case study of Google. Just like people can say “Google = autonomy” the autonomy spreads all organization and employees in Google. The ‘20% project’ gives the labor autonomy to employees and it drives the creative and innovative ideas. Volunteers for the project originated from the proposed idea in the aspect of bottom-up not top-down work together so the entrepreneurial independence can be enhanced.

Like this, Google establishes a frame to drive various new ideas and to carry out them by giving the autonomy to its employees. So the constituents try to face the challenges not to worry about the fail. Generally big companies are content with the status quo so they opt to drop its Crown because they can’t make no innovation. But Google is a company which always pursues the innovation not to stay. So the autonomy in Google becomes the driver to

search for new opportunity (innovativeness), to challenge and risk-take for new business opportunity (risk-taking) and proactive competence in the industry (proactiveness). About this Shane, Locke, and Collins(2003) explain the performance of pursuing opportunity can be differentiated by own spontaneity and Mudambi and Navarra(2007) interpret the self-determinant as a power succession and give result that the power succession of a company enhances the innovation so the autonomy is very important for corporate entrepreneurship.

Therefore 5 elements of entrepreneurial orientation by Lumkin & Dess(1996) including autonomy, innovativeness, proactiveness, risk-taking and aggressiveness are not in same level and it is proper to regard that innovativeness, proactiveness, risk-taking and aggressiveness stay under the autonomy in a hierarchy.

Proposition 1: Giving the autonomy within the organization will influence on corporate entrepreneurship

Proposition 1.1 Giving the autonomy will influence on the risk-taking among the elements of corporate entrepreneurship

Proposition 1.2 Giving the autonomy will influence on the proactiveness among the elements of corporate entrepreneurship

Proposition 1.3 Giving the autonomy will influence on the innovativeness among the elements of corporate entrepreneurship

4.2.2 The autonomy and harmonious passion

Locke & Latham(2004) insist that intrinsic motivation is increased with autonomic recognition of labor environment of organization constituents and the passion and interest occur with increased intrinsic motivation. Then how the autonomy is reflected on the harmonious passion of organization constituents in Google? Does Google perform its work with the base of the harmonious passion?

Google gives the autonomy to its constituents as the form of entrepreneurial independence and the responsibility and power succession encourage the desire to success. Also the autonomic labor environment increases the creativeness of its constituents and the work in Google has the form of entrepreneurial independence. So the constituents think and behave based on complete self-determinant and this form encourages the autonomous orientation of the constituents in the aspect of the theory of self-determinant. Through this, the constituents are motivated to make new world with strong intrinsic motivation and they work for themselves with fun not by someone's commands. As we can see in the one of the ten reasons to want to work for Google 'work and play are possible' the strong intrinsic motivation leads to the harmonious passion not obsessional passion in Google. Like this, giving the autonomy to an organization drives the autonomic personality to its constituents and this autonomic personality drives the harmonious passion from its constituents. We can see that example with the case of Google and existing studies.

Proposition 2: Giving the autonomy within the organization will influence on the harmonious passion of its Employee

4.2.3 The harmonious passion and corporate entrepreneurship

Baum and Locke(2004) insist that the passion for work gives the entrepreneurial motivation and it gives positive influence for growth of a company. Amabile(1996) develops KEYS (Assessing the Climate for Creativity) to find out the elements of labor environment which enhances the creativeness and focuses on the personal recognition and perception about the labor environment which influences on the organizational creativeness. While the organization with more creativeness has more recognition for the autonomy the organization with lower creativeness has more recognition for the disturbance of organization and the

pressure to workload. That is, the autonomy influences on the harmonious passion of the constituents and corporate entrepreneurship including innovativeness with driving creativeness.

Then how they are reflected on Google? The harmonious passion of constituents of Google raises the loyalty for the organization and makes to try new challenges. And these become a driver to activate the innovativeness, risk-taking and proactiveness. Therefore we can confirm the harmonious passion encourages the corporate entrepreneurship.

Also in the study about the emotion which causes the motivation and passion (Vallerand, 2010; Vallerand et al., 2003) the harmonious passion can be an intermediation in the relationship between the motivation and emotion. That is, the autonomy influences on the harmonious passion and this harmonious passion influences on positive emotion. In the case of Google the harmonious passion of its constituents influences much on positive emotion so the work can be a play in Google. And it makes them to have high job satisfaction and self-respect.

Proposition 3: Harmonious passion will influence positively on corporate entrepreneurship

Proposition 3.1 Harmonious passion will influence on the risk-taking among the elements of corporate entrepreneurship

Proposition 3.2 Harmonious passion will influence on the proactiveness among the elements of corporate entrepreneurship

Proposition 3.3 Harmonious passion will influence on the innovativeness among the elements of corporate entrepreneurship

4.2.4 The controlling role of procedural justice in the relationship between the autonomy and corporate entrepreneurship

The effect of autonomy of an organization can be differentiated by how fair the procedure of decision-making is. Prooijen(2009) insists the procedural justice can control the autonomy and it is consistent with the theory of self-determinant. That is, the self-determinant of the constituents can be differentiated by how the procedural justice and giving autonomy are reflected on the company.

Also Shimizu(2012) insists there are some issues about the autonomy related to the studies on the risks of corporate entrepreneurship. That is, when gathering ideas the idea with big risk can't be drawn and when giving too much autonomy it could be too distraction. To solve these issues the external elements such as stock option, management and supervision or procedural justice should be provided.

In case the effect of giving the autonomy can't drive good results we should pay attention to the procedural justice. In Google the information itself is shared broadly and there are understandings and trusts how my idea is evaluated and adopted to industrialize it. That is, the organizational justice works. Also the feedback for the idea is exchanged in mutually equal relationship. The communication is performed in horizontal relationship not vertical. With these, more various ideas are gathered and more innovative and proactive product appears. Therefore giving the autonomy, organizational justice and forming trust encourage the autonomy of the organization.

Proposition 4: The influence according to the level of procedural justice will show meaningful difference in the relationship between giving the autonomy in the organization and the corporate entrepreneurship

4.2.5 The procedural justice and harmonious passion

According to many researchers including McFarlin and Sweeney(1992) insist the procedural justice influences on organizational commitment and job satisfaction for the constituents.

Miltion(1981) defines the job satisfaction as the positive attitude for own job. Also he explains the entity of job satisfaction is the sense of achievement from the job. This satisfaction can be classified into intrinsic and external one. And the intrinsic satisfaction can be achieved from the job itself including the difficulty of job, the sense of challenge, importance, variety and the relationship with colleagues.

Like this, job satisfaction involves positive emotion and feeling and giving the motivation of justice leads the harmonious passion of the constituents and connects to the result of positive emotion eventually in the mechanism of motivation-passion-emotion.

In Google the procedural justice influences on the job satisfaction of constituents. The autonomy and the trust between its constituents give the job satisfaction. And especially in Google the constituents have high satisfaction from intrinsic elements including the difficulty of job, the sense of challenge, importance, variety and the relationship with colleagues which Milton suggested. That's because they feel joy and delight through the challenges and experiences with the curiosity for new things. This satisfaction from the intrinsic value is related to the harmonious passion. That's because the satisfaction can be made from the intrinsic value through the harmonious passion. Therefore the procedure justice influences on the harmonious passion and this harmonious passion drives the job satisfaction from the intrinsic value.

Proposition 5: The procedural justice will influence on the harmonious passion

4.2.6 The corporate entrepreneurship and performance of innovation

The conventional studies confirm the corporate entrepreneurship has positive relationship with the performance of a company. Slevin & Covin(1990) insists that the entrepreneurial behavior has negative relationship in rigid organization while it has positive relationship in flexible organization.

In Google the corporate entrepreneurship influences on the actual performance of innovation. That's because it offers the innovative products or services including Google Earth and Google Glass. Maybe these products could not be industrialized without the risk-taking and innovativeness in the organization.

Proposition 6: The corporate entrepreneurship will influence on radical innovation

Proposition 6.1 The risk-taking among the element of corporate entrepreneurship will influence on radical innovation

Proposition 6.2 The proactiveness among the element of corporate entrepreneurship will influence on radical innovation

Proposition 6.3 The innovativeness among the element of corporate entrepreneurship will influence on radical innovation

5. CONCLUSION

We will perform the verification with specific measuring items for the variables. With this case study we can estimate that the autonomy has meaningful relationship which influences on the innovativeness, risk-taking and proactiveness.

The innovation is very important for continual growth of a company and its influence is so big that a company's rise and fall depends on it. Therefore we should pay attention to corporate entrepreneurship for these innovation and continual growth. Until now, though many studies focus on the positive influence for the performance of innovation of corporate entrepreneurship and its importance there has been not much study on the determinants of corporate entrepreneurship. With considering its importance it is required to perform in-depth study of which determinant drives the corporate entrepreneurship in the relationship between

an organization and its constituents. We expect this study encourages the corporate entrepreneurship in the theoretical and actual business aspect and this can be a starting point to activate studies on the determinants of corporate entrepreneurship.

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FACTOR ANALYSIS OF THE MOTIVATION ON CROWDFUNDING PARTICIPANTS: AN EMPIRICAL STUDY OF FUNDER CENTERED REWARD TYPE PLATFORM

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ABSTRACT
As the Internet evolves to Web 2.0 which makes opening, sharing and participating easy and more people use SNS (Social Network Service) on the mobile device the current trend of social movement is being changed. The crowdfunding has drawn attention to get concern, encouragement, talent donation, money and goods support and investment from the people through new media including SNS. As the government expects the success of crowdfunding for economical development and better service through people's participation by expending money procurement and encouraging investment we need to analyze the motivation of crowdfunding investors to encourage them to make it. Therefore the aim of this paper is to analyze the relationship of continual participation of crowdfunding based on the motivation to secure and keep the investors for crowdfunding. The result shows the intention for continual participation to the crowdfunding influences on enjoyment, familiarity, agency credibility and reward and the group of fund-raising to give the control effect has the meaning difference. That is, this study is expected be used as a basic source to activate the platform of crowdfunding in various fields including culture and art by proposing the participation motivations which influence on funder's intention to continual participation for the crowdfunding.

Keywords: Crowdfunding, crowdsourcing, funding, fundraising, investing, and motivation

1. BACKGROUND

1.1 Background and purpose of this study

As the Internet evolves to Web 2.0 which makes opening, sharing and participating easy and more people use SNS on the mobile device the aspect of charity, establishment, creative work and social movement are being changed. And the crowdfunding has drawn attention to get concern, encouragement, talent donation, money and goods support and investment from the public through new media. The crowdfunding is a method to collect money to invest through the public and it means a person or entity that needs money collects small amount of money from an unspecified number of the general public through the Internet or agent and secures the target funding (Ko et al., 2013).

Currently the worldwide market for crowdfunding is expanding rapidly about 81% in a year from $1.47 billion in 2011 to $27 billion in 2012(Massolution, 2013). Especially, with passing of US JOBS ACT law in April 2012 which make it legal for start-ups or SMBs to raise fund from the public through the crowdfunding, the Korean business market pays big attention to the establishment of related system and crowdfunding of governments to develop creative SMBs.

The crowdfunding can be classified into equity, lending, reward and donation based type by the purpose of investment and its method. Especially the reward-based crowdfunding is being paid attention as a money-raising method for an individual or start-up that has a creative technology and it is thought to contribute to the circulation of venture ecosystem by establishing pre-circulating investment system which overcomes the limitation of conventional money procurement system including financial institutes, venture capitals or angel investors. Therefore this study finds and verifies the internal and external motivation based on the motivation theory which influences on the individual's participation in the crowdfunding and inspects the directions to plan the successful crowdfunding by drawing the elements related to the investor's intention for continual participation. Especially, this study is centering on the reward which is paid attention as a new method to raise money for the creative technology or its use.

2. THEORETICAL BACKGROUND OF THE STUDY

2.1 Crowdfunding

2.1.1 The concept of crowdfunding

The crowdfunding is a method to collect money to invest from the public and it means a person or entity that needs money collects small amount of money from an unspecified number of the general public through the Internet or agent and secures the target funding (Ko et al., 2013).

Also, the crowdfunding is "the way to use generally the online community to draw the donation, reward or investment agreement from an individual not career capitalist" and it is defined by US JOBS law. As a fund procurement method for 1-person companies or start-ups which have problems to raise money to invest to secure it by the donation, reward or investment agreement through the Internet it is called "social funding" because it uses actively the SNS such as Twitter or Facebook. These crowdfunding is being used in the sector of IT and culture including the movie or music and has no limitation to apply including the company foundation with an idea.

2.1.2 The types of crowdfunding

The types of crowdfunding can be classified by the investment method and its purpose, investment form and the hybrid of them. Firstly, according to investment method and purpose the crowdfunding can be classified into equity, lending, reward and donation based and the types can be classified with the focus on the reward (Kim, 2002).

Table 1 – Types of crowdfunding by its investment method and purpose

Type	Description
Equity-based	Gets the stake in proportion to the amount of investment through the form of angel investment for start-ups or founders with small capital. The purpose of this investment is to create profits.

Lending-based	Supports an individual or self-employed operations with the form of small loans through the Internet. The purpose of this investment is to earn the interest.
Reward-based	Many investors support the money-raising project with money and receive rewards with other form of money.
Donation-based	Similar with reward-based type. But this type does not expect any reward. This is just to donate.

As Table 1 shows, it is easy to find out the "reward expectation" of participants to the crowdfunding but it is difficult to reflect the actuality of crowdfunding where the agent exists between money giver and consumer. That is, there is some difficulty to understand the relationship between money giver and agent and money consumer and the agent as well as the reward expectation between money giver and consumer. Secondly, the types of crowdfunding can be classified by reward, P2P and bonds & securities based. Table 2 shows the actuality of the crowdfunding where the agent exists between money giver and consumer. Lastly, there is a method which compounds the investment way, purpose and investment form of the crowdfunding. Samsung economic research institute classifies this into 3 categories including angel investment, self-support and public benefit based and this is the hybrid method of the classification according to investment purpose of money giver and investment form.

Table 2 – Types of crowdfunding by its investment form

type	description
Reward based	The money giver supports money to help the business or project of money consumer
Peer to Peer based	Direct financial transaction between individuals through the Internet excluding a financial company
Bonds & securities based	The money giver supports money to the business of money consumer and receives the interest or revenue sharing for that

Table 3 – Types of crowdfunding by the combination of investment form and its purpose

type	description
Angel investment based	The general public gets support of needed money at the development stage of start-up through the Internet
Self-support based	A person who has difficulty of living is self-supported by small loan through the Internet
Public benefit based	Investors support the project of money consumer without expecting pecuniary benefit

2.1.3 Related studies

Related studies about the crowdfunding in Korea can be classified into culture & art and the business. The representative study for culture and art is Hwee Jung Kim's and for business Min Seop Yoon's. Kim expects the culture and art crowdfunding project has brighter outlook than the one of business foundation for start-ups and reward-based because it has more public appealing (Kim, 2012). Yoon defines the concept of the crowdfunding is "to raise desired money from the individuals by opening and promoting own project or business through the Internet and SNS". Also he proposes the systemization method of bonds & securities based crowdfunding (Yun, 2012) and this study can be used as a basic for the study of understanding the development direction of crowdfunding in Korea. These studies can be found in foreign countries and especially the

crowdfunding manuals “Crowd Funding Bible” and “Crowd Funding Success School” from Kickstarter and RocketHub, US agency for crowdfunding, are useful for successful funding in the aspect of money consumer. But there is no empirical and analytical study about the elements to consider when using the crowdfunding in the aspect of the investor and sponsor.

2.2 Motivation theory

The motivation means the psychological process to draw and encourage voluntary behavior for the goal. This motivation is interpreted and classified by various researchers and many factors are found in various aspects. The studies about motivations are being researched by researchers of organizational behavior, economy and psychologist (Acar et al., 2011) and modern motivation theory can be classified into 2 categories including motivation content theory and motivation process theory. The motivation content theory is mainly about the foundation to encourage the motivation and has characteristic of focus on analyzing who does what behavior. Maslow’s 5 steps of need theory, Alderfer’s 3 steps of need theory, Hertzberg’s dualism and McClelland’s achievement motivation theory are the examples of it. The motivation process theory is about to the behavior for achieving the goal and has characteristic of adding what causes the choice based on the need theory. Vroom’s expectancy theory, Adams’s equity theory, Skinner’s reinforce theory and Locke’s goal setting theory are the examples of it. The motivation factor based on these theories has needs to get external recognition including rational reward and promotion opportunity and social needs for human relationship and friendship. And it tries to show own achievements with challenge for acceptable goal and we understand that should be performed through fair process. Also these motivations have been studied focus on external and internal motivations (Leimeister et al., 2010, Smith et al., 2013). Davis (1992) insists the internal motivation is the motivation to pursue pure enjoyment and the external motivation is the one to pursue something when we expect to get useful result from it.

2.3 Donation

We should understand the word “philanthropy” and the donation based on it first. The philanthropy means to give money in a narrow sense that is it means to give something exchangeable without expecting reward. And in a collective sense of humanity not individual it means to donate money to systemized organization for social services (Payton, 1988). The donation can be classified into various categories by its method and W.K.Kellogg foundation classifies it into online and offline one by the Internet and defines the online donation as the donating behavior for various non-profit organizations through online including web-site and email. As online donation can be possible with the development of the Internet non-profit organizations have paid attention to it as a new method to create resources and raise money. The online donation has characteristics of convenience, usability and time saving which can compensate and enhance the functionality of conventional offline donation. And this online donation affects strongly on cost saving (Kim, 2002). Especially, Sang Hyuk Lee’s study (Lee et al., 2010) is an empirical study based on the motivation theory and it verifies which factor of online money-raising campaign influences on visitor’s donation rate.

2.4 Crowdsourcing

The crowdsourcing is a combination of “crowd” and “outsourcing” and it means an unspecified number of the general public participate in a project with the form of public subscription(Howe, 2008), which assigned people did conventionally. In other words, it is an outsourcing solution to the public by making participation of consumer or public to make better product or service and

sharing the profit in the process of producing and service. This crowdsourcing is an approach to make specific community or unspecified number of the general public participate in the process of producing, servicing and problem solving of a company and is defined as a higher concept of crowdfunding. Current crowdsourcing has been studied with focus on case studies of companies and Kaufmann et al.(2011) and Acar et al(2011), published many papers and Lietsala et al.(2007) did some. In the study of Kaufmann et al.(2011) the factor of participating motivation is classified into external and internal and verifies 431 people's motivation factors using crowdsourcing platform of Amazon by developing study model which unifies the theories including motivation theory, work motivation theory and open source software development theory. Also Ji Yong Lee(2013) performs empirical study on analyzing factors of participating motivation for securing potential investors with focus on public idea proposal contest in public sector.

3. STUDY MODEL AND HYPOTHESIS

3.1 Study model

The result of this study shows major factors which related studies emphasize through the donation, crowdsourcing and crowdfunding based on the motivation theory to specify the participating motivation to activate the crowdfunding and use it strategically. And with the expert interview who has opportunities to participate in many crowdfunding projects the independent variables can be set by refining process. That is, this study classifies the participating motivation factors for activation and strategic usage of crowdfunding into internal and external motivation and that is classified again into 5 independent variables including enjoyment, familiarity, peer influence, agency credibility and reward. Also, by adding the money-raising mode as a control variable the empirical analysis model for continual participation to a project can be established.

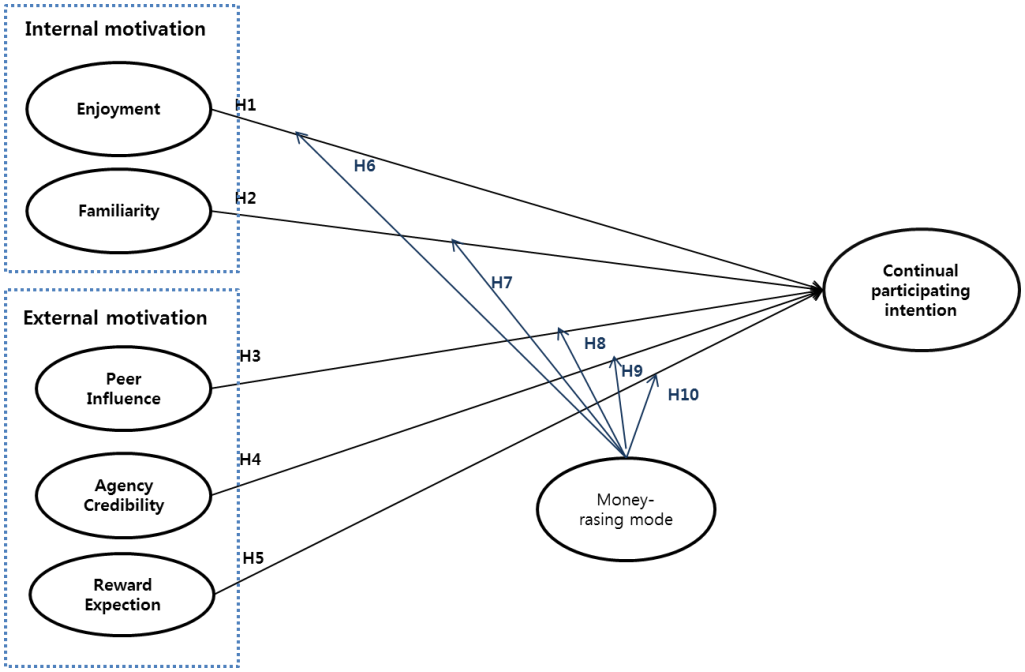

Figure 1 - Research Model

3.2 Study hypothesis

3.2.1 Enjoyment

Davis et al.(1992) insist that the internal motivation is a motivation to pursue the pure enjoyment from behaving itself and by adopting the internal motivation to technology acceptance model(ATM) the internal enjoyment users achieve from the use of IT can encourage the user's intent to behave. Moon et al.(2001) define the internal motivation as the personal enjoyment felt objectively and verifies that the enjoyment of performing specific behave or action is core factor for the Internet user's acceptance. Therefore this study makes a hypothesis that the enjoyment which encourages user's intention to behave can influence on the investor's continual participating intention for crowdfunding.

H1: The enjoyment can influence on the investor's continual participating intention for the crowdfunding positively.

3.2.2 Familiarity

The familiarity is defined as consumer's exposure to the advertisement, information searching and experience to the product (1987) and pre-experience or degree of familiar where how much people know specific brand (Kent et al., 1994). Because this familiarity plays an important role when a user makes own choice for something it cannot be ignored (Balogulu, 2001). Prentice et al.(2007) insist the familiarity is the most efficient way to express the behavioral visiting intention and Yatan(2013) specifies the familiarity as major motivation factor for the investors in the crowdfunding study. Also, when interviewing the experts it is found that the investors make investment to the project which he or she has basic understanding, has interests and is in the field. Therefore this study makes a hypothesis that the familiarity which encourages user's intention to behave can influence on the investor's continual participating intention for crowdfunding.

H2: The familiarity can influence on the investor's continual participating intention for the crowdfunding positively.

3.2.3 Peer influence

With the characteristics of the study the most actual approach is to search the factors which influences on the investor's behaves including social phenomenon, that is common influence factors. Celsi et al.(1998) explain that consumers are influenced by the external information such as the advertisement and peers influence on investor's decision making because he or she wants to get an insight for the factors which gives influence on the investment making. Mark et al.(2008) measure two groups influenced by factors of motivation and common influence through classifying relationship making and relationship for participating in the crowdfunding into major factors. And they insist the common influence including peer behaviors influences on the decision making process such as the investment making (2011). Therefore this study makes a hypothesis that the common influence which influences user's decision making can influence on the investor's continual participating intention for crowdfunding.

H3: The peer influence can influence on the investor's continual participating intention for the crowdfunding positively.

3.2.4 Agency credibility

The studies about the credibility have been performed in the field of social and organizational studies and that is because the credibility interacts socially and economically in the form of coexistence of uncertainty and reliance. Blau (1964) explains that the social trade theory which specifies the partnership in the marketing is based on the credibility to explain the trading relationship between investors and the credibility plays the important role in making long relationship and facilitating the trade relationship. Paul et al.(1981) explain that with the belief that other party does own duty in the trade relationship we can expect the other party wants to cooperate and tries to do own duty. Because the reward expectation types of crowdfunding is based on the reward without money for the result of a project it is close to the donation or reward based. And according to related studies the information opening about how much money is raised can be measured by the credibility of the agency and that can be an important factor for the donators (Yun, 2012). Also when interviewing the crowdfunding experts we can understand that payment method, policy, fee and refund rule for the platform are the most important factors and especially the matter of credibility for the agency influences on the investment making as well as the amount of investment. Therefore this study makes a hypothesis that the credibility for the platform can influence on the investor's continual participating intention for crowdfunding.

H4: The agency credibility can influence on the investor's continual participating intention for the crowdfunding positively.

3.2.5 Reward expectation

The reward expectation is the degree of expectation for reward by participating in a project. Related studies including Vroom's, Skinner's and Locke's explain that pecuniary or non-pecuniary reward influences on the participating motivation. Also, it is specified that with the provided reward expectation or positive expectation for the project result investors get to have the participating motivation to participate or invest in the project directly (Lambert et al., 2010). Therefore in this study the reward expectation is added as a variable to explain individual's external motivation and this study makes a hypothesis that the reward expectation can influence on the investor's continual participating intention for crowdfunding.

H5: The reward expectation can influence on the investor's continual participating intention for the crowdfunding positively.

3.2.6 Money-raising mode

The money-raising mode is the method to transfer money to the project registrant for the crowdfunding platform who tries to raise money. Representative money-raising mode of crowdfunding platform in Korea is classified in to "all or nothing" and "keep it all". And the method the project registrant can select is subject to the policy of the crowdfunding platform. The "all or nothing" mode is the method to transfer money to project registrant when the goal amount is raised after the project registrant sets it. The "keep it all" mode is that the raised money is transferred to the project registrant no matter how much money is raised. In the case of foreign countries the money-raising mode is subject to the platform too. Representative foreign money-raising mode is "all or nothing" and "partial funding"(Smith et al., 2013) and those have similar meaning of "all or nothing" and "keep it all" in Korea. Also, when interviewing the experts we understand that investors consider the inclination of the project.

Therefore this study makes a hypothesis that the money-raising mode can influence on the investor's continual participating intention for crowdfunding.

H6: The money-raising mode can influence on the investor's continual participating intention for crowdfunding as much as the enjoyment, familiarity, peer influence, agency credibility and reward expectation does.

4. METHOD OF THIS STUDY

4.1 Operational definition of study variables

The variables of this study are defined through related studies and experts' group interview and <Table 4> shows the operational definition for these variables.

Table 4 – Operational definition of study variables

Item	Variable	Description	Reference
internal motivation	Enjoyment	Feeling of enjoyment when participating in the crowdfunding	Moon et al. (2001)
	Familiarity	Knowledge and familiarity for the investment project of crowdfunding	Wheat et al. (2013)
	Peer Influence	The others' influence on investment making for crowdfunding	Carlson (1988)
external motivation	Agency Credibility	The belief for the service and payment method the crowdfunding platform provides	Garbarino et al. (1999)
	Reward Expectation	Expectation for pecuniary or non-pecuniary reward from the platform	Kent et al. (1994)
Money-raising mode		Representative money-raising mode for crowdfunding platform in Korea is "all or nothing" and "keep it all"	FGI
Continual participating intention		The investor's intention to participate continually in funding through the crowdfunding platform	Bhattacherjee (2001)

4.2 Measuring items of the variables

To measure the variables of this study we use the measuring items verified the validity and reliability from related works and total 28 measuring items are developed by revising them to fit to the crowdfunding environment through the expert interview. Also, to specify they explain understanding and their concept properly the pilot test for initial measuring items was performed for 15 people and the measuring items were revised by 5 experts who has experiences to participate in more than 30 projects through the crowdfunding platform. The items were revised or deleted by the process of problem finding and finally 19 items were selected. Each item have the re-cut point of about 7.

4.3 Sampling and resource collection

In this study the survey was performed for the investors over 20 years old who have ever used the crowdfunding platform or participated in the project through the platform to verify above hypotheses. Its target was the individual investors who use Korean representative

crowdfunding platforms such as Tumblbug, Goodfunding and Ucanfunding and it was performed for 1 week. Also 500 sample investors were selected who have ever participated in at least 5 projects to limit the survey participants who have many experience. We used 320 returned surveys among 323 and 3 return surveys were excluded because they were not filled completely or had wrong value.

5. DATA ANALYSIS AND RESULTS

5.1 Verification on the validity and reliability of measured values

In this study the cause analysis was performed to analyze the constitution validity of measure and Cronbach's alpha value was specified to verify internal consistency between the measures. As a result of cause analysis the validity is verified with over 0.6 of the cause carrying value of all measure. Also, as a result of reliability analysis based on the measurement values of cause analysis the reliability is verified with over 0.7 of Cronbach's alpha value of all variables excluding the independent variable enjoyment and as the result of correlation analysis the distinction validity is verified with under 0.6 of Pearson correlation figures of all independent variables. Also, as the result of VIF value analysis to check the multicollinearity for the independent variable enjoyment it shows generally accepted under 10 so there is no problem of multicollinearity. Therefore the validity and reliability for all measure are verified through the cause analysis and correlation analysis.

Table 5 – The Rotated Component Matrix

	Ingredient						Cronbach's Alpha	VIF
	1	2	3	4	5	6		
PAR01	.822						.907	
PAR02	.829							
PAR03	.855							
FAM01		.885					.818	1.079
FAM02		.808						
FAM03		.783						
CRE01			.745				.800	1.174
CRE02			.803					
CRE03			.855					
PEER01				.734			.745	1.084
PEER02				.847				
PEER03				.807				
ENJ01					.743		.652	1.082
ENJ02					.797			
ENJ03					.708			
REW01						.891	.794	1.072
REW02						.790		

PAR: Participation, FAM: Familiarity, CRE: Agency Credibility, PEER: Peer Influence, ENJ: Enjoyment, REW: Reword

Table 6 – Correlation Coefficient

	ENJ	FAM	PEER	CRE	PAR	REW
ENJ	1					

FAM	.092	1				
PEER	.042	.092	1			
CRE	.271**	.179**	.229**	1		
PAR	.299**	.388**	.179**	.471**	1	
REW	.056	.221**	.103	.156**	.438**	1

PAR: Participation, FAM: Familiarity, CRE: Agency Credibility, PEER: Peer Influence, ENJ: Enjoyment, REW: Reword

***p < 0.001, **p < 0.05, *p < 0.01

5.2 Verification on the hypothesis

In this study the multiple regression analysis is performed to specify the causation among the variables and to verify statistical dependency. And the validity, reliability and correlation by cause are verified and path coefficient is presumed. Also t value is used for the criterion of hypothesis verification generally used.

In this study the independent variable enjoyment, familiarity, agency credibility and reward expectation have t value bigger than 1.645 and are meaningful with the probability of 0.05. And the common influence is neglected. The hypothesis 1 is supported with 0.169 of the path coefficient of enjoyment and continual participating intent, 3.887 of t value and 0.05 of meaningful probability. The hypothesis 2 is supported with 0.251 of the path coefficient of familiarity and continual participating intent, 5.754 of t value and 0.05 of meaningful probability. The hypothesis 3 is rejected with 0.038 of the path coefficient of peer influence and continual participating intent, over 0.1 of t value and 0.05 of meaningful probability. The hypothesis 4 is supported with 0.322 of the path coefficient of agency credibility and continual participating intent, 7.088 of t value and 0.05 of meaningful probability. The hypothesis 5 is supported with 0.319 of the path coefficient of reward expectation and continual participating intent, 7.349 of t value and 0.01 of meaningful probability. In short, in the aspect of path coefficient as the dependent variable agency credibility (0.322), reward expectation(0.319), familiarity(0.251) and enjoyment(0.169) influence on the continual participating intention in the order of them.

Table 7 – The Result of Hypothesis Testing

Hypothesis	Path	Path Coefficient	t-value	p-value	R^2	Mean	Adoption/ Rejection
H1	Enjoyment → Continual participating intention	0.169	3.887	0.000	.446	5.6417	Adopted
H2	Familiarity → Continual participating intention	0.251	5.754	0.000		5.2188	Adopted
H3	Peer Influence → Continual participating intention	0.036	0.881	0.379		4.5333	Rejected
H4	Agency Credibility → Continual participating intention	0.322	7.088	0.000		5.2688	Adopted

H5	Reward Expectation → Continual participating intention	0.319	7.349	0.000		4.9406	Adopted

***p < 0.001, **p < 0.05, *p < 0.01

5.3 Analysis on the control effect

In the study model multiple group analysis is performed to specify the control effect of money-raising mode where enjoyment, familiarity, peer influence, agency credibility and reward expectation influence on the investor's continual participating intention for crowdfunding. The money-raising mode to analyze the control effect is classified into 2 characteristics including "all or nothing" and "keep it all" and the difference of path coefficient between two groups is verified whether there is meaningful difference according to following formula which Chin(1998) proposed.

$$t = \frac{Path_{sample1} - Path_{sample2}}{\sqrt{\left[\frac{(m-1)^2}{(m+n-2)} * S.E._{sample2}^2 + \frac{(n-1)^2}{(m+n-2)} * S.E^2._{sample2} *\right] * \left[\sqrt{\frac{1}{m} + \frac{1}{n}}\right]}}$$

As a result of comparing path coefficient between "all or nothing" and "keep it all" mode by using Chin's formula(1998) the path coefficients of familiarity, peer influence and agency credibility have meaningful difference and the enjoyment and reward expectation have no meaningful difference between groups.

Table 8 – Result of difference in path coefficient per group

Path		Measurement Item	All or Nothing (N=175)	Keep It All (N=145)	Result
H1	Enjoyment → Continual participating intention	Path coefficient	0.216	0.118	NS
		Standard error	0.137	0.197	
		t-value	0.441		
H2	Familiarity → Continual participating intention	Path coefficient	0.048	0.431	ALL < KEEP
		Standard error	0.061	0.086	
		t-value	-3.729		
H3	Peer Influence → Continual participating intention	Path coefficient	-0.086	0.163	ALL < KEEP
		Standard error	0.063	0.089	
		t-value	-2.345		
H4	Agency Credibility → Continual participating intention	Path coefficient	0.530	0.143	ALL > KEEP
		Standard error	0.089	0.103	
		t-value	2.866		
H5		Path coefficient	0.279	0.286	NS
		Standard error	0.049	0.064	

	Reward Expectation → Continual participating intention	t-value	0.441-0.089	

***p < 0.001, **p < 0.05, *p < 0.01

5.4 All or nothing mode

Following is the hypothesis verification result for 175 investors who select "all or nothing" as the money-raising mode. The accept or reject of the hypothesis is verified by the statistical meaning based on the t value and verification for both t values is performed. As a result of hypothesis verification in the aspect of path coefficient as the dependent variable agency credibility(0.530), reward expectation(0.279) and enjoyment(0.216) influence on the continual participating intention in the order of them and the relationship between familiarity and peer influence and continual participating intention is rejected.

5.5 Keep it all mode

Following is the hypothesis verification result for 145 investors who select "keep it all" as the money-raising mode. The accept or reject of the hypothesis is verified by the statistical meaning based on the t value and verification for both t values is performed. As a result of hypothesis verification in the aspect of path coefficient as the dependent variable familiarity (0.431), reward expectation(0.286), peer influence(0.163) and agency credibility(0.143) influence on the continual participating intention in the order of them and the relationship between enjoyment and continual participating intention variables is rejected.

6. CONCLUSION

In this study the motivation factors for continual participating in crowdfunding are drawn from the related works about crowdsourcing and crowdfunding and study hypotheses are proposed with refined study models through the expert interview. To verify them the survey for 320 investors who have ever participated in domestic crowdfunding projects was performed and empirical analysis was also did. The results and insights of this study is as follows:

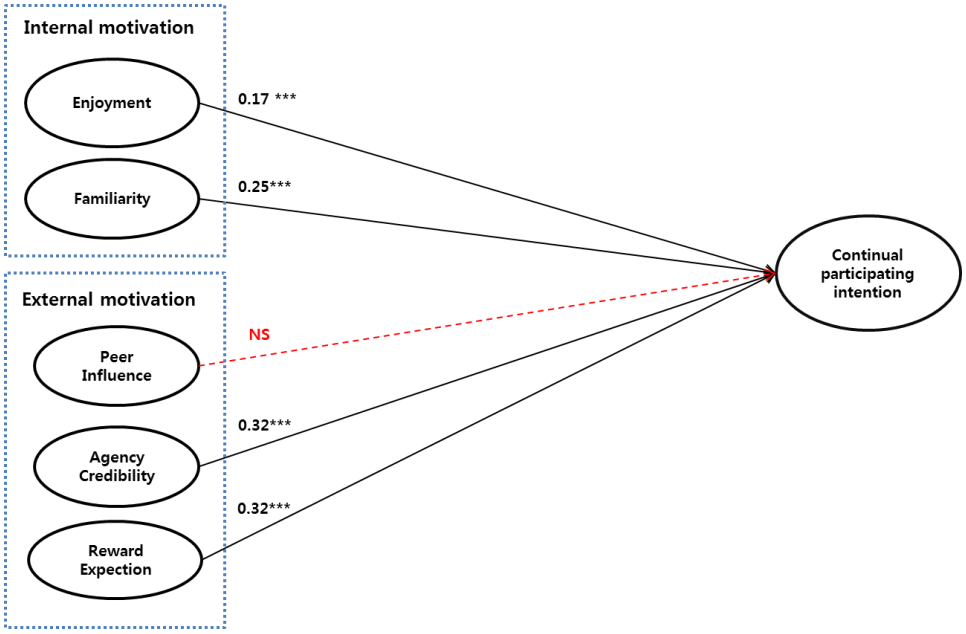

Figure 2 – Result of Hypothesis Testing

6.1 Conclusion of the study

As a result of this study the funding investors of type platform of reward expectation are motivated to participate by enjoyment, familiarity, agency credibility and reward expectation but not by peer influence. This can be interpreted that because they regard the crowdfunding as the donation they invest to the project regardless how much money is raised by other investors and through the interview with crowdfunding experts that was verified. And as the result of hypotheses verification that there will exist difference between groups of money-raising mode we can verify the familiarity, peer influence and agency credibility have meaningful difference between two groups. The "keep it all" group is more influenced by familiarity and peer influence than "all or nothing" and "all or nothing" group does by the agency credibility than "keep it all". So if an investor who has some experience and background makes investment with "keep it all" mode he or she will think the proceed of the project more important than the result of it and prefer the project which can be kicked off with small amount of money regardless of raising the goal money. Also because the project can be kicked off with some raised money and it can be led to failure of the project in case too small money was raised the "keep it all" group thinks more carefully about the ratio of money-raising goal and its deadline. Because the "all or nothing" group thinks they should get refund when the money-raising goal is not met it thinks more carefully about the policies including payment and fee and secure guarantee. Lastly, the enjoyment and reward expectation have no meaningful difference between two groups and that can be interpreted as the enjoyment motivated by own willingness is not influenced by the money-raising mode. Also in the aspect of reward expectation the money-raising mode doesn't show any difference because no pecuniary or non-pecuniary reward is expected.

6.2 Academical insights

The studies related the crowdfunding are emerging and related studies are mainly focus on the concept of it and usage model in the aspect of economy and management. But there has been no empirical and quantified study which considers the actual factors for the investors and sponsor. Therefore this study verifies the factors which influence on continual participating

intent for the investors to the crowdfunding, draws final factors through the expert interview and re-establishes it based on the motivation theory. So with the attention and importance of the crowdfunding is getting paid this study is expected to give meaningful insights to study fields related to the crowdfunding.

6.3 Practical insights

Currently successful use of crowdfunding is getting attention which offers better service and benefit to the investors through the participation of the public. As a result of this study, the investors who participate in the crowdfunding think payment method, policy, fee and refund rule most importantly and that is consistent with the needs for transparency of the crowdfunding platform as our society pays more attention to it. Especially, because the transparency of crowdfunding is important factor for the individual investor to make investment and it can influence on the investment itself as well as the investment amount the operator of crowdfunding platform should regard securing the reliability through the transparency importantly. Also as the study result shows the "all or nothing" mode thinks the agency credibility more and "keep it all" does the familiarity more. So the management of project by the money-raising mode can be more effective. Therefore this study can be said to give practical usefulness because it performed the empirical study for the project investors and the result can be used to manage the crowdfunding platform efficiently.

Limitation of this study and future work

This study has following limitation though it gives theoretical contribution through the verification on crowdfunding investor's factors for continual participating intention. Firstly, this study can't specify the difference by factors according to the types of crowdfunding because it targets for the representative reward expectation types of the crowdfunding. So comparing work for types of the crowdfunding is need as future work. Secondly, because this study is an empirical study for the investors of crowdfunding project the factors which influence on other project registrant and those in the aspect of crowdfunding operators are not considered. Therefore additional study for the project registrant supported by crowdfunding platform and in the aspect of crowdfunding operator will be needed.

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CASE STUDY ON CORPORATE ENTREPRENEURSHIP PROGRAM FOR INNOVATION

: WITH FOCUSING ON THE IN-COMPANY VENTURE SYSTEM AT KOREAN COMPANIES

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Abstract

By entering international low-growth phase of financial economy, global companies tr y to find out new business values and establish the sustainable growth by industrializi ng them. So the in-company corporate entrepreneurship is being paid attention as a m ethod to create value in a company. Currently as the need of in-company venture sys tem is raised as an efficient way to tackle the low-growth Korean companies try to fi nd out new innovative business through the system. Also the movement to transplant in-company corporate entrepreneurship into organizational culture is seen to overcome the crisis of low-growth. After analyzing 3 company case, we draw 3 critical success factor for Korean company's Corporate Entrepreneurship program. The first factor is strong will of top management, and the second factor is social and solid process to induce brilliant ideas from company members. The last one is the effort for changing over company's culture. The aim of this study is to drive the characteristics and types of the venture system in K orean companies and to give suggestions for the companies to adopt the system succe ssfully by performing case studies of three Korean companies with different types.

Keywords: Corporate Entrepreneurship, Innovation, Korean Company

1. Introduction

1.1 Research background and purpose

Today Korean companies are facing new challenge such as how to derive new growth engine from the creativity of its employees along with the objectives of the companies themselves. Especially, the rigid corporate culture in Korea and insufficiency of sustainable renovation process are being considered as main cause to hamper the continuous growth of

companies. As an effective alternative to overcome such problem, the promotion of Corporate Entrepreneurship (CE) has been suggested. Corporate Entrepreneurship means the series of actions of which the members, by utilizing the concept of start-ups' entrepreneurship in the existing corporate, voluntarily suggest creative ideas regarding new products or services and make them the company's new growth engine. Corporate Entrepreneurship can be utilized as the source of renovation in which the members act as Intrapreneur and keep growing. However, for the time being, the study about Corporate Entrepreneurship is rare in Korea. There are many studies about Corporate Entrepreneurship's concept and classification framework, but any case study with analyzing Corporate Entrepreneurship implementation process in the company is rare. Especially, related study is rarer in Korea, because Korean company began to look at Corporate Entrepreneurship recently. This study, by looking into the characteristics and types of Korean Corporate Entrepreneurship program focusing on the in-company venture cases of companies, intends to analyze management plan suitable to the Korean corporate culture and draw any meaningful suggestion. Through this study, it is expected to be the trigger to vitalize studies about the system promoting Corporate Entrepreneurship through defining differences of Corporate Entrepreneurship's process and objectives from industrial characteristics.

2. Literature Review

2.1. The definition of Corporate Entrepreneurship

Corporate Entrepreneurship can be summarized as an act of entrepreneur to improve the profitability of corporate core business or to improve the corporate profitability by implementing new profitable business model into the internal organization of company and aim to the growth of entire company. (Kim, Hak-soo, 2009) Furthermore, Sharma and Chrisman, in their study, broadly defined Corporate Entrepreneurship as "a process by individual or group, which makes a new organization within an existing organization or renovate or renew the existing organization". According to the existing study, Corporate Entrepreneurship is used for two purposes in companies. One is to make new organization within the existing organization, and the other one is to renew the existing strategy. Corporate Entrepreneurship means the pursuit of corporate action or plan in order to change the existing organization through strategic renovation process and expansion of its business boundary. (Guth & Ginsberg, 1990)

Furthermore, Corporate Entrepreneurship can be considered to be relevant to two distinctive features although it is related to the renovation process of organization (Guth & Ginsberg, 1990). Firstly, they are renovation and corporate venture. Narayanan et al. (2009) alleged corporate venture is focused on the procedure of making new business and consolidating it into the overall business portfolio of the company. In the Corporate Entrepreneurship system which Sharman and Chrisman (1999) stated, corporate venture is divided to internal corporate venture and external corporate venture. Internal corporate venture generally includes a new business development within the corporate system. Although it exists in a semi-voluntary form of spin-off in outside of the company, still the new business is considered to be included in the internal corporate venture. A company can invest in an idea or necessary business generated from outside of the company as well. It is called external corporate venture and it includes corporate venture capital, licensing, acquisition or joint venture (Phan et al. 2009). Secondly, corporate venture includes renovation measures which improve ability to compete and take risk during the course of challenging new business. Morris et al. (2008) an

d Kuratko and Audretsh (2009) defined corporate venture in this point of view as Str ategic Entrepreneurship and Ireland defined strategic entrepreneurship as what is releva nt to catch the opportunity in order to create comparative advantage and utilize (Irela nd et al., 2003). And Corporate Entrepreneurship can also mean a creative process w hich is related to the training of employees. Such relevant acts enable employees to at tain new knowledge (Miller & Friesen, 1982; Popper & Lippitz, 1998). If such new knowledge is associated with the business experiences of employees, a new business idea may be created (Oguz, 2001). Summing up, under the uncertain and rapidly cha nging atmosphere, Corporate Entrepreneurship is very appealing factor when renovatio n of strategy and creation of new business are necessary (Dess et al. 2003; Kuratko et al. 2004). The reason is that the entrepreneurship of mid-management who has acces s to the real time information of competitor and consumer can catch more easily the new opportunity which top management cannot.

2.2. Type of Corporate Entrepreneurship promoting system

So far many scholars have developed various models to find out the internal and ext ernal factors which affect Corporate Entrepreneurship (Alpkan et al., 2010; Covin and Slevin, 1991; Guth and Ginsberg, 1990; Ireland et al., 2009). Recently, studies are b eing focused on Corporate Entrepreneurship related to the institutional environment (Sa muel et al. 2011; Lim et al., 2010). In this perspective, Wolcott & Lippitz (2007) sug gested certain decisive factors for Corporate Entrepreneurship achievement through cas es of companies which successfully combined new innovative business field which is highly profitable and expected to grow, with the existing business. Divided in two per spectives, it is whether or not there is any formal organization which is responsible f or new business development and whether or not there is any dedicated human resour ces for new business development. Wolcott and Lippitz (2007) suggested four models of Corporate Entrepreneurship approach through combination of such factors as followi ng.

Table 1 Models of Corporate Entrepreneurship approach (Ref: Wolcott & Lippitz, 2007)

		Organizational Ownership	
		Diffused to organization	**Focused on specific organization**
Resource Authority	**Dedicated Resource**	**The Enabler** The company provides separate funding and exec utive attention to prospecti ve projects among creative ideas of employees. Ex) Google	**The Producer** The company establishes and s upports a full service group w ith mandate for Corporate Entr epreneurship. Ex) IBM, GE
	Support on necessity	**The Opportunist** The company has no sepa rate funding or organizatio n but internal and external networks drive new busi ness selection and resourc e allocation. Ex) Zimmer Holdings	**The Advocate** Separate organization exists, bu t existing business units provid e the primary funding if neces sary. Ex) DuPont

(1) **Opportunist**: it is the case where the outcome is made through the efforts of individual member with no official organization or funding exclusively for new business development. The Opportunist model can be pursued where various social network and trust among organizations within company are secured. This model which is not organized or systematic is not suitable as means of innovation for company's self-sustainable growth.

(2) **Enabler**: It is the case where there is no internal or external organization but there is a funding exclusively for Corporate Entrepreneurship. Top management allocates funding to select prospective idea under a certain standard, implement as project and develop and commercialize it. However, the innovative characteristic of employees and insight of top management towards the change of technology and market are prerequisite for the successful outcome.

(3) **Advocate**: It is the model which has organization exclusively for Corporate Entrepreneurship to pursue business opportunity and develop new business model and share with existing business unit. However, the funding for such organization is allocated from the existing business unit if necessary. Those operating R&D center of technology lab for technology development can be the cases of this model.

(4) **Producer**: It is a model which seeks new business opportunity through formal organization with separate solid funding and develops potential entrepreneurship. This type of model applies to global enterprises such as Samsung Electronics or IBM and the business opportunity not directly relevant to its core business field can be actively pursued.

2.3. Analyzing frame-work of Corporate Entrepreneurship promoting system

Morris et al. (2009) suggested, as following Table 2, framework considering four factors in order to analyze Corporate Entrepreneurship promoting system. Suggested frame work provides various perspectives about mechanism and design element necessary for environment promoting Corporate Entrepreneurship.

Table 2 Elements for environment of creative Corporate Entrepreneur (Ref.: Morris et al. 2009)

Issue	Question
Culture	●How shall employees act as to the faith and proposition what the company is about? ●How to define himself comparing external environment?
Structure	●Formal pattern of company consisting of function and hierarchy. ●Viewpoint about how different members and functions react each other.
Resource Control	●Official and unofficial mechanism which shows to manager that resources are attained and used effectively and efficiently.
Human Resource Management	●Process for recruiting, training, motivating of employee

Those four elements mentioned above have been, through preceding research, objecti vely proved to invigorate entrepreneurship. (e.g. Green et al., 2008; Hamel & Breen, 2007; Kuratko et al. 2005; Rutherford & Holt, 2007) The mentioned studies, applying this frame-work, consist of detailed analysis items and questionnaire to analyze Corp orate Entrepreneurship of domestic companies. By analyzing each company's system to promote Corporate Entrepreneurship in each item, they intended to compare the com position and operation of system depending on company's vision and strategy.

Table 3 Case Analysis Frame-work

Item	Question
Entrepreneurial Strategic Vision	● What is your company's vision of CE program for achieving company's strategic objectives? ●What is the strategy and vision of your company's CE program?
Entrepreneurial Processes & Behavior [About Structure, Culture, Resou rce, Reward system of CE Program]	●Please describe about process and role of your comp any's CE Program? ● Is there any organization for coordinating and contro lling CE program? ●How is the CE culture and any effort to invigorate it? ●How does CE process go on? ●What is the incentive for it? ●Is there systematic support for CE?
Individual Entrepreneurial Cognition on CE	●What is your company's individual Entrepreneurial C ognition (Beliefs, Attitudes, Value)?
CE and Performance	●Please tell about you CE program's achievement and success case.
CSFs in CE	●What is the success factor for your company's CE a chievement?
Lesson Learned	●Could you give any suggestion or advice for compa-nies that newly create their own CE program?

3. CASE STUDY OF CORPORATE ENTREPRENUERSHIP PROMOTION SYSTEM

3.1. Range and method of case study

This study, which is targeting three domestic major companies which possess normali zed system has collected and analyzed data of each company regarding In-company v enture system. Collection of data has been carried out through literature materials and actual interview with those who are in charge of the system and it has been tried to draw any meaningful implication by comparing and analyzing the operation condition of corporate venture system depending on each company's vision and strategic goal.

3.2. Subject company of study

The subject companies of this study are as following Table 4. Each company is carr ying out its business as mentioned before and has established and operated a normaliz ed In-company venture system and achieved objective outcome. Therefore, it can be c

onsidered to be typical example of domestic company, of which this study intends to study the In-company venture system. The study of these three companies is carried out by visiting each company and interviewing from July 2013 to August 2013. Inter view has been carried out with those who are in charge of In-company venture syste m and supplemented through media report, PR material or e-mail interview.

Table 4 Subject Companies

Company	Industry	Motive for CE program	Type of CE program (Ref. Wolcott & Lippitz)
A	Digital contents - Advertising, mark eting and online co mmerce - Affiliate of teleco m company newly established in 2011	To convert their mai n business from tel ecommunication ser vice to platform ce ntered service	Enabler Type
B	- Building material producing company - Separated from a major chemical co mpany	To develop innovati ve new business	Producer Type
C	- Provides internet services through its portal site - Started up as ven ture enterprise and became domestic m ajor internet service company	- To develop innova tive new service - To reform overall company business c ulture	Producer Type

3.3. Strategic Vision of In-company venture System

In case of A, to effectively cope with the rapidly changing digital contents/commerc e environment, it realized the corporate venture system to promote Corporate Entrepre neurship as essential strategy to innovate the company structure and came to plan and carry out In-company venture system with the support of its management. Especially, a established the system with vision to strengthen innovation of its employees by int ernalizing Corporate Entrepreneurship in their employees and to internalize the develop ed technology by planning and developing the innovative service within the company and such vision of A can be found from the interview with the manager K, who pla nned the system as follows.

"Previously, we collected ideas through push type idea festival and such ideas were given for the other organization to implement and those who initiated did not carry o ut. However, as the other organization implemented it, it was not run smoothly and r

arely kept till the stage of actual commercialization. From those cases, it has been su ggested to provide employees an environment of voluntary ideation and opportunity fo r those who made ideas to commercialize and it was aimed for corporate entrepreneu r to be found and trained during such procedure, for the tool to get rich and for su ch entrepreneurship to be piled up and spread in the company."

(K, the manager of A for planning and operation of CE promotion system)

Company C, the internet service provider found clue from the entrepreneurship regard ing how to develop new services and systemized it as well. Especially, it studied the 'Lean Startup', the American venture fostering process as its theoretical background a nd established corporate venture system to which the methodology is applied. On esta blishing system, C tried to reflect its intention to combine its corporate venture syste m with the innovation and growth of the company by realizing it as key pipe line fo r entire innovation strategy of the company as well as the original purpose, which is to develop innovative new service.

However, unlike A and C, in case of B, the manufacturing company, it focused on pursuit, development and success of innovative new business and planned and carried out CE promotion process mainly with its R&D center. It was because, due to the ch aracteristic of industry, idea related to technology plays key role in the procedure of seeking distinctive new business. Therefore, B appreciated Corporate Entrepreneurship as low level strategy conflated with its overall vision and intended to plan and carry out In-company venture strategy related to its vision.

As mentioned above, from the analysis of strategic vision regarding each company's In-company venture system, it has been found out that they began to establish system with different strategic necessity depending on the industry characteristic and market condition. And depending on which one is emphasized between the two expected outc omes of CE promotion system, the success of new business development and the esta blishment of organization innovative culture, it was found that specific composition an d action strategy of system can be varied.

3.4. The Cultivation and Acceptance of Corporate Entrepreneurship

The core part of the In-company venture system is the process which distinguishes i deas and develops new business for commercialization. Each company built detailed n ew business development process from idea selection to commercialization according t o its vision and from the interview it could have been found out that detailed evaluat ion method and compensation system were institutionalized as well.

[Table 5] shows the new business development process, detailed evaluation method a nd compensation system for new business developer.

Table 5 In-company venture System Process

	A	B	C
New Business development process	1) New business idea 2) Concept refinement in the team 3) First Demonstration (Pass or Fail) 4) Prototype development 5) 2nd Demonstration (Pass or Fail) 6) Commercialization	1) New business idea 2)Board approval of new business 3) Resources allocation (HR, Funding) 4) Interim check (Milestone Cross-checking) 5) Commercialization	1) Idea selection 2) Placing initiator in CE team 3) Resources allocation and development 4) Preliminary evaluation (Pass or not) 5) Commercialization 6) Post evaluation
Evaluation Method	**1st Competition** : Employee evaluation group's Y/N online vote after presentation **2nd Competition** : Evaluation group vote (70%) and executive's post evaluation (30%) **Characteristic** : Intuitive and simple evaluation process	**Interim check** on the sustainability of new business 1) Operation: whether suitable for market condition 2) Lab: evaluation of technology development **Characteristic** : Consistent review and judgment on whether its product has distinctive competitiveness in market	**1) Preliminary evaluation**: degree of technology realization **2) Post evaluation**: ACTIVATION POINT (key index, the most important point per service) evaluation **Characteristic** : Suspension of commercialization when not reach to the objective standard through internal/external expert evaluation : Same industry model comparison + KPI in each month
Incentive	**Interim stage** Monetary compensation **After Commercialized** Promotion to the team leader Monetary compensation Highest point in performance evaluation	**Monetary compensations** for the initiator and actual developer	**Support for commercialization** Incentive when hard to materialize Man power support

From the analysis of three companies' new business development approach, it has been found out that three companies have in common that each company established an

d carried out a strict evaluation process compatible with its own characteristic and vis ion before commercialization of its idea. And when commercialization is confirmed th rough such process, every company fully supports the new business in various way. T he other one thing in common was that, especially by funding and supporting operati on man power such as general affairs, accounting, design and etc. and consistent men toring with management, each company fully supports for effective planning and devel opment as well.

However, A and C which are internet service oriented companies and B, the manufa cturing company are distinctively different in the detailed process of idea selection an d resource injection.

In case of A and C, they consider every employee as potential initiator and establis hed a process to extend participation. Especially, in order to overcome the missing ti ming due to the complex process of large company, a venture company's lean startup process which is commercialized in spite of few things amiss and modified later is adopted by both companies.

However, in case of B, the manufacturing company, executive officer takes the role to decide idea selection and resource injection and in commercialization stage, A and C seem to evaluate more strictly the market trend and innovativeness of new technolo gy. Such difference is due to the industry characteristic and mainly it is because life cycles of product/service each company provides are different.

3-5. Change in Cognition of Company towards In-company venture System

This study presumed, during the process of introducing and operating In-company v enture system, employees would share the vision and value voluntarily and cognition and action pattern about innovation would change accordingly. From the interview wit h system manager of each company on such presumption, in case of A, it has been t old that the company culture to set up team voluntarily among members and materiali ze ideas has been settled. As evidence, it has been shown that the vision of A to int ernalize Corporate Entrepreneurship in the organization has become visualized. In case of C, since the system is in the middle of settlement, any visual outcome is not sho wn but the reply was positive saying that voluntary participation to help system opera tion within individual's capacity has been increased. However, in case of B, since the In-company venture system was established focusing on the successful development o f new business, new business developing process is found to merely affect the compa ny culture of employees. Still, also B seems, from the interview with executive office r, it realizes that discovery and training of man power with entrepreneurship is crucial in development and success of new business.

“We ought to have someone to materialize new ideas aggressively. Although we inje ct many resources strategically and support, if there is no core human resource to ca rry it out, there would be no success. The companies' efforts to foster such human re source can be seen as crucial part of Corporate Entrepreneurship.”

(Mr. M, the executive officer of B for new business development)

From the interview about In-company venture system and organization cultural chang e, it has been found out that companies commonly realize that it shall discover and u tilize human resource with entrepreneurship through In-company venture system. Howe ver, it has been also deduced that the system operation and the change of company c

ulture are quite different between the company intending to innovate the company cult ure as whole through spreading entrepreneurship and the company intending to succee d a new business by discovering core manpower.

3-6. Achievement of In-company venture System

There are generally two goals which subject companies wish to accomplish through In-company venture system. Firstly, it is to discover innovative new business, and seco ndly, it is to innovate the company culture among its employees.

In first perspective, A, which commercialized 6 ideas has accomplished visible outco me through In-company venture system. B, as well achieved result of developing new business to produce electronic material for smart-phone by commercializing the idea of a researcher. In case of C, there are two new services launched in market through In-company venture system. Although it is early to evaluate the result, the strengthen ing and support are expected to continue since the innovation of company culture thro ugh innovative ideation is the ultimate goal of C Corporate Entrepreneurship.

Such will of C can be found in the "what we learned" Session, which operate the s ystem with other members and share the result no matter the project is successful or not. The system manager of C mentioned about the system operation and sharing pro cess as following:

"We are making session for sharing what we have learned from the system as well as collecting and commercializing ideas. No matter it was successful or not, we are sharing the outcome with other members through documentation and PICTHING. Thi s procedure itself stimulates the planning of new services within the company."

(Ms. L, the general executive officer for In-company venture system of C)

Another biggest achievement of A and C through Corporate Entrepreneurship is the changeover of innovative atmosphere. The system did the positive role of making the airs of organization which can become easily passive and tend to ignore the importa nce of creative idea, to active airs.

3-7. Critical Success Factors of In-company venture System

From the interview with subject companies about the success factor for the soft land ing of In-company venture system and spreading the effect to the organization, the 'w ill of top management' was mentioned as critical factor in common among them. In c ase of corporate venture system, the resistance from the existing organization and con flict about resource injection are highly likely to arise and then the will of top mana gement can be the crucial factor for the success of the system. Especially considering the characteristic of the domestic company culture, in order to smoothly transplant th e Corporate Entrepreneurship within the company, it seems to be critical for top man agement to show its firm will to carry out such system.

Furthermore, it is suggested as a crucial success factor to organize and maintain eff ectively the social process to induce member's new idea. It is critical precondition to motivate members and keep doing so and it has to establish the process which gives members ownership and autonomy. Under the systematic environment in which idea is continuously kept critically generated and materialized, members can build innovative t hinking and the innovation within company can be triggered under such ground.

Lastly, to successfully promote the Corporate Entrepreneurship, changeover of the co

mpany culture is thought to be accompanied. While establishing and operating In-com pany venture system, the possibility for feud among organizations and conflict of inter est is exists. To prevent such concern, it seems necessary to make consistent efforts to build trusts within company through long term commitment.

4. CONCLUSIONS

This study went through, by carrying out case study on companies which introduced and operating corporate venture system, the vision and the course of making process in order to spread the Corporate Entrepreneurship within company and discover new business, effect of system operation and critical success factor.

Especially, it can be shown and compared how those companies with different objectives, which are dissemination of innovative mind through research and development of new business, build the system process and operate according to their own vision. And from the system building process and operation of A, B and C, there are three critical success factors necessary for the settlement of In-company venture systems in Korean companies system. They are, 1) the will of top management is necessary to dispel the resistance and conflict within the organization, 2) the system shall be invigorated by building process to promote new ideation of members, and 3) the consistent efforts to build trust within among organizations and change over the company culture shall be made in order to prevent the feud among organization and the conflict of interests. These factors are consistent with former studies. However, the managers from three company emphasized the first factor is greatly important for maintain Corporate Entrepreneurship programs, because of existing organizational conflict. This point may be the distinctive characteristic of Korean company case.

The operating manner of In-company venture system and success factors drawn out by the study may provide meaningful implication to those companies wish to introduce similar system sooner or later. However, this study result is somewhat self-limited in the aspects as following. First of all, since there are few companies successfully operating the system, the study result has been deduced from the interview with only a few (three) companies operating corporate venture system. Furthermore, since the data has been collected from the point of planner's view, the cognition of program participant and general employees are not ascertainable. Based on the limitations mentioned, if a study of which the research on corporate venture system participant and employees is supplemented and the quantitative determination is combined, is carried out, the effects on company culture may be found out in more details.

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PATENT ANALYSIS OF THE ORCHID INDUSTRY IN TAIWAN

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ABSTRACT
To get awareness of technological development of the orchid Industry in Taiwan, the purpose of the research uses patents analysis to explore competitive advantage of the industry. After using proper data collection method, the research has 60 effective patents for analysis. In analyzed data of patents presented that most patents belongs to personal than companies. The patents related to orchid concentrate on the two ends of the value chains of the industry. The findings are worth to pay attention for future competitive advantage of the orchid in Taiwan.

Keywords: Patent Analysis, Value Chain, Orchid Industry

INTRODUCTION

Among subtropical flowers, orchid is the most beautiful and the best representative (Chen, Y. C., 2004). The prospects of the orchid market are brightening as industry, government, academia, and the research community have invested large amount of efforts. According to the statistical data provided by Dr. Chu Yaw-En, convener of the Flower and Ornamental Plant Group of the Executive Yuan National Science and Technology Program, Taiwan controls over 50% of the orchid genetic resources and over 40% of core production technologies (Chen, Y. H., 2004). Along with knowledge-based economy, the biotechnologies for the orchid industry are very advanced. Taiwan's orchid industry also has been transformed from traditional agricultural industry to a biotechnological industry that is knowledge intensive, technology intensive as well as capital intensive. Effective application of biotechnologies has increasing the importance of technology in orchid production and result in high profits and values. Analyzing the orchid industry with intellectual property patents analysis will raise our understanding of competitive advantage of the orchid industry in Taiwan. Thus, the research explores the following questions: 1.What is the outlook of patents technology of the orchid industry in Taiwan? 2. How to enhance competitive advantage of the Taiwan's orchid industry with the results from the results of patent analysis? The purposes of

the research with answering above questions includes: 1.By searching patents concerning Taiwan's orchid industry, the research provides a better understanding of the technological development of the industry in Taiwan. 2. The research could offer an overview of the background of development of patents and relevant information to benefit to integrate the value chain of Taiwan's orchid industry.

LITERATURE REVIEW

Patent analysis

Patent is the representative in the knowledge-based economy. Patent is a powerful weapons for hi-tech industries of two rivals to compete in economic markets (Narin, 1995). Document of patents serves as an information resource that technology researchers often refer to. Businesses rely on patent literate for their innovation, research and development. Patent literatures inspire new research directions, provide detailed explanation of inventions, improve the application of old technologies, predict the growth of industries, and provide complete research information. Using technologies to effectively collect patent information can shorten the time and money for research and development, and lower the risk of patent right infringement (Liu & Shyu, 1997). As above, patent literature demonstrates the importance sources of information for business.

A patent map, or patent analysis, refers to applying statistical analysis approached to patent information and other related information and presenting the information as analyzable and interpretable charts or figures. Patent analysis is also defined as the interpretation of patent information as technological competition intelligence. A patent map transfers details of patent information into patent intelligence. The contributions of patent analysis are including (Daim et al., 2006; Hsieh, 1998; Ernst, 1995, 2003; Ernst et al., 2000): 1. Provide detailed explanation of inventions. 2. Provide information for comprehensive research projects. 3. Offer industrial development directions, and creating competition advantages. By transferring patent data into useful patent information, patent analysis is an effective tool for technology research and development planning and intellectual property management. Also, patent analysis serves as a reference for technology competition analysis, technology trend analysis and patent claims analysis (Hall, Griliches, & Hausman, 1986). Patent analysis helps businesses to understand the technology focus and advantages of rivals, and the competitive advantages, opportunities, and threats of the market. According to patents information, firms can formulate development programs or give up additional research and development tasks (Jung & Imm, 2002). Patent analysis provides important information for intellectual property management. Thus, the research uses patent analysis as tool for understanding and clarifying the technological trends of the orchid industry.

The Orchid Industry in Taiwan

Because there are numerous variations, looks, and colors of orchids, orchids are considered to be very valuable and beautiful flowers. Orchids originated growth in tropical and subtropical areas that is same to Taiwan's area. Due to fit environment, the orchid industry has naturally become an important flower industry in Taiwan. The export volume of orchids accounted for 46% of the export volume of flowers and seeds. Taiwan is experienced in orchid breeding and cultivation, and applies aseptic operations to orchid cultivation, so Taiwan's orchid plays an important role in the international market. Taiwan exports large numbers of plant tissues, seedlings and cut flowers. The prospects of the industry are great by breeding new species. Taiwan has long been a major exporter and supplier of orchids. The success due to Taiwan has made significant achievements in orchid breeding and cultivation by laying a solid foundation of agricultural biotechnologies (Lin et al., 2008). Thanks to the advanced development of biological technologies, the biological makeup of orchid can be changed completed by changing the genes, cells or tissues. Traditional cultivation and planting methods for orchid have been transformed too. Taiwan, Japan, the US and the Netherlands are hungry for new biological technologies and techniques, including genetic modification programs, tissue culture technologies, transgenic technologies, development of functional genomics, and research of plant growth. As a consequence, it is important to protect relevant patents. In the past, there is rarely research on technological development on agriculture industry, especially on the orchids industry from patent analysis view. For understanding the foundation of competitive advantage, viewing on resource-based theory, we need to realize the roots of technology in orchids industry.

The growth stages of orchids can be segmented into six phases: breeding, tissue culture, bottle seeding, small seeding, medium seeding, big seeding, and blossoms. In addition to retail and wholesale phases at marketing end, the research standing on wholly industry value chain to divide three phases, breeding, culture, and marketing (see Figure 1) for following analysis.

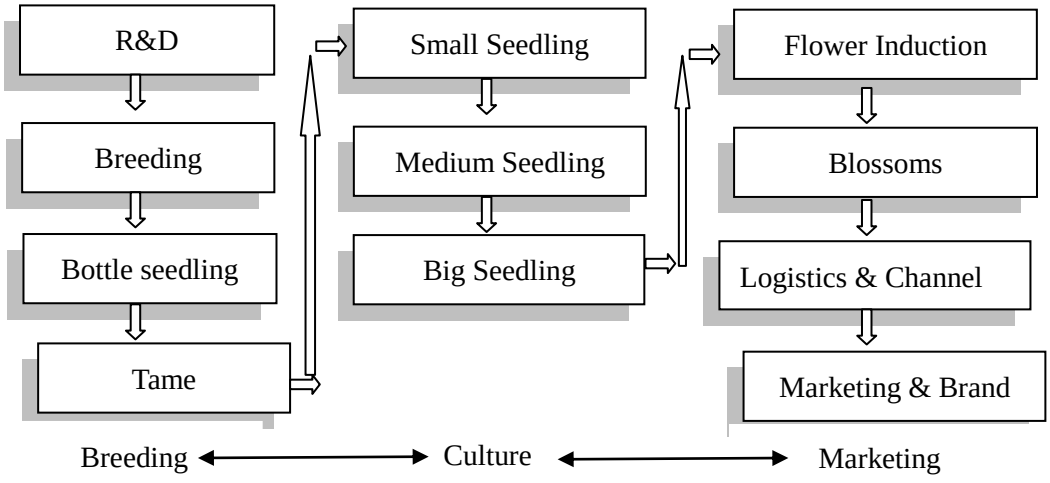

Figure 1: The Value Chain of Orchid Industry

METHODOLOGY

Patent analysis, or a patent map, refers to applying statistical analysis approaches to patent information and other related information and presenting the information as analyzable and interpretable charts or figure. The paper analyzes patents including: patent number, annual patent number, countries, company, IPC etc. Patent Guider 2.0 is used in the research as patent analysis tool, and the data is provided by the Intellectual Property Offices. The scope of the research covers the orchid industry in Taiwan. Information search refers to formulating a series of steps based on the issue to be discussed. These steps include the selection of database, setting of search conditions, and choosing analytical approaches. A correct patent search will benefit future research and development, so the setting of search conditions is considered the most important step. The research uses "orchid" as keyword for patent searches, the researchers screened and categorized all returned information, and employed the International Patent Classification(IPC) to confirm the classification of relevant patent technologies to prevent missing patents. Keywords used for the research resulted in 89 entries being located. The research removes 29 entries that are irrelevant with the research and found 60 available entries.

Analysis and Discussion

The study found that Japan, The Netherlands, Korea, and the Republic of China (Taiwan) applied for patents in Taiwan. Table 1 shows the number of patents and patent owners. According to the table, most applications are filed by applicants in the Republic of China (Taiwan). Taiwan has been developing the orchid industry for a long time, and Taiwan should have signification achievements in orchid patents, but according to the statistics, Taiwan does not have many patents. This is because at the earliest stages of technology development, the Taiwanese government offered technologies to farmers free of charge in order to improve Taiwanese agriculture and take care of farmers. As a consequence, the number of patents is limited.

Table 1: Analysis of Countries Owning Patents

Countries	Number of Patents	Number of Patent Owners
Japan	1	1
The Netherlands	1	1
The Republic of China (Taiwan)	57	55
Korea	1	1

Figure 2 show the varieties of patents. If patents for both culture and marketing are not taken into consideration, it is observed that more patents are related to breeding and marketing. The

finding is consistent with the “smile cure”. The ends of the chain have a higher value than the middle part of the chain. The figure also illustrates that orchid industry in Taiwan is developing according to the smile curve as well. More patents are committed to the ends. When patents for both culture and marketing are taken into consideration, however, the figure tells a different story. It shows that Taiwan’s orchid industry has strong production and technological capabilities.

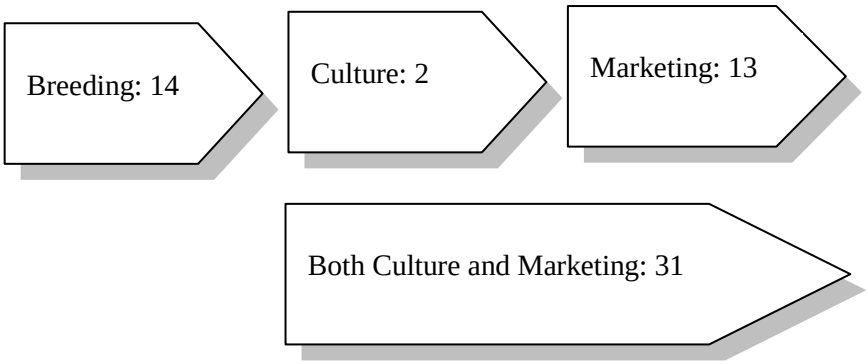

Figure2: Varieties of Patents in the Value Chain

Table 2 shows that 1990 marks the peak of patent applications, and that development has been very steady since then. The year 2000 marked a new peak, probably because more and more people were educated in regards to protecting technologies so as to maintain their competitive advantages. That is to say, Taiwan started to value the importance of technology protection. The export market is important to the orchid industry, and the territoriality principle is applied to patents, so it is worth discussing if patent owners have visions for patent deployment.

Table 2: Patent Application by Country

Year	Taiwan	Japan	Netherlands	Korea
1986-1990	12	0	0	0
1991-1995	10	0	0	0
1996-2000	9	1	0	1
2001-2005	17	0	0	0
2005-2007	8	1	1	0

Table 3 shows that according to 3-level IPC distribution, most patents are classified as A01G (horticulture; cultivation for vegetable, flowers, rice, fruits, grape, hops, seaweeds; forestry; watering) and C12N (microorganism; reproduction, preservation and maintenance of microorganism; genetic variation and genetic engineering; culture medium). According

5-level IPC distribution, most patents are classified as A01G9/02, containers, e.g. flower pots or flower boxes (hanging flower baskets and containers for flower pots are classified as A47G7/00); glass containers for flowers, and A01G9/00, containers or greenhouses for flower, vegetables or rice. Most patents in the industry are patents for containers. Possible reason for this may be the fact that in the past, the government offered technologies for farmers free of charge, and farmers did not have a high level of education so they could not contribution significantly to the improvement of containers. That is probably why the patent for containers is most significations. More studies are expected for the part.

In the analysis of applicants, it is found that 47 individuals applied for patents, accounting for 78.46% of all applicants; 10 businesses applied for patents, accounting for 21.53%. This demonstrates that many individuals are involved in patents in the orchid industry that means firms of orchid may still in the introduction stage of industry development.

Table 3: IPC Distribution

IPC	number of patents	IPC	number of patents	IPC	number of patents
F24J	1	C05F	4	A01N	1
F24F	2	B67B	1	A01H	2
F16L	1	B65D	1	A01G	38
E04F	1	B65B	2	A01D	2
E04B	1	A63H	1	A01C	2
C12N	8	A47G	1	A01B	1
C07K	1	A47C	1	14/0	1
C07H	3	A23N	1	14	2

CONCLUSION

Findings and Suggestions

From the results of patent analysis, the research finds that patent applications are filed by more individuals that businesses in Taiwan. This means that the division of the orchid industry is very detailed, and each unit focuses on its division, so no individual or business covers an entire process. Educational institutes also place some contribution for the industry, for example, National Cheng Kung University, National Taiwan University and National Chung Hsing University. At the earliest stages of development, the government of Taiwan provided technologies and techniques to farmers free of charge, so that the industries would cherish and make the most of the technologies to prevent technology or variety drain. If such a drain happens, Taiwan’s orchid industry will lose its competitive advantages little by little.

Farmers therefore should cherish and utilize these technologies to develop Taiwan's orchid instead of ravaging them. By doing so, Taiwan's orchid industry will remain competitive in the global market. In Taiwan, a few patent applications are filed by applicants from other countries. This implies that more research is required to find out how other countries value the patent of Taiwan's orchids. Agricultural intellectual property rights is an innovative concept in Taiwan, and at the current stage, the number of intellectual properties is increasing. After a few years, the concept of patents becomes prevalent and that was an increase in patent applications. Future research may place more attention to patents in the value chain of the orchid industry. Generally speaking, from the analysis of patents in the orchid industry, it is found that there is much room for improvement in the application and employment of patents in Taiwan.

Generally speaking, the research has following important contributions in the field of technology management. First, the paper is the one of using patent analysis try to analyze technological development in Taiwan's orchid industry. Second, the study stands on wholly industrial value chain to find out the key point of technological development in Taiwan's orchid industry. Finally, the research provides some possible ways to build up industrial technological strength.

Limitations

The research limitations, however limited because of insufficient research resources, and also because the experiments were effectively controlled, are including: 1.Intellectual property right is a broad disciple, but the research focuses only on patents. Other parts of intellectual property rights are not covered in the research. 2. The research is not including patent database of other country, USA, Japan and Europe, may missing the significant patents of the orchid industry. 3. The searching method of the research may not include complete keywords also can missing the significant patents of the orchid industry.

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A STUDY ON THE DEFINITION OF SMART CITY

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ABSTRACT

Smart City is taking the center stage as a solution to tackle the problems that are arising with rapid urbanization. However, the concept itself is too comprehensive and unclear, that it is hard to apply to the business promotions that have compatibility factors. Therefore, this research attempts to make a unified definition of the Smart City by analyzing previous studies on the Smart City. The main methodology used in this research is definition deduction by analyzing the Smart City and its similar concepts. Also, a term analysis was done on the word 'Smart' to analyze the definition of the Smart City. Through these analyses, the research tries to find out the main important components that form the concept of Smart City and also propose suggestions to carry out successful Smart City projects.

Keywords: Smart city, u-city, People

I. INTODUCTION

What is the source of continual development and growth of the city? This question has been paid attention for a long time by researchers and policy makers for urban development. With the rapid expansion of scale of cities, urban planners have made complex management systems and policies to manage food provision, water provision from long distance, waste disposal and traffic management system. The quality of these systems has an important role to determine the quality of citizen's living (The Science Museum, 2004). Through there exist various problems and defects related to metropolis complex people all over the world are centering into the cities continuously.

Almost half of world population are living in the cities. This trend is anticipated to be continued and the UN foresee about 70% of world population will live in cities by 2050. Also we can see the rapid expanding trend of average size of cities. This expansion was possible with the development of high technologies so cities could accommodate more citizens.

The problems related to metropolis have been solved with creativity, human resources, interest parties' cooperation and new ideas. That is, those can be called as 'smart' solutions. Therefore the name of 'smart city' can mean 'clever' solutions which can make modern cities prosper. Through the word 'smart city' is used widely there is no proper and exact definition for it because it is used with various context.

The word 'smart' is already used widely such ad 'smart phone', 'smart TV' and 'smart home'. Through the word 'smart' seems to mean 'intelligence' or 'automation' there is no unified concept for it. The concept of 'smart city' is also vague. So its meaning can be inferred as the

solution to make cities smart with solving many problems of cities beyond just combination of concept between ‘smart’ and ‘city’.

Therefore the aim of this paper is to search for exiting researches about the definition of ‘smart city’ and find out its proper definition. This kind of paper can be a foundation for future research about the smart city and give hands to its academic and practical advancement.

II. BACKGROUND AND DEVELOPMENT OF SMART CITY

According to United Nations Population Fund, about half of world population live in city area in 2008 and it is anticipated that world population living in cities will be increased to 5 billions by 2030. Also 80% of world GDP is produced from the cities and its ratio is being increased continually and rapidly.

With the explosive increasing of world population living in cities, those cities face various dangers and difficulties. Unprecedented expansion ratio of cities has made finding the solution immediate which can manage and solve its related problems.

Another background of appearance of smart city is the change of citizens’ life pattern (sang hoon lee, 2013). Through the social industrialization, people pursue the quality of life with economical wealth and think the health care and eco-friendly important. The concept of smart city is highlighted to meet those citizens’ needs.

To respond to the important issues of the climate change and sustainable growth, governments all over the world have established urban plans to be more smart and eco-friendly. To solve the traffic jam and environmental destruction caused by rapid urbanization developed countries try to plan sustainable urban developing model with combining ubiquitous functions based on ICT technology into urban environment. As a part of these tries in early 2000, USA tried to make networked infrastructure of cities with the foundation of the research of ‘smart grid’ and rapid development of IT technologies(Korea small business institute, 2013).

The trend of smart urbanization is not limited to specific area but a worldwide current. Firstly from Europe now to Middle East and China adopt the smart city model to solve the side effects from rapid urbanization and to develop new cities. So the trend can be said to be being escalated to a worldwide current.

III. DEFINITION OF SMART CITY

The concept of smart city is an early phrase one which is not established. Many academic and practical researches to drive the exact definition of smart city have been attempted. In this paper we analyze the concept of smart city with currently most used two methods in the research area of smart city. The first method is to draw the definition through analyzing similar concepts for smart city and the second is to draw the definition of smart city through analyzing the word of ‘smart’ used widely. These two methods have advantage to show the difference of definitions of the vague word ‘smart city’ clearly through comparing.

1. Similar concept with smart city

The concept of smart city has been developed with various conditions along the development of ICT technologies. It has been developed from various concepts including intelligent city, information city, knowledge city and digital city as well as ubiquitous city which have similar meaning with smart city. Though these various concepts of city have some common characteristics, they also have different area and highlights. Because the concept of smart city is still being born it has vague meaning and institutions and entities which use this word don’t

have standardized definition and use it without consistency. Figure 1 shows the change of the concept related to the smart city.

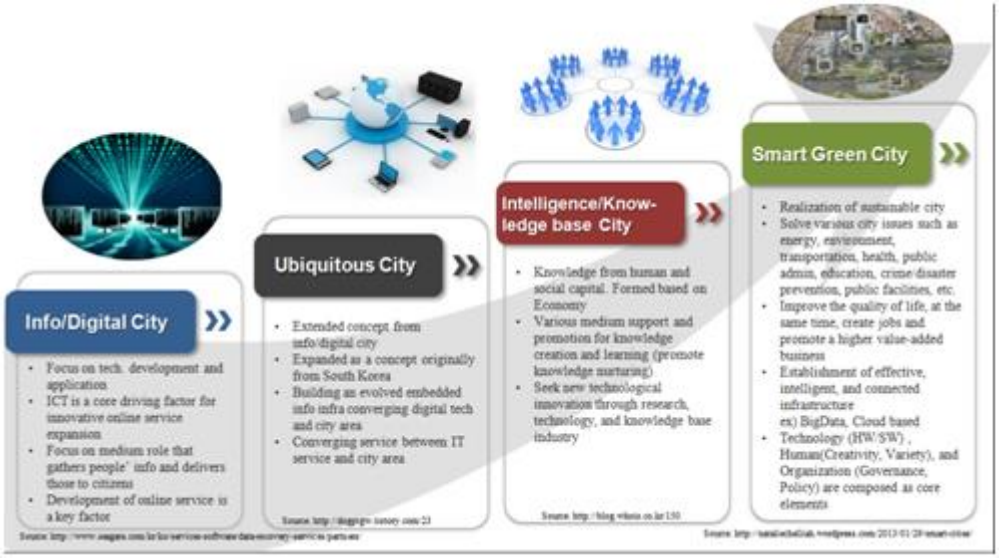

Figure 1 - Similar concepts with smart city (J.H. Lee, et.al., 2013)

To find out the commons from multidimensional components we should study similar concepts with smart city carefully and check the origin of widely used word. Variously labeled cities can be classified into following 3 dimensions: technology, people and community (Nam& Pardo, 2011). These cities with various concepts are used mixed together not independently in the aspect of the definition.

1.1 TECHNOLOGY DIMENSION

There are many concepts for smart city drawn from technology dimension. The concepts of information city and digital city are based on the technology and they assume the ICT as the main driver which makes innovative online service. In the information city, public sector gathers information from its people and uses it through the Internet. Yovanof & Hazapis define the definition of digital city as follows: inter-connected city which combines service oriented computing infrastructure flexible with based on broadband communication infrastructure and open industrial standard. That is, the city which offers innovative service to meet the needs of government and its staff, citizens and business sector. The information city means a digital environment where the local community gathers the information and offers the information to citizens through web portal (Anthopoulos & Fitsilis, 2010; Sairamech et al., 2004; Spoull & Patterson, 2004; Widmayer, 1999).

The concept of intelligent city is created combing the digital city and intelligent society (where the elements such as knowledge and creativity are highlighted and human/social resource are thought as the most important asset) (Moser, 2001). Malek(2009) defines the intelligent city as what has the info-structure and infrastructure for information technology and what has high-end communication, electronic and mechanical technologies. The concept of intelligent city focuses on the better ability of the ubiquitous city. These are accomplished by following 3 dimensional innovation: 1) intelligence, inventiveness and creativity; 2) collective intelligence, 3) artificial intelligence. The tries for this cooperative governance is established by the systemic unification of embedded technologies such as sensors and interact media. The

concept of intelligent city is developed in the concept of knowledge economy where human and social resources are the most assets. Technological innovation for them is the key for the intelligent city.

In the virtual city, the functions of city are performed within the cyber space (Boulton et al.2012). The empirical difference between cyber and physical space become vague and the category of the concept of smart city is composed of the hybrid city where the virtual city corresponds to the physical organization and real people. Realistically the physical IT ground (cable, data center etc.) with large scale can make it possible.

The ubiquitous city has been understood as the extended concept of digital or information city in the aspect of accessibility and infrastructure (Anthopoulos & Fitsilis, 2010). People can use the information of the city anytime, anywhere through the embedded urban infrastructure. The goal of ubiquitous city is to make an environment where people can use his/her desired service anytime anywhere through any device. According to Ministry of Land and Transport and Maritime Affairs in Korea (2007), the definition of ubiquitous city is as follows: the city which is managed by the network through BUCI(installed u-city infrastructure) and MUCI(mobile u-city infrastructure) including high technologies such as sensors and offers services and contents to the citizen through the network.

Lee et al.(2013) defines the concept of ubiquitous city as the unification of IT services in the which can be accessed anytime anywhere. These services focus on enhancing the quality of citizen's life and reinforcing the competitiveness of cities. But the concept of ubiquitous less focuses on social infrastructure in the aspect of human and social resource when compared to smart city. Whereas the virtual city reproduces components of city in virtual space the ubiquitous city inserts computer chips or sensors into those components.

1.2 PEOPLE DIMENSION

According to the studies the creativity is key driver to develop successful smart city. So human, education, learning and knowledge are very important human resources for smart city. The creative city is one of the visions of smart city. Human infrastructure such as creative job and labor, knowledge network and volunteer work institution is key axis for the development of city(Florida, 2002). The smart human resource makes social capital and has benefits from it. The smart city is related to the unification of education/training, culture/art and business/commerce(Bartlett, 2005) and is harmonious compounding of social company, cultural company and economical company.

Smart city is a human city which has various chances to lead a creative life by using human resource in city. Winters(2010) analyses why the smart city grows, who leads it and who lives there by focusing on education. According to his opinion the smart city is developed with the individuals who have higher and good quality education. In this context of study there are abundant labor force well educated in the smart city(Glaeser & Berry, 2006). With incoming of smart human resource new creative culture originated from them are another driver for the development of the city.

1.3 INSTITUTIONAL DIMENSION

The smart community movement was formed as a strategy to broad the IT user(Mose, 2014). The smart community can be defined widely from small local community to that of a country size. The member, company and government institution of it establish a cooperative relationship to change the environment they face drastically(Industry Canada, 1998). This concept highlights the governance between stakeholder and institutional elements for it. California

Institute for Smart Communication(2001) defines the notion of smart community as follows: The communities(2001) defines the notion of smart community as follows: The community where government, company and people understand the potential of information technology and make decision to use the technology to change the life and labor drastrically and positively.

The planning and developing smart city involves the pursue of smart growth(Moser, 2001). The smart growth was widely used word in the context of 'smart' inside the city before the concept of smart city appeared(Urban Land Institute, 1998). Smart growth movement is a counterplan of government to correspond to more and more severed traffic jam, school insufficiency, air pollution, disappear of open space, disappear of historic space and price jump of public facility and it was highlighted in 1990's(Freilich, 1990; Ingram et al, 2009; Poter, 2002). The smart city is similar to the function of smart growth plan in the aspect it is a solution for problems of city. But the smart growth thinks the growth of city as a counterplan for spatial sprawl of city(Benfield et al, 2001; O'Tool, 2001). The lesson from smart growth is improperly planed and coordinated development causes the side effects. And it promotes the smart growth movement(Benfield et al., 2001). By the city plan based on the governance of various stakeholder becomes the focus of smart growth the plans of smart city need the governance for their success.

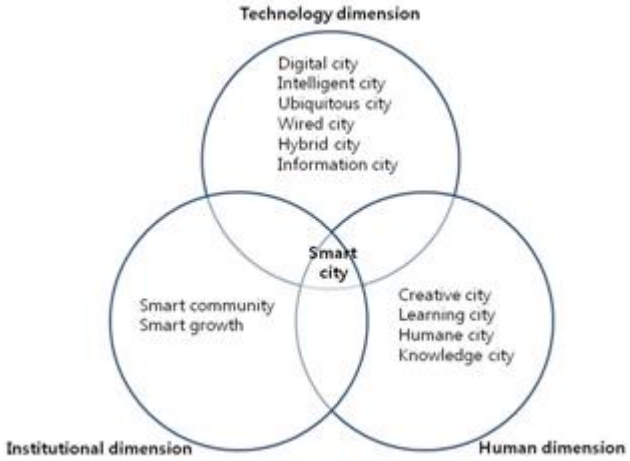

Figure 2 – the relation between smart city and similar concepts (Nam & Pardo, 2011)

2. *The definition of smart city from analysis of similar concepts*

According to the studies above discussions are originated from various viewpoint of smart city. Though the concept evolves to the concepts of the city interconnected with ICT or open city all similar concepts(such as ubiquitous city and intelligent city) have following 3 common elements: technology (infrastructure of hardware and software), human(creativity, variety and education) and institutions(governance and policy). Also many researchers including Giffinger et al.(2010) explain the concept of smart city have following 6 main dimensions: smart economy, smart mobility, smart environment, smart people, smart living and smart governance. These papers defines the smart city as follows(Caragliu et al., 2009): The city where the investment to traditional(e.g. traffic) and latest(e.g. ICT) communication infrastructure and human and social capital can promote continual economic growth and quality of life through efficient management of environmental resource and citizen-participate governance.

Also public researchers add the system to manage and support the city. City government of Amsterdam defines the smart city as that uses innovative technology and has willingness to change the behaviors related to energy use to meet the goal of the climate change. The smart city of Amsterdam a synthetic approach to design and develop sustainable and economically-executable reduction program of city's carbon emission(Amsterdam smart city, 2011).

Lastly, leading research institutions give more specific analysis criterion for the definition of smart city. Forrester(2011) defines the smart city as follows: the intelligent, interconnected and efficient use of smart computing technologies to better connect critical city infrastructure components and services(city administration, education, healthcare, public safety, real estate, transportation and utilities). Gartner defines the smart city through information flow approach as follows(Maloi, 2012): the smart city is based on the intelligent exchange of information between various sub-systems. The information flow is analyzed and interpreted into citizen and commercial service. The smart city extends this information flow to eco-systems and uses to make resources be more efficient and sustainable. The information exchange is based on the smart governance of actually performed framework for the sustainability of city.

In short, the goal of smart city is to solve various city problems(insufficient public service, traffic, excessive development, rise of price of land and unbalance including environment and hygiene) through ground ICT technology connected to infrastructure of city. The eventual goal of smart city is to plan a balanced development by opening the city's data to its people and recycling it efficiently. Through this smart city improves people's quality of life and the citizen think it as better and more sustainable city in the aspect of environment and economy(Lee et al., 2013).

According to the definition analysis and classification result, smart city has key components. Those are service, infrastructure, human/social capital(Nam & Pardo, 2011). The correlation of these components are when human/social capital and the investigation to IT infrastructure prompt the sustainable development by offering service to people or business and they can enhance the quality of life the city can be called as smart.

The technology which consists of IT infrastructure is the key to make overall changes of life and labor inside of the city with using the ICT(Holland, 2008). The well-working infrastructure itself is insufficient to be a smart city. IT infrastructure is just a precondition for the smart city. The quality and availability of IT infrastructure are not only definition for the smart city(Caragliu, 2009). A definition emphasizes human infrastructure, human capital and the role of education in city development(Boulton et al. 2012). So the category of human resource emphasizes the creativity, social learning and education. Lastly, people's participation is the most important in the smart city. For it the government of smart city unifies their services and offers various services. The most important thing is the smart government should offer the real citizen-centric service.

3. *The definition of smart city from analysis of similar concepts*

As we can see through above the definition for smart city is various. Through the concept of smart city is well known and widely used it is being used with different meaning in different context. There are many kinds of cities where the word 'smart' is changed to other. Holland thinks the smart city as a phenomenon of urban labeling. The labeled smart city is confusing concept and not used consistently. But there is no sample for framing of smart city nor widely used one-size-fit-all definition for smart city. The tracking of evolutionary process of smart city in labeled smart city can help to understand and how the concept of 'smart' be added to the city. Also we can understand the smart city better.

In the aspect of marketing words the smartness focuses on the user perspective. So the smart city offers customized interface and is request to reflect the users' needs. The government and all levels of public institutions admit the concept of smartness to distinguish new strategy which sets goal of better quality of life, economic growth and sustainable development with conventional one. They connect the concept of smart to performing successful policy. In the context of technology the smartness means automated computing principle including self-configuration, self-healing, self-protection and self-optimization.

The most important thing is the smart city has been thought as a big organic system. Dirks and Keeling(2011) emphasize organic unification of system. The smarter city inputs information to be shared into physical infrastructure to understand problems of city, restore them, recover rapidly from a disaster, collect information for better decision making, assign resource efficiently, collaborate beyond original organization and field. But just giving function to each sub-system of the city(traffic, energy, education, building, physical infrastructure) is not sufficient to be 'smart city'. The smart city should be thought as organic whole(as a network or connected system)(Kanter & Litow, 2009).

Whereas the systems of industrialized city are mostly bones and skins post-industrial cities are same with an organic which has artificial nervous system for the cities to behave with intelligently set way(Mitchell, 2006). So new intelligence of city can be possible through more and more efficient combination between digital communication network(or nerves), ubiquitously embedded intelligence(or brains), sensors and tag(or sensory organs) and software(or knowledge and cognitive competence). The web is being increased, which connects electrical system for a building, home appliances, production machinery, factory, traffic system and electrical grids as well as water supply and disposal of waste network, a system which offers peace security and all thing we can imagine for human behavior.

4. *The definition of smart city from analysis of similar concepts*

The concept of ubiquitous city(u-city) was firstly made in Korea and Korea has lead usage of the word. But the concept of u-city and smart city are used in mix in Korea. The word 'u-city' was firstly used at the presentation paper and report on 'u-city model study in Songdo new information city' from Incheon free economic zone authority 2003. And it has mainly been used at public sector. But the word 'smart city' has been used in private sector lately from around 2009 with the effect of smart phone appearance including the i-phone. But in these days the public sector realizes the limits of its leading U-city and starts to use the word "smart city" to keep pace with the private sector. The concept of U-city is as follows: Information city and ICT-centric U-city is the phrase which focuses on the development of information communication technology including the construction of ICT and BcN wired network and the development of U-city services. the construction target of U-city focuses on the service and technology. The concept of urban space and location centric U-city is broadened with the unification of ICTs and urban facilities(Jung Hoon Kim, 2007; Chang yeon Kim, 2005), the unification of ICTs and urban space(Do Nyun Kim, 2007) and the unification of ubiquitous urban infrastructure, ubiquitous urban service and ubiquitous technology(Ministry of Land, Transportation and Maritime Affairs, 2007; Leem & Yigitcanlar, 2008). The concept of multi-layered U-city emphasizes the U-city as a system where service-ICTs-infrastructure-management and the governance is unified together. Whereas Conventional concept of U-city focuses on the target or development direction multi-layered U-city focuses on components and functional completeness of U-city(Koo & Lee, 2008).

1.1 u-city 1.0

This was when the concept of ubiquitous service which offers broadcasting, communication and internet service anywhere anytime with using IT infrastructure including BcN and RFID/USN was pushed and it was time of "IT-centric". In the basic plan for BcN construction II(2006.2) U-city was considered as a method to stimulate the construction of BcN infrastructure during urban development. The concept of U-city in the basic plan for stimulation of U-city construction(2006. 12) is defined as "future high-tech city where IT infrastructure, technology and service are applied to various components including living, economy, traffic and facility". 4 visions of U-city were convenient city, safe city, comfortable city and healthy city.

1.2 u-city 2.0

It is developed to the viewpoint of "unification of construction and IT". This is the unification of urban planning and U-city 1.0 and U-city 1.0 is unified to urban development or construction phase. The definition of U-city is the city where U-city services are offered anywhere anytime through U-city infrastructure constructed with the technology of construction and information communication. And IT technology, especially ubiquitous computing technology, is applied to urban base facility and urban service. In the time of U-city 2.0 the concept begins to unify with urban planning and philosophical base for U-city is appeared including "urban humanism, urban culturism, urban rationalism, urban naturalism and spatial and temporal transcendentalism". With these base philosophy 6 urban vision of convenience, safety, pleasantness, culture, production and participation is proposed.

But the limit of U-city 2.0is that because it develops facility and management software including crime prevention and disaster prevention(CCTV-centric), management of urban facility(water and sewage, streetlight), traffic(traffic information, illegal parking) and environment rather than that used in ordinary life. So people can't feel them sufficiently.

1.3 u-city 3.0

With the time of creative economy U-city becomes more important to offer contents properly for urban living(Korea creative industry institution, 2010). Especially the importance of private contents is increased. The time of U-city 3.0 can be possible with the appearance of contents-centric smart phone including I-phone. By offering public services from U-city 2.0 to personal smart phone rather than PC or public boards in the street People's satisfaction can be raised.

In the U-city 3.0 the energy is added to the unification key words. So it will be "unification of construction+energy+IT". Because the reduction of energy and carbon emission becomes a topic all over the world it is time for city-level smart grid is needed. U-Eco city R&D of Ministry of Land, Transport and Maritime Affairs develops useful "U-Eco city planning and design tools" in U-city 3.0 including the supporting system of urban ecosystem plan and urban energy plan and operating support system.

Above concept of U-city 3.0 is very similar with that of smart city. In plain words the smart city is that by adding smart contents vis smart phone on conventional concept of U-city services are offered to people feel them. Domestic U-city and smart city market is lead by the public sector. Some key public institutions define smart city as follows:

According to the Korea Small Business Administration (2013), the smart city means the future high-tech city where urban main facilities and public functions are networked with ICT. In this concept soft-infrastructure close to ordinary life including education, healthcare, security and safety as well as basic social infrastructure including energy(electronic, gas), traffic and water and sewage should be smarted. By all systems in smart city are connected organically via high-tech ICT infrastructure all environment including personal job and living as well as urban infrastructure are changed to be intelligent. Because it is possible to make the function of city efficient by applying high-tech ICT the smart city is thought as a new urban model where the city can be accomplish the sustainable development without environment destruction and energy drain. The smart city means the base facilities for telecommunication which are connected to every ends like human's neural network. As a 21th new city model anticipated by futurists the smart city has characteristic that every individual has perfect network and well constructed transportation network like spider's thread. Researchers imagine the shape of coming smart city with the base model of current Silicon valley USA.

IV. CONCLUSION

Smart City is getting the spotlight as a solution for solving various city problems due to urbanization. It is thought as a powerful solution for the next generation in vitalizing the depressed construction industry and the IT industry. However, as seen from above, various dimensions on the definition of Smart City exists in reality. What is common in these definitions are that Smart City puts main emphasis on the IT 'Infrastructure', 'people', and 'governance'. The ultimate goal of the Smart City is to create a city, in which the citizens actively participate. This would eventually lead to solving many complex problems that the city faces. The important part here is the participation of the citizens. This is part of the factor of 'people'. There had been previous attempts in the past to solve the problems of the city through the IT. The core element in order to success and to move forward to the next step is the citizen's participation. The idea is that the citizen's participation leads to new ideas that improve the city. Smart City can really become 'Smart' through the process in which the citizens that belong to the city with different needs share their ideas together. When the citizens share their ideas, it leads to the creation of new ideas that help in bringing out the best solution.

When looking at the result of analyzing the U-city project conducted by local governments since 2003, there was a strong tendency to focus on only the supplier's part. Korea's U-City project only focused on the efficient resource distribution of the local governments and one way information delivery using the IT infrastructures. It lacked in the effort to induce citizen's participation and knowledge sharing. This kind of Smart City has high risk of failure in constructing a durable ecosystem.

By providing human centered service, the platform for citizens to freely share knowledge can be constructed, and give motivation to participate in creating new ideas. This kind of knowledge sharing will lead to the reformation of Smart City by developing the 'knowledge-flow layer' on top of existing IT infrastructure.

V. Contribution & Future Research

This research reorganized the various definitions of Smart City and analyzed the similarities and differences between those definitions. This was conducted in order to solve the problems that Smart City Research field is facing due to the various conceptual confusions that are being raised. This research hopes to contribute to further researches and businesses by drawing out a unified definition on Smart City, and providing a standard for the concept of Smart City. In the

future studies, there should be in-depth research on the actualization of the role of the government, the corporations, citizens, and all others that are concerned with this issue, and how to vitalize their cooperation system.

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How country of origin affects purchasing intention: the case of mobile phone in Taiwan

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Research Background

Due to the development of information technology, the penetration rate of mobile phone is rapid increasing recently. The consumer behavior and using habit is also changing a lot. The mobile phone is no longer a symbol of social status. It becomes indispensable necessity goods. People may have more than one set of mobile phone. Confronting this trend, manufacturer provides its products with multiple types, more diversified and more functions which combine commercial, recreational and life style for stimulating purchase. This makes mobile phone more interesting in addition to communication tool. Therefore, the frequency of changing to new phone set is increasing according to mobile phone innovation rate.

The keen competition in mobile phone market also pulls manufacturer to innovate in many aspects such as screen from B/W to color, panel from non-touch to touch. The marketing strategy also changes from price war to better promotion package fixed with telephone number. If you look at different brands in the market, the mobile phones of Galaxy S5, Xperia, Galaxy Note 3, Galaxy S4, iPhone 5s, HTC One, are most likely the similar features in processor, water proof, dust proof and display quality. If this is the case, the consumers will likely include country of origin to consider beside product characteristics of price, appearance and functions. The image of country will accordingly influence buying behavior. For instance, when consumers make purchase for the electronic products, “made in Japan” will be more welcome than “made in China”. Consumers are more sensitive in country of origin in the globalization world. Therefore, country image has been a critical factor when consumers make their purchase decisions.

Since mobile internet has been so popular, mobile phone become top one in consumer electronic products in terms of market and size. According to Gartner report, the sales quantity amount of smart phone is 967m sets in 2013, which accounts for 42.3% growth rate from 2012. Due to severe competition, the top 5 brands implement global strategy to outsource and even establish their production plant in foreign country. In this case, the country of brand is not equivalent to

country of manufacturing. The final product is most likely a hybrid, mixed or combined one. This makes customer confusing to recognize the country of origin.

Here are the evolution of cellphone and the market share in Taiwan for top brands:

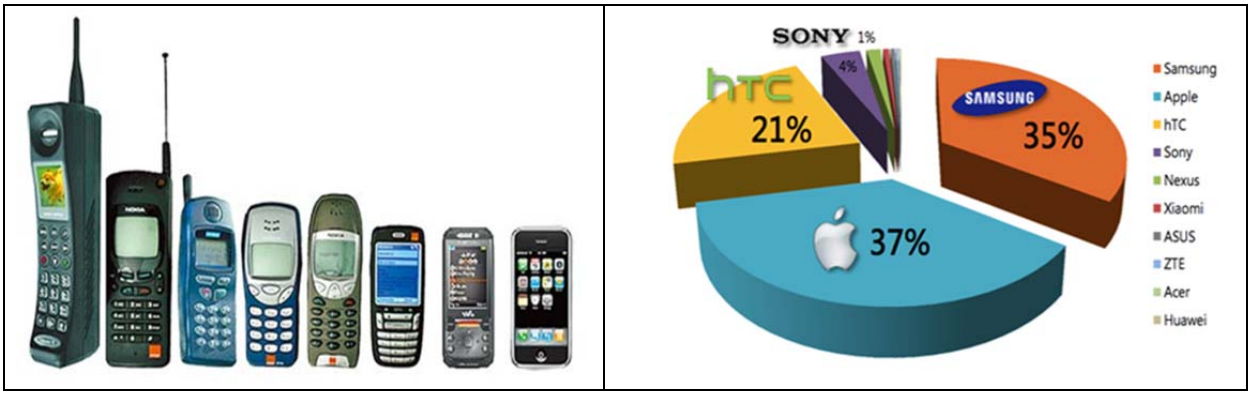

Fig 1. Evolution of cellphone and market share in Taiwan (Source: Taiwan Mobile Vpon)

In order to expedite purchase behavior for mobile phones among diversified brand and different types. Brand image provides an important role for customer to make buying decision. Manufacturers try to relate brand with high quality, reasonable price, and better after service. This would differentiate from other products in market. In consumer point of view, country of origin is also a key consideration during purchase process. In mobile phone case, Samsung and LG represent Korea, Sony represents Japan, and acer and HTC represent Taiwan. However, country of origin has many different interpretations such as “made in”, “assembled in”, “designed in”…etc. This study will take two dimensions of “country of manufacture” and “country of brand” for research purpose.

It is quite common that a customer may change his mind when he knows where the product is from. The change of decision may result from country of origin which he dislikes. The term of animosity is used here to express affection including marshal, economic, personal and political animosity. For example, Chinese may unlike to buy Japanese goods because Japan attacked mainland China in the year of 1937-1945. Many were injured or dead during war. People lost their relatives since then. Customer may not buy goods from Japan if he has this unhappy experience. Korea and Japan may have similar affection also caused by World War II. This feeling has nothing to do with product quality. Therefore, this study uses it as moderating variable.

Country of Origin

Since the mid-1960s, numerous studies have been conducted on country image. In general, they have found that consumers have significantly different country images or general perceptions about products made in different countries. In examining the role of country image in product evaluation, nearly all previous studies have explicitly or implicitly viewed country image as a halo that consumers use to infer the quality of an unknown foreign brand (Bilkey and Nes 1982). Recent studies by Erickson, Johansson, and Chao (1984) and Johansson, Douglas, and Nonaka (1985) found that country image affects consumers' evaluation of product attributes, but not their overall evaluation of products. These findings support the role of country image as a halo in product evaluation. Note that country image is defined here as consumers' general perceptions of quality for products made in a given country (Bilkey and Nes 1982). Such perceptions are typically specific to product categories, as suggested by Etzel and Walker (1974) and Hafhill (1980). For example, the country image for Afghan rugs would be very different from that for Afghan television sets (Han, 1989).

The halo hypothesis has two theoretical implications. First, consumers make inferences about product quality from country image. Second, country image affects consumer rating of product attributes. Country image, like brand image, can be viewed as a summary construct. Consumers may abstract information about a country's products because brands with identical country of origin have very similar product attributes. For instance, Japanese automakers operate in nearly identical market segments. In a sense, they are each other's competitors. Similarly, the biggest competitor of Samsung in the low-priced segment of the U.S. market for television sets may well be another Korean manufacturer Goldstar. Therefore, consumers can construct country-specific information by generalizing product information over brands with the same country of origin to such an extent that the brands are perceived to have similar attributes. The summary construct hypothesis has two implications. First, consumers make abstractions of product information into country image, in contrast to inferences implied by the halo hypothesis. Second, country image directly affects consumer attitude toward a brand from the country instead of affecting it indirectly through product attribute rating (Wright 1975). Thus, the summary construct hypothesis suggests the following structural relationships: beliefs —> country image —> brand attitude (Han, 1989)

Sethi and Elango (1999) argue that nations engender competitive advantage through a combination of factor endowments, unique cultural traits, and deliberate policy options. For example, a country’s homogeneity of workforce, patterns of social harmonization, and emphasis on education may provide that nation’s economic

institutions with a more productive and disciplined workforce. Similarly, a nation's political structure and supportive industrial policies may lend its companies with lower cost resources not available to companies from other countries. Therefore, these factors should be considered both individually and collectively in assessing their impact on that country's MNCs in the international competitive strategies. Countries do not compete, companies do. Therefore, to the extent that these COE-related factors contribute to the competitive advantage of firms from a certain country, they will manifest themselves only through the actions of the companies from particular countries in their operations in international markets. A country's physical and human resources and political institutions, as well as culturally based characteristics, could provide its firms with superior competitive advantage in comparison with firms from other countries. We call this combination of factors as the "country of origin effect: or COE (Elango, 1997; Sethi and Elango, 1997). These COE-based factors induce MNCs from different countries to exhibit differential behavior in their strategic choices and operational modes. COE comprises of three sets of elements: (1) economic and physical resources and industrial capabilities; (2) cultural values and institutional norms; and (3) national government's economic and industrial policies. Table 1 provides a summary of these elements along with their attributes and salience (Sethi and Elango, 1999).

Table 1

Attributes and salience of the elements defining country of origin effect

Elements of COE	Components	Attributes	Saliency of the influence
Cultural values and institutional norms	Cultural norms and social values, societal expectations, institutional norms, and corporate governance and control	Passive	Internalized
Economic and physical resources, and industrial capabilities	Country resources comprise: physical resources, legal and political structures, accumulated wealth of skills and knowledge in a society, linkage capabilities, and skill levels of its workforce	Evolving	Sets boundaries for firm strategy
National government's economic and industrial policies	The nature and extent to which a nation's government commits itself to directing that nation's physical resources as well as its sociopolitical infrastructure in pursuit of certain economic goals	Active	When policy is positive, it expands a firm's strategic options; when policy is proscriptive it sets boundaries for firm strategy

Source: Sethi and Elango (1999)

Animosity

It is possible that a product's origin will affect consumers' buying decisions directly and independently of product judgments. History is fraught with illustrations of the

dramatic and damaging effects of hostility between nations. If international tension can lead to armed conflict and atrocities, it seems plausible that animosity toward a current or former enemy also will affect willingness to buy products produced in or by firms from that country (Klein, Ettenson and Morris, 1998). Consumer animosity refers to strong negative emotions toward purchasing products from a disliked nation or group. The majority of consumer animosity studies have examined the attitudes of the members of one nation towards the products of another nation. Klein et al. (1998) introduced the concept of consumer animosity which they conceptually defined as "remnants of antipathy related to previous or ongoing military, political or economic events". Using the Nanjing massacre in 1937 as a historical background for the Chinese's still persisting anger against Japan, they empirically showed that animosity had a negative impact on Chinese consumers' willingness to buy Japanese products. At the same time, however, they showed that the negative feelings did not distort the same consumers' quality evaluations of the concerned products. In other words, consumers harboring feelings of animosity acknowledged the quality of products stemming from the disliked nation, but tended to refuse to buy them. Klein et al. (1998) study was the first to show a direct effect of products' country-of-origin on buying decisions, independent of product judgments. This challenged the conventional wisdom in the country-of-origin literature, according to which "made in" influences on consumers' willingness to buy foreign products were assumed to impact on buying decisions indirectly via product judgments. Importantly, consumer animosity was shown to have independent effects on the willingness to buy from consumer ethnocentrism which describes "the beliefs held by consumers about the appropriateness, indeed morality, of purchasing foreign-made products". Indeed, animosity and ethnocentrism were shown to be distinct constructs, having distinguishable effects on foreign product preferences. Thus, while ethnocentric consumers tend to avoid buying products from any foreign country, consumers possessing feelings of animosity may find it well acceptable to buy products from a variety of foreign countries but refuse to purchase products coming from one specific foreign country which is the target of animosity feelings (Reifler and Diamantopoulos, 2007).

Research Design

Experiment design is used in this study. The independent variables include country of manufacturer, country of brand. The dependent variable is purchase intention while animosity against nation as a moderating variable. The independent variables including country of brand and country of manufacture are conducted by means of between subjects design. Meanwhile, the subject is not informed the purpose of this

study to make sure his or her correct response.

Table 2 Factor Design Table

Country of Manufacturer / Country of Brand	High	Low
USA	(USA, High)	(USA, Low)
South Korea	(South Korea, High)	(South Korea, Low)
Taiwan	(Taiwan, High)	(Taiwan, High)
China	(China, High)	(China, High)

Table 3 Pretest sample evaluation for different country of origin

Country	Mean	Ranking
China	3.17	10
Germany	4.01	5
USA	4.40	1
India	3.86	8
South Korea	4.11	3
Taiwan	3.96	6
Canad	3.92	7
Brazil	3.18	9
Singapore	4.07	4
Japan	4.38	2

If using Liker scale to measure the country of image, the outcome will be as following:

Table 4: The Measurement Outcome of Likert Scale

Country	Mean	Ranking
China	4.14	5
Japan	6.33	2
USA	6.52	1
Taiwan	5.80	3
South Korea	5.71	4

Conclusions

The following hypotheses will be proposed for purchase intention or willingness to buy. The higher the country of origin, including country of brand and country of manufacture, is positively related to the purchase intention. However, the animosity will moderate and influence the relationship between country of origin and purchase

intention.

TAX CLIENTELE EFFECT IN MAINLAND CHINAESE STOCK MARKET

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ABSTRACT

This research explores the ex-dividend day price behavior in China stock market. It collects 330 listed companies quoted on the Shanghai and Shenzhen Stock Exchange, and all of them have distributed cash dividend in 2006, and analyzes how the share price in China stock market reacts to the ex-dividend day event. Different from the tax clientele hypothesis, we could not find enough evidence to support that the entire samples' price on the ex-dividend day drop proportionally to the dividend paid, regardless of dividend yield. However, the price drop is significantly higher than the dividend distributing amount. This suggests that the stock market in China overreacted to the ex-dividend day event.

Key Words: Ex-dividend effect; China stock market, Tax clientele hypothesis.

INTRODUCTION

Most mature public companies pay a cash dividend to shareholders. A dividend actually is a distribution to a company's owners a part of the company's earnings. Dividend distribution causes fluctuation of the stock price of a company. The company's board of directors must authorize (declare) payment of the dividend. When the dividend is declared, the company will announce the record date, which is the date the company will determine who is a shareholder,

and the payment date. Table 1 shows a series of dates related to cash dividend:

If investors buy the stock after the dividend announcement, they will not receive a "free" dividend but actually pay for the impending dividend in the stock price. And, they must hold the stock until at least the ex-date in order to receive the dividend. Otherwise, they pay for the dividend priced into the stock, but do not receive the dividend.

The ex-dividend date is always one or two business days before the record date. In order to get the dividend, you must buy the stock before the ex-dividend date. Before the ex-date, the stock is said to trade "with dividend", because buyers of the stock will receive the dividend. On and after the ex-date, the buyer will not receive the dividend and the stock is said to trade "without dividend".

Because investors purchasing a stock on or after the ex-date do not receive the dividend, no one would pay the same price on or after the ex-date as paid before the ex-date. That is, the market prices the dividend in before the ex-date and prices it out on the ex-date. Put it in another way, when a stock goes ex-dividend, the stock price will be driven downward because the dividend payment reflects a distribution of corporate assets, and thus the stock is simply not worth as much as before.

Although the stock would almost certainly fall on the ex-date, the price drop cannot be determined exactly. In this study, we focus on ex-dividend date behavior of stock prices. Our initial sample is made of 330 listed companies quoted on the Shanghai and Shenzhen Stock Exchange, and all of them distributed cash dividend in 2006.

In the next section, we review the previous studies. Sample selection is described in section 3. Section 4 explains how China tax systems work on stock market. Section 5 presents the methodology. The results and conclusions are presented in section 6 and section 7, respectively.

LITERATURE REVIEW

In a seminal paper, Elton and Gruber (1970) observed that stock prices on the ex-dividend day fall by a smaller amount than the dividend paid. They attributed this difference to the fact that the dividend is taxed. They showed that if taxes enter investors' decisions, then the fall in price on the ex-dividend day should reflect the post-tax value of the dividend relative to the past-tax value of capital gains on that day. Because dividends are taxed more heavily than

capital gains, the theory suggests that if taxes affect investors' choices, the fall in stock price in general be less than the dividend, and the drop could be used to infer marginal tax rates.

Since then, many researchers have explored into this area, either supporting or questioning the related tax explanation of ex-dividend day behavior. Most of the following studies agree with Elton and Gruber's findings. Green and Rydqvist (1999) provide evidence consistent with the tax explanation of ex-dividend day stock price behavior. They study the behavior of prices of Swedish lottery bonds. These bonds have a unique tax treatment; their coupon payments are tax-exempt while their capital gains are taxed.

As the authors point out, because the coupon payments received by bondholders are random, interest is not accrued prior to a coupon payment. Instead, the entire price of the bond paid prior to the coupon distribution constitutes the investor's tax basis, and the price drop associated with coupon distribution is considered as capital loss. Thus, these bonds are taxed as if they were stocks offering a tax-exempt dividend. Consistent with the tax effect, since the coupon distributions are taxed at zero percent while the capital losses generate tax credits, the bond price should fall by more than the coupon distribution when the bond goes ex-distribution.

But there are also many studies challenge Elton and Gruber's point of view. One of the challenges to the tax explanation of ex-dividend day behavior arises from microstructure arguments.

Bali and Hite (1998) state that the drop in price less than the dividend is really due to discreteness in prices rather than taxes. They hypothesize that because of discreteness in prices the ex-dividend day price should fall by amount equal to or smaller than the amount of the dividend and that this has been mistakenly attributed to tax effects.

Frank and Jagannathan (1998) hypothesize that the collection and reinvestment of dividend is bothersome for individual investors but not for market makers, this means that individuals want to sell the stock before it goes ex-dividend and are anxious to buy it back after it goes ex-dividend. They argue that market makers can purchase stock at the bid price before the stock goes ex-dividend and sell at the ask price after it goes ex-dividend. They then state that in absence of taxes this means that the fall in price on the ex-dividend date will be less than the dividend. They argue that this bid-ask bounce contributes to, if not totally explains, a phenomenon other than tax effects.

Besides examining ex-dividend day stock price behavior in US, a wide variety of studies explored this effect in Japan (Kato and Loewenstein, 1995), Canada (Booth and Johnston, 1984; Bauer, Beveridge and Jha, 2008), Israel (Sarig and Tolkowsky, 1997), Hong Kong (Frank and Jagannathan, 1998), Australia (Jun, Alaganar, Partington and Stevenson, 2008), Norway (Dai and Rydqvist, 2009), Finland (Rantapuska, 2008), Spain (Garcia-Blandon and Martinez-Blasco, 2012), and Greece (Dasilas, 2009).

It is well known that China stock market is very special as it is highly affected by the government's macro-control and policy adjustments, and the underground manipulation and speculation in China stock market is also exist and could not be eliminated in the short term. The objective of this paper is to increase the understanding of stock price reactions at the ex-dividend day in such a complicated market environment.

STOCK MARKET AND TAXATION IN MAINLAND CHINA

China stock market is an emerging and transition market experiencing rapid growth. The primary laws and regulations on stock market include "Securities Law", "Company Law", and "Securities Investment Funds Law". There are two stock exchanges in Mainland China. The Shanghai Stock Exchange (SHSE), the largest stock exchange based in Shanghai, was established on November 26 and was in operation on December 19, 1990. Shenzhen Stock Exchange (SZSE) is another stock exchange that was established in December 1, 1990 in Shenzhen Special Economic Zone. The two stock exchanges are non-profit organizations directly administered by the China Securities Regulatory Commission (CSRC). More than 2,222 companies were listed in these two stock exchanges with a total market capitalization of RMB 26094.45 billion (about US$ 4014.5 billion) as of June 2011. There are more listed companies in SZSE than in SHSE. However, SHSE outperforms SZSE in terms of total market capitalization and turnover. The SHSE and SZSE are two of five largest stock exchanges globally in terms of turnover in 2010. The other three are NYSE, NASDAQ and TSE (Tokyo Stock Exchange). Speaking of total market capitalization, China stock market is second only to NYSE. In addition, China stock market led the world in funds raised through initial public offerings (IPOs).

China stock market has its own specific characteristics. Due to tight capital control, listed companies may issue two types of shares, A-share and B-share. Both A-share and B-share are RMB-denominated. However, B-share is traded in US dollars at SHSE and Hong Kong dollars at SZSE. Originally, domestic investors can only trade A-share and foreign

investors are limited to trade B-share. The restriction on share trading was loosened in the early 2000. On 19 February 2001, CSRC allowed domestic investors to trade B-share through the secondary market. In 2002, the Qualified Foreign Institutional Investor (QFII) program was implemented to allow licensed foreign investors to exchange A-share. As of the end of 2010, 98 foreign institutional investors have been approved to be QFII.

Retail investors and speculators have long dominated China stock market. In order to have a better investor structure, Chinese government put a lot of effort to cultivate institutional investors. In 2003, Social Security Fund was allowed to invest in stock market. Securities Investment Funds Law was effective in 2004. As of November 2010, 61 funds companies managed 619 funds with net asset value of RMB 2.2 trillion. In addition, Chinese regulators also contribute to the construction of multimarket structure. SME Board was founded in 2004. ChiNext, a listing platform for innovative, high-tech, and high growth enterprises, was opened in SZSE on October 23, 2009.

China has reformed its tax system several times since 1980. There is no capital gain tax in mainland China. Income from buying and selling financial assets was not taxed. Interest revenue and cash dividend were taxed at 10%.

METHODOLOGY

We examine the impact of sample companies' stock returns in ex-dividend day using market adjusted returns. Elton and Gruber (1970) firstly used the Tax Clientele Model. According to this model, the tax rate of the marginal stockholders of a company should affect the ex-dividend day behavior of the company's common stock. It argues that, if without tax effect, the price drop should be exactly the amount of dividend distributed by the company. However, as there is a tax on dividend, a shareholder who wants to sell his shares in hand, will think about whether to sell the shares before the stock goes ex-dividend or after the shares goes ex-dividend. For the shareholders to be indifferent as to the timing of the sale, the wealth received from either course of action should be the same. According to this premise, the following expression was derived.

Let: R_m = daily market return

P_0 =Stock price on the ex-dividend day

P_{-1} = Stock price on the day before the ex-dividend day

T = Tax rate on dividend

D = Dividend payment amount

Define day '0' as the ex-dividend day for a company, and the day before the ex-dividend day can be defined as day "-1" accordingly. And then the corresponding three days' market indexes (day 0, day -1 and day -2) were recorded to compare with the individual company's stock prices.

The following equation expresses how to calculate the daily market return:

R_m = (Market Index on Day 0 – Market Index on Day -1)/ Market Index on Day -1

The key measurement is the magnitude and sign of the ex-dividend stock price movement in relation to the stock price in the last cum day for these 267 taxable cash dividends. And we also try to find how long the market needs to digest the negative effect of this event.

If the share was kept on the last cum day (day -1), the shareholder's wealth on the ex-dividend day (day 0) from holding one share will be its price on that day (P_0) plus the amount of the after-tax cash dividend (D). To prevent arbitrage, this value should not be different from the share price that a seller has received on the last cum date (P_{-1})

$$P_{-1} = P_0 + D(1 - T)$$
$$P_{-1} = P_0 + D(1 - 10\%) \qquad (1)$$

Subtract P_0 from both sides of this equation and divided by D we get the Raw Price Drop to Dividend Ratio (RPR):

$$\text{RPR} = \frac{p_{-1} - p_0}{D} = 0.9D/D = 0.9 \qquad (2)$$

The Raw Price Drop to Dividend Ratio describes the price change from the last cum day to the ex-dividend day in terms of dividend paid; it always reflects the relative marginal tax rates of the stockholders of the firm's common stock. According to Elton and Gruber (1970), one should therefore be able to infer these tax rates by observing the raw price drop to dividend ratio of the common stock.

The left hand side of equation (2) shows how we should calculate the observed value of

the raw price drop to dividend ratio. Accordingly, the right side of equation (2) gives the theoretical (predicted) value of raw price drop to dividend ratio, after tax adjustment, of each stock. As the equation shows, because the tax rate is fixed and stable, so the raw price drop to dividend ratio should also be fixed and stable at a level of 0.9.

The RPR is also subject to market fluctuation between the two days. If it is a bull market, then the signal stock price may also perform better than the shareholders expect, as the investors might get confidence from the positive economic environment. The Market Adjusted Price Ratio (MAPR) could be developed by discounting the price on the ex-dividend day by daily market return:

$$\text{MAPR} = \frac{(p_{-1} - p_0)/(1 + R_m)}{D} \qquad (3)$$

The right hand side of equation (3) shows how to calculate the observed value of market adjusted price ratio. The theoretical value of MAPR should be approximately equal to the right hand side of equation (2). In other words, the theoretical value of MAPR should be approximately at a level of 0.9.

The price difference between day 0 and day -1 can also be expressed in terms of price. We use the stock price on the day before the ex-dividend day P_{-1} as the denominator instead of dividend D. We define Raw Price Drop Return (RPD) as follows:

$$\text{RPD} = \frac{p_{-1} - p_0}{p_{-1}} = \frac{D(1-t)}{p_{-1}}$$

$$\text{RPD} = \frac{p_{-1} - p_0}{p_{-1}} = 0.9\frac{D}{p_{-1}} \qquad (4)$$

The left hand side of equation (4) shows how to calculate the observed value of the raw price drop return. Accordingly, the right side of equation (4) gives the theoretical (predicted) value of raw price drop return, after tax adjustment, of each stock.

Similar to the market adjusted price ratio, the RPD is also subject to market influence between the two days. Market adjusted price drop return (MAPD) can also be calculated according to equation (4) and discounting the price on the ex-dividend day by daily market return in the same way as in equation (3):

$$\text{MAPD} = \frac{(p_{-1} - p_0)/(1 + R_m)}{p_{-1}} \qquad (5)$$

Since there is no single stable and fixed theoretical value against which to test the mean of RPD and MAPD, we calculate the right hand side of equation (4) and use them as reasonable approximation values in our test.

In summary, we test the following null hypotheses for those taxable cash dividend observations:

H_{1a}: the mean of RPR = the mean of the right hand side of equation (2)
H_{1b}: the mean of MAPR = the mean of the right hand side of equation (2)
H_{2a}: the mean of RPD = the mean of the right hand side of equation (4)
H_{2b}: the mean of MAPD = the mean of the right hand side of equation (4)

DATA

A sample of 330 public companies is constructed. 210 companies are chosen from the constituents of Shanghai and Shenzhen 300 Index which have dividend announcement in 2006. The other 120 companies are selected randomly from both Shanghai and Shenzhen stock market. The sample covers a variety of industries, such as financial services, energy, chemicals, textiles, infrastructure, transportation, real estate, power, machinery, high-tech, communication, retail, apparel, and tourism.

Three different types of index are used as comparative indicator in this research. One is Shanghai Composite Index and another is Shenzhen Component Index. These two indexes are most commonly used to measure performance of individual stock market. The daily stock return observations of each company in the sample will be compared with the corresponding index regarding to the stock exchange it listed. If a company is listed in Shanghai Stock Exchange (SHSE), then its daily stock return will be compared with the Shanghai Composite Index. Otherwise, it will be compared with Shenzhen Component Index.

Shanghai Composite Index is an index of all listed stocks, including A shares and B shares, at Shanghai Stock Exchange. The stock prices of individual companies are weighed averaged by their market capitalization (calculated as the total number of outstanding shares multiplied by the market price per share). The index was launched on July 15, 1991. Its base period is December 19, 1990 and the base value is 100.

The Shenzhen Component Index is an index of 40 representative stocks that are traded at the Shenzhen Stock Exchange (SZSE). It was launched on May 5, 1995 and is a commonly used indicator to reflect SZSE's market performance. Its base period is July 20, 1994 and its base value is 1000.

Shanghai and Shenzhen 300 Index can be considered as a barometer of the whole China stock market. It is published in April 8, 2005. As we mentioned before, the Shenzhen Component Index and Shanghai Composite Index only represent the two markets separately, none of them could represent the performance of the stock market of whole China. On the contrary, 179 A-shares listed in SHSE and 121 A-shares listed in SZSE are selected to be included in the index, which covered about 60% of the market capitalization in China. The constituents of the index are comprehensively representative, highly liquid, and actively traded stocks.

In China, there are three general types of dividend, cash dividend, stock dividend and a combination of the two. The dividend types of 330 companies in the sample in 2006 are as follows:

Table 1

Dividend types	No. of companies
Cash dividend	281
Stock dividend	16
A combination of cash dividend and stock dividend	33
Total	330

We only test the samples with cash dividend in 2006. Then, the sample was further filtered, excluding some stocks experiencing significant unusual price changes. Finally, 267 stocks have been retained.

More than 60% of the companies in the sample are constituent stocks of Shanghai and Shenzhen 300 index. Constituent companies are the top companies in different industries.

RESULTS

The differences between the means of Raw Price Drop to Dividend Ratio, Market Adjusted Price Ratio, Raw Price Drop Return and Market Adjusted Price Drop Return and their corresponding theoretical values are tested using the paired t-test. The results are illustrated in

Table 2.

Table 2

Observations=267			
Variables	Mean	Median	Std. Dev.
Dividend (D)	0.1642	0.1200	0.1362
Dividend Yield ($d = D/P_{-1}$)	0.0232	0.0178	0.0179
Price Drop = $P_{-1}-P_0$	0.3560	0.0900	1.449103
Raw Price Drop to Dividend Ratio ($RPR) = (P_{-1}-P_0)/D$	2.4806	0.7273	14.1250
Market Adjusted Price Ratio (MAPR)	2.8829	1.1080	16.8747
Raw Price Drop Return (RPD) = $((P_{-1}-P_0)/ P_{-1}$	0.0307	0.0155	0.0771
Market Adjusted Price Drop Return (MAPD)	0.0336	0.0224	0.0824

As shown in Table 2, the mean dividend is 0.1642, the median of the dividend is 0.12, and the corresponding price drop ($P_{-1}-P_0$) is 0.356, indicating that the price drop is much greater than the dividend distributed. The mean raw price drop to dividend ratio is 2.4806 and the mean market adjusted price ratio is 2.88. The mean raw price drop return is 0.0307 and the mean market adjusted price drop return is 0.0336, both are higher than the mean dividend yield (0.0232). It seems that the market might overreact to the event of ex-dividend day.

Table 3

Mean	Theoretical value	Observed Values	p-value
Raw Price Drop to Dividend Ratio (RPR)	0.9	2.4806	0.068605
Market Adjusted Price Ratio (MAPR)	0.9	2.8829	0.055915
Raw Price Drop Return (RPD)	0.0208	0.0307	0.032284
Market Adjusted Price Drop Return (MAPD)	0.0208	0.0336	0.009602
Dividend Yield ($d = D/P_{-1}$)		0.0232	

As shown in Table 3, the mean raw price drop to dividend ratio is 2.4806, the corresponding p-value is 0.069, suggesting that the difference between the mean and corresponding theoretical value of 0.9 is not statistically significant at 0.05 level. The test for market adjusted price ratio also got the similar result; the observed mean market adjusted price ratio is 2.8829, while the theoretical value is 0.9. The p-value of 0.056 indicates that the difference between the mean market adjusted price ratio and the corresponding theoretical

value is not statistically significant at 0.05 level.

Furthermore, the mean raw price drop return is 0.0307 with a p-value of 0.032; suggesting that the difference between the mean raw price drop return and the corresponding theoretical value of 0.0208 is statistically significant at 0.05 level. The mean market adjusted price drop return is 0.0336 with a p-value of 0.0096, while the theoretical mean value of market adjusted price drop return is 0.0208. The difference between observed mean and theoretical mean market adjusted price drop return are statistically significantly different from each other at the 0.01 level. These results suggest that the percentage stock price change (return) is more than the corresponding dividend yield (0.0232).

Based on the paired t-test of related mean values, it suggests that the hypotheses H_{2a} and H_{2b} can be rejected, and there is no evidence to reject H_{1a} and H_{1b}.

CONCLUDING REMARKS

This paper analyses the ex-dividend day effect on stock price in Chinese stock market. Different from the tax clientele hypothesis, we could not find enough evidence to support that the entire samples' price on the ex-dividend day drop proportionally to the dividend paid, regardless of dividend yield. However, the price drop is significantly higher than the dividend distributing amount. This suggests that the stock market in China overreacted to the ex-dividend day event.

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Innovative Supply Chain Technologies for Management Decisions

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ABSTRACT
In this paper we seek to identify how to accelerate innovation in order to promptly respond to the market demand as well as how to map web generation to the Supply Chain Management (SCM) technologies. Our investigation reveals the important alignment of e-business with the SCM perspective, and the advantages that cloud computing can provide over a traditional, enterprise resource planning (ERP) systems. Furthermore, the authors link the emerging SC solutions with the continued developments in recent web generations. Finally, the paper draws conclusions about the advent of new technologies in favour of the SCM.

Keywords: Supply chain management, innovative technologies, management decisions

1. INTRODUCTION

Supply chain innovation and management need interdisciplinary methodologies from multiple fields including SCM, information systems, knowledge management, etc. Given the dynamism in SCM and emerging business trends and technology, it would be interesting to explore how IT has made an impact on SCM. The exponential growth in IT is creating solutions for every function of SCM and has made real time decision making possible.

Today SCM requires effective use of an integrated enterprise resource planning (ERP) system. Usage of any ERP system is shaped by many design factors that make it easier (or harder) to learn and use. For example, consistency in the user interface make an ERP system easier to learn and use. System functionality and e-commerce integration also shape usage in different manufacturing and distribution environments.

The reminder of this paper is organized as follows: In Section 2 we discuss the importance of innovation acceleration in order to promptly respond to the market demand. In Section 3 our investigation reveals the necessary alignment of e-business with the SCM perspective, how to map the web generation with the SCM technologies, and the advantages that cloud computing can provide over the traditional ERP systems. Subsequently, in Section 4 the authors make an overview of the emerging SC solutions and link them with the continued development in recent web generations. Finally, in Section 5 the article draws conclusions about the advent of new technologies for the SCM.

2. ACCELERATE INNOVATION AND RESPONSE TO MARKET DEMANDS. SCM SYSTEMS

A fine-tuned SCM system delivers better communication, shorter planning times and more reliable forecasting. The amalgamation of all of these benefits is a balance between keeping costs reasonable and maintaining production levels. This is definitely worth the effort and delivers value to businesses.

2.1 SCM software

Planning systems oriented toward decision making are provided by SCM software. To illustrate, we consider how ERP and SCM approach an order-processing problem. There is a fundamental difference: The question in SCM becomes "Should I take your order?" instead of the ERP approach of "How can I best take or fulfill your order?" The following example demonstrates how SCM software works.

Example - IBM links its global SC with SCM software - IBM reengineered its global SC in order to achieve quick responsiveness to customers and to do so with minimal inventory. To support this effort, IBM developed a SC analysis tool called Asset Management Tool (AMT). AMT integrates analytical performance optimization, simulation, activity-based costing, graphical process modeling and enterprise database connectivity into a system that allows quantitative analysis of extended SCs. IBM has used AMT to study such issues as inventory budgets, customer-service targets, and new-product introductions. The system was implemented at a number of IBM business units and their SC partners. AMT benefits include savings of over $750 million in material costs and reductions in administrative expenses each year (Lin et al., 2000). However, SCM solutions need to be coordinated, and they sometimes require information provided by ERP software. Therefore, it makes sense to integrate ERP and SCM.

Integrating ERP and SCM - One approach for ERP-SCM integration is to work with different software products from different vendors. For example, a company might use SAP R/3 as an ERP and add to it Manugistics' manufacturing-oriented SCM software. Such an approach, which is known as the "best of breed" approach, requires fitting different software from different vendors, which may be a complex task unless special interfaces exist (Getting, 2007). The second approach is for the ERP vendors to add SCM functionalities, such as decision support and business intelligence capabilities. Business intelligence refers to analysis performed by DSS, EIS, data mining, and intelligent systems. These added capabilities solve the integration problem. But as is the case with integration of database management systems and spreadsheets in Excel, the result can be a product with some not-so-strong functionalities. However, most ERP vendors are adding such functionalities for another reason: it is cheaper for the customers. Packages with these added functionalities represent the second-generation ERP, which includes not only decision support but also customer relationship management (CRM), e-commerce, and data warehousing and mining. Some second-generation systems include a knowledge management component as well. The inclusion of business intelligence (BI) in SC software solutions is referred to as SC intelligence (SCI). SCI applications enable strategic decision making by analyzing data along the entire SC.

SCM software can have tremendous financial benefits for companies. Some businesses have saved millions just by automating their SC, but those savings gain often do not come easily. When it comes to implementation, SCM software is one of the most difficult systems to effectively put in place. However, there are ways to prevent SCM implementation problems. Another problem

companies discover with SCM is that the software is rarely 100% compatible with their existing ERP systems. In many cases, the ERP will need to be modified in order to accommodate the new SCM system (Grant et al., 2000). These are steps that companies need to be prepared for in advance so that, they can be dealt with promptly.

SCM cannot be adopted lightly. It requires careful planning and preparation. Companies must make sure that their employees, their suppliers and their existing technology is ready if they want to see a successful implementation. No manufacturer needs to put up with wasteful MRO (maintenance, repair, operations) spending. A few changes in procurement strategy can cut costs and improve profit margins significantly. Therefore, the first part of making an effective SC is understanding the different links involved. The first of these links, software, is often the one most frequently ignored by businesses since it all begins with a great deal of careful planning. Because SCs are complex and are important to the overall success of company's operations, businesses must make sure that they know what resources are involved in and know how to measure their system's effectiveness once it is in place. Part of the planning also involves selecting the individuals who will be in charge of setting up, implementing, and overseeing the SC system once it is ready.

After the planning stage, companies must choose the vendors and suppliers they want to work with on a continuing basis. These decisions cannot be taken lightly because these businesses serve an important role in the chain. Once these vendors are selected, the next step is the actual manufacturing of the goods. SCs come into play here as well, because they help monitor the quality of the goods and overall productivity. Next, the finished materials must be delivered. Within the logistics link of the SC, warehouses are networked, transportation is coordinated and invoices are created. Finally, businesses must ensure that their SC also includes a method for taking back goods that do not meet the expectations of buyers or that are defective. Without this step, customers may be unsatisfied and the overall SC simply isn't complete. While all of these different elements may make it seem that SCs are too complex to ever be effective, the reality is that managing them can be made easier with the right tools. Different software is available to help with each link of the SC, such as tracking inventory or managing logistics. This software not only makes it easier for businesses to put all of the pieces together and to keep the SC connected, it can also minimize problems because it reduces the risks of human error. Additionally, the software helps businesses communicate with their vendors and suppliers around the world more easily and more quickly. As well, with the right amount of training, employees will find that the SCM software simplifies their jobs. For all these reasons, more companies than ever have begun to adopt SCM software to help them manage the links in their SCs.

Several software companies offer a number of software modules that can assist businesses with their specific SCM needs. Each module is designed to help with one particular link in the chain, such as warehouse management or SC event monitoring. While all of the modules are available individually, they can also be combined in many ways to help a company run their SC more efficiently. In addition, all of the modules can even be grouped together into one single, SCM program in order to automate and streamline the entire production process.

Solutions, such as those offered by Epiq, can dramatically improve the way businesses handle procurement, production, distribution and even some aspects of customer service. Since in SC software most of the parts are designed to work together, businesses don't have to worry about overlapping features or about software conflicts, which can sometimes hamper SCs which are managed by a number of separate software applications. In the end, companies who want to

improve their SCs should start by adopting software that makes it easier for them to manage all of the elements conveniently and effectively.

Since the late 1990's SC software has been available to companies, but until recently most firms steered clear because of the costs of implementation and the past disappointments in deploying other, so-called revolutionary technological advances. When the economy started to take a downturn, however, many organizations recognized the need to do something drastic to turn the tide in their favor or at least to minimize the negative impact the economic changes brought about. SC software was one of the answers many companies chose.

The majority of all large businesses are currently using SC software and most of them are seeing positive results. One company was able to cut several million off its inventory expenses while another has been able to extract over $15 million in value from its SC software implementation. SC software can deliver these results, because it allows companies to streamline communication between the company and its vendors. For example, SC software allows vendors to be automatically notified when the company's inventory of a specific product needs to be replenished. The vendor can prepare the order, get it filled, and send it to the company in considerably less time than it would take the old-fashioned way. With this approach, the business no longer has to keep a large inventory on hand, because it can be refilled on as needed basis.

Another cost saving feature of the SC software is that it lowers the time required between purchase and delivery. The software allows vendors and businesses to deliver quotes in real-time and to acknowledge order receipts instantly instead of in the 1-2 days it would normally take. Placing orders, making transportation arrangements, and dealing with returned merchandise can all be done faster and with fewer hassles thanks to modern SC software.

Additionally, many organizations are recognizing that SC software can be an asset to their customer service. Because SC software allows companies to check in real-time the status of their orders, their inventory and their deliveries, they can give exact and up-to-date information to customers who inquire about the status of their orders. This more exact system is a vast improvement from the mostly guesswork companies used to have to do in order to answer customer questions.

SC software can also be an asset in the logistics field. Not only can the software help coordinate transportation for goods and finished products, but it can also help manage warehouse inventory and distribution centers. This benefit can not only save the businesses and the vendor’s money on shipping, but can also shave the time off of delivery.

To take advantage of those and the other benefits of SC software, companies must be willing to foot the costly bill that goes with implementing the technology. The combined costs of the software, hardware, consultations and training for some companies could cost millions to put in place. Even though that amount of expenditure may seem high when the economy is in uncertain waters, companies who have completed the implementation successfully are generally pleased with the effects it has had on their bottom lines.

Essentially, SC software works because it tightens the connections between the business and the vendors. This relationship is one of the most important a company can foster, because both parties are interdependent. When the company begins to suffer, the vendor can expect a loss of business and revenue, as well. Likewise, when the company is running smoothly and doing well, the vendor will benefit from more orders and more profit.

Despite the high price tag of implementation, SC software has the potential to bring numerous cost-saving benefits to almost any large company. These benefits will definitely outweigh the initial expense in the long run.

2.2 Electronic Procurement (e-Procurement)

The main components of e-procurement include e-tendering, e-auctioning, vendor management, catalogue management, purchase order integration, order status, ship notice, e-invoicing, e-payment and contract management. Based on the number of components involved, it is clear that a very efficient information system should be in place for this level of integration.

e-Procurement is a way of using the Internet to make it easier, faster and less expensive for businesses to purchase the goods and services they require. While e-procurement is a general term that covers a wide assortment of techniques, such as reverse auctions, its overall goal is to streamline the purchasing process so businesses can focus more management time on earning revenue and serving customers. Implementing an e-procurement system offers a company many benefits.

e-Procurement is more than just a system for making purchases online. A properly implemented system can connect companies and their business processes directly with suppliers while managing all interactions between them. A good e-procurement system helps a firm organize its interactions with its most crucial suppliers. It provides those who use it with a set of built-in monitoring tools to help control costs and assure maximum supplier performance. It provides an organized way to keep an open line of communication with potential suppliers during a business process. The system allows managers to confirm pricing, and leverage previous agreements to assure each new price quote is more competitive than the last.

With electronic procurement all purchases are easier to track because they are done over the Internet and the company's managers can easily see who made which purchases without having to wait to receive a monthly revolving credit statement. Also, e-procurement saves time. Buyers do not need to leave their desks or make phone calls to suppliers in order to place orders, they simply go through the Internet. As well, because suppliers receive the order almost immediately, they can also fulfill and ship it much faster than with the traditional procurement methods.

Although the benefits of e-procurement are plentiful, there are obstacles that can arise in implementing this type of process. The biggest pitfall is treating all areas of procurement and all products the same. The reality is that what may work for one good or service may simply not work for all of them, so successful e-procurement systems use a number of different techniques. The best way to illustrate this point is through a comparison of products. One product is what is called an urgent item. These items are those which are supplied by only a few companies or individuals, but which are in high demand. Most companies stock up on urgent items if possible so that they do not run out and find themselves in a difficult situation. Another product might be classified as a noncritical item, such as printer paper or coffee filters. These type of items are not extremely important to the business but they are needed. Generally, this category of items accounts for 80% of all company purchases (ABC inventory analysis or classification). While both products are needed by the company, they would require different procurement techniques or else the buyer would end up paying more. With an urgent item that is in high demand, for instance, a buyer would never want to hold a reverse auction because the seller would be able to drive up the price since

they, not the buyer, have all the power in that relationship. Reverse auctions work quite well, on the other hand, for noncritical items and can lower costs for these items by as much as 35%.

Large companies such as Dell conduct auctions of products or obsolete equipment on their web sites. Electronic auctions can shorten the cycle time in the SC and save on logistics and administrative expenses.

e-Commerce (EC) can introduce structural changes in the SC. For example, the creation of electronic markets drastically changes order processing and fulfillment. In many cases, linear SCs are changed to hubs. An eHub is a web-enabled platform for multiple trading parties to find, exchange and prioritize information related to buying and selling. Also, it automates all the different transactions that need to occur in customer fulfillment, both inbound and outbound. The eHub is more than a static central repository for storing SC data. It is a dynamic environment that identifies and prioritizes the actions that need to occur in the SC at any given time. It then pushes relevant information to the appropriate trading partners so, they can react to it and make the best decision possible. It does this according to configurable workflows that automate some of the more-manual decision making that occurs in any well-defined business process.

Integration of ERP with e-Commerce - Since many middle-sized and large companies already have an ERP system, and since e-commerce needs to interface with ERP, it makes sense to integrate the two. For example, SAP started building some EC interfaces in 1997 and in 1999 introduced mySAP.com as a major initiative. The mySAP initiative is a multifaceted Internet product that includes EC, online trading sites, an information portal, application hosting and user-friendly graphical interfaces.

The logic behind integrating EC and ERP is that by extending the existing ERP system to support e-commerce, organizations not only leverage their investment in the ERP solution, but also speed up the development of EC applications. The problem with this approach is that the ERP software is very complex and inflexible (difficult to change), so it is difficult to achieve easy, smooth and effective integration. One other potential problem is that ERP systems tend to focus on back-office (administrative) applications, whereas EC focuses on front-office applications such as sales and order taking, customer service and other CRM activities. Ideally, one should attempt to achieve tight integration along the entire SC.

Information technologies (IT) - The Center for Advanced Purchasing Studies reports that on average, across all U.S. industry categories, companies currently purchase about 9% of their total requirements through EDI arrangements with suppliers and about 4.5% through business-to business (B2B) e-commerce sites on the web (Center for Advanced Purchasing Studies, 2002). However, these numbers are expected to grow dramatically in the next decade. The more common B2B examples and best practice models are IBM, Hewlett Packard (HP), Cisco and Dell. For instance, Cisco receives over 90% of its product orders over the Internet.

ITs are extremely useful in supporting global SCs. For example, TradeNet in Singapore connects sellers, buyers and government agencies via electronic data interchange (EDI). A similar network, TradeLink, operates in Hong Kong, using both EDI and EDI/Internet to connect thousands of trading partners. There are also difficult issues in global SCs such as: legal issues, customs fees and taxes, language and cultural differences, fast changes in currency exchange rates and political instabilities.

e-Procurement models are still evolving and there are several categories of sites currently doing business on the web. These can generally be classified under the following categories:

- Supplier-hosted web sites (essentially web-based catalogs & ordering)
- Supply-side trade exchanges
- Buyer-side trade exchanges
- Electronic auction sites

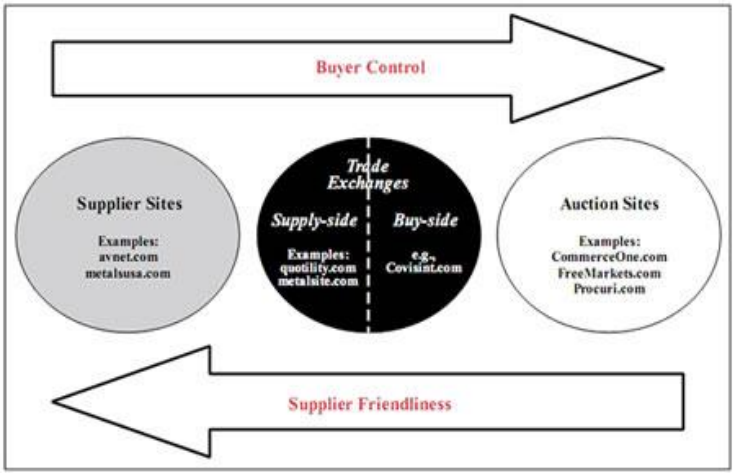

Figure 1 - B2B e-procurement web site types (Boston Consulting Group, 2002)

These various categories of e-procurement sites provide varying degrees of buyer control balanced against what might be called supplier friendliness. Figure 1 illustrates this spectrum.

It remains to be seen which models or combination of models will ultimately prevail in the marketplace, but what is clear is that companies are under increasing pressure to realize the potential cost savings inherent in these e-procurement tools. In a study by the Boston Consulting Group, it was estimated that, on average, manufacturing companies could expect to save 12-15% of total cost on materials that were migrated from traditional procurement methods to e-procurement (Boston Consulting Group, 2002). Such potential savings will place procurement organizations under increasing pressure to expand e-procurement.

2.3 e-Procurement software

Purchasing the goods and services that a company needs can be challenging. However, one technique can help simplify the process in many instances. This technique, called the reverse auction, allows buyers to initiate the proceedings and to choose from interested suppliers not just on the basis of price, but on whatever specifications they feel are most important to their needs. So, reverse auctions are a buyer-initiated quotation process, where purchasers post an RFQ (request for quotation) for a product, while suppliers electronically bid against each other in a progressive way and compete in an online bidding event to achieve a sale for the requested product. They are based on game theory, with dynamic price applications used to streamline the RFP (request for proposal) process (Mahdavi, 2011).

The benefits of a reverse auction is best illustrated with an example. If a business needs to have flyer printed, it could send out RFPs to many potential printers. Unaware of what their competitors are providing or charging, each printer takes the time to prepare the offer and to submit it for

consideration. Then, the decision-maker for the buying business must review those detailed proposals to choose a supplier. On the other hand, the business could hold a reverse auction. With this method, the business simply alerts potential suppliers that the auction is underway and those interested suppliers bid on the project. Because the suppliers are able to determine what other individuals are charging and offering, they can compete by lowering their price, speeding up delivery times or providing unique extras. The buyer can then choose from among the bidders, but he is not obligated to choose the lowest bid. Instead, he can pick the supplier who has the best reputation or with whom he has the best relationship. He can also use the existing bids to negotiate with suppliers who bid higher.

There are a number of benefits related to reverse auctions. For one, the entire time for procurement cycle is significantly reduced. All stages of the process from the listing of the auction, to the placing of bids, to the reviewing of supplier qualifications is faster than with the traditional RFP method. Besides, the buyer has the opportunity to pre-screen suppliers. Instead of requesting the RFP, then going through the qualifications, the buyer can look over those qualifications before giving serious consideration to the supplier's bid. As a result of using a reverse auction, buyers can end up reducing their purchasing costs by as much as 35%. It gives suppliers an opportunity to truly compete with one another through price, quality and service. Reverse auctions also save time for both buyers and sellers. Buyers no longer have to spend time reviewing numerous RFPs before making a purchasing decision and sellers don't have to go through the time-consuming process of preparing RFPs for buyers.

Epiq (www.epiq.com) can assist most companies in running more effective reverse auctions by providing them with software that simplifies the process. For example, Epiq's e-procurement software supports numerous types of auctions, including private, vickrey, Dutch and hybrid varieties. The software also provides auction templates, specifiable parameters, customizable emails for particular events, buildable lists of qualified suppliers and many features that assist suppliers in bidding more efficiently such as outbid notifications, upcoming auction previews and registration areas. Beyond these features, Epiq's software also provides numerous reporting benefits. Users can review the bid history for specific auctions or suppliers as well as RFQ reports and winning bid comparisons. All of these features make it easier for businesses to create an auction, notify potential suppliers, manage and review bids, manually select a winner and compare statistics related to the process.

For companies interested in streamlining the procurement process and in cutting their purchasing costs, reverse auctions are an excellent idea to consider. While they won't work in every purchasing situation, they can assist businesses in purchasing writing services, business materials, outsourcing assistance, computer-related services and more. Receiving these benefits is easier for businesses when they use such software to help them plan, run and review their reverse auctions.

2.4 e-Sourcing

Saving money is always at the forefront of every business decision, but when it comes to purchasing and sourcing, there are a number of ways to cut costs that are often neglected or which do not use to their full advantage. Companies who fail to see these possibilities could be standing in the way of significant savings that would dramatically improve their bottom line.

In order to identify potential savings opportunities in this area, companies need to take a straight look at their current operations to determine areas that need improvement. Rejected parts or

excessive downtime are two of the most common problems for many companies and both of these areas can significantly add to the cost of operations. To solve the problem, companies should call in their suppliers, provide them with the necessary information and ask them to come up with suggestions. These suggestions will usually come in the form of value-added services from the suppliers. These extra services can then become the backbone of the supplier selection process. Many companies make the mistake of choosing vendors strictly on the basis of the quoted price however, the lowest stated cost does not always spell the best deal for the business. Instead of focusing strictly on price, buyers need to evaluate suppliers additionally on their willingness to provide these value-added services.

Most companies do not currently use the TCO model for judging vendor performance and instead base their decisions solely on quoted costs. These companies generally find out in the long run that a low price does not always equal adequate performance.

While all of these cost saving measures may sound good on paper, many companies may find suppliers reluctant to cooperate. One reason suppliers are often hesitant to get involved in these value-added ideas is that to achieve their objectives they require cooperation from within the company itself. If a vendor is asked to make a process within the plant more efficient but workers within the plant are interfering with their ability to make that happen, then this reflects badly on the vendor who does not live up to his or her end of the bargain. Companies need to reassure suppliers that they will have total cooperation from all levels of management and staff to accomplish their tasks. The individuals in charge of purchasing should also maintain an open line of communication with the suppliers throughout the process so that, they can be alerted immediately if conflicts do arise.

Companies often overlook the value-added services that many vendors offer simply, because their savings are harder to quantify. By using the TCO model and getting suppliers more actively involved in the creative process, however, companies can see definite improvements in their bottom line.

2.5 Electronic Marketplaces (e-Marketplaces)

Laseter et al. (2001) define an e-marketplace as a ―forum that leverages the Internet to facilitate commerce among businesses including a wide range of entities — from independent or pure-play dotcoms financed by venture capital, to industry consortia backed by pooled funds, to private networks created by individual companies.

An e-marketplace is a location on the Internet where companies can obtain or disseminate information, engage in transactions, or work together in some way. Most of the e-marketplaces provide two bases functions: 1) they allow companies to obtain new suppliers or buyers for company products, or 2) developing streamlined trading networks that make negotiating, settlement and delivery more efficient. Currently e-marketplaces exist in many different industries. E-marketplaces can be structured in several different ways. One way to structure a marketplace is similar to eBay, where the market-maker is neither a buyer nor seller, but is a neutral third party. Other e-marketplaces are set up to be a consortium of sellers that leverage their combined power to efficiently sell their products to buyers. Buyers can also set up a marketplace to reduce their costs and obtain better purchasing terms.

In order for a site to fall into the category of an e-marketplace, the site needs to be open to multiple buyers and sellers and needs to provide one or more commerce related functions. These

functions include: forward or reverse auctions, vendor catalogues, fixed price ordering, trading exchange functionality, bulletin boards/ wanted ads, and RFQ, RFI (request for information) or RFP capability. Successful e-marketplaces can deliver significant value to their users or members.

The Internet enables processes between organizations to be improved by more closely bringing together the four key SC elements - suppliers, manufacturers, customers and consumers -in the following equation: connectivity = collaboration = visibility = speed (1)

With the Internet come new associated technologies and managerial policies that shift the frontier outward. An outward shift represents either a decrease in cost for a given level of performance along a customer need or a higher level of performance at a given cost. The shift in the efficient frontier on adding the Internet to available channels will vary by industry (Chopra et al., 2000). In some instances, the Internet may shift the frontier by significantly decreasing the cost for existing levels of performance (see Fig. 2).

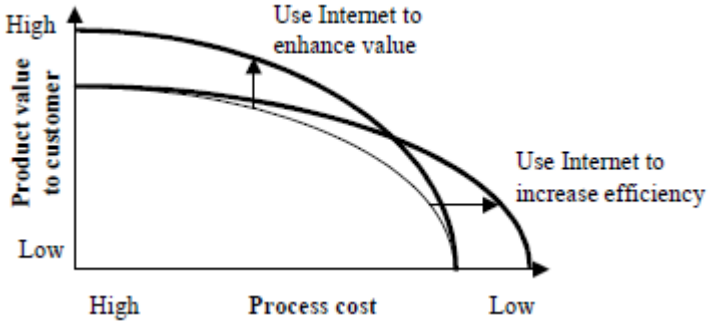

Figure 2 - The Impact of the Internet on the efficient frontier (Chopra et al., 2000)

For example, at industrial supplier W.W.Grainger, e-business does not change any of the underlying processes, but makes them cheaper to execute. This would mean that the main advantage from e-business would be to increase efficiency by automating previous activities (i.e., substituting labor for capital). Sometimes, e-business may shift the frontier out along both dimensions simultaneously, as is the case for Dell Computers that is able to deliver both higher customer value in terms of customization and responsiveness, and lower process cost.

We are interested in characterizing the conditions under which e-business is most likely to increase cost efficiency or to enhance value in terms of some non-price factors like responsiveness, variety or quality (see Fig. 2). Firms can use such a characterization to decide how e-business can best be positioned to support the strategic position (Chopra et al., 2000).

3. MAPPING WEB GENERATIONS WITH SCM TECHNOLOGIES

With the advent of cloud computing, older, standalone ERP solutions may not be the right decision. Nowadays, the practice needs a multi-party cloud computing model which is one very similar to a retail network.

Cloud ERP is a hosted service delivered over the Internet. One example is Plex manufacturing ERP software — reside in the cloud. The cloud provides the computing power to run the ERP solution which is available to users ‘on demand’ via subscription pricing. For the Plex manufacturing ERP software users need only an Internet connection for secure access. Custom

feature requests are folded into the base application. The Plex manufacturing Cloud ERP solutions are always up to date. Typically, new features are enabled when configured (www.plex.com/, accessed 6/10/2014).

Since ERP solutions are single entity solutions, these products are not really addressing all problems. When one looks at business processes, especially those in operations such as SCM, they are all multi-party. Logistics, distribution, etc. all require many parties to work together to optimize the process. Companies need to rethink their strategy to move themselves into the 21st century (See Fig.3).

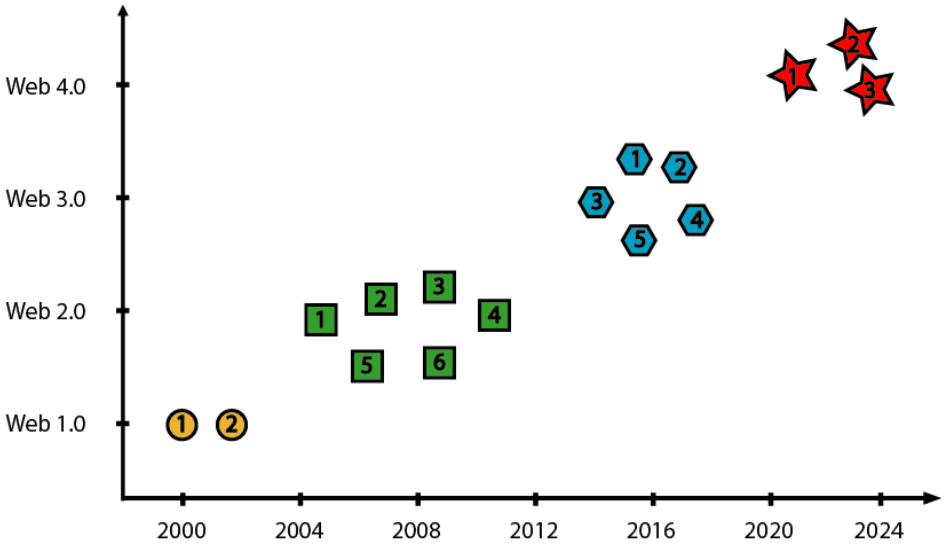

Figure 3 - Mapping web generations to SCM technologies (Shaikh, 2014)

Table 1 - Selected examples of SCM solutions (Shaikh, 2014)

Web 1.0	Web 2.0	Web 3.0	Web 4.0
1 EDI	1 User Centered Design	1 Web of Data	1 WebOS
2 E-Commerce	2 Crowd Sourcing	2 Global Database	2 Mind Contolled Interface
	3 C-Commerce	3 User Engagement	3 Intelligent Web
	4 SaaS & Cloud Computing	4 Unicode	
	5 Web Platform	5 Uniform Resource Identifier(URI)	
	6 Dynamic Content	6 EDI	

Technology solutions to SCM evolve with the evolution of the technology itself. With each web generation development came newer technology solutions to SCM challenges. Fig. 3 shows the adoption of evolutionary web technologies to move SCM from an enterprise platform to a mobile platform with location based secure solutions and anticipated selected examples. Some of the selected examples of SCM solutions are listed in Table 1 and mapped in Fig. 3.

Web as a Platform - The first concept of Web was introduced by Tim Burners-Lee in 1989 and in the due period of time researchers talked about Web 2.0 which is believed as the current era. He also talked about Web 3.0 and even Web 4.0 which do not exist but there are currently speculations based on the trends of web technologies and the business needs of large global organizations who need efficiency in their SCs. The era of Web 2.0 brought technologies like user centered design, crowd sourcing, using web as a platform, collaboration, power decentralization, dynamic content, software as a service (SaaS) and rich user experience. Aghaei et al. (2012) presented an overview of the evolution of four web generations and compared their characteristics. They predict that artificial intelligence (AI) techniques will be embedded in all aspects of web applications and will allow intelligent interactions.

Compatibility of platforms and different applications had been one of the main challenges in terms of collaboration in SCM. Web 2.0 resolved this compatibility issue by allowing users to use the web as a platform and eliminated the requirement to download any application (Ooi et al., 2011). Figure 4 summarizes the web generations and their characteristics as given by Getting (2007).

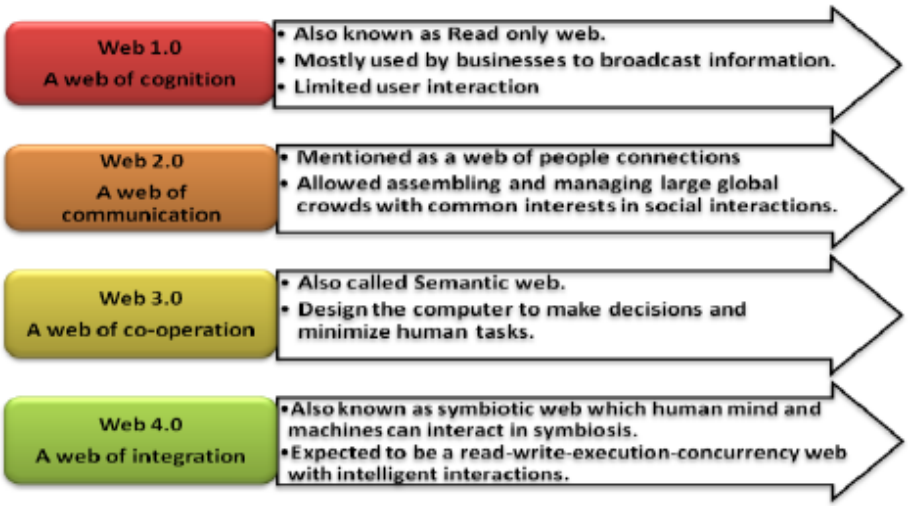

Figure 4 - Web generations and their characteristics (Shaikh, 2014)

B2B and e-commerce may also allow application to use web as a platform but Web2.0 uses AJAX (Asynchronous Java Script) and XML (Extended Markup Language) due to which only little information will pass between the server once the page is loaded and the web site will be loaded in real time dynamically (Anderson, 2007).

SaaS and Cloud Computing - SaaS is a business delivery model for many business applications such as MIS (Management Information System), CRM, DBMS, ERP, HRM, CAD etc. The SaaS is especially suitable for SME to reduce SCM cost as it can be deployed on the Internet according to the demand and requirements of a customer and the customer only pay for what is needed (Ooi et al., 2011).

Cloud computing is similar to distributed computing which means to run a program on all the connected computers in a network at the same time. This cloud computing also helps the SME to reduce the cost of powerful applications. Unlike other business technologies like B2B, EDI etc, separate server is not required and the SME can use it for SCM without paying a lot. Today cloud

computing solutions are not only available but viable. In what follows below we discuss how to embrace, not replace, the ERP systems or their components for successful deployment.

ERP systems are limited to a single enterprise model. The inability to represent the entire value chain causes major issues in terms of how customer service levels are managed because there is often limited visibility to inventory, in-transit info or supplier production planning information. Partners are challenged as they cannot see finished goods demand or consumption. This requires the retail business to build in manual processes that do not guarantee compliance and instead require buffering against uncertainty by building more inventory or compromising service. This reduces the return of a project and complicates the solution. ERP solutions in the market today have embedded the process model in the database schema. This reduces the ability of the application to map to unique or variant models. This increases cost, time and risk. The integrated approach that ERP vendors have taken when trying all of their business processes to one model has limited their customer's ability to use and benefit from other vendor or custom applications. This is because integration to other applications is extremely difficult, time consuming and expensive.

In theory, value chain partners should all be focused on the same metric: customer satisfaction. The disparity in the plans creates the classic bullwhip effect. As a result, the products are not available when you need them, transportation costs are higher than they should be, and raw material is not available when manufacturing needs it.

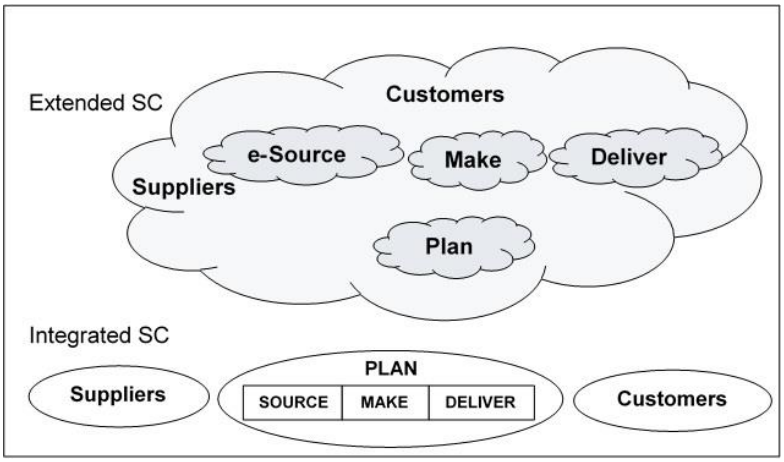

Figure 5 - Extended Supply Chain

Extremely large, multi-party, cloud computing networks are revolutionizing industries. With the advent of new technologies, such as multi-party cloud computing and the use of cycles of learning – the long, costly, high risk projects focused only on internal needs, can be converted to full value chain focused projects organized in manageable, low risk phases, each resulting in rapid ROI. A demand-driven cloud computing network can be deployed at thousands of customers and has been proven to drive significant results not just for a business, but for the entire value chain (see Fig. 6). Inside software solutions such as ERP, the cloud provides the perfect architecture for multi-enterprise solutions, which are inherent in the SC world.

When companies integrate the information they capture it during stages of the value chain – from inbound logistics and production through sales and marketing - they construct an information

underlay of the business. This integrated information provides managers with the ability to see their value chains from end to end.

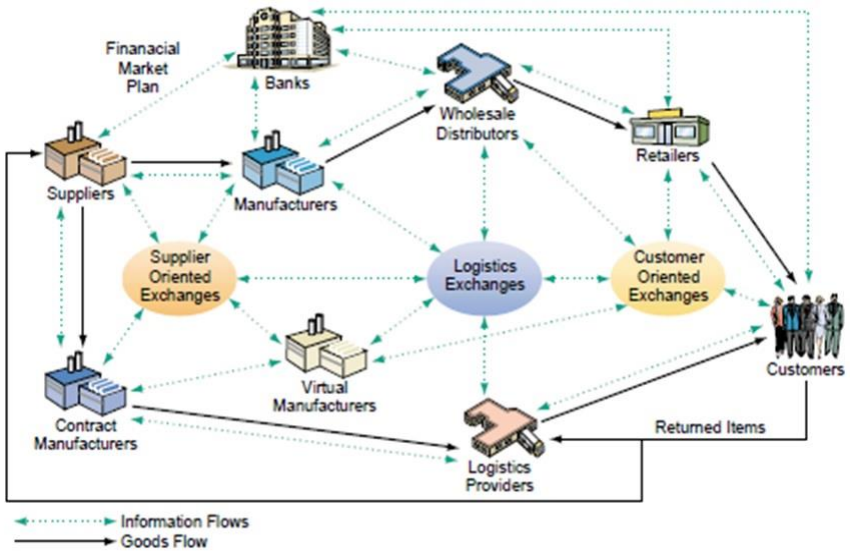

Figure 6 - Web-based supply chain involving exchanges

4. EMERGING SUPPLY CHAIN SOLUTIONS FOR MANAGEMENT DECISIONS

The trends in SCM fall in line with the technological developments in the IT industry. Kumar (2001) stated that ― enterprise-focused systems such as ERP systems, executive information systems and decision support systems become a key to achieving cost efficiencies and organizational effectiveness through intra-organizational process integration. He further emphasized the use of Advanced Planning Systems (APS) which was later integrated as part of the ERP systems. The SC managers then had already started looking forward to transfer information and raw data into knowledge that can be used for operations. Singh (2003) discussed the concept of Automatic Data Capture (ADC) which was capable of handling bar code scanning, voice recognition and radio frequency data capture (RFDC). He further added that Artificial Intelligence (AI) can be used to solve complex SC problems that involved intelligent decision-making data and online analytical processing (OLAP).

It was already predicted by 2005 that RFID can fill some of the information gaps in the SC, especially in retailing and logistics and as a mobile technology, RFID can enable ―process freedom and real-time visibility into SCs (Angeles, 2005). RFID started gaining popularity and the researchers predicted RFID and EPC (Electronic Product Code) as an enabler to provide intelligent B2B e-commerce SCM (Wamba et al., 2006). In the year 2007, RFID was among the most promising technologies in SCM and the others in the list were multi-enterprise visibility systems, people enabling software, execution-driven planning solutions, and human SC technology (Harrington, 2007). A collaborative research project (Soon, 2008) based on oil industry was conducted from the Auckland University to examine the emerging technologies for SC. In this research, which was based on the oil industry, were found four very rapid up-and-coming

technologies that again included RFID along with GPS (Global Positioning Systems), AIDC (Automatic Identification and Data Capture), and OCR (Optical Character Recognition). A study on retailers and the emerging technologies listed RFID, wireless data communications such as 2.5 and 3G, EDI, POS (Point of Sales), and DM (Data Mining) as most promising technologies (Xie, 2009). To end all the government needed documentation and approvals in easier manner which reduces cost and enhance responsiveness time, the use of SC Networks was proposed with e-government ideology (Chen, 2011).

For example, Adidas has effectively saved resources and money by reducing material waste, transportation and distribution costs by utilizing 3D virtualization technology. In 2004, Adidas Group set out to begin using 3D digital technology to showcase their products after being influenced by how effective the automotive and aerospace industries were in using this technology to save resources. Since then, they've experienced amazing results. Besides, General Motors has provided its dealers with a variety of tools that allow them to become web-enabled.

So that, e-commerce is already having a significant impact on SCM in some companies. Internet technologies have grown out of a range of standards that are based on the need to communicate and interact openly. As such, we can expect to see day-to-day activities such as shopping, ordering, booking tickets and personal services increasingly moving online. With the use of Internet, the design and execution of local SCs within cities will change significantly. Local and national government will need to adapt to new realities such as taxation, voting patterns, education levels and payments as people question the need for fixed assets and locations such as buildings. Government and local SCs will need to be more responsive or companies and people will be increasingly willing to circumvent their authority and control. While e-commerce will make us more efficient it is also likely to make our SCs more vulnerable to shocks.

5. CONCLUSIONS

In this paper, we have outlined how the impact that has e-commerce on the SCM will increase over time as companies adopt e-commerce solutions more broadly and increasingly collaborate between companies and across countries. The benefits of SC technological improvements will be considerable, however, representing 5–15 per cent of overall SC costs. Leading SC operators are likely to achieve collaboration with their key value chain partners far more speedily and effectively than their slower competitors. We can expect soon a fundamental restructuring of the way that companies collaborate and synchronize their SCs. The benefits of cost savings and performance improvements will accrue to the companies that are the best at harnessing e-commerce solutions.

As companies perfect the way of handling returns for e-commerce transactions, consumer confidence in e-business will increase dramatically. Meanwhile, virtual fulfillment companies will become more tangible. It’s time for B2B e-commerce to focus on the broader set of activities in SCM. It’s time to move away from simple auction and e-procurement capabilities for indirect materials and toward collaborative SC planning and execution automation for indirect and direct materials. e-Commerce will not only have an impact on the SCs of medium to large companies. It will also change the way we live and work in our cities and communities, it will change government at both local and national level and it will affect the way that we build contingency into our lives. There will be also more virtual 3PLs (third-party logistics providers) and new fourth/five/six/seven-party logistics providers—essentially, the 4PLs will manage the 3PLs, etc.

The e-based solutions discussed in this article are real, highly effective new approaches to SCM. However, the objectives that underlie them are the same ones that have always been in the heart of SC issues. How far we go in empowering our SC depends solely upon how much we want to try to do. As companies become more comfortable with using the Internet to handle their purchasing needs, the number of companies will continue to grow. Once companies see the potential benefits of such a system, they can only choose to move forward. So that, e-business activities and solutions are shaping the SCM into e-SCM, and the related trends for that are provided in the present paper. These innovative SC technologies will greatly enhance the management decisions.

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A FRAMEWORK FOR INTELLIGENT MIND MAPPING USING COLLABORATIVE FILTERING

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ABSTRACT
In knowledge and information society, the importance of idea becomes more and more increasing. It is required to identify and formulate ideas for individuals and organizations. To create new idea, we usually use brainstorming or mind mapping technique. Brainstorming can support group discussion, while mind mapping is usually used for personal purpose. It is essential to provide some clues for users for intelligent mind mapping. In this paper we propose an intelligent model to recommend proper keywords for mind mapping based on collaborative filtering technique.

Keywords: Intelligent Mind Mapping, Keyword Recommendation, Collaborative Filtering

INTRODUCTION
Because information has most values in this century, it is important to organize the idea and information. In most of firms, the ideas are core competence and intangible asset. It becomes more and more important to organize the ideas even in individual case. For these reasons, many applications such as iThoughts, Thinkwise, Maptini have been released for organizing and representing the ideas of people.

But these applications mostly depend on only individual experience and knowledge. In most of corporations and organizations many experts create ideas for important issues using the brainstorming technique. On the contrary, a lot of general people do not have experts with those perform brainstorming, so they use only their knowledge and experience. It means that they have some limitations in using applications and/or techniques to organize their ideas.
In this paper, we propose a framework for intelligent mind mapping based on collaborative filtering technique. We provide proper keywords to users in constructing a mind map for proactive service. It enables for people to complete a mind map efficiently and effectively.

RELATED WORKS

Mind Map
Mind mapping was developed by Tony Buzan by analyzing original breakthrough scientific insights into the workings of the brain. The mind map is an expression of radiant thinking and

is therefore a natural function of the human mind. The mind map can be applied to every aspect of life where improved learning and clearer thinking will enhance human performance (Buzan & Buzan, 1996). Fig 1 shows a mind map example.

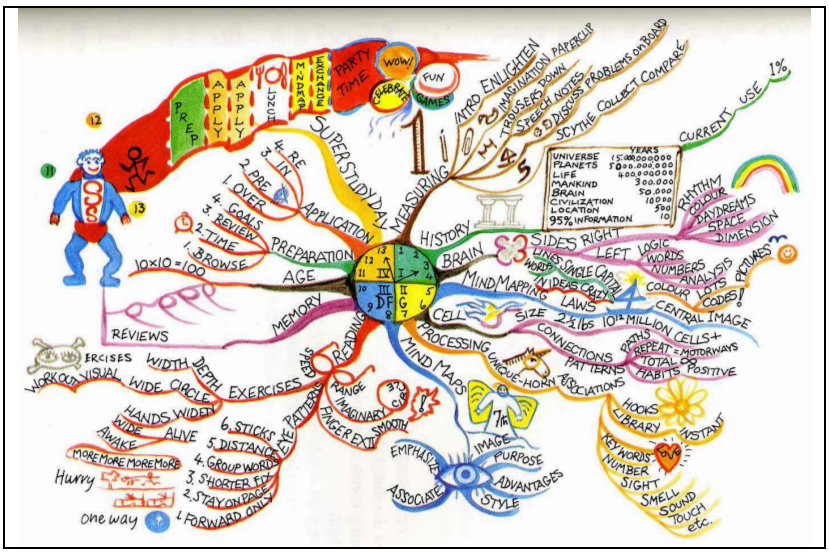

Figure 1 – A Mind Map

Mind Map is based on organizing information via hierarchies and categories. Major topics or categories associated with the central topic are captured by branches flowing from the central image. Each branch is labeled with a key word or image. Lesser items within each category stem from the relevant branches (Budd, 2004).

Some Research provides different technique using mind map. Evrekli et al. (2010) proposed a scoring system to assess mind maps and Wickamasinghe et al. (2012) find that effectiveness of mind maps as a learning tool for medical students. In this research, 97.1% participants perceived technique as a useful method of summarizing information.

Collaborative Filtering

Collaborative filtering (CF) is a technique for recommender systems. Basically, Collaborative filtering can utilize preference by various users to determine recommendations to a target user based on similar users (Albadvi & Shahbazi, 2009). Collaborative filtering are particularly popular by large online retailers and used for producing personalized recommendations by computing the similarity between the current user and other user with similar choices (Nilashi et al., 2014).

Up to recently, many researchers apply collaborative filtering in the various recommender systems. Such as Pereira et al. (2014) suggest a recommendations system using collaborative filtering for video recommendations based on cloud service. Zhang et al. (2013) uses collaborative filtering in the social regularization for TV program recommendation.

On the other hand, cold start is widely known issue with collaborative filtering. Generally, collaborative filtering recommends something based on others used and choices, but cold start

have not enough data to calculate recommending score for each items. Consequently, some research performed to solve cold start (Bobadilla et al., 2012; Ahn, 2008).

In this paper, we apply collaborative filtering in other to effectively extend mind map through recommended keywords from related map data in the others.

RESEARCH FRAMEWORK

We propose a framework for recommend keywords to extend mind mapping using collaborative filtering. Fig 2 shows a recommendation procedure.

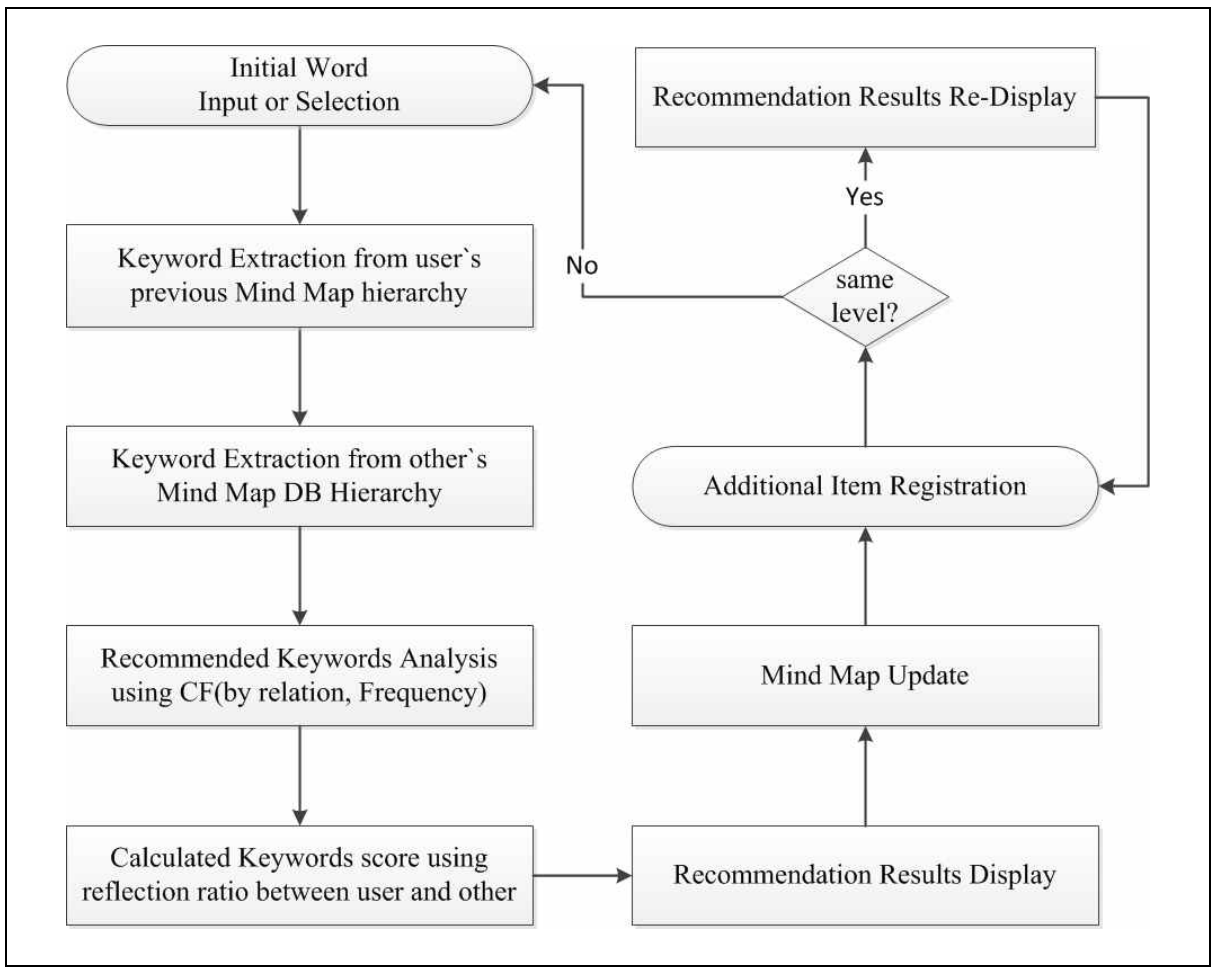

Figure 2 – Recommendation Procedure

First step is an initial word input or selection. This step can be a trigger to start the proposed recommendation procedure. When users input some keyword or selection, recommend system is ready to analysis.

Next step is the keyword extraction from user's previous mind map hierarchy. In this step, the recommendation system retrieves keywords including a word by initial input or selection from mind map database. In the same ways, keywords are extracted from other's mind map DB hierarchy. Continuously, the system finds all mind map hierarchies including a keyword

and extracts all sub-level keywords. Search results are delivered to the recommended keywords analysis step. Table 1 shows a sample of mind map hierarchy for an initial word, 'personal digital device'.

Table 1 – A Sample of Mind Map Hierarchy for 'personal digital device'

Level 1	Level 2	Level 3	Level 4	…
Smartphone	I-Phone 6	iOS 7.0	…	
	Galaxy S5	Android		
	HTC DesireS			
SmartPad	I-Pad II	SmartCover		
	Galaxy Tab	Pen	Jot Script	
	Identity Tab			
	Kindle Fire			
Digital Camera	DSLR	Pentax ist Ds		
	Mirror-less	OlympusPEN		
Navigation	i-Navi	KoreaMap	T-Map	
	TomTom	CanadaMap		
…	…	…		

Recommended keywords analysis step derives candidate keywords using item-based approach, a collaborative filtering technique, and save the results into recommendation database. Keywords are analyzed based on two attributes: semantic relatedness (SR) and frequency. Semantic relatedness is measured as a similarity score among words and the score can be calculated by similarity algorithm or WordNet, a semantically structured lexical database. Frequency *f* can be derived by accumulating counts of all keywords from mind map database for extracted keywords. Let us call Syn(a)={syn_{a1}, syn_{a2},…} and Syn(b)={syn_{b1}, syn_{b2},…} the set of synonyms of ontological terms a and b, respectively. Then, comparisons are performed by as follows:

$$s(a,b) = \frac{\sum_{i,j} s(syn_{ai,bj})}{|Syn(a)| \bullet |Syn(b)|}, 1 \le i \le |Syn(a)|, 1 \le j \le |Syn(b)|$$

Semantic relatedness and frequency attributes are stored in the recommendation database by keywords.

In the next step, the recommendation system calculates keywords score using reflection ratio between a user and the others. The reflection ratio is set by user preference. The results of calculating are delivered to next step.

In recommendation results display step, the system receives score from the previous step and shows that list to enable for users to select a preferred keyword among recommended keywords.

Finally, mind map update step supplements keywords and updates mind map based on recommended and selected results. Detailed mechanism of keyword display step and mind map update step can be represented as the following pseudo-code.

```
// recommended_keywords display
WHILE (new_item)
{
IF (new_item_level == current_keyword_level)
THEN
display recommended_keywords_except_pre_selected_item
ELSE
replace currently_selected_keyword with input_word
goto step 1
// mind map update
IF (recommended_keyword_status == “selected”)
THEN
insert selected_keyword into mind map automatically
ELSE
insert a keyword into mind map by user
}
```

Table 2 shows the advantage of the proposed mind mapping framework by comparing with existing method.

Table 2 – Existing vs. Proposed Method of Mind Mapping

Existing method	Proposed method
a) start; b) mind map build; c) mind map store	a) start; b) keywords retrieval; c) related keywords infer; d) keywords recommend; e) recommended keyword select or key-in; f) mind map store and share
Passive support of mind mapping	Intelligent support of mind mapping using automatic keywords recommendation

CONCLUSION

In this paper, we have suggested a framework for recommending keywords for mind mapping based on collaborative filtering technique. This framework enables for users to build a high-quality mind map effectively in a short time because mind map constructors can utilize their own idea and accumulated one of other people. That is, the proposed method can realize the concept of collective intelligence. It is expected that the suggested method can be used in any idea generation process. In the future, it is required to perform further research for implementing and verifying the proposed model.

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RETAILER SERVICE QUALITY, CUSTOMER SATISFACTION AND CUSTOMER LOYALTY: EMPIRICAL EVIDENCE IN VIETNAM

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ABSTRACT
This study investigates the relationship between retailer service quality, customer satisfaction and customer loyalty by conducting questionnaire survey on 664 buyers in several supermarkets in Vietnam. This questionnaire was constructed with 49 retail service quality items covering 6 service quality dimensions namely Physical aspects, Reliability, Personal Interaction, Problem solving and Policy and Information of goods, and 3 customer satisfaction items and 2 customer loyalty items. Statistical analysis results indicate the significant link between customer loyalty, customer satisfaction, and such dimensions of service quality as Problem solving, Policy and Personal Interaction. From these findings, managerial as well as theoretical implications have been discussed.

Keywords: Service quality, Retail industry, Supermarket.

INTRODUCTION
Service quality is often regarded as a global judgment, or attitude, relating to the superiority of the service (Parasuraman, Zeithaml and Berry, 1988). Service quality has been received a great deal of attention to practitioners, managers and researchers over the past few decades, due to its strong impact on business performance, lower costs, customer satisfaction, customer loyalty and profitability. That is the reason why studying on the definition, modeling, measurement, data collection procedure, data analysis etc., issues of service quality, leading to development of sound base for the researchers (Seth et al., 2005).

In Vietnam, the increasing trend of average income per capital offering many opportunities for both domestic and foreign retail enterprises. Especially, according to Vietnam Ministry of Industry and Trade, Vietnam, after joining in the WTO, committed to open its retail market to foreign investors, and allow foreign retailers to set up 100% foreign owned retail enterprises. In spite of the domination of traditional channels of retail service providers, many leading international retail brands have been making huge investment in Vietnam. Many forms of retail service providers have been developed such as business center, supermarket, grocery stores, convenient stores, and so on. Vietnam is considered as one of the most dynamic economy in South East Asia which has obvious advantage to attract retailers.

This situation raises a question about how retail businesses can perform better in this highly competitive market. Attaining customer satisfaction and customer loyalty which are

fruitful sources of profits could be a potential answer for this question. To address this need, this study aim to examine service quality as well as its impacts on customer satisfaction and customer loyalty to find out which components of service quality significantly contribute to improve customer satisfaction and customer loyalty for retail businesses in Vietnam.

LITERATURE REVIEW

Service quality and Service quality models

Gronroos (1984) and Parasuraman et al. (1985) proposed that service quality is a function of the difference between customers' expectation and their perception of the actual service received. Customers are satisfied when the perceived value meets or exceeds their expectations. In contrast, they are dissatisfied when they feel the perceived value below their expectations. This definition is accepted by a majority of academics as well as practitioners, and widely used to address research as well as in business issues.

It cannot be denied that measuring service quality is obviously more difficult than goods' quality. The reason why is that unlike physical products, service product has a fewer tangible cues (Parasuraman et al., 1985) and also requires higher consumer involvement in the consumption process (Gronroos, 1984). Gronroos (1984) found that three dimensions including technical quality, functional quality and corporate image were critical component used to assess service quality. Then, Parasuraman et al. proposed the conceptual model namely SERVQUAL in 1985 which has become the most widely used model to measure service quality for many years. This model presented 10 key service quality aspects including Reliability, Responsiveness, Competence, Access, Courtesy, Communication, Credibility, Tangibles, Understanding the customer, and Security. By 1988, Parasuraman refined these 10 dimensions into only five dimensions including Tangibles, Reliability, Responsiveness, Assurance and Empathy.

Table 1: Dimensions measuring service quality of SERVQUAL

Dimensions	*Definitions*
Tangibles	Physical facilities, equipment, and appearance of personnel
Reliability	Ability to perform the promised service dependably and accurately
Responsiveness	Willingness to help customers and provide prompt service
Assurance	Knowledge and courtesy of employees and their ability to inspire trust and confidence.
Empathy	Caring, individualized attention the firm provides its customers.

Source: Parasuraman, Zeithaml & Berry, 1988, p.23

Despite SERVQUAL – multiple-item scale has been applied in the study of different types of service industries, there are some limitations and also criticisms on its confusion (Babakus and Mangold 1989; Finn and Lamb 1991; Pitt, Oosthuizen and Morris 1992; Spreng and Singh 1993). In 1992, Cronin and Taylor developed SERVPERF scale to measure service quality. Unlike SERVQUAL scale, SERPVPERF maintains only the perceptions of service quality through the use of 22 perception items. The advantage of SERVPERF scale has been demonstrated in various studies including those by Avkiran (1999), Lee et al., (2000) and Brady et al., (2002).

Although SERVQUAL has been empirically tested in a number of studies, it has not been validated in a retail industry. Finn and Lamb (1991) examined the usefulness of this scale in four different types of retail stores. Results do not support the proposition that the scale can be used to assess perceived service quality in retail setting. Dabholkar et al., (1996) developed Retail Service Quality Scale (RSQS) basing on SERVPERF scale. This scale comprises of 28 items of which 17 items from SERVPERF and 11 items developed by qualitative research. It has five dimensions – Physical Aspects, Reliability, Personal Interaction, Problem Solving, and Policy. This scale was widely adopted to examine service quality in retail sector in many studies such as Christo & Terblanche (1997), Boshoff and Terblanche (1997), Mehta et al. (2000), Kaul S. (2007), Anupam Das et al. (2008), Wong, A., Amrik S. Sohal, (2006), Bloemer, J., Ruyter, K., and Wetzels M. (1998)

Table 2: Dimensions measuring service quality of RSQS

Dimensions	*Definitions*
Physical aspects	Appearance and Convenience of retail store.
Reliability	Retailers keep their promises and do the right things
Personal interaction	Service employees are courteous/helpful and inspire confidence in customers
Problem solving	Retail store personnel are capable to handle returns and exchanges as well as customer' complaints.
Policy	Store policy on operation hours, merchandise quality, parking, credit cards.

Source: Dabholkar et al., 1996, p.6-7

Dimensions used in *Dabholkar*'s model are stated as important component to measure retail service quality in the literature. The convenience of shopping such as store layout also is demonstrated as one of service quality dimensions in retailing which impacts on customers' perceptions (Gutman and Alden 1985; Hummel and Savitt 1988; Oliver 1981). Moreover, Westbrook (1981) found that customers were sensitive to how retailers treat to problems and complaints. Mazursky and Jacoby (1985) also shows that the ease of returning and exchanging merchandise and the credit and charge account policies of the store are really important to retail customers. Baker, Grewal, and Parasuraman (1994) also mention that store environment comprising of ambient attributes, design attributes and social attributes play important role in evaluating retail service quality of customers. Besides, other retail service quality dimensions such as convenient parking, quality of merchandise are presented in the empirical study of Oliver (1981).

Particularly, there are some studies concerning service quality and customer satisfaction topics in Vietnamese retail industry such as Service quality, customer satisfaction and loyalty: A study of supermarkets in Ho Chi Minh city by Trang, N.T.M, (2006); Determinants of retail service quality – a study of supermarkets in Vietnam by Nhat, N.D.D, and Hau, L.N, (2007). Trang, N.T.M, (2006) examined the relationships between the service quality of supermarkets and the customer satisfaction and loyalty by using a sample of 318 supermarket shoppers in Ho Chi Minh City. The methodology of this study has been combined of RSQS and qualitative research of author. The results indicated that five dimensions comprising of the Quality of merchandise, Service personnel, Layout of retail store, Appearance and Safety

were important factors that makes customers satisfied and loyal to a supermarket. Nhat, N.D.D, and Hau, L.N., (2007) tested RSQS at 440 shoppers in various supermarkets in Ho Chi Minh City. The findings showed that 4 factors namely Service Personnel, Physical Aspects, Policy and Reliability have impact to service quality in supermarket.

Customer satisfaction and customer loyalty

It is no doubt that service quality, customer satisfaction, and customer loyalty have been becoming obviously important factors of successful business advantage for service providers (Rust et al., 1995; Zeithaml, 1996, Kitapci et al. 2013). Service quality and its components are stressed as antecedent to customer satisfaction and customer loyalty. In turn, with the mediating role of customer satisfaction, customer loyalty which is a strong determinant of business profitability is the final target of many organizations.

Customer satisfaction, from service perspective, is a result of customer experience with a service quality encounter and comparison of that encounter with the expectations (Caruana et al., 1998, Kitapci et al. 2013). The important of customer satisfaction has provoked on-going researches on developing indicator to measure it. Fornell et al (1992) proposed a system of measuring customer satisfaction in the world at the national level (SCSB – Swedish Customer Satisfaction Barometer). Then, Fornell (1996) published ACSI (American Customer Satisfaction Index) in U.S. Until now, CSI models has been applied in 10 countries such as Sweden in 1989, Germany in 1992, ACSI in 1994, Norway, Switzerland, South Korea, New Zealand and Taiwan, China, Malaysia. Besides, ECSI (European Customer Satisfaction Index) has been deployed simultaneously in 11 European countries (AliTurkyilmaz, 2007).

In the late of 1980s, the result of the study on customer satisfaction revealed the detection of customer loyalty or complaints for products/services. Auh and Johnson (2005) defined store loyalty as the possibility or tendency of repurchasing a specific product or service. It reflects that store loyalty is a direct result of customer satisfaction, and customer satisfaction plays a role as an essential catalyst for developing loyalty. In 2008, Gee *et al*. listed the advantages of customer loyalty as following: (1) The service cost of a loyal customer is less than new customers; (2) They will pay higher costs for a set of products; (3) For a company, a loyal customer will act as a word-of-mouth marketing agent. Walsh *et al*. (2005) also assumed that it is better to look after the existing customer before acquiring new customers. Ndubisi (2005) and Pfeifer (2005) claimed that the cost of serving a loyal customer is five or six times less than a new customer.

Table 3: Summary of Several Studies on Retail Service Quality Measurement

Authors	*Research settings*	*Study sample (s)*	*Instrument*	*Factor structure/Key findings*
Dabholkar et al. (1996)	Southeastern USA	227 respondents of seven stores from two department store chains	Retail Service Quality Scale	A hierarchical structure for Retail Service Quality was proposed including of five basic dimensions: Physical Aspects, Reliability, Personal Interaction, Problem Solving and Policy. Among which, three dimensions have two subdimensions each.
Christo & Terblanche (1997)	South Africa	Hypermarkets shoppers	RSQS (Dabholkar et al., 1996)	The findings demonstrated that RSQS proposed by Dabholkar et al. (1996) has reasonable fit.

Authors	*Research settings*	*Study sample (s)*	*Instrument*	*Factor structure/Key findings*
Boshoff and Terblanche (1997).	South Africa.		RSQS (Dabholkar et al., 1996)	The findings reported highly encouraging results for the RSQS applicability in the context of department stores, specialty stores and hypermarkets in South Africa.
Mehta et al. (2000)	Singapore	Customers of supermarkets and electronic goods retailers	RSQS (Dabholkar et al., 1996) and SERVPERF (Cronnin & Tailor, 1992)	RSQS was found to be fit in a supermarket environment. SERVPERF was better for a retailing context where the service element is prevalent. Five new dimensions were presented from combining of RSQS and SERVPERF.
Trang, N.T.M (2006)	Vietnam	318 supermarket shoppers in HCMC	RSQS and qualitative research of author	The results indicated that there are five retail service quality dimensions comprising of the Quality of merchandise, Service personnel, Layout of retail store, Appearance and Safety.
Kaul S. (2007)	India	144 adult shoppers at large format apparel stores in the city of Bangalore	RSQS (Dabholkar et al., 1996)	The RSQS dimensions and subdimensions are *not* clearly identifiable. The dimension of 'Physical Appearance' is the only one that is relatively clear. All other dimensions are ill-defined. RSQS is *inappropriate* for application in Indian retail
Nhat, N.D.D, and Hau, L.N.	Vietnam	440 shoppers in various supermarkets in HCMC	RSQS (Dabholkar et al., 1996)	The findings showed that 4 factors namely Service Personnel, Physical Aspects, Policy and Reliability have impact to service quality in supermarkets.
Anupam Das et al., (2008)	Kazakhstan	220 respondents collected from the Almaty city of Kazakhstan.	RSQS (Dabholkar et al., 1996)	The findings indicated that there was a good fit of the RSQS dimensions and the items
Bloemer, J., Ruyter, K., and Wetzels M. (1998)	Belgium	708 respondents from a super market, two competitive providers in each entertainment, fast food and health care	SERVPERF by Cronin and Taylor (1992).	22 items with cross-level design. Negative association between organizational commitment and perceived service quality; role ambiguity and both organizational commitment and commitment to quality; commitment to the organization and customer perceived service quality and customer loyalty. Perceived service

Authors	*Research settings*	*Study sample (s)*	*Instrument*	*Factor structure/Key findings*
		category		quality seems to be the key to customer loyalty.
Caruana, A. (2002)	Malta	194 banking customers	Three instruments – service loyalty (Gremler and Brown, 1996), service quality (Parasuraman et al., 1994), customer satisfaction (Bitner and Hubbert, 1994)	37 items in a mediation model linking service quality to service loyalty via customer satisfaction. Customer satisfaction does play a mediating role in the effect of service quality on service loyalty. The effect of several demographic indicators on service loyalty are discussed (education, age).
Wong, A., Sohal, A. (2002)	Victoria, Australia	1,261 respondents	Modified version of SERVQUAL scale (Parasuraman et al., 1988)	29 items, five dimensions in a conceptual model of relationship between dimensions of service quality and customer loyalty. Positive correlation between customer loyalty and service quality, especially at company level with the most significant predictor is tangibles, while at interpersonal level it is empathy.
Wong, A., Amrik S. Sohal, (2006)	Victoria, Australia	customers from 8 different stores	Combination of instruments by Dabholkar et al. (2000), Morgan and Hunt (1994), Barnes (1997), and (Parasuraman et al., 1994)	Using 26 items in 6 categories in a model of relationship strength investigates the effect of service quality, trust, service commitment. The findings generally were consistent with hypotheses from the marketing/management literature. Empirical support is provided for the relationship between service quality and trust.
Ponirin, P, Scott, DR & von der Heidt, T (2009)	Indonesia	3 e-stores and 324 Indonesian e-customers of the last 12 months in 2001/2002	New set of survey questions developed by the authors	Six determinants of performance based service quality for an e-store were tested for validity and reliability. A strong positive association between e-store service quality and e-store customer loyalty was found.
Beneke, J., Hayworth, C., Hobson, R. Mia, Z. (2012)	South Africa	307 respondents within a major metro pole area and through an online interface	RSQS (Dabholkar et al., 1996)	Physical Aspects and Personal Interaction had a direct relationship with Customer Satisfaction. Customer satisfaction was also confirmed to be positively linked to store loyalty.

Authors	*Research settings*	*Study sample (s)*	*Instrument*	*Factor structure/Key findings*
Kitapci, O. (2013)	Turkey	505 supermarket customers	Measuring service quality with 17 items adapted from Kueh and Voon (2007); Measuring customer satisfaction and customer loyalty adapted from Laroche et al. (2004) and Nam (2008)	Paths model between the five SERVQUAL dimensions (Parasuraman et al., 1985). Empathy, tangibility, responsiveness, and assurance are factors that are positively related to customer satisfaction, which in turn is positively related to customer loyalty.

Analytical framework

Retail service quality scale (RSQS) is widely used to measure service quality in retail industry at different countries, a scale designed to measure five distinct dimension: Physical aspects, Reliability, Personal Interaction, Problem solving and Policy. Among which, Physical aspects has 2 subdimensions such as Appearance and Convenience, Reliability also has 2 subdimentions as Promises and Doing it right.

Additionally, the differences in culture also impact to measure quality in a service sector (Ueltshy & Krampf, 2001). When measuring retail service quality in Vietnam environment, we referred "Regulation of supermarkets and commercial centers in Vietnam" (Ministry of Commerce, 2004). This regulation indicated a set of requirements of goods and service products at supermarkets and commercial centers. This set by Ministry of Commerce in 2004 related to label, code and packaging of merchandises. Further, the price of goods must be clearly marked on the packaging, labeling or in the counter.

By combining RSQS with the regulation of goods at Vietnamese supermarkets, this study will assess retail service quality through 6 dimensions:

- Physical aspects: the appearance of supermarket/staffs, physical facilities, visual materials for customers and the convenience at supermarket.
- Reliability: Supermarket keeps their promises and do the right things at the first time.
- Personal Interaction: Supermarket staffs are courteous/ helpful and built confidence in customers about knowledge and skills of supermarkets staffs.
- Problem solving: Supermarket's willingness to handle returns and exchanges as well as complaints of customers.
- Policy: supermarket's policy including high quality merchandise, parking facilities, convenient operating hours and acceptance of major credit cards.
- Information of merchandise: label, origin, packaging of goods and price marked in each products.

Besides, this study also examines the relationship between retail service quality and customer loyalty. The analytical framework is as following:

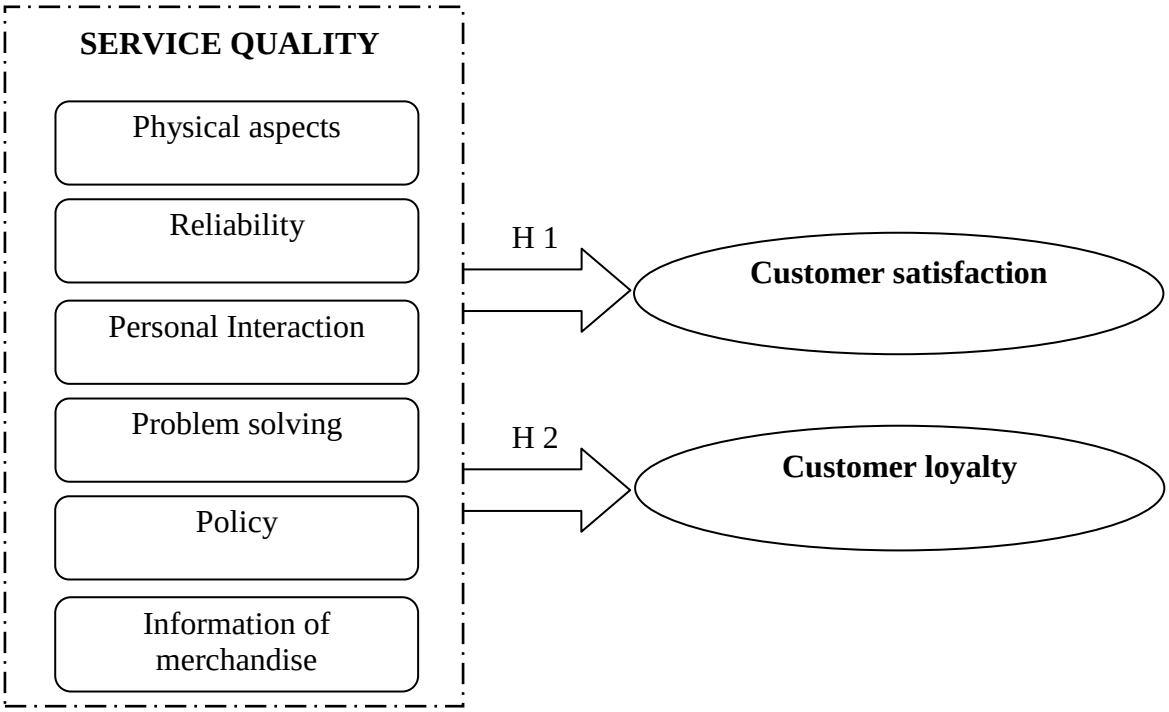

Figure 1: Analytical framework

Hypotheses of this research model are:

Hypothesis 1: Service quality has significant positively impact on customer satisfaction

Hypothesis 1a: Physical aspects component of retail service quality has significantly impact on customer satisfaction

Hypothesis 1b: Reliability component of service quality has significantly impact on customer satisfaction

Hypothesis 1c: Personal interaction component of service quality has significantly impact on customer satisfaction

Hypothesis 1d: Problem solving component of service quality has significantly impact on customer satisfaction

Hypothesis 1e: Policy component of service quality has significantly impact on customer satisfaction

Hypothesis 1f: Information of merchandise component of service quality has significantly impact on customer satisfaction.

Hypothesis 2: Service quality has significant positively impact on customer loyalty

Hypothesis 2a: Physical aspects component of retail service quality has significantly impact on customer loyalty

Hypothesis 2b: Reliability component of service quality has significantly impact on customer loyalty

Hypothesis 2c: Personal interaction component of service quality has significantly impact on customer loyalty

Hypothesis 2d: Problem solving component of service quality has significantly impact on customer loyalty

Hypothesis 2e: Policy component of service quality has significantly impact on customer loyalty

Hypothesis 2f: Information of merchandise component of service quality has significantly impact on customer loyalty

DATA COLLECTION AND MEASUREMENT TEST

Data collection

Based on reviewing literature to model the analytical framework, a questionnaire was developed as an adapted version of RSQS (Dabholkar, 1996), and referenced from "Regulation of supermarkets and commercial centers in Vietnam" (Ministry of Commerce, Vietnam, 2004).

The questionnaire was divided into 3 sections:

- The first section was designed to assess the overall retail service quality perception from customers. This part includes 44 statements in total measuring 6 dimensions of retail service quality namely: Physical aspects (11 items), Reliability (4 items), Personal interaction (6 items), Problem-solving (3 items), Policy (8 items), and Product information (5 items). Besides, this part also measures the important level of the above 6 retail service quality dimensions (6 items).

- The second section aims to measure the satisfaction as well as loyalty level of customers. Customer satisfaction is assess by asking about satisfaction level on goods quality, supermarkets' staff and general service quality of the supermarket (3 items). Customer loyalty is examined through the possibility of revisit the supermarket and whether respondents would introduce that supermarket to other people (2 items).

- The last section consists of questions relating to demographic information about respondents such as age, gender, and income.

The first two sections are measured using a 5 point Likert rating scale which corresponding to 1 = strongly disagree, 2 = somewhat disagree, 3 = neither agree nor disagree, 4 = somewhat agree, 5 = strongly agree. This questionnaire was used to survey customers shopping at supermarkets in Hanoi so that they could give more meaningful responses.

The respondents of the survey are current buyers of supermarkets in Hanoi, Vietnam. Survey was conducted through a direct interview method. 700 potential customers were approached and 664 feedbacks were obtained indicating a response rate as 93%. All respondents are Vietnamese.

Measurement test

Data collected is firstly tested to ensure the reliability through Cronbach's alpha value with the purpose to check the internal consistency. In other word, this test checks whether respondents' scores on any one indicator tend to be related to their scores on the other indicators. In this study, the results indicate that all Cronbach's alphas of 6 dimensions ranged from 0.794 – 0.884, showing high reliability level of the database.

Then, validity test is conducted to measure whether the item or scale truly measures what it is supposed to measure or nothing else. *Content validity* of the questionnaire is confirmed by intensive literature reviewing. The measurement items have been carefully constructed, validated and refined by Dabholkar et al. (1996) with some customization to be suitable for the context of Vietnamese retail market. *Construct validity* is tested through factor analysis to

ensure that the scale is an appropriate operational definition of an abstract variable (Flynn et al., 1990). In this study, within scale factor analysis is conducted for 6 service quality scales, namely Physical Aspects, Reliability, Personal interaction, Problem Solving, Policy, and Information of Merchandise, and for Customer Satisfaction and Customer Loyalty scale. The results reveal that the questionnaire is a valid measure of retail service quality, customer satisfaction and customer loyalty in Hanoi, Vietnam because the items which are arrange within a scale in the questionnaire are proven under the same factors. The results of the factor analysis for all 6 dimensions are presented in the following table.

Table 4: Reliability and Validity tests

Constructs	*No. of Items*	*Cronbach's alpha*	*Number of factors*	*% of Variance*
1. Physical Aspects	9	0.884	1	47.408
2. Reliability	4	0.764	1	58.706
3. Personal Interaction	4	0.852	1	69.391
4. Problem Solving	3	0.831	1	74.887
5. Policy	8	0.853	1	49.936
6. Information of Merchandise	5	0.883	1	68.356
7. Customer Satisfaction	3	0.856	1	77.759
8. Customer Loyalty	2	0.794	1	83.008

DATA ANALYSIS

The demographic description of respondents indicates that the majority of survey participants are female with 471 out of 664 ones, accounting for 70.9%. Among them, the customer group at the age of 25-40 represents the largest group with 45.0% (corresponding to 299 respondents). They are the young who newly get married or have family with small children. Meanwhile, the age group of under 25 made up approximately one third of total respondents. In addition, From 41 to 55 and Over 55 group account for smaller figure with 13.1% and 11.0%, respectively.

Regarding to the income of the buyer, the largest portion fell in respondent group with monthly income at middle level ranging from USD200 to USD500 (407 respondents out of 644, corresponding to 61.2%). This income level is slight higher than the average income per capital of Vietnamese in 2013 (USD200 per month). This situation is suitable for the strategic development of supermarket sector which concentrates on common class in Vietnam.

Table 5: Demographics of respondents

Gender		*Age*		*Income (per month)*	
Male	28.916%	Under 25	30.873%	Low income (Less than USD200)	23.042%
Female	70.934%	From 25 to 40	45.030%	Medium income (From USD200 to USD500)	61.295%
N/A	0.151%	From 41 to 55	13.102%	High income (Higher than USD500)	16.663%
		Over 55	10.994%		

Regression analysis is conducted to test the relationship between service quality and customer satisfaction as well as the relationship between retail service quality and customer loyalty of supermarkets in Hanoi. At first, mean scores of both dependent variables (customer satisfaction, customer loyalty) and independent variables (Physical Aspects, Reliability, Personal Interaction, Problem Solving, Policy, Information of Merchandise) for 664 respondents are calculated. Then, mean scores of service quality are multiplied by weight score measuring the important level of each component which are assessed by respondents.

Impact of retail service quality on customer satisfaction

Table 6: Regression analysis on the relationship between service quality and customer satisfaction

R	0.747				
R square	0.558				
Sig.	0.000				
	Beta coefficient	**t value**	**Sig.**	**Collinearity Statistics**	
				Tolerance	**VIF**
(Constant)	0.250	2.159	0.031		
Physical Aspects	0.221	5.040	0.000	0.350	2.860
Reliability	0.037	0.828	0.408	0.347	2.884
Personal Interaction	0.239	5.355	0.000	0.338	2.956
Problem Solving	0.112	2.723	0.007	0.396	2.523
Policy	0.173	4.322	0.000	0.423	2.367
Information of Merchandise	0.087	2.220	0.027	0.440	2.274

It can be seen that R-square value accounts for 0.558 which means that 55.8% of the variance in customer satisfaction can be explained by 6 retail service quality variables, namely Physical Aspects, Reliability, Personal Interaction, Problem Solving, Policy, and Information of Merchandise. In addition, Sig. value which is 0.000 confirms that group of six service quality components have a statistically significant relationship with customer satisfaction variable.

Apart from Reliability, 5 remaining service quality components express significantly positive impact on Customer satisfaction at the 5% significant level (Sig. values are smaller than 0.05). Among them, Personal Interaction which measures the truthfulness and politeness of supermarket staff shows the strongest impact on customer satisfaction with the highest coefficient value of 0.239. Physical aspects which measure the appearance and convenience of the supermarket also reveal a rather high influence with coefficient of 0.221. Furthermore, policy, problem solving and information of merchandise represent smaller statistically impact with coefficient value of 0.173, 0.112, and 0.087 respectively. Meanwhile, Reliability is the only independent variable which show positive relationship with Customer satisfaction but is not a statistically relationship at the 5% significant level.

Impact of retail service quality on customer loyalty

In examining the impact of service quality on customer loyalty of supermarket in Hanoi, R-square value indicates that 50.6% of variance in customer loyalty can be explained by 6 retail service quality variables. Moreover, significant value of 0.000 confirms that group of

six service quality components have a statistically significant relationship with customer loyalty variable at the 5% significant level.

Table 7: Regression analysis on the relationship between service quality and customer loyalty

R	0.711				
R square	0.506				
Sig.	0.000				
	Beta coefficient	**t value**	**Sig.**	**Collinearity Statistics**	
				Tolerance	**VIF**
(Constant)	0.279	2.100	0.036		
Physical Aspects	0.288	6.209	0.000	0.350	2.860
Reliability	0.069	1.478	0.140	0.347	2.884
Personal Interaction	0.130	2.747	0.006	0.338	2.956
Problem Solving	0.086	1.983	0.048	0.396	2.523
Policy	0.158	3.745	0.000	0.423	2.367
Information of Merchandise	0.095	2.292	0.022	0.440	2.274

It is interesting that the influence of service quality on customer loyalty is somehow similar to this impact on customer satisfaction in which 5 service quality components excluding Reliability stress obvious significantly impact on customer loyalty with Sig. value of each smaller than 0.05. Physical aspects component shows the strongest impact with the highest coefficient value of 0.288, followed by policy and personal interaction with coefficient values of 0.158 and 0.130, respectively. Additionally, information of merchandise and problem solving represent smaller impact on customer loyalty (coefficient values of 0.095 and 0.086). Meanwhile, Reliability is the only service quality component which express positive but not statistical impact on customer loyalty at the 5% significant level.

Income effects on the relationship between retail service quality, customer satisfaction and customer loyalty

Retail service quality, customer satisfaction and customer loyalty are differently because of controlling variable such as income, age, visiting frequency, regions, and so on. In this section, the paper examines the influence of income on assessment of retail service quality, customer satisfaction and customer loyalty from supermarkets' respondents. The whole sample is divided into 3 groups based on the income level of respondents:

- ***Group 1 – Lower income:*** includes customers with income being lower than the monthly average income per capital of Vietnamese in 2013 which is USD200 per month.
- ***Group 2 – Mediumer income:*** includes customers with income being higher than the monthly average income per capital of Vietnamese in 2013 which ranges from USD200 to USD500 per month.
- ***Group 3 – Higher income:*** includes customers with income being 3 times higher than the monthly average income per capital of Vietnamese in 2013 which is more than USD500 per month.

Table 8: The assessment of service quality, customer satisfaction, and customer loyalty in 3 groups

	Group 1	Group 2	Group 3	F	Sig.	Pairwise Difference
Physical Aspects	3.664	3.546	3.555	4.275	0.014	Group 1 vs Group 3
Reliability	3.587	3.535	3.495	0.556	0.574	
Personal Interaction	3.358	3.342	3.283	0.358	0.699	
Problem Solving	3.351	3.358	3.260	0.694	0.500	
Policy	3.535	3.550	3.445	1.049	0.351	
Information of Merchandise	3.910	3.735	3.594	5.500	0.004	Group 1 vs Group 2 Group 1 vs Group 3
Customer Satisfaction	3.456	3.401	3.346	0.721	0.487	
Customer Loyalty	3.734	3.585	3.481	3.472	0.032	Group 1 vs Group 3

One-way analysis of variance (One-way ANOVA) is used to investigate if there are any significant differences between the means of three groups: Group 1 - Lower income, Group 2 – Medium income, Group 3 – Higher income. By Tukey pairwise comparison test with the significance level at 5%, the ANOVA result table indicates that there are some differences between Group 1 and the other two groups in customer assessment on Physical Aspects, Information of Merchandise, and Customer Loyalty. These differences indicate that the assessment of Group 1 is significant higher than Group 2 and Group 3. Regarding to the remaining components namely Reliability, Personal Interaction, Problem Solving, Policy and Customer Satisfaction, the assessment from three customer groups are quite homogenous.

DISCUSSIONS

This study adopted Retail Service Quality Scale (Dabholkar, 1996), and reference from "Regulation of supermarkets and commercial centers in Vietnam" (Ministry of Commerce, 2004) with some customizations to measure retail service quality at supermarket in Vietnam. The questionnaire comprises 49 items measuring 6 service quality components, customer satisfaction and customer loyalty. Data were collected from 664 customers at supermarkets in Hanoi.

Data analysis results indicated that service quality is still an important driver for both customer satisfaction and customer loyalty. This finding is supported by many studies such as Trang N.T.M. (2007) in Vietnam, Caruana, A. (2002) in Malta, Wong, A., Sohal, A. (2002), Wong, A., Amrik S. Sohal, (2006) in Australia, Bloemer, J., Ruyter, K., and Wetzels M. (1998) in Belgium, Ponirin, P, Scott, DR & von der Heidt, T (2009) in Indonesia, Beneke, J., Hayworth, C., Hobson, R. Mia, Z. (2012) in South Africa, Kitapci O. (2013) in Turkey.

Retail Service Quality Scale was carefully constructed, validated and refined by Dabholkar et al. (1996) and demonstrated being reasonable fit for retail context in many countries, namely South Africa (Christo & Terblanche, 1997), Singapore (Mehta et al., 2000), Kazakhstan (Anupam Das et al., 2008). However, this scale was proven being inappropriate for application in Indian retail (Kaul, 2007).

In specifically, regression analysis revealed that among 6 service quality components, Physical Aspects, Personal interaction, Problem Solving, Policy, and Information of Merchandise stress statistically and positively significant impact on both customer satisfaction and customer loyalty whereas Reliability just shows its positive relationship but not statistically significant one. Especially, Personal Interaction and Physical Aspects are two factors which express the strongest impact. This is also highlighted in the study by Beneke, J., Hayworth, C., Hobson, R. Mia, Z. (2012) in South Africa. In addition, this finding is also supported

by Olgun Kitapci (2013) in Turkey which stated that empathy, tangibility, responsiveness, and assurance are factors that are positively related to customer satisfaction, which in turn is positively related to customer loyalty, and by Wong, A., Sohal, A. (2002) in Australia which stated that tangible and empathy are two most significant factors which show strongly positive relationship with customer loyalty.

Furthermore, when investigating the differences between the means of three groups – Lower income, Medium income, and Higher income – in their assessment of service quality component as well as their satisfaction and loyalty level, the result indicated that customers with lower income seem to evaluate better about some service quality component of supermarkets and also have higher loyalty level with those supermarkets.

CONCLUSION

In examining the impact of service quality on customer satisfaction and customer loyalty at several supermarkets in Hanoi, it can be concluded that service quality is an undeniable driver of customer satisfaction and express obviously strong effects on customer satisfaction level. Among 6 components of service quality, Physical Aspects, Personal interaction, Problem Solving, Policy, and Information of Merchandise indicate their statistically significant impact while Reliability does not. Moreover, the investigation of controlling factor, such as income, also find some influence on customers' evaluation which leads to differences in service quality and loyalty assessment.

The results of this study are expected to either enrich the literature of service quality management in retail sector or enhance understanding about Vietnamese retail service quality from customers' perspective. In addition, the findings could benefit quality managers of supermarket sector in Vietnam who strongly desire to improve service quality of their organizations to get competitive advantages and sustainable development.

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RELATIONSHIP BETWEEN SERVICE QUALITY AND CUSTOMER SATISFACTION ON ATM SERVICE: CASE STUDY OF A PRIVATE COMMERCIAL JOINT STOCK BANK IN VIETNAM

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ABSTRACT
One of key challenge for Vietnamese commercial banks is how to compete in the market place with commonly undifferentiated services. The aim of this study is to investigate the impact of service quality performance on customer satisfaction on ATM service in a commercial bank in Vietnam Bank in Vietnam. This study applies SERVPERF framework to analyze the data collected from a questionnaire survey and found that ASSURANCE and TANGIBLES factors significantly impacts on the customer satisfaction.

Keywords: service quality, SERVPERF model, customer satisfaction, bank, ATM

INTRODUCTION

That Vietnam was an official member of WTO in 2007 has opened a new page for Vietnamese banking sector. Vietnamese commercial banks now must improve their competitiveness and exploit opportunities which are brought back from the opened market. The biggest challenge is the increasingly competitive pressure on the domestic market when Vietnam becomes more integrated, and demands of customers are changeable. In that sense, one of the most essential things Vietnamese commercial banks have to do is to improve service quality and diversify product line to meet various needs of customers and thus helping the banking sector become more and more integrated positively into the development of the banking sector in the region and in the world.

By applying modern banking technologies, Vietnamese commercial banks have launched a new product and service such as Automated Teller Machine (ATM). The appearance of ATM service has changed the basic transaction method in Vietnam's economy. Previously, almost all transactions and transfers on the market are primarily carried out by cash. But now, there is a significant change when Vietnamese has altered their habit from cash payment to using bank transfers and ATM services.

Therefore, developing ATM service is one of methods to increase competitive position of a bank in the market today in Vietnam. Indeed, ATM service is becoming a mean of transaction which is essential for banks to increase their competitiveness in the market. Together with the

race of providing diversified services of transaction, Vietnamese commercial banks also find out how to improve the quality of ATM service and satisfy customers. Thus, assessing the quality of ATM service and researching the relationship between service quality and customer satisfaction for ATM service are meaningful to improve the quality of ATM services of banks in the future.

Although researches on the impact of service quality on customer's satisfaction have been numerous (Chinh & Anh, 2008; Aborampah, 2011; Vijay & Selvaraj, 2012), those in Vietnam, especially for ATM service of banks, are still rare. Objective of this research is to provide one more empirical evidences for academics and practitioners by investigating the impact of service quality on customer's satisfaction for ATM service in Vietnam's commercial joint stock banks through using SERVPERF model. This research focuses on analyzing a case study of a private commercial joint stock bank (the Bank), to suggest solutions for itself and thus may generalize new findings for other commercial banks in Vietnam. The research uses quantitative method through questionnaire survey. Data collected from this survey was analyzed by SPSS 16.0 in order to find out the impact of service quality on customer's satisfaction for ATM service in the Bank.

This paper is divided into 7 main parts. Beside this introduction part, Section 2 provides literature review for the study. Research methodology is given in Section 3. Section 4 and 5 present research analysis and discussion. Recommendations for practitionners are given in Section 6. Finally, the paper provides a conclusion in Section 7.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Service quality and Customer satisfaction

There may be numerous definitions of service quality. *Service quality* is a customer's overall impression of the relative inferiority or superiority of the organization and its services (Bitner & Hubbert, 1994). Edvardsson, Thomsson & Ovretveit (1994) suggested that service quality is a service that fulfills the expectations of customers and satisfies their needs. Parasuraman et al. (1985) defined service quality as "the global evaluation or attitude of overall excellence of services". So, service quality is the difference between customers' expectation and perceptions of services delivered by service firms. Nitecki et al. (2000) defined service quality in terms of "meeting or exceeding customer expectations, or as the difference between customer perceptions and expectations of service". In addition, one of important definitions is that the quality of service as perceived by customer is the result of an evaluation process in which they compare their perspective of service outcome against what they expected (Gronroos, 2007).

Automated Teller Machine (ATM) is one type of innovation that can mechanically accept deposits, issue withdrawals, transfer funds between accounts, and collect bills**.** ATM service quality is defined as the customer's overall evaluation of the excellence of the provision of services through electronic networks such as Automated Teller Machine (ATM).

Measuring quality in service sector is more comprehensive than measuring quality of manufactured sector because quality evaluations are not made solely on the outcome of a service; they also involve evaluations of the process of service delivery. One of many service quality research models in the world nowadays is SERVPERF proposed by Cronin and Taylor (1992). This scale was based on SERVQUAL scale (Parasuraman *et al.*, 1985, 1988) which assessed service quality through the gaps between customer "expectations" - (E) and "perceptions" - (P).

However, SERVQUAL has been criticized on its confusion, and SERVPERF was proposed by Cronin and Taylor (1992) in which "expectation" - (E) component of SERVQUAL be discarded and instead "performance" - (P) component alone be used. Cronin and Taylor provided empirical evidence across four industries namely banks, pest control, dry cleaning, and fast food to collaborate the superiority of their "performance – only" instrument (Sanjay K Jain and Garima Gupta, 2004). The scale measure performance of five service quality components termed Tangible, Reliability, Responsiveness, Assurance, and Empathy (Parasuraman *et al.,* 1988).

The definition of *customer satisfaction* has been widely debated as organizations increasingly attempt to measure it. Customer satisfaction can be experienced in a variety of situations and connected to both goods and services. It is highly personal assessment that is greatly affected by customer expectations (CSSP.org, 2007).

Kotler defined customer satisfaction is the extent to which a product's perceived performance matches a buyer's expectations. If the product performance falls short of expectations, the buyer is dissatisfied. If performance matches or exceeds expectations, the buyer is satisfied or delighted (Kotler *et al*., 2005). Customer satisfaction is an important theoretical as well as practical issue for the marketers and consumer researchers. Customer satisfaction can be considered as the essence of success in today's highly competitive world of business (Vanniarajan & Anbazhagan, 2007). In this study, customer satisfaction is defined as the levels of service quality performances that meet customers' expectations.

Relationship between service quality and customer satisfaction

Parasuraman stated that there is a distinction between service quality and customer satisfaction: perceived service quality is a global judgment or attitude relating to the superiority of the service, whereas customer satisfaction is related to a specific transaction (Parasuraman *et al.,* 1988). However, many researchers have investigated the relationship between service quality and customer satisfaction.

Cronin & Taylor (1992) tested this relationship and concludes that perceived service quality leads to customer satisfaction. The other studies also conclude that service quality is the antecedent of satisfaction (Spreng & Mackoy, 1996; Brady and Robertson, 2001) and is the main factor which affects satisfaction (Ruyter, Bloemer, Peeters, 1997).

Sureshchandar et al., (2002) used a factor specific approach to test the relationship between service quality and customer satisfaction of different banks in India. These critical factors used are (1) core service or service product, (2) human element of service delivery, (3) systematization of service delivery: non-human element; (4) tangibles of service – servicescapes, (5) social responsibility. Questionnaires comprising 41 items in total were distributed to 452 customers from 51 different banks, and then 277 completed questionnaires from 43 banks were obtained. Analysis results revealed that correlation statistics between service quality and customer satisfaction are reasonably high which demonstrated high relationships between service quality and customer satisfaction.

Anber et al. (2011) conducted a research about service quality perspectives and customer satisfaction in commercial banks working in Jordan. The research examined level of service quality as perceived by 260 customers and its effect on customer satisfaction with the questionnaire survey including 20 items to measure 5 dimensions of service quality (Reliability, Responsiveness, Empathy, Assurance, and Tangibles) and 5 items to measure customer

satisfaction. The results indicated that 5 dimensions of service quality have significant influence on customer satisfaction when 26.1% of customer satisfaction can be explained by them.

From these researches, it can be concluded that service quality and customer satisfaction have a positive relationship in which service quality is an antecedent as well as an important factor impacting on customer satisfaction.

SERVPERF model

SERVPERF is one of popular models measuring service quality in the world. It was used in many researches (Zhou, 2004; Hudson P. Rogers, 2004; Do Tien Hoa, 2007; Pham Ngoc Thuy and Nguyen Huy Phong, 2007…). In SERVPERF model, five dimentions include:

- Tangible includes physical evidences of the service such as appearance of physical facilities, equipments, personnel, etc.
- Reliability involves the ability of the organization to perform the promised service dependably and accurately.
- Responsiveness concerns the willingness or readiness of employees to help customers and provide services.
- Assurance refers to knowledge and courtesy of employees and their ability to convey trust and confidence.
- Empathy is individualized cares and attentions that the firm provides to its customers.

In short, the study will be applied SERVPERF model to measure service quality of ATM in a private commercial Joint Stock Bank in Vietnam as well as its customer satisfaction. Moreover, there are a few researches that were applied SERVPERF model to measure service quality in Vietnam. Especially, the numbers of researches are fewer in banking sector comparatively with others. Traditionally, SERVQUAL model is used to measure service quality frequently, therefore applying SERVPERF model is quite new in service quality measurement in Vietnam. This study will contribute for advance of service quality measurement and it will become a reference or sample to other researches in the future.

To find out the relationship between customer satisfaction and service quality, it is necessary to hypothesize the relationship among service quality dimensions, perceptions of customer and their satisfaction.

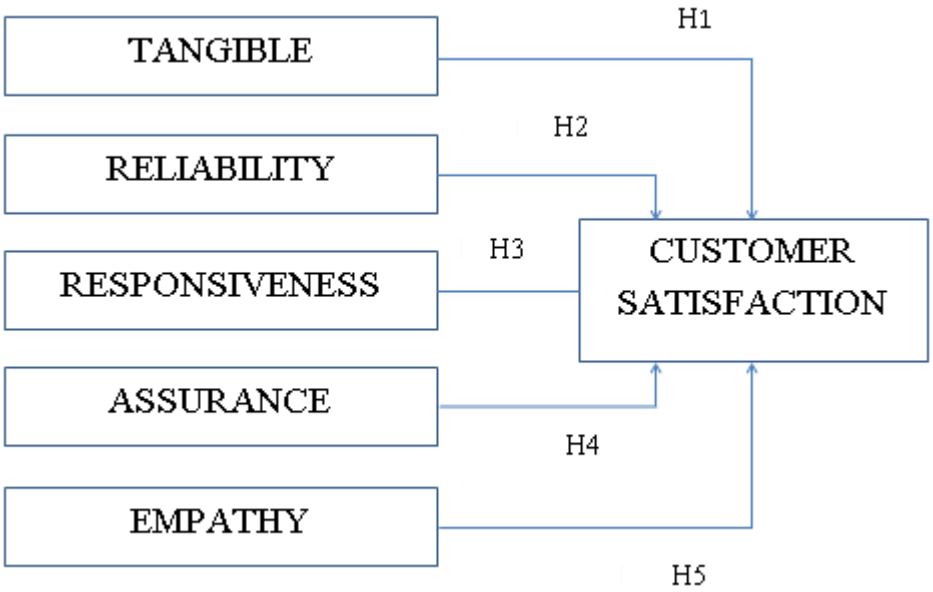

Figure 1 - Hypotheses of research model

Where:

- H1: Tangible component and customer satisfaction have a positive relationship.
- H2: Reliability component and customer satisfaction have a positive relationship.
- H3: Responsiveness component and customer satisfaction have a positive relationship.
- H4: Assurance component and customer satisfaction have a positive relationship.
- H5: Empathy component and customer satisfaction have a positive relationship.

RESEARCH METHODOLOGY

Designing questionnaire

The questionnaire survey includes mainly 24 observed items under SERVPERF model, in which 22 items are divided into 5 components of service quality: Tangible, Reliability, Responsiveness, Assurance, and Empathy; the 2 remaining variables are used to measure customer satisfaction. This measurement bases on a 5-point rating scale which corresponding to 1 = strongly disagree, 2 = somewhat disagree, 3 = neither agree nor disagree, 4 = somewhat agree, 5 = strongly agree. Specifically, these variables can be described and encoded as follows:

- Reliability Component: representing the reliability and confidence of customers to the bank services, including 5 observed variables (From R1 – R5);
- Responsiveness Component: representing the ability to quickly resolve customers' requirements, concerns or inquiries which are related to ATM Card, including 5 observed variables (From S1 – S);

- Assurance Component: representing the qualification as well as polite and courteous attitude of ATM Card Issuing officers to customers, including 5 observed variables (From A1 – A5);
- Empathy Component: representing the empathy and considerate caring to customers and provide customers with as the best possible service, including 4 observed variables (From E1 – E4);
- Tangibles Component: is evaluated through the appearance outsides the ATM service facilities such as: Appearance and uniforms of the staffs, including 3 observed variables (From T1 – T3).

Table 1 - Encoding the quality rating scale of ATM Service of the Bank

No	Code	Description
	R	**Reliability Component**
1	R1	Bank commits to provide customers all the ATM services (withdrawals, account management, money transaction etc) in accordance with the terms specified in the signed contract
2	R2	Any clients' questions, complaints or concerns about ATM Card Service are satisfactorily resolved by bank
3	R3	Customers are informed after every transaction done on ATM
4	R4	ATM carries out exactly what customers required
5	R5	Customers received ATM Card at the time committed by bank
	S	**Responsiveness Component**
6	S1	Bank staffs are willing to answer any questions or concern of customers
7	S2	Bank staffs are not willing to help customers solving their problems or concerns
8	S3	Bank staffs do not heartedly serve customers in peak hours.
9	S4	ATMs are installed at the places which is convenience for customers to make transaction.
10	S5	ATM always provides enough cash for customers to withdraw on special occasions or Tet holidays.
	A	**Assurance Component**
11	A1	ATM Issuing staffs always clearly get information about cards and policies while consulting customers.
12	A2	ATM Issuing staffs have a clear and understandable explanation to customers.

13	A3	Customers feel safety when make any transaction at ATM
14	A4	Bank staffs are always gentle and polite.
15	A5	Customers put more and more trust and confidence in ATM staffs after each transaction.
	E	**Empathy Component**
16	E1	Whenever going for a transaction at bank, customers are always warmly welcomed by receptionist.
17	E2	Whenever going for a transaction at bank, customers are always guided to the right parking area by safe guard.
18	E3	Bank staffs always spend a lot of time to understand the concerns of customers.
19	E4	Bank staffs always take care for each and every individual customer.
	T	**Tangibles Component**
20	T1	ATM Card has good appearance and suitable size
21	T2	The screen of ATM always displays clearly
22	T3	There are always instruction signboards put at the place ATMs installed which is easy for customers to identify.
		Customer Satisfaction
23	CR	Customers are totally satisfied with quality of the ATM Service
24	CS	Customers will introduce the ATM Service to other people

Data Sample

Information will be collected from the surveys of customers coming to the Bank branches or transaction offices within Hanoi from February 17 to May 5, 2013. Direct interview accompanied with surveys are used to collect the information.

Samples were chosen in a random and convenient manner, including all customers who are using the Bank ATM service, regardless of gender, age and financial capabilities. Analysis methods that are mainly used in this research are Explanatory Factor Analysis EFA and Multiple Regression Analysis. According to Hair et al (1998), it is necessary to collect a data containing at least 5 samples in each observed variables in order to obtain Explanatory Factor Analysis.

This research model has 24 observed variables. According to the criteria - 5 samples for an observed variables - the needed size of sample will be n= 120 (24 x 5). To obtain the required sample size, 250 questionnaires were sent to interview. After two weeks, authors collected 200 questionnaires back including 14 invalid ones, which contained many blank answers. Therefore, after removing14 invalid questionnaires, 186 remained questionnaires met the requirement on size of samples. With sample size is 186, the author will use SPSS 16.0 software to clean and process data.

Analysis methodology

The data collected will be refined and processed by SPSS 16.0 software. Several following analysis methods are used in this research to find out and test impact of the factors on the quality of ATM service.

Reliability analysis

This method assists analysts in removing irrelevant variables. It also helps evaluating the reliability of the measurement by Cronbach Alpha coefficient. Variables which have item-total correlation less than 0.3 will be removed. Measurements with Cronbach Alpha being greater than or equal to 0.6 can be deployed (Nunnally, 1978; Peterson, 1994; Slater, 1995). Normally, measurements with Cronbach alpha from 0.7 to 0.8 will be used. Many researchers assume that those which have the reliability from 0.8 to nearly 1.0 are acceptable measurements.

Exploratory Factor Analysis

After assessing the reliability of measurements by Cronbach Alpha coefficient and removing unreliable variables, exploratory factor analysis will be used to reduce and summarize the data. This method is very useful in determining the variable set necessary for the research as well as in finding the relationship between variables.

In exploratory factor analysis, KMO index (Kaiser – Meyer – Olkin) is deployed to indicate the suitability of factor analysis. If KMO index lies between 0.5 and 1, the analysis is suitable.

In addition, factor analysis depends on Eigenvalue in determining the number of factors. Only factors with Eigenvalue greater than 1 are kept in the model. Eigenvalue represents the varying element explained by factors.

One significant part of the factor analysis result table is the component matrix or rotated component matrix. This component matrix contains coefficients representing standardized variables by factors (each variable is a polynomial of factors). Factor loading coefficients show the link between variables and factors. Those coefficients reveal how close the relationship between variables and factors is. As the research uses factor extraction - principal component method, factor loading coefficients must have weights greater than 0.5.

Regression analysis

After extracting factors from exploratory factor analysis EFA, we search the necessary assumption violations in the multiple linear regression model such as testing standardized residual, testing Variance inflation factor VIF. If its assumptions are not violated, the multiple linear regression model will be used. And the adjusted R^2 depict how well the model has been built.

ANALYSIS RESULTS AND DISCUSSION

Reliability test

Table 2 - Cronbach Alpha coefficients of measurement components

Observed Variable	Expected value if the variable is removed	Variance if the variable is removed	Item-total correlation	Cronbach's Alpha if the variable is removed
Reliability component (R): Alpha = .819; N of Item = 5				
R1	14.8925	11.469	.650	.771
R2	14.7957	11.850	.589	.790
R3	14.9247	12.816	.542	.802
R4	14.8925	12.756	.527	.806
R5	14.8387	10.979	.747	.740
Responsiveness component (S): Alpha = .796; N of Item = 5				
S1	15.4677	10.856	.580	.756
S2	15.4677	10.402	.610	.746
S3	15.7419	10.549	.549	.766
S4	15.4516	10.335	.597	.750
S5	15.5269	11.040	.546	.766
Assurance component (A): Alpha = .808; N of Item = 5				
A1	14.1237	11.168	.631	.759
A2	14.1559	11.246	.630	.760
A3	14.0860	11.398	.631	.760
A4	14.1828	11.642	.524	.793
A5	14.2258	11.711	.559	.782
Empathy component (E): Alpha = .736; N of Item = 4				
E1	10.4892	7.992	.502	.692
E2	10.5484	7.935	.575	.653
E3	10.8172	7.566	.537	.671
E4	10.6935	7.781	.503	.692
Tangibles component (T): Alpha = .687; N of Item = 3				
T1	7.0591	3.559	.557	.536
T2	7.2258	3.268	.524	.566
T3	7.1452	3.390	.437	.685

After making reliability test, all those 22 variables have the correlation greater than 0.3, so they are all accepted. Moreover, as Cronbach Alpha coefficient is more than 0.6, reliability component measurement is qualified. Those variables will be included in the next factor analysis.

Exploratory Factor Analysis (EFA)

ATM service quality measurement of the Bank is in accordance with SERVPERF model, comprising 5 main components with 22 observed variables. All 22 variables have passed the reliability test by Cronbach alpha coefficient. Exploratory factor analysis EFA is utilized to re-assess the convergence of observed variables around the main components.

KMO and Barlett's test in factor analysis show that KMO index is high at 0.904 (greater than 0.5) with the significance equal to 0 (sig = 0.000). It can be concluded that EFA is suitable for the analysis.

Table 3 - Exploring factor analysis for service quality scale

KMO and Barlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.904
Bartlett's Test of Sphericity	Approx. Chi-Square	1.73703
	Df	231
	Sig.	.000

Total variance explained

Component	**Initial Eigenvalues**			**Rotation Sums of Squared Loadings**		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.364	38.019	38.019	3.279	14.902	14.902
2	1.478	6.718	44.736	2.787	12.668	27.570
3	1.282	5.829	50.565	2.708	12.311	39.881
4	1.128	5.127	55.692	2.266	10.302	50.183
5	1.041	4.734	60.427	2.254	10.244	60.427

Rotated Component Matrix

	Component				
	1	2	3	4	5
R1	.661				
R2	.726				
R3	.640				
R4	.562				
R5	.703				
A1			.640		
A2			.601		
A3			.594		
A4			.717		
A5			.566		
S1		.732			

S2		.751			
S3		.547			
S4		.655			
S5		.577			
E1				.712	
E2				.514	
E3				.729	
E4				.494	
T1					.629
T2					.603
T3					.750

Applying the extraction method: principal components analysis and varimax rotation method at every level of Eigenvalues greater than 1 and, analyzing variables which has been extracted 5 from 22 observed variables and with cumulative variance is 60.427% (greater than 50%) satisfied.

Based on the analysis of the Rotated Component Matrix table, there are 5 Reliability components, including: R1; R2; R3; R4; R5 all with loading coefficients greater than 0.4 (respectively: 0.661; 0.726; 0.640; 0.562 and 0.703). The second components have 5 observed variables, including: S1; S2; S3; S4; S5, with loading coefficients greater than 0.4 (respectively: 0.732; 0.751; 0.547; 0.655 and 0.577). The next components are Assurance (A), which have 5 variables: A1; A2; A3; A4; A5 all having coefficients greater than 0.4 (respectively: 0.64; 0.61; 0.59; 0.717 and 0.56). Similarly, all Empathy and Tangibles components have loading coefficients greater than 0.4.

In summary, the result of analyzing explortory factors (EFA) shows that every service quality component remain 5 factors with 22 observed variables, including: Reliability component (R); Responsiveness component (S); Assurance component (A); Empathy component (E) and Tangibles component (T).

Customer Satisfaction Scale Analysis

Table 4 - Exploring factor analysis for customer satisfaction scale

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.500
Bartlett's Test of Sphericity	Approx. Chi-Square	54.407
	Df	1
	Sig.	.000

Component Matrix

	Component
	1

CS1	.868
CS2	.868
Eigenvalues	1.507
% of Variance	75.327

The analysis of KMO and Bartlett's test of sphericity shows that the analysis of EFA is rather suitable, with KMO coefficient = 0.500 and Sig value = 0.000.

Customer satisfaction scale has been extracted into one component that is greater than Eigenvalue 1. Furthermore, the two customer satisfaction loading coefficients are all greater than 0.4. According to that, after applying EFA for customer satisfaction, the 2 remaining variables were extracted into 1 component: Customer Satisfaction (CS)

Regression Analysis

In multiple regression analysis, dependent variable is Customer Satisfaction (CS) and independent variables are Reliability component(R), Responsiveness component (S), Assurance component (A), Empathy component (E) and Tangibles component (T). The mean value of independent and dependent variables was calculated before conducting multiple regression analysis.

Table 5: Regression analysis summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.586[a]	.343	.325	.76883

Coefficients

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
Model	B	Std. Error	Beta	t	Sig.	VIF
(Constant)	.832	.316		2.628	.009	
R	.031	.096	.028	.319	.750	2.073
A	.484	.102	.427	4.728	.000	2.233
S	.002	.094	.002	.022	.982	1.737
E	.028	.089	.027	.317	.752	2.001
T	.196	.085	.180	2.299	.023	1.672

In the Model summary table, the coefficient R^2 is 0.343. Thus, 5 service quality components explain 34.3% of Customer Satisfaction deviations, including: Reliability component, Assurance component, Empathy component and Tangibility component.

The relatively small result of Variance Inflation Factor (VIF) (smaller than 10) shows that these independent variables are not closely related to each other so there is no multicollinearity

occuring. The coefficients analysis table shows the result of multiple regression analysis. Positive mark of regression coefficients show that components in the regression model above has positive relationship with customer satisfaction.

In terms of each component, Assurance component (A) has a coefficient of 0.484, with significant value = 0.000 (<0.05). Thus, Assurance component (A) has the most significant impact on customer satisfaction. Similarly, the coefficient of Tangibles component (T) is 0.196, Sig. = 0.023 (<0.05). Because of that, Tangibles component (T) also has significant influence on customer satisfaction.

The 3 remaining independent components including: Reliability component (R), Sig. = 0.982; Responsiveness component (S), Sig. = 0.750; Empathy component (E), Sig. = 0.752 are greater than significant level 0.05, so all these components are not significantly effect on customer satisfaction. It means that we only accept two out of five hypotheses H4 and H5. Although 3 components: Reliability, Responsiveness, Empathy have no significant impact on the level of customer satisfaction, but these 3 components act as sufficient condition to establish the quality of the Bank service

DISCUSSION ON THE SATISFACTION OF CUSTOMERS OVER THE QUALITY OF ATM SERVICE IN THE BANK

Customer satisfaction with the Bank's ATM service was created by five quality components, which are Reliability, Responsiveness, Empathy, Assurance, and Tangibles. Results of linear regression shows that service delivery capacity and tangible utilities have significant influence on customer's satisfaction. It means that the higher assurance and tangibility are, the more satisfaction of customers get. More specifically, in terms of assurance, customers highly appreciate the thorough knowledge about expertise and professionalism of banking officers in contact with customers, which requires the affability, courtesy and politeness, thus building up the trust and credibility for customers. Therefore, it can be seen that the Bank has staffs with deep expertise and professionalism in providing customers with ATM service. The good human resources have brought the Bank the competitive advantage in providing ATM service. Besides, the level of security, confidentiality and utility in transactions are also chosen by customers as the criteria to demonstrate their satisfaction over ATM banking service of the Bank. Customers feel secure and committed to become long-term customers of the Bank.

Regarding tangibility, the quality of ATM card (nice design and suitable size), the equipment for transactions such as: always-clear computer display screen, convenient and easy identification of the teller (ATM machinery) are the factors that create satisfaction of customers over the service. Among them, quality criteria, appearance, design of cards are highly evaluated as they are appropriate for using in a dynamic and modern life. Furthermore, the display screen of machinery also affects the quality of service of the Bank. ATM machineries' screens of the Bank have high resolution, user-friendly and convenient window display for users, which create advantage for the quality of service of the Bank. Last but not least, customers highly appreciate the convenient, easily-identified and highly secured place of ATM machinery in making transactions.

RECOMMENDATIONS

Based on the findings mentioned above, the paper can give several valuable recommendations. First and foremost, the Bank should review its business strategy, especially strategy of development of ATM service to see whether the Bank is following strategy of best products and services or total customer solutions. Then, customer segmentation will be considered to decide the best appropriate strategy and thus improving properly service quality to serve the customer better. After determining the strategic directions, following specific recommendations should be considered.

Recommendations for Assurance

The Bank needs to constantly improve service quality to enhance customer satisfaction, especially improving the quality of human resources. It is important to have enough human resources and also improve the capabilities of human resource. Customer caring staffs must be knowledgeable, professional and equipped with soft skills i.e communication skill and sales skill. Simultaneously, the bank staff should also have good service attitude, be polite, enthusiastic to meet customer's expectation and to shape positive behavior and attitude in customer service among their employees.

The Bank continuously improves the level of modern banking technology. The technological capabilities and people using that technology play a crucial role in the quality of customer service. Technology creates rapid advancement and enhances the ability to meet customer expectations. The trust and loyalty of customers depend on modern technology, as well as the utility, value added services for customers.

Bank offices, especially where conducting transactions with customers should be decorated beautifully, eye-catching and have harmonious color combinations, easily recognizable and distinctive decorations against other banks. Headquarters should have a logo and slogan statement in ensuring quality services. The staff uniform also creates a comfortable and friendly atmosphere for customers and make customers more assured when having transactions with the bank.

The Bank should regularly communicate with customers. Exchanging information with customers plays an important role in understanding and meeting customer expectations. Information exchange can be carried out in various forms and can be implemented parallel to each other such as customer conference, advertising programs, promotion of products and services, survey of customer needs, and hotline set up etc. By doing these, banks transmit to customers information about products, services, handle customer requests and collect feedback as well as customer complaints related to banking activities. The bank also needs to store centralized data about customers to facilitate customer service.

Moreover, customer complaints should be considered as signal for the banks to continuously improve service quality. The research shows that customers often complain about certain types of errors. If these errors could be found out timely, recorded, and amended actions to be made promptly, the number of complaints would drop. It also translates to the fact that customer confidence and satisfaction are enhanced. Many bank employees, even managers are worried, scared and reluctant to handle customer complaints. It is common that they do not show enthusiasm upon receiving complaints. This is a misconception because customer complaints not only provides an opportunity to rectify and improve service processes but also creates an

opportunity to retain customers. In addition, it also limits the spread of information since dissatisfied customers would tell others about their dissatisfaction.

The Bank should build a base of regular and loyal customers. The loyal relationships of customers are reflected in long-term transaction relationships, the ability to increase the size and diversity of the transaction and the ability to persuade others to use the bank's services. Customer loyalty increases profits through increased sales, reduce customer sensitivity to price, and reduce customer service costs because they are now familiar with the bank's operating system. To have a base of loyal customers, the bank should firstly start to build customer's trust & belief in bank services and also ensure service quality provided by the bank. In addition, the attitude, professionalism and the ability to satisfy customer needs are important factors. Besides, it is not correct to assume that discount and promotion campaign are enough to attract and retain customers. These solutions only work in short term and can attract just a small number of random customers. However, they would fail to gain customer loyalty if these campaigns cannot ensure service quality of the bank.

Recommendations for tangibles

For transaction space, the Bank needs to estimate the future market development before choosing to open new transaction locations in order to avoid the circumstance that the Bank must upgrade or widen them only after a short time, which is wasteful and has negative influence on the psychology of customers when transactioning during time of construction. In addition, card division should be established in each transaction location to give exact advice to the customers on the advantages and utility of using cards.

Regarding documents, leaflets on ATM ervice, the Bank should check the currently used leaflets to reject the ones with too obsolete information, too sketchy design or overlapping contents. It also should have professional design organizations consult about necessary contents and images to yield leaflets that can attract customers' care and attention. Especially, the Bank needs to design unique and fresh banners in promotion programs to advertise the sevice directly and lively.

In terms of ATM locations, while carrying out a survey and choosing locations to install ATMs, along with the criteria of population density, traffic system, the Bank needs to carefully study the secutity issues, especially parking place for the customers. To do this effectively, parking area should be included in the ATM room construction design, which is an important factor that helps customers feel comfortable and safe with their properties when conducting transactions.

CONCLUSION

Service quality plays a significant role in maintaining and developing sustainable competitive advantage of company or firm because service quality influence on customer satisfaction directly. Thus, this study focus on investigating on the relationship between the service quality and the customer satisfaction on ATM service of a private commercial bank in Vietnam by using SERVPERF model.

The research used 24 observed items divided into 5 components of service quality and one component of customer satisfaction based on SERVPERF model. The number of respondents is 186 and these samples were tested by using SPSS software 16.0 through descriptive analysis,

factor analysis and regression analysis. As a result, there are two factors that have impacts on ATM service quality of the Bank, which are assurrance and tangibles, in which assurrance has the strongest effect on the customer satisfaction.

Based on these findings, some recommendations for improving the ATM service quality of the Bank are raised in the upcoming time. In addition, the study results are also useful implication for other banks when making their service policy. This study provides one more empirical evidences for academics on ATM service quality of commercial banks by using SERVPERF model.

The study made positive contribution to the bank in learning about factors affecting the customer satisfaction at ATM service quality. However, this study also has the following limitations: firstly, the study was carried out on customers using the ATM service of the Bank so its generalization level is not high. Its generalization level would have been higher if this study had been carried out for some more banks in other cities in Vietnam, which is a direction for the next research. Secondly, this study only focuses on private customers with their own criteria to evaluate the service quality, so the study results cannot be right for all customers. This study should be additionally conducted on enterprise customers, thus we can generalize the customers satisfaction at ATM service quality. Finally, the study mainly considers the effects of quality factor on the customer satisfaction at ATM service quality. There may be many other factors which affect the customer satisfaction such as enterprise image, customer value, etc. This also suggests for further research.

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CHINESE PEOPLE'S PERCEPTIONS OF TELEWORK −COMPARING BETWEEN WORKING EXPERIENCE GROUP AND NO WORKING EXPERIENCE GROUP

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ABSTRACT
The advancement of ICTs has changed working styles and locations of western developed nations. Teleworking is well-known and widely applied to enhance working efficiency, working life quality, balancing work-family life, etc. On the other hand, although telework is on the way more than 10 years in China, there are still a number of people, even the on-the-job staffs, are unfamiliar with the concept of 'telework'. However, it is said that many Chinese people were familiar with the concept of SOHO, which is a type of Telework. In order to make clear of these confusions, successions of surveys were conducted. These surveys are the first study to investigate the people's perceptions of and their attitudes toward 'telework' in China. The results show that perceptions about SOHO are significantly different between two groups ("Working Experience Group" and "No Working Experience Group"). On the other hand, perceptions of other concepts on telework are almost identical between two groups.

Key words: Telework, Chinese, Working Experience, Perception, Attitude

INTRODUCTION
With over 20 years' rapid development and the global economic integration, China, like many other developed countries, has faced various problems, such as overcrowded metropolis and uncontrollable environmental problems due to concentration of industries and business activities in big cities. In particular, the problems such as increasing land price, heavy traffic jams, air pollution, and long-time commuting in big cities such as Shanghai and Beijing are serious and appear to be a never ending problem. However, it is possible that many of these problems can be solved by implementing telework (Higa & Wijayanayake, 1998).
Telework has been in a rapid rise since the growing popularity of internet at the end of the twentieth century. People's perceptions regarding the changing of conventional working style to telework can be a determining factor in human resource management (Hsu & Chang, 2006). In the view of Chinese, as the biggest developing country and the nearly one quarter of population in the world, the emerging telework also present a rising demand for technology associated with it (Hsu & Chang, 2006). However, in China, the environment to carry out telework has not yet been well established (Wang, Zhang & Xu, 2004). Furthermore, there is only limited data on the extent to which telecommuting is used, or its success in China

(Raghuram & Fang, 2011). Actually, the concept of 'telework' has not spread over the people in China (Wang, Zhang & Xu, 2004). According to a survey, it was only 17.9% of the respondents had heard of the word of 'telework' (Zhao & Higa 2007).

On the other hand, in contrast with being less recognized 'telework', it is said that many Chinese people had recognized SOHO (enread com, 2007). However, most of them confused 'SOHO' with 'telework'. Some of them regarded telework as SOHO; the others considered WAH (work at home) was identical with SOHO (Chinese Learning, 2003).

In order to make sure of these confusions above and investigate what extents do Chinese people know about telework, successions of surveys were conducted. The purpose of these surveys is to explore the job-seekers and working staffs' perceptions of 'telework' and their attitudes toward the new working style. The reason why conducting the survey to job-seeking students is that their knowledge of these concepts and attitudes toward the new working style play an important role in job-seekers' expectation of recruitment. On the other hand, the reason why conducting the survey to on-the-job MBA students is to make sure what is the relationship between working experiences and cognitions of telework and as well as attitudes toward it. These surveys are the first study to disclose the people's perceptions of and their attitudes toward 'telework' in China.

The structure of remaining paper is organized as follows. In section two, we introduce existing telework researches on China and find the deficiencies in previous studies. The description of the research methodology including survey design and data collection is explained in section three. The results of data-testing and analysis of survey are displayed in section four. Findings, limitations of the study and future researcher are discussed in section Five. In the final section, conclusion of the research is presented.

LITERATURE REVIEW

The terms of 'telework' or 'telecommuting' were coined in 1973 (jala.com, 2011). Up to now, the new working style is becoming more and more popular. According to a Reuters poll (Patricia, 2012), approximately one in five workers around the globe, particularly employees in the Middle East, Latin America and Asia, telecommute frequently and nearly 10 percent work from home every day.

With over 20 years' rapid development and the global economic integration, China is being constantly in line with advanced trends of the world from various aspects. The adoption and the implementation of 'telework', the latest working style, is one of the typical examples.

Adoption of telecommuting has been reported from time to time. For example, during the 2008 Olympics when the Beijing municipal government asked the city's state-owned enterprises, institutions and social groups to handle business online and arrange flex-time arrangements (such as work at home) where feasible (XinHua Net, 2008). From 2009, smart commuting services (telecommuting) have been delivered by the Chinese telecom industry, such as China Mobile, to reduce CO2 emissions (Yang, Hu, Zheng & Dennis, 2009). In 2010, in order to reduce gross national carbon emissions, China National Development and Reform Commission chose Hubei Province to undergo the country's first telecommuting pilot program (CNBusinessNews.2010). Still in the year of 2010, take advantages of opportunity of EXPO 2010, Shanghai government issued policy options for ICT for 'Smart Cities' and one of them was encouraging and supporting telecommuting (Shanghai Manual, 2010).

Among the researches on 'telework' in China, some are focus on the efficacy or productivity if employees telework. According to the results of Ctrip company's (a leading travel agency in China) experiments, home workers were more productive (Bloom, Liang, Roberts and

Ying, 2013). Some are combining telework with conventional culture environment of China. For examples, Long, Kuang and Buzzanell (2013) discussed the legitimacy of Chinese teleworkers and how they dealt with Chinese traditional culture, such as guanxi. Researchers Hsu and Chang (2006) explored how Chinese people perceive telework differently from their western counterpart under Chinese collective culture. Some are concentrated on the managers, such as supervisory power (Raghuram & Fang, 2013). The others are standing on the point of social views and studying on the benefits or policies to 'telework' (Wang, Zhang and Xu, 2004). However there were no researches focuses on Chinese people's extents of perceptions of telework in China.

Some initial studies have been carried out to assess viability of telecommuting in China (Raghuram & Fang, 2013). While these studies note benefits similar to those experienced by their Western counterparts (Chen & Ling, 2004), they also note some drawbacks specific to the Chinese context. One such study identifies the importance of management style based on trust and delegation, organization and communication skills, and communication technology (Shao, 2006). Another study emphasizes the importance of performance monitoring and the use of appropriate evaluation criteria (Chen & Ling, 2004; Li, Zhang & Liu, 2005). Approximately 40% of the companies reportedly gave up telecommuting because of managerial issues such as the perceived loss of control or inability to monitor subordinates (Zhang, 1999).

However, although this new working style is on the way more than 10 years in China, there is only limited data on the extent to which telecommuting is used, or its success in China (Raghuram & Fang, 2011). It can be said that there is little research on telework in China as well (Long, Kuang & Buzzanell, 2013). One obvious example is that the concept of 'telework' has not spread over the people, even some on-the-job staffs, in China (Wang, Zhang & Xu, 2004). According a survey to the working people conducted by Zhao & Higa (2007), it was only 17.9% of the respondents had heard of the word of 'telework'. On the other hand, in contrast with being less recognized 'telework', it is said that many Chinese people had recognized SOHO (small office home office), which is one of the categories of telework (enread com, 2007; Sato, 2008). Actually, most of them are confusing 'SOHO' with 'telework'. Some of them regard telework as SOHO; the others consider WAH (work at home), which is another categories of telework, is identical with SOHO (Chinese Learning, 2003; Sato, 2008). In other words, both 'SOHO or telework' and 'SOHO or WAH' are thought to be used interchangeably in China. Therefore, it is necessary to make clear these confusions and investigate the extents of Chinese people's perceptions of 'telework'.

Furthermore, the nature of telework of working without actual presenting in person may be perceived differently by people in different cultural and social background (Hsu & Chang, 2006). The culture theory states that there is difference in people's perception on lots of issues in different region due to different living condition (Cheng, Jung & Cheng, 2002). Therefore, based on the conventional culture, will Chinese people accept 'telework' or not? And can this new working style apply to Chinese working places or not?

In order to make clear these confusions and problems above, a succession of surveys were conducted. The purpose of these surveys is to explore the job-seekers and working staffs' perceptions of 'telework' and their attitudes toward the new working style. The reason why conducting the survey to job-seeking students is that their knowledge of these concepts and attitudes toward the new working style play an important role in job-seekers' expectation of recruitment. On the other hand, the reason why conducting the survey to on-the-job MBA students is to make sure what is the relationship between working experience and perceptions

of telework and as well as attitudes toward it. These surveys are the first study to disclose the people's perceptions of and their attitudes toward 'telework' in China. Through these surveys, both theoretical and practical implications could be conducted.

METHODOLOGY

1. Surveys Design

Sampling of these studies is by anonymous questionnaire survey. Subjects been tested are full-time universities students employees and MBA students. Most of them are in Shanghai.

Surveys were conducted three times in all. The 1st survey was investigated to the full-time students and the rest two were investigated to the MBA students. The questions on perceptions in three surveys were totally the same, but in the sections of attitudes, according to different respondents and specified situation, questions were revised and added.

There are 3 sections in surveys. Part one is respondents' personal background information. In this section, according to different kinds of respondents (full-time students and on-the-job MBA students), corresponding information was asked. For example, in the 1st survey, all the questions in part one is about personal information for full-time students such as major and grade. However, in the 2nd and 3rd surveys, due to respondents were changed into on-the-job MBA students, the questions about working situation such as tenure and industrial sectors were asked.

Part two is 'The Investigation of Respondents' Levels of Perceived Views of Telework'. In this section, 7 questions were set up in all three surveys and respondents' own knowledge on telework were investigated. In additon to 'Telework' and 'SOHO', 'Work at home' became another investigation target of perception. It is because that these three concepts are easily confused by Chinese people (enread com, 2007; Chinese Learning, 2003). Through these questions, it may uncover some special relationships among 'Telework', 'SOHO' and 'work at home' to Chinese people.

Part three is 'The Investigation of Respondents' Attitudes toward Telework'.In part three, first of all, a brief introduction of telework was given in all surveys. After reading it, respondents were asked to finish the following questions. In this section of the 2nd and 3rd surveys, questions related to personnel management policies at working places such as 'Work Life Balance (WLB) 'were added besides the common questions in all surveys. Almost all of the questions in section three are aim to find the respondents' attitudes toward telework.The last question of the whole surveys is an open type written-question and the purpose is to collect ideas, comments or suggestions about adoption or implement of telework in China from respondents.

Since one brief introduction of telework was given in part three, and if respondents revised their answers after reading the material, it might impact the acuraccy and facticity of the percepition of telework. In order to avoid this problem, the online-based questionnaires (1st and 3rd surveys) were designed to be irreversible. In other words, respondents could not return to previous pages to revise their answers. As for the paper questionnaire in 2nd surveys, after respondents finishing and handing over the papers of part one, papers of part two and part three with brief introduciton were handed out into their hands. Therefore, all the surveys could guarantee the accuracy and facticity.

Table 1 is the detail of three surveys.

Table 1-Detail of Surveys

	Survey 1	Survey 2	Survey 3
Conducting Period	2012.8.10.-9.20	2013.1.24	2013.9.20-10.20
Qualifications of Respondents	Undergraduate students and above	MBA students	MBA students
Respondents	165	15	98
Valid Samples	160:(123 No WE vs. 37 Yes WE)	15	98
Conducting Method	Online	Paper	Online
Number of Question Items	22	26	30

Notice: 'WE' refers to 'Working Experience'

2. Data Collection

In this paper, we only focus on the section of Chinese people's perceptions of telework.

In order to measure how working experiences impact the perception of 'telework', the data and results showed below were divided into two groups: one group with working experiences and the other without. According to table 1, the number of respondents in two groups is respectively 123 (No Working Experience) and 150 (37+15+98, With Working Experience).

(1) Perceptions of 'Telework (TW)', 'SOHO' and 'Work at home (WAH)'

Table 2-Perceptions of 'Telework (TW)', 'SOHO' and 'Work at home (WAH)' in Two Groups

	TW		SOHO		WAH	
Know	10 (8.13%)	35 (23.33%)	21 (17.07%)	61 (40.67%)	40 (32.52%)	69 (46%)
Only heard	87 (70.73%)	95 (63.33%)	63 (51.22%)	80 (53.33%)	76 (61.79%)	77 (51.33%)
Unknown	26 (21.14%)	20 (13.34%)	39 (31.71%)	9 (6%)	7 (5.69%)	4 (2.67%)
N	123 (No WE)	150 (WE)	123 (No WE)	150 (WE)	123 (No WE)	150 (WE)

Notice: 'WE' refers to 'Working Experience'

If regarding 'Know' and 'Only heard but not know well' as cognition, and regarding 'Totally unknown' as no cognition, table 3 can be summarized.

Table 3-Cognitions of 'Telework (TW)', 'SOHO' and 'Work at home (WAH)'

	WE	No WE
Telework	130 **86.67%**	97 **78.86%**
SOHO	139 **94%**	84 **68.23%**
WAH	146 **97.33%**	116 **94.31%**
N	150	123

Notice: 'WE' refers to 'Working Experience'

Since telework is a kind of new working style, the one who has working experiences should perceive telework much better than the one who has no working experiences.

We could assume the hypotheses below: ('WE' refers to 'Working Experience')

H1: There is significant difference of the perception of TW between 'WE' and 'No WE' groups.

H2: There is significant difference of the perception of SOHO between 'WE' and 'No WE' groups.

H3: There is significant difference of the perception of WAH between 'WE' and 'No WE' groups.

(2) Perceptions of the pair-wise relationship among 'Telework', 'SOHO' and 'Work at home'

Question items regarding perception of the pair-wise relationship among 'Telework', 'SOHO' and 'Work at home' are conditional questions and only respondents who selected specific options in previous questions were asked to finish these items.

According to Sato (2008), SOHO and WAH are two types of telework. On the other hand, the concepts of telework, WAH and SOHO are often found in a blend with each other in China (Chinese Learning, 2003). Therefore, following pair-wise relationships can be made.

Table 4-Pair-wise Relationships of Perceptions in TW, SOHO and WAH

	WAH&TW		WAH&SOHO		SOHO&TW	
Different expressions of the same meaning	6	10	13	41	9	18
Not same but can be used interchangeably	3	16	14	36	8	24
Include and be included	69	101	28	41	29	60
No relationship	1	4	2	4	4	11
I have no idea	6	3	24	15	27	14
Others	0	0	1	1	1	1
N	85	134	82	138	78	128

Notice: Numbers in boxes refer to 'WE' group

It is said that in China, many Chinese people considered 'Work at home' is quite identical with the meaning of 'SOHO' ('WAH'≈'SOHO'). In other words, if someone is 'Working at home' someday, it can be said someone is 'SOHOing at home' as well (Chinese Learning, 2003; enread. com, 2007; prnasia.com, 2012).

'Interchangeable' words mean almost the exact same thing and could be used in the same way. Here, if regarding item 1 'Different expressions of the same meaning' and item 2 'Not same but can be used interchangeably' as 'WAH'≈'SOHO', table 5 can be summarized.

Table 5-Perceptions of the Relationship between WAH and SOHO

	WE	No WE
SOHO≈WAH	77 人 **55.80%**	27 人 **32.92%**
Others	61 人 44.53%	55 人 67.08
N	138	82

Notice: 'WE' refers to 'Working Experience'

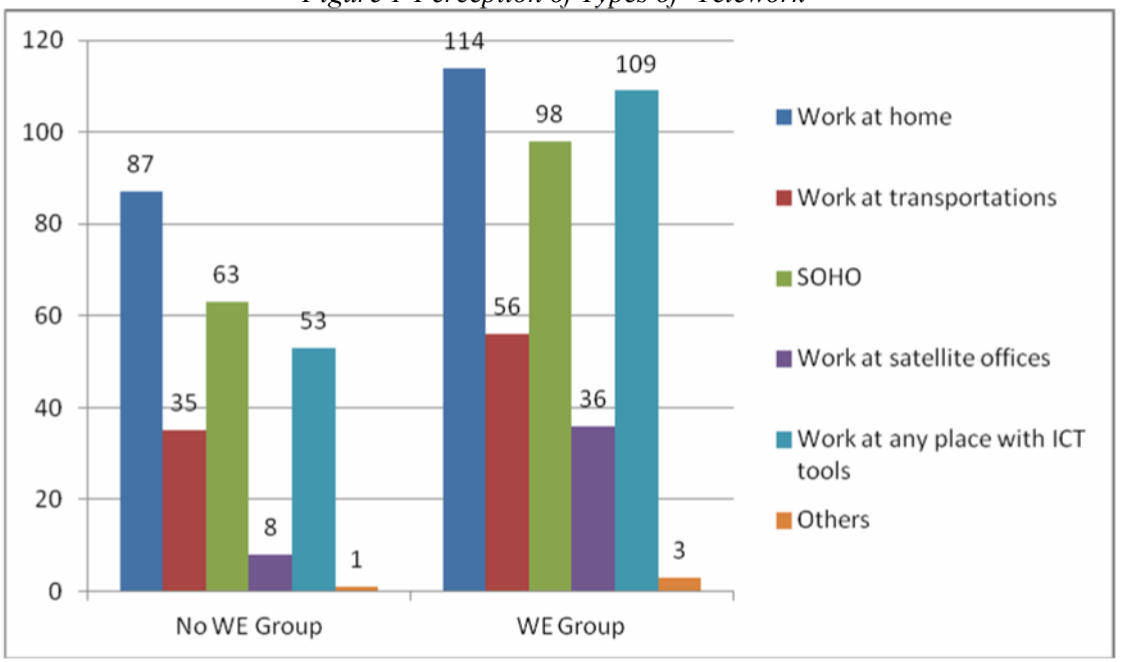
Here we supposed the hypothesis below: ('WE' refers to 'Working Experience')

H4: There is significant difference of the perceptions of the relationship between SOHO and WAH between 'WE' and 'No WE' groups.

(3) Perceptions of Types of Telework

This is also conditional question and only respondents who selected specific options in previous questions were asked to finish these items.

Figure 1-Perception of Types of 'Telework'



RESULT OF STUDY

We used independent-samples T test to compare means and tested hypothesis.

1. T-test Results of Different Perceptions of 'Telework', 'SOHO' and 'Work at home' between Two Groups.

Table 3-Cognitions of 'Telework (TW)', 'SOHO' and 'Work at home (WAH)'

	WE	No WE
Telework	130 **86.67%**	97 **78.86%**
SOHO	139 **94%**	84 **68.23%**
WAH	146 **97.33%**	116 **94.31%**
N	150	123

Notice: 'WE' refers to 'Working Experience

Table 3-1 Group Statistics of Cognitions

	WE	N	Mean	Std. Deviation	Std. Error Mean
SOHO	Yes	150	1.07	.262	.021
	No	123	1.32	.467	.042
TW	Yes	150	1.13	.341	.028
	No	123	1.21	.410	.037
WAH	Yes	150	1.03	.162	.013
	No	123	1.06	.233	.021

Table 3-2 T-test of Cognitions

	t value	*P* value	*MD*	*SE*
SOHO	-5.436	.000***	-.244	.045
TW	-1.717	.087	-.078	.045
WAH	-1.263	.208	-.030	.024

According to the results of table 3-2, as for the ***perception of SOHO***, comparing with the group without working experiences, the group with working experiences has a significant higher perception.

On the other hand, there is no significant difference of the ***perception of TW and WAH*** between these two groups.

H1: There is significant difference of the perception of TW between 'WE' and 'No WE' groups. (✗)

H2: There is significant difference of the perception of SOHO between 'WE' and 'No WE' groups. (√)

H3: There is significant difference of the perception of WAH between 'WE' and 'No WE' groups. (✗)

2. T-test Results of Relationship between 'SOHO' and 'Work at home' between Two Groups.

Table 5-Perceptions of the Relationship between WAH and SOHO

	WE	**No WE**
SOHO≈WAH	77 人 **55.80%**	27 人 **32.92%**
Others	61 人 44.53%	55 人 67.08
N	138	82

Notice: 'WE' refers to 'Working Experience'

Table 5-1 Group Statistics of Relationship

	WE	N	Mean	Std. Deviation	Std. Error Mean
Relationship	Yes	138	1.44	.498	.042
	No	82	1.67	.473	.052

Table 5-2 T test of Relationship

	t value	*P* value	*MD*	*SE*
Relationship	-3.354	0.001**	-.229	.068

According to the result of table 5-2, comparing with the group without working experiences, the group with working experiences should be tend to recognize the relationship ***which SOHO almost the same meaning as WAH in China*** further.

H4: There is significant difference of the perceptions of the relationship between SOHO and WAH between 'WE' and 'No WE' groups. (√)

DISCUSSION

1. Findings

According to the results of tested hypotheses, some findings can be acquired.

1) It is true that after starting working career, Chinese people are more familiar with the concept of 'SOHO' than 'telework'. Furthermore, ones who have working experiences tend to regard 'SOHO' was identical with 'Work at Home' in China. Actually, comparing with the concept of 'telework', the concept of 'SOHO' is more well-known and more official in China. SOHO, as an alphabet Chinese word, has been edited into *THE CONTENPORARY CHINESE DICTIONARY* since 2002. On the opposite, there is no exact Chinese translation of the word 'telework' (Chinese Learning, 2003). Moreover, the most common type of 'telework' in China is 'Work at Home (WAH)', which is usually called 'SOHO at Home' by public media (2002, Xu). It was because of the wide propaganda by mass media that made 'SOHO' becomes more and more fashionable and prevalent, so that more and more Chinese people, especially young men, chose to become a 'SOHOer' (2004, Tan). Approximate 140 alphabet words entered into the latest *THE CONTENPORARY CHINESE DICTIONARY* means that the rapid language development is in keeping tightly with the development of economy in China. Sometimes, alphabets words represent the conversions of traditional culture and the latest tendencies in the world (2004, Tan). Chinese people are delighted to accept new things, and it is no doubt that 'SOHO' is the newest concept in working area, therefore the statement that Chinese people, who have working experiences, are quite familiar with SOHO makes sense and is in line with the results of surveys and hypotheses as well.

2) Regardless of having working experience or not, Chinese people's perceptions of 'telework' and 'work at home' are quite similar. One reason is that there is no exact Chinese translation of the word 'telework' (Chinese Learning, 2003). The other reason is that the main common type of 'telework' in China is WAH (SOHO), so the word 'telework' is usually replaced by WAH (2002, Xu). As for the concept of WAH, almost everyone can know the literal meaning as soon as they see the word no matter they works or not.

3) According to figure 1, both of the two groups considered WAH, SOHO and 'mobile work (work at any place with ICT tools)' as the three main types of telework. It is interesting that the 'No WE' group preferred SOHO to 'mobile work' while the WE group preferred 'mobile working' to 'SOHO'. It may be because that 'mobile working', which means work at anywhere with ICT tools, is more flexible than SOHO. It is probably that 'flexibility' attracts working people more. On the other hand, working at satellite office, which is quite common in western countries, is still far from people in China. It is because establishment of satellite offices counts on government. It is the government itself can build several telecenters/satellite offices or organize several big companies to set several telecenters/satellite offices (Wang, Zhang & Xu, 2004). However, the whole environment to carry out telecommuting has not yet been well established in China (Wang, Zhang & Xu, 2004). Therefore, it is easy to understand why few people familiar with the concept of satellite offices in China.

4) Respondents' levels of perceived views of 'telework' are rising. According to a survey to the working people conducted by Zhao & Higa in 2007, it was only less than one–fifth (17.9%) of the respondents had heard of the word of 'telework'. But according to this survey (see table 2), the level of cognitions are getting higher. Since adoption or implement of

telework is a tendency in China (Wang, Zhang & Xu, 2004), there are reasons for believing that more and more Chinese people will get to know telework gradually.

2. Contributions (Implications)

1) Theoretical

This paper makes two theoretical contributions.

First, these surveys and this paper are the first study to clarify the people's extents of their own perceptions of 'telework' in China.

Second, this paper contributes to understanding issues of different levels of cognitions of telework in specified groups.

2) Practical

This paper has three practical contributions.

First, for companies in China, having a rough knowledge on employee's levels of perceptions of telework is quite necessary and important. It may help them being adopting, making or adjusting suitable policies of telework to recruit or attract to newcomers and avoid or reduce staff turnover.

Second, for respondents, through these surveys, most of them would pay more attention to telework and this may instruct them to find their appropriate jobs.

Last but not least, through this paper and these surveys, more and more readers could begin to know telework. This might help to encourage China to learn advanced and effective human resource management from their western counterparts and improve the whole Chinese conventional working environment better.

3. Limitations

1) The number of samples is not sufficient enough.

2) Most respondents of surveys are in Shanghai. Therefore, the results can not represent the whole situation of China very well.

3) Although have been revised many times, there are still many problems and insufficiencies in questionnaires, such as not strict enough.

4. Future Research

1) The data and results of attitudes toward telework will be made up and findings will be researched.

2) Last question was an open type written one. In this question, respondents' advice, suggestions on 'telework' were collected. Among them, some were useful. Therefore, it is necessary to sort out them.

3) Conducting interviews to the respondents who did telework before or are doing telework right now in surveys and carrying on further researches on the respects such as 'guanxi' in Chinese working places.

CONCLUSIONS

The concept of 'telework' has not spread over the people in China. On the other hand, in contrast with being less recognized 'telework', it is said that many Chinese people had recognized SOHO and both 'SOHO or telework' and 'SOHO or WAH' are thought to be used interchangeably in China. In order to make clear of these confusions, investigations were conducted.

According to the data, some findings could be drawn.

First, comparing with the group without working experiences, the group with working experiences has a significant higher perception of SOHO. On the other hand, there is no significant difference of the perception of TW and WAH between these two groups.
Second, comparing with the group without working experiences, the group with working experiences should be tend to recognize the relationship which SOHO almost the same meaning as WAH in China.
Third, 'WAH' in 'WE group' shows that 'mobile teleworking' is becoming more and more common in Chinese working places. However, the concept of 'Satellite offices-based teleworking', which is also frequent overseas, is still unfamiliar to even on-the-job Chinese people.
Last but not least, Chinese peoples' levels of perceived views of 'telework' are rising higher than before.

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SUPPLY CHAIN RETURN AND RISK MANAGEMENT - A DELPHI STUDY AND AN INTEGRATED OPTIMIZATION MODEL

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ABSTRACT

Various types of risks and risks management studies in the supply chain context have attracted the attention of the researchers and practitioners in recent years. This study starts by reviewing the literature to understand the trend of supply chain risks studies and supply chain risk management (SCRM) strategies. The review shows that very limited research on managing the whole supply chain risk, and there is no optimization model helping decision makers in planning the production quantity in the supply chain context, with the consideration of all types of supply chain risks costs. Thus, this study identifies the impacts of all types of supply chain risks using the Delphi method to estimate probabilities of occurrence, expected effects and the associated additional costs for each type of risk. The perceptions of both manufacturers and academic on the importance of various types of risks were collected. It is interesting to find out that in terms of risk concerns, respondents tend to put higher weightings on supply and manufacturing risks, while in terms of efforts of managing risks, respondents believe the company should have good control on manufacturing and distribution risks. Lastly, using the findings from Delphi study, a nonlinear programming model is formulated to provide a profit maximization production plan with the considerations of both risks and returns.

Keywords: Supply Chain Risks, Supply Chain Profit, Risk Classification, Delphi Study, Optimization Model

1 INTRODUCTION

1.1 Background

Supply chain involves the planning, organizing, directing, and controlling flows of raw materials, work in process and finished goods among involved parties. In the past two decades, the industry believed that the supply chain performance is affected by three factors: quality, time and cost. Then, their focus shifted to responsiveness and agility. By the late 90s, the industry started concentrating on the concept of risk (Kearney, 1999). Risk is defined as the effect of uncertainty on objectives, and an effect is a positive or negative deviation from what is expected (ISO 31000:2009). It is no doubt that there are a lot of uncertainties and deviations occur, especially in global supply chain. In recent years, the risk in supply chain has gained more attentions as it has become the major factor in affecting the supply chain performance (Jüttner et al., 2003).

In the previous researches, risk is mainly identified and mitigated from one supply chain party's perspective, such as supplier, manufacturer or distributor. It is seldom being considered and managed from an integrative perspective. Supply chain risks can turn out be a series of negative outcomes in various areas of the supply chain, including sales, customer service, operations, marketing and supply. The outcomes include over order, inaccurate forecasting, over produce, long buffer of delivery, delay in new product launches, etc (Christopher and Lee, 2004). All these outcomes can severely affect multiple parties participating in the supply chain, and worsen the supply chain efficiency and performance significantly. Therefore, it should be managed from an integrative perspective – managing the whole supply chain.

Before exploring an effective approach in managing supply chain, we have to find a common standard to quantify the risk impacts. A suitable measurement would be in terms of profit or monetary value. For example, to reduce the risk in delay, a company may implement the supply chain risk management (SCRM) by extending the lead time to create buffers for processes. This will increase the inventory costs. Alternatively, if the company chooses not to implement SCRM, they may suffer from backlog cost and delay penalty costs. Similarly, the quality of the supply chain can be measured using the concept – Cost of Quality (COQ), which means the total cost of quality-related efforts and deficiencies (Feigenbaum, 1956). COQ has two types of costs, "Costs of control" and "Costs of failure". The costs on implementing SCRM can be measured using costs of control, while the undesired outcomes from supply chain can be considered as costs of failure.

Risk is also an element that affects the overall return of the supply chain, where return refers to the earning power of assets. However, in finance and supply chain, they define different relationships between risks and return. From the finance industry perspective, the relationship between risk and return can be characterized as "positive". If a particular investment with a high level of risk is bought, a high potential return is expected. In other words, a higher level of risk may lead to a higher potential return for compensation; less return comes with a potential low level of risk. In short, risk in finance is two-sided (Stephen et al., 2003). From the aspect of supply chain, the risk-return relationship is defined as "negative". A smooth supply chain means less risk and less uncertainty existed so that managers can project the potential return with more confidence. A supply chain with high level of risk will lead to low potential return. Risk in the supply chain is only one-sided. It seems to be true that a high level of risk may generate a high return in the finance industry and a smooth supply chain with less risk can help to maintain a stable supply chain with a constant return. It would be interesting to know if the finance concept can be transformed and applied onto the supply chain context.

1.2 Research Objectives

To the best of our understanding and literature review, there are no well-known and accepted classifications on supply chain risks and no single model is able to calculate all types of risks in the supply chain. Also, the relationship between risk, return and quality has not yet been well-defined.

Thus, there are three objectives for this research, 1. to identify the common risks in various types of supply chain; 2. To investigate their impacts on supply chain performance, 3.to establish a mathematical model to provide guidance on production with the consideration of supply chain risks and return.

In this study, we will systematically identify and assess the risks. We first identify the risks from literature and establish a supply chain risk classification. Then, risks are assessed as to their probability of occurrence and the potential severity of impact. A questionnaire was designed to interview both practitioners and academics on their views on risk concerns, management focus and specific risk mitigation strategies. The Delphi method would be used to get consensus among respondents. Next, an integrated mathematical model is formulated, with the objective of profit maximization, by considering the available resources, types and levels of supply chain risks. This provides decision makers guidance on the cost allocation as well as control of each type of risk. Lastly, limitation and future research directions were discussed.

2 LITERATURE REVIEW

In this section, researches on risk classification, risk trend, modeling and risk management are studied. We have reviewed over hundred journal articles which discussed various types of supply chain risks from 1999 to 2012. Based on the findings, we propose risk classification and identify the risk trend. The risk modeling approaches for different types of risks were explored. Lastly, the latest risk management and mitigation methods are discussed.

2.1 Risk Classification

In supply chain, there is no well-established way to classify risks. Unlike in the finance realm, risk is well-defined as systematic risks and unsystematic risks (Kelliher et al., 2011). For different supply chain industries, it is up to decision maker's choice to decide how to sort the risks according to their specific needs and situations. The grouping of risks, therefore, is very complicated and diversified. They can be classified according to role, organization structure, operations, sources and types.

Classification by role: Douglas (2007) proposed three general types of risks: suppliers risks, internal risks and the customers' risks. For supplier, there are four areas of risks: standards, supplier, technology and practices (Sinha et al., 2004).

Classification by organization: Finch (2004) suggested three levels of risks: application level, organization level and inter-organizational level. Wu classified the risks into two categories – internal (production) and external(supplier). For each category, it is divided into three parts which are controllable, partially controllable and uncontrollable (Wu, 2006). Such risk classification is relatively clear and ordered.

Classification by operations: Musa (2012) used supply chain operations - source, make and deliver to classify the risks. Chopra & Sodhi (2004) identified nine categories of risks including disruptions risk, delays risk, systematic risk, forecast risk, intellectual risk, procurement risk, receivables risk, inventory risk and capacity risk.

Classification by sources or types: Bob & Clare (2007) classified the risks into seven sources which are environment characteristics, industry characteristics, supply chain configuration, supply chain members, organization's strategy, problem specific variables and decision making unit. Risks can be grouped as seven types: price risk, quantity risk, quality risk, technology risk, economic risk, environmental risk, process risk, management risk, chaos risk and inventory risk (Matook et al., 2009). Frank and Marco (2012) classified the risks into two types only — operational risks and strategy risks.

In short, there is no standard risk classification in supply chain as compared with the finance.

The literature is incomprehensible to delineate the whole supply chain risks. In our research, we will group them into four categories of risks: supply risks, manufacturing risks, distribution risks and external risks. The classification of risks follows the basic supply chain flow - upstream, manufacturers and down-stream. These risks were summarized for multiple studies, and they are categorized in Table 1.

Table 1 - Summary of risks review in past studies

Supply Risk	
Relationship Risk	Douglas (2007)
Supplier Deliver Risk	Frank & Marco (2012), Wu (2006)
Supplier Disruption Risk	Douglas (2007)
Technical Risk	Frank & Marco (2012), Wu (2006)
Manufacturing Risk	
Production Capability Risk	Frank & Marco(2012), Chopra & Sodhi (2004), Wu (2006) (2004)
Forecasting Risk	Chopra & Sodhi (2004)
Quality Risk	Douglas (2007), Frank and Marco(2012), Matook et al. (2009)
Security Risk	Wu (2006)
Product Design Risk	Markeset & Kumar (2004)
Technical Risk	Douglas (2007), Sinha et al. (2004)
Human Resources Risk	Douglas (2007)
Financial Risk	Douglas (2007), Wu et al. (2004)

Distribution Risk	
Relationship Risk	Douglas (2007)
Delivery Risk	Frank & Marco(2012), Wu (2006)
Security Risk	Wu et al. (2004)
Inventory Risk	Frank & Marco(2012), Matook et al. (2009), Chopra & Sodhi (2004)
Financial Risk	Douglas (2007), Wu (2006)
External Risk	
Political Risk	Douglas (2007), Wu (2006)
Business Environmental Risk	Douglas (2007), Frank & Marco(2012)
Natural Disaster Risk	Douglas (2007), Wu (2006)
Market Dynamic Risk	Douglas (2007), Frank & Marco(2012), Wu (2006)

2.2 Risk Trend

Supply chain risk management has become a popular research topic in recent years. To understand the focus on different types of risks, we systematically reviewed over hundred journal articles from 1999 to 2012 in eight reputable supply chain management (SCM) journals: *Decision Sciences, International Journal of Operations & Production Management, International Journal of Physical Distribution & Logistics Management, International Journal of Production Research, Management Science, Production & Operations Management, Supply Chain Management: An International Journal, and the International Journal of Logistics Management*. We recorded the frequencies of various types of risks being discussed. We classify supply chain risks into six categories – outsourcing risks, supply risks, manufacturing risks, distribution risks, external risks and whole supply chain risks, and use related keywords to search the journal articles on a year basis. The distribution of articles discussing various types of risks is depicted in Fig 1. In the past 13 years, outsourcing risks has the highest percentage (30%). It is followed by supply risks (24%). This matches with the development of supply chain, which focuses on global outsourcing and sourcing. For the manufacturing risks, it accounts for 18% which is higher than distribution risks (13%), external risks (13%) and whole supply chain risks (3%). In short, the number of studies on whole supply chain risks is very limited.

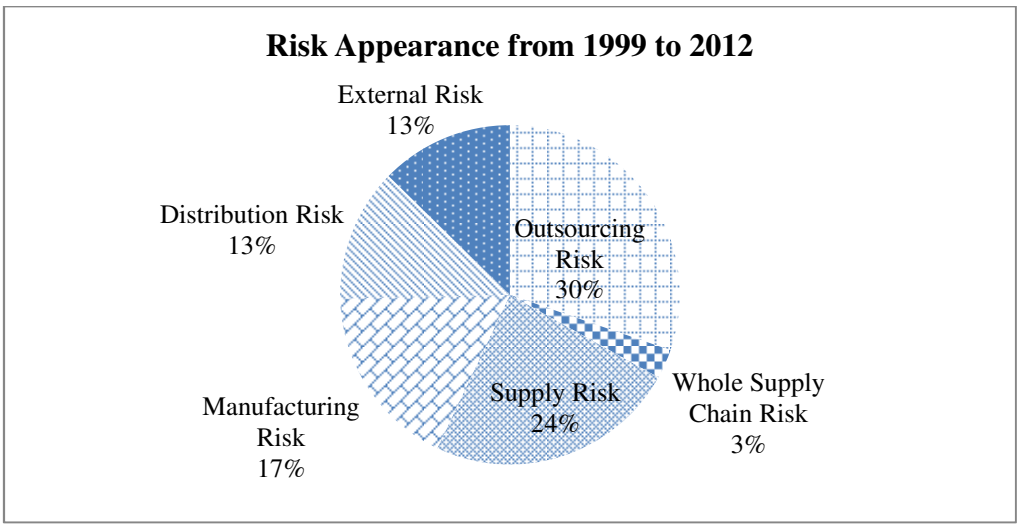


Figure 1: Risk appearance in journal articles from 1999 to 2012

On top of the risks distribution, we also calculated the number of studies against time to understand the trend of risk management studies (Figure 2). Outsourcing and supply risks were mentioned back in early 1999. Distribution risks, manufacturing risks and external risks were considered starting from in 2003-2004. The number of articles related to manufacturing risks is fluctuating but the number of studies on external risk is pretty steady. There were very few papers discussing the whole supply chain risks and the only one appeared in 2006. This figure clearly shows the whole supply chain risk is under-explored.

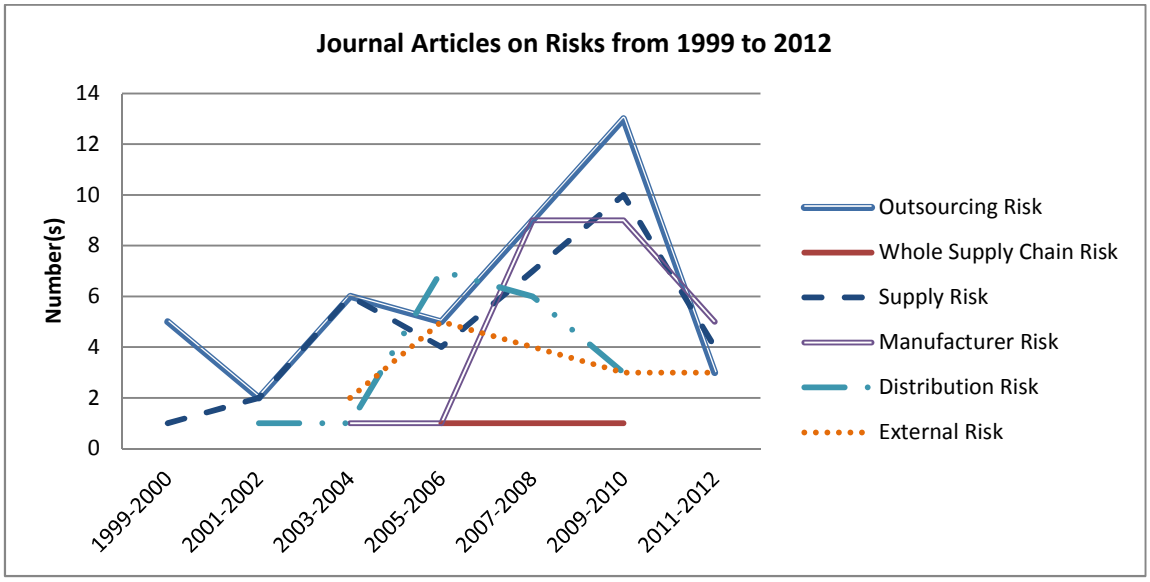


Figure 2: Risk Trend from 1999 to 2012

2.3 Risk Modeling

Risks arise from the supply chain network can be measured by mathematical models. Past studies mainly focus on supply risk modeling. Wu (2006) studied the inbound supply risk management and proposed an AHP model, using multi attribute decision-making (MADM) technique, to calculate the risk. It enables decision makers to structure a MADM problem visually which provides a flexible and easy understanding way of analyzing complicated problems. Tomlin (2006) studied the sourcing problem in the supplier selection by applying a combination of disruption management strategies to select between two suppliers. Ravindran et al. (2010) developed a multi criteria model to address risk management issues in the context of supplier selection in global supply chains. The model includes a risk quantification framework and a

two-phase risk adjusted multi criteria supplier selection model. The model proposed by Kumar (2010) is one of the few studies which considered costs associated with supply, production, market and warehouse risks. Tse and Tan (2011) focused on manufacturing risk, by proposing margin incremental analysis (MIA) method to manage product quality.

2.4 Risk Management and Mitigation

Effective risk management methods include conducting self-assessment to find out what types of risk existing around the company, establishing a good information management system and maintaining effective collaboration with partners. Yang and Yang (2009) suggested that companies should examine the level of complexity of the supply chain before adopting certain risk mitigation strategy. A good information management can facilitate managers to grasp the latest situation of their company so as to make a good decision. In addition, knowing who to cooperate with is also important for risk management.

Besides, managers need to know how to handle the potential risks in order to optimize their profit portfolio. They also need to evaluate the supply chain progress in order to make the most appropriate decision. Ziegenbein (2007) recommended a risk management process model to identify, assess, monitor and control the risks. Later, Tummala and Schoenherr (2011) proposed a Supply Chain Risk Management Process (SCRMP) to aid managers in making the right supply chain decision. SCRMP is divided into six parts: risk identification, risk measurement, risk assessment, risk evaluation, risk mitigation & contingency plans and risk control & monitoring. SCRMP is similar to the process of ISO 31000:2009, which is an international standard to cope with risks. For both ISO 31000:2009 and SCRMP, they are generic method/framework of risk management and they do not take return into consideration.

In finance, the risk mitigation is relatively straight-forward, all types of risks can be reduced through appropriate diversification (Kelliher et al., 2011). However, it is a lot more complicated for supply chain mitigation and multiple methods were proposed. Christopher and Lee (2004) summarized them as two types of approaches – improving "Visibility" and "Control". Improving "Visibility" refers to information sharing so that it can reduce the uncertainty between different parties, while "Control" means improving the flexibility in the whole supply and own process to maintain a good reaction to the new information and accidence.

3 DELPHI STUDY ON SUPPLY CHAIN RISKS

In this section, risks are assessed as to their probability of occurrence and the potential severity of impact. The specific measures to be put in place to manage risks and their effectiveness are also investigated. To achieve these two purposes, we applied the Delphi method to assess the risk levels from both the academic and industries practitioners' perspective. As a pilot study, we focus on the supply chain risk strategies on the electronic industry, which the product life cycle is shorter than other industries. We believe that the impacts of risks would be prominent with the rapid change of the market. The findings could be generalized to other industries with verifications.

Delphi Method is a structured communication technique, originally developed as a systematic, interactive forecasting method. Applying a Delphi method to conduct a survey can utilize and absorb the different experience and views from experts (Norman and Olaf, 1963). Delphi method can be divided into six steps: 1. Identify the topic, the experts for the survey as well as the sample size; 2. distribute the questions or requirements to experts; 3. analyze the collected data and list the analysis systematically 4.distribute the pervious analysis and questions to the experts again; 5. analyze the second rounds' collected data and list the analysis systematically; 6. repeat step five until the experts do not change their answers anymore and analyze the collected data.

3.1 Identify Experts

We invited eight respondents from electronic industry and academia. Respondents came from two different backgrounds can provide a comprehensive view on analyzing the problems. Respondents from industry have the knowledge and experience on how their companies are handling the supply chain risks in real practice; while respondents from academia can provide a theoretical view for references. The four respondents from industry have over 10 years of managerial experiences in electronic industries, who have in-charged the supply management, production and marketing and sales. Similarly, the four academic respondents have over 8 years of tertiary teaching and research experiences in supply chain management.

3.2 Questionnaire Design

Two sets of questionnaires, with some differences, were designed for academic and industry practitioners respectively. For the academic questionnaire, respondents need to provide weightings for the four categories supply chain risks concerns: supply, manufacturing, distribution and external risks. In addition, respondents also need to provide rating (importance) of each risk type which the supply chain management team should control. For the industry survey, in addition to the above questions, company profile and current risk management strategies information are also collected. In particular, the current performance of the company in managing each type of risks is interviewed. The questionnaires can be provided upon request. All respondents answered the questionnaire using the face-to-face mode.

3.3 Initial Results

A. Weighting on Risk Concerns

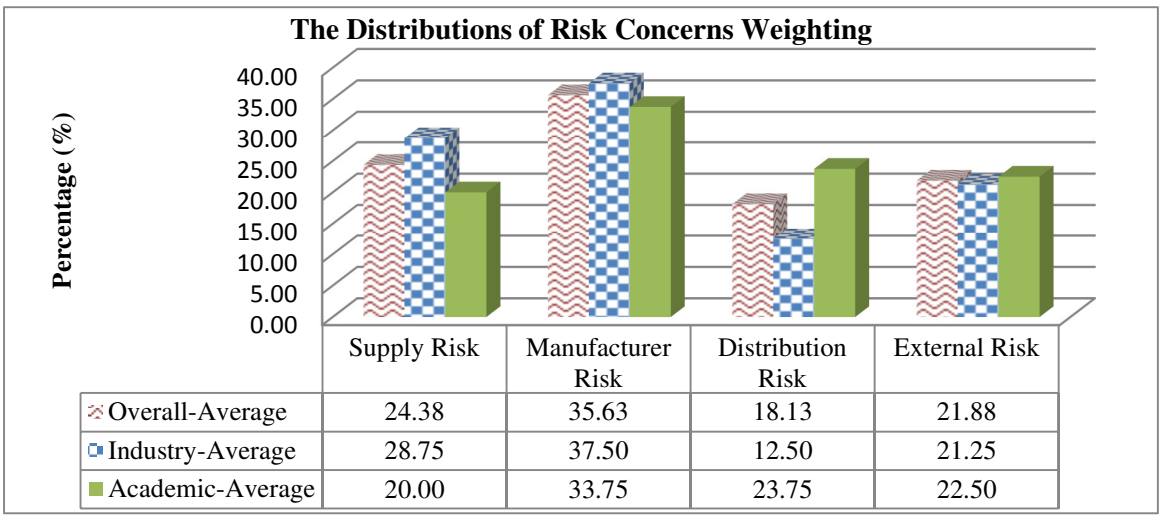
Table 2 shows risk allocation by the respondents. According to the data, most of the respondents put over 30% of the concerns on managing manufacturing risk. As the quality of the product is mainly determined during the production, most respondents believed that it is necessary putting a substantial part of resources to control this risk. To sustain the fast production cycle in electronic industry, respondents believed that they have to ensure enough materials would be delivered before production. Therefore, supply risk was their second major concern. For external risk, two groups of respondents shared similar view; they weighted around 20% of concerns onto this category of risk. Lastly, academic respondents put more focus on distribution risk, as compared with industry respondents. The average weightings for industry and academic respondents are depicted in Figure 3.

Table 2: Weighting on risk concerns (the sum of 4 risks allocations equals to 100 %)

	Industry				**Academic**			
Supply Risk	30	25	40	20	20	30	15	15
Manufacturing Risk	20	40	25	65	20	40	30	45
Distribution Risk	10	15	15	10	20	20	30	25
External Risk	40	20	20	5	40	10	25	15

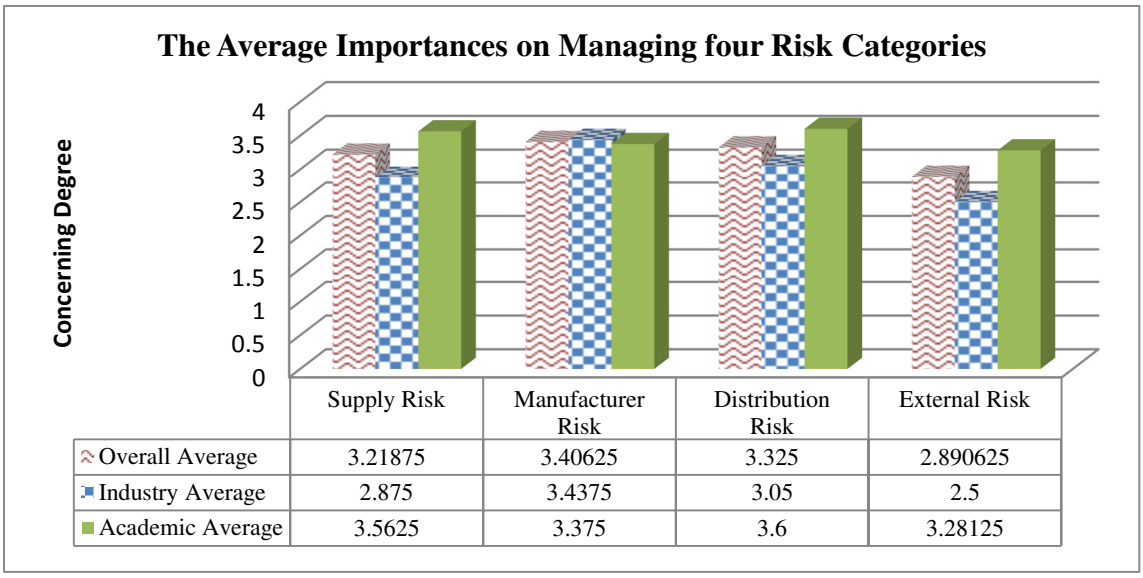
B. Importance of Risk Management

In this part, respondents indicated their importance ratings on risks that a SCM team should manage. Figure 4 shows that except external risk, the average value of other three categories of risks is higher than 3, meaning these risks should be carefully managed by the SCM team. The figure also shows the gaps between two groups of respondents, the academic respondents are more concerning about supply, distribution and external risks. As academics have forward looking vision, these differences reflect that the management on these three categories of risks would become important in the near future.



	Supply Risk	Manufacturer Risk	Distribution Risk	External Risk
Overall-Average	24.38	35.63	18.13	21.88
Industry-Average	28.75	37.50	12.50	21.25
Academic-Average	20.00	33.75	23.75	22.50

Figure 3: The Distribution of Risk Concerns Weighting



	Supply Risk	Manufacturer Risk	Distribution Risk	External Risk
Overall Average	3.21875	3.40625	3.325	2.890625
Industry Average	2.875	3.4375	3.05	2.5
Academic Average	3.5625	3.375	3.6	3.28125

Figure 4: The Average Importance on Managing four Risk Categories

Figure 5 shows the detailed importance ratings on each specific risk by two groups of respondents. For the supply risk categories, both groups believed that more concerns are needed on the "supplier delivery risk" and "supplier disruption risk", as they directly lead to production breakdown. It was interesting to find that there was a significant different in rating by academic and industry respondents on "supplier relationship risk". For the manufacturing risk category, the top three risks ratings were "production capability risk", "forecasting risk" and "quality risk". This shows their focus lies on forecasting and production abilities. The rating on "technical risk", "human resource risk" and "finance risk" were just fair. For the "distribution risk" category, both groups thought that more attentions are required on "relationship risk", "delivery risk" and "inventory risk". If these risks can be managed properly, the company can avoid producing excess products and decrease the holding costs. Lastly, for the "external risk" category, academics believed that should be managed attentively while industry respondents put lower ratings on these risks.

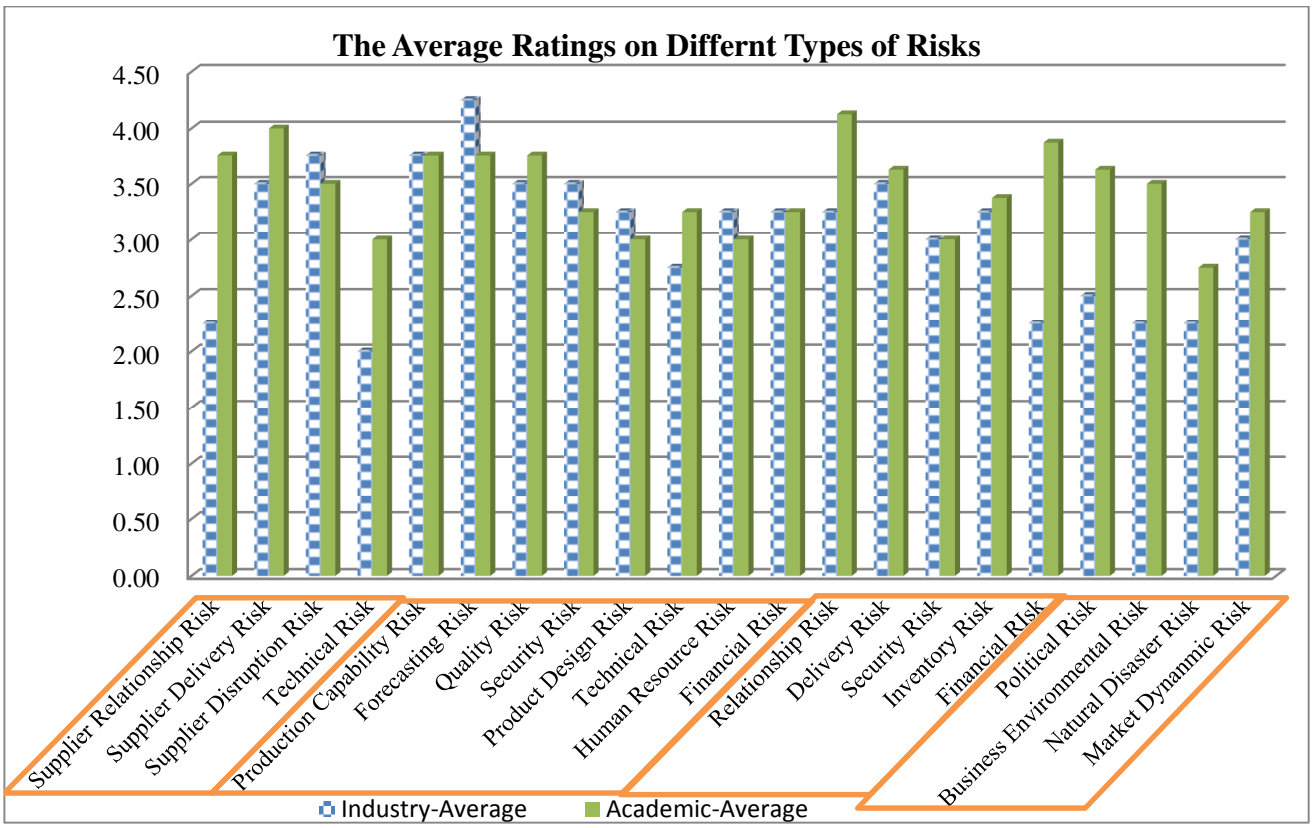


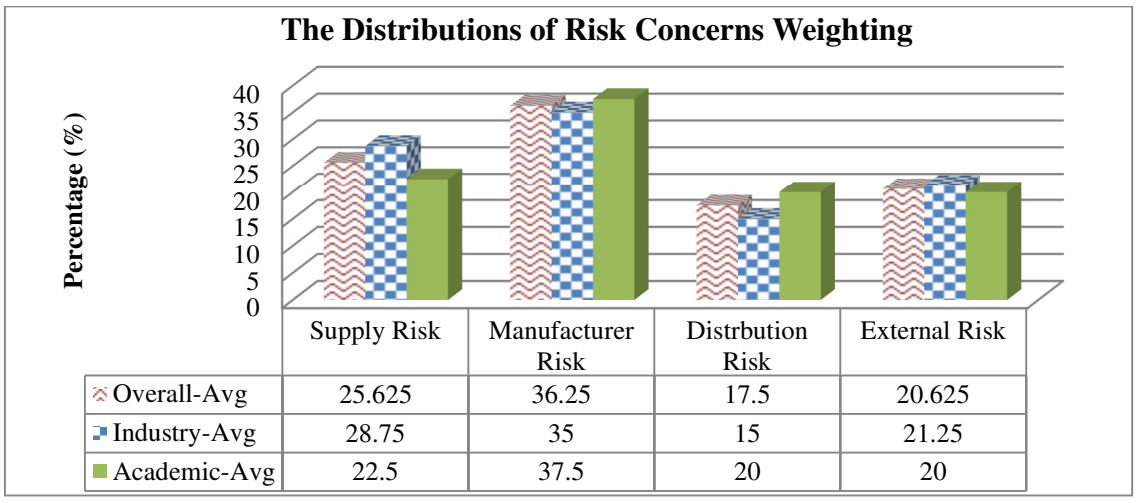
Figure 5. The average ratings on different types of risk

3.4 Final Results

The above findings were presented to the respondents. They were invited to conduct the weighting on risk concerns and importance ratings again with the facilitation by the interviewer. For the weighting on risk concerns, five of the respondents revised their weightings on risks as shown in Table 3, with changes were highlighted. As shown in Figure 6, the differences between two groups of respondents are getting smaller. Similarly, the average ratings of various types of risks are getting close. In most cases, the industry respondents raised their importance ratings on risks after knowing the ratings from the academic respondents (Figure 7). All these results were then sent to the eight respondents and they confirmed that they would not change their ratings again.

Table 3: Weights of Risk (Final)

	Industry				**Academic**			
Supply Risk	25	25	40	25	20	30	25	15
Manufacturing Risk	30	40	25	45	30	40	35	45
Distribution Risk	15	15	15	15	20	15	20	25
External Risk	30	20	20	15	30	15	20	15



	Supply Risk	Manufacturer Risk	Distrbution Risk	External Risk
Overall-Avg	25.625	36.25	17.5	20.625
Industry-Avg	28.75	35	15	21.25
Academic-Avg	22.5	37.5	20	20

Figure 6: The Average Distribution of "Weight of Risk" (Final result)

For all four categories risks, we will separate them into two groups, "low importance" and "high importance", by drawing a line at level 3.0. As shown in figure 7, we found those 17 risks above 3.0, and only 4 risks equal to or below 3.0 or overall ratings. Among these 17 risks, the highest is forecasting risk, followed by distribution delivery risk and supplier delivery risk. These findings show that industry major concern is on the accuracies of the product quantity and the delivery. In general, the risks belong to the supply and manufacturer categories require more attention than the distribution and external category. In the following supply chain risk and return model, we will make use of these ratings as the importance of each individual risk.

Comparing with figure 6 and figure 7, it is interesting to find out that in terms of risk concerns, respondents tend to put higher weightings on supply and manufacturing risks, while in terms of efforts of managing risks, respondents believe the company should have good management on supply, manufacturing and distribution risks. This shows the necessity in managing distribution risks do not match with companies concerns, which can be realized in existing resource allocations.

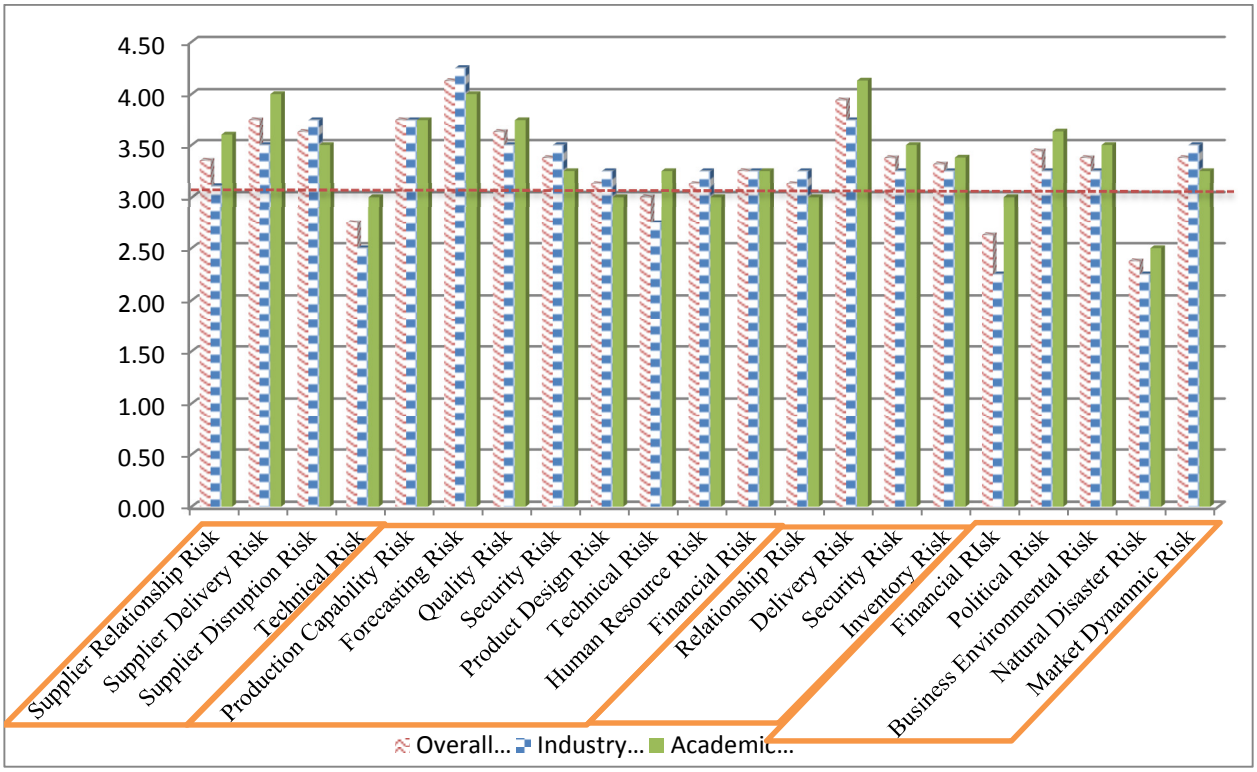


Figure 7. The average ratings on various types of risk (Final result)

3.5 Risk Mitigation Methods

Besides the ratings on each type of risks, we also collected the current practice for risk mitigation from the industry respondents. Despite all companies implement several risk mitigation methods; they seldom calculate the cost of mitigation, or the cost on each risk, except the defect product cost or backlog cost. In particular, various strategies were suggested to mitigate each category of risks as follow:

1. Supply risks: companies implemented Just-in-time (JIT) or multi-sourcing to avoid delivery risk and supplier domination. Although JIT allows manufacturers reducing their inventory cost and level, some companies refuse to implement it as they need to share inventory information with suppliers.
2. Manufacturing risks: Materials Resource Planning (MRP) and International Organization for Standardization (ISO) were adopted to mitigate production capability risk, quality risk, technical risk and forecasting risk. MRP enables manufacturers aware of the most updated information of all resources, while ISO ensures all the processes are controlled by rules.
3. Distribution risks: most respondents suggested establishing alliance and franchise, as well as building trust to reduce the risks. Through these methods, manufacturer can develop a good relationship with the distributor and achieve an effective inventory management by information sharing.
4. External Risks: assessment on the policy and the environment including business markets and nature were conducted in advance. Before building a new plant, manufacturers would evaluate whether they can benefit from the local policies and consider whether the natural environment is suitable for them.

4 SUPPLY CHAIN COST AND RISK OPTIMIZATION MODEL

4.1 Parameters

To calculate the exact costs in managing supply chain risk, there deem to be an optimization model which takes into consideration all the supply chain costs and risks. This model makes use the cost distributions in handling different risks, and the risk ratings collected by Delphi method. Here, we assume all the risks can be modeled by Taguchi's loss functions (Ravindran et al, 2010), with their associated costs belong to either S-type (smaller the better), N-type (nominal the better), or L-type (larger the better) loss functions. Table 4 summarizes the risk types, loss function type, notations and examples.

Table 4. Specific Risk Cost Declarations

Risk Name	Taguchi's loss function	Quantity dependent	Cost Notation	Management Importance Notation	Example(s)
Supply Risk					
Supplier Relationship Risk	L-type	✔	C_{S1}	$\alpha_{S1} = 1 + \frac{(3.35-3)}{3}$	Low mutual trust, switching suppliers
Supplier Delivery Risk	S-type	✔	C_{S2}	$\alpha_{S2} = 1 + \frac{(3.75-3)}{3}$	Delay, overnight delivery
Supplier Disruption Risk	S-type	✔	C_{S3}	$\alpha_{S3} = 1 + \frac{(3.63-3)}{3}$	Defects of the raw materials
Technical Risk	S-type	×	C_{S4}	$\alpha_{S4} = 1 + \frac{(2.75-3)}{3}$	Defect of the supplier machine Supplier's low technology skills
Manufacturing Risk					
Production Capability Risk	L-type	✔	C_{M1}	$\alpha_{M1} = 1 + \frac{(3.75-3)}{3}$	Mismatch the ordered quantity and supply
Forecasting Risk	S-type	✔	C_{M2}	$\alpha_{M2} = 1 + \frac{(4.13-3)}{3}$	Accuracy of forecasting, Information distortion due to exaggeration demand

Quality Risk	S-type	✔	C_{M3}	$\alpha_{M3} = 1 + \frac{(3.63-3)}{3}$	Product safety, defects of the products, which may result in product recall
Security Risk	S-type	✔	C_{M4}	$\alpha_{M4} = 1 + \frac{(3.38-3)}{3}$	Confidential documents leakage, thievery
Product Design Risk	N-type	×	C_{M5}	$\alpha_{M5} = 1 + \frac{(3.13-3)}{3}$	Simplicity or complexity of the product design
Technical Risk	S-type	×	C_{M6}	$\alpha_{M6} = 1 + \frac{(3.00-3)}{3}$	Defects of the machine
Human Resource Risk	S-type	×	C_{M7}	$\alpha_{M7} = 1 + \frac{(3.13-3)}{3}$	High turnover rate, training and learning effort for new staff
Financial Risk	N-type	×	C_{M8}	$\alpha_{M8} = 1 + \frac{(3.25-3)}{3}$	Liquidity of the cash flow
Distribution Risk					
Relationship Risk	L-type	✔	C_{D1}	$\alpha_{D1} = 1 + \frac{(3.13-3)}{3}$	Degree of mutual trust
Delivery Risk	S-type	✔	C_{D2}	$\alpha_{D2} = 1 + \frac{(3.94-3)}{3}$	Delay, overnight delivery
Security Risk	S-type	✔	C_{D3}	$\alpha_{D3} = 1 + \frac{(3.38-3)}{3}$	Confidential documents leakage, thievery
Inventory Risk	N-type	✔	C_{D4}	$\alpha_{D4} = 1 + \frac{(3.32-3)}{3}$	Holding cost, rate of obsolescence, high ordering cost
Financial Risk	L-type	×	C_{D5}	$\alpha_{D5} = 1 + \frac{(2.63-3)}{3}$	Distributor's poor financial conditions
External Risk					
Political Risk	N-type	×	C_{E1}	$\alpha_{E1} = 1 + \frac{(3.44-3)}{3}$	Government policy
Business Environmental Risk	N-type	×	C_{E2}	$\alpha_{E2} = 1 + \frac{(3.38-3)}{3}$	Competition, legal framework
Natural Disaster Risk	S-type	×	C_{E3}	$\alpha_{E3} = 1 + \frac{(2.38-3)}{3}$	Flooding, earth quake, etc.
Market Dynamic Risk	S-type	✔	C_{E4}	$\alpha_{E4} = 1 + \frac{(3.38-3)}{3}$	Variations in demand

Other notations for parameters used in the model are summarized in Table 5.

Table 5: Notations used in the mathematical model

Notation	Description	Notation	Description
R_S	A set of supply Risk	q_{ij}	Quantity supplied by supplier i and produced by manufacturer j
R_M	A set of manufacturing Risk	I_P	Investment in production
R_D	A set of distribution Risk	m_{ci}	Unit material cost by supplier i
R_E	A set of external Risk	p_{cj}	Unit production cost by manufacturer j
S	Total number of suppliers	l_{cij}	Unit logistics cost from supplier i to manufacturer j
M	Total number of Manufacturer	l_{cjk}	Unit logistics cost from manufacturer j to distributor k
D	Total number of Distributor	F_{Si}	Fixed cost for supplier i
Q	Total production quantity by the supply chain	F_{Mi}	Fixed cost for manufacturer j
FC	Fixed Cost for production	F_{Di}	Fixed cost for distributor k
p	Market price of the product	TC_{Sij}	Total cost of supply risk r from supplier i to manufacturer j
θ	Mark up level (%)	TC_{Mj}	Total cost of manufacturer risk r to manufacturer j
x_i	Supplier i	TC_{Djk}	Total cost of distribution risk r from manufacturer j to distribution k

y_j	Manufacturer j	TC_E	Total cost of external risk
z_k	Distributor k	λ_{Swij}	The sum of prevention cost and appraisal costs, for supplier risk w, involving supplier i and manufacturer j
β	Risk acceptance level	$F_{Swij\zeta}$	The sum of internal and external failure costs, for the scenario ζ
Λ_{Si}	Capacity for supplier i	$\eta_{Swij\zeta}$	Failure event
Λ_{Mi}	Capacity for manufacturer j	$\tau_{Swij\zeta}$	Improvement event
Λ_{Di}	Capacity for distributor k	$S_{Swij\zeta}$	Improvement saving
TC_R	Total risk cost	Ψ_S	Upper percentage limit on supplier risk cost
c_P	Production cost	Ψ_M	Upper percentage limit on manufacturer risk cost
		Ψ_D	Upper percentage limit on distributor risk cost

4.2 Mathematical Formulation

The objective of this model is to maximize the expected profit, by calculating the production quantities with consideration of the risks existed in each part of the supply chain.

Maximize Profit

Profit = Revenue – (Total Production Cost + Total Risk Cost)

$$\text{Max} \quad pQ - c_pQ - FC - TC_R \tag{1}$$

We assume p is estimated using a cost-base strategy, so that it can cover all the costs involved in the supply chain. It equals to the sum of the production and risk costs multiplied by a mark-up level. In this model, Q is the decision variable, representing the optimal quantity of production.

$$p = \frac{c_PQ + TC_R}{Q} \times \theta \tag{2}$$

The unit cost c_p comprises of material cost, production cost and logistics cost, where the administration and setup costs are represented by FC.

$$c_p = \left[\sum_{i=1}^{S} \sum_{j=1}^{M} x_i q_{ij} (m_{ci} + l_{cij}) + \sum_{j=1}^{M} y_i q_j p_j + \sum_{j=1}^{M} \sum_{k=1}^{D} z_k q_{jk} l_{cjk} \right] / Q \tag{3}$$

$$FC = \sum_{i=1}^{S} x_i F_i + \sum_{j=1}^{M} y_j F_j + \sum_{k=1}^{D} z_k F_k \tag{4}$$

The total production quantity Q equals to the total delivery quantities by distributors, and it should equal to the total production and raw material quantities. Here we assume the defects in each process are calculated in the risk cost.

$$Q = \sum_{i=1}^{S} \sum_{j=1}^{M} x_{ij} q_{ij} = \sum_{j=1}^{M} y_j q_j = \sum_{j=1}^{M} \sum_{k=1}^{D} z_k q_{jk} \tag{5}$$

The risk spending should fit in the total risk cost obtained from the Delphi study. The probabilities of the risk factors occurrences and the associated cost in each scenario will be considered. The risk costs can be classified into production quantity dependent or independent. The total risk cost is given as:

$$TC_R = \sum_{i=1}^{S} \sum_{j=1}^{M} TC_{Sij} + \sum_{j=1}^{M} TC_{Mj} + \sum_{j=1}^{M} \sum_{k=1}^{D} TC_{Djk} + TC_E \tag{6}$$

According to Table 4, the quantity dependent risks costs for supply risk category include relationship risk, supplier delivery risk cost, supplier disruption cost, where the quantity independent risk cost is technical risk. The TC_{Sij} cost follows the cost of quality (COQ). The failure cost is denoted by the integration of risk loss by each scenario times the probability of each scenario. Here, we assume the probability of risk loss scenario is dependent on the prevention measures taken, i.e. with more prevention cost incurred, the lower the probability of failure. In addition, for both S-type (smaller the better) and L-type (larger the better) loss functions, we assume that extra savings can be attained if the performance is better than the satisfactory level β_{sw}. For example, with lower defect rate, the customer satisfaction is higher and cost on materials is

lower. Again, the probability of such good performance happens is also depending on the effectiveness of prevention measures. This is different from the previous studies which only assume uncertainty in risks decrease the company performance.

In short, the risk cost for supply risk, L-type and quantity dependent is modeled as:

$$\sum_{i=1}^{S}\sum_{j=1}^{M} x_i y_j[\lambda_{Swij} + \int_0^{\beta_{sw}} F_{Swij\zeta} P(\eta_{Swij\zeta}, \lambda_{Swij}) - \int_{\beta_{sw}}^{1} S_{Swij\zeta} P(\tau_{Swij\zeta}, \lambda_{Swij})] \times q_{ij} \quad \text{where } w = 1 \tag{7}$$

The risk cost for supply risk, S-type and quantity dependent is modeled as:

$$\sum_{i=1}^{S}\sum_{j=1}^{M} x_i y_j[\lambda_{Swij} + \int_{\beta_{sw}}^{1} F_{Swij\zeta} P(\eta_{Swij\zeta}, \lambda_{Swij}) - \int_0^{\beta_{sw}} S_{Swij\zeta} P(\tau_{Swij\zeta}, \lambda_{Swij})] \times q_{ij}$$
where $w = 2$ & 3 (8)

The risk cost for supply risk, S-type, quantity independent is modeled as:

$$\sum_{i=1}^{S}\sum_{j=1}^{M} x_i y_j[\lambda_{S4ij} + \int_{\beta_{s4}}^{1} F_{S4ij\zeta}\ P(\eta_{S4ij\zeta}, \lambda_{S4ij\zeta}) - \int_0^{\beta_{s4}} S_{S4ij\zeta} P(\tau_{S4ij\zeta}, \lambda_{S4ij\zeta})] \tag{9}$$

The determination of λ_{Swij} follows a function of management importance α_{Sw} on supply risk w, and investment *I*.

$$\lambda_{Swij} = \Phi(\alpha_{Sw}, I) \tag{10}$$

Also, we assume the total prevention and appraisal costs lower than the total failure costs, i.e.

$$\lambda_{Swij} \le \int_0^{\beta_{sw}} F_{Swij\zeta}\ P(\eta_{Swij\zeta}, \lambda_{Swij}) \tag{11}$$

For manufacturer risk costs, both S-type and L-type risks have similar models as equations (7) – (9). For example, the manufacturer risk, the S-type and quantity dependent is modeled as:

$$\sum_{j=1}^{M} y_j[\lambda_{Mwj} + \int_{\beta_{Mw}}^{1} F_{Mwj\zeta} P(\eta_{Mwj\zeta}, \lambda_{Mwj}) - \int_0^{\beta_{Mw}} S_{Mwj\zeta} P(\tau_{Mwj\zeta}, \lambda_{Mwj})] \times q_j \tag{12}$$

For the N-type risk cost, as there will only be failure cost once the value deviates from the desirable region ($\beta_{Mw} \pm \delta_{Mw}$) , so the model becomes:

$$\sum_{j=1}^{M} y_j[\lambda_{Mwj} + \int_0^{\beta_{Mw}-\delta_{Mw}} F_{Mwj\zeta} P(\eta_{Mwj\zeta}, \lambda_{Mwj}) + \int_{\beta_{Mw}+\delta_{Mw}}^{1} F_{Mwj\zeta}\ P(\eta_{Mwj\zeta}, \lambda_{Mwj})] \tag{13}$$

As the models of distributor risk from manufacturer *j* to distributor *k* are also similar to equations (7) – (9) and equation (13), we will skip the detailed models here. Lastly, the N-type external risks for all manufacturer *j* locate is modeled as:

$$\sum_{j=1}^{M} y_j\ [\lambda_{Ewj} + \int_0^{\beta_{Ew}-\delta_{Ew}} F_{Ewj\zeta}\ P(\eta_{Ewj\zeta}, \lambda_{Ewj}) + \int_{\beta_{Ew}+\delta_{Ew}}^{1} F_{Ewj\zeta}\ P(\eta_{Ewj\zeta}, \lambda_{Ewj})] \tag{14}$$

While the S-type external risks for all manufacturer *j* is modeled as:

$$\sum_{j=1}^{M} y_j[\lambda_{Ewij} + \int_{\beta_{Ew}}^{1} F_{Ewj\zeta}\ P(\eta_{Ewj\zeta}, \lambda_{Ewj}) - \int_0^{\beta_{Ew}} S_{Ewj\zeta} P(\tau_{Ewj\zeta}, \lambda_{Ewj\zeta})] \tag{15}$$

Similar sets of external cost models are applied to the locations where a particular supplier *i* or distributor *k* locate.

Next, we have to ensure that the total cost is restricted by the available investment. For all suppliers, manufacturers and distributors, the capacity limit for each player should not be exceeded.

$$c_p Q + FC + TC_R \le \mathrm{I}_p \tag{16}$$

$$\sum_{j=1}^{M} q_{ij} \le \Lambda_{Si} \quad \text{for } i = 1 \text{ .. S} \tag{17}$$

$$q_j \le \Lambda_{Mj} \quad \text{for } j = 1 \text{ .. M} \tag{18}$$

$$\sum_{j=1}^{M} q_{jk} \le \Lambda_{Dk} \quad \text{for } k = 1 \text{ .. D} \tag{19}$$

It is optional to set the resource allocation limits on three types of risks based on the concerns

weightings found by Delphi method. Lastly, all x_i, y_j, z_k are binary variables.

$$\sum_{i=1}^{S}\sum_{j=1}^{M} TC_{Sij} / [\sum_{i=1}^{S}\sum_{j=1}^{M} TC_{Sij} + \sum_{j=1}^{M} TC_{Mj} + \sum_{j=1}^{M}\sum_{k=1}^{D} TC_{Djk}] \leq \Psi_S \quad (20)$$

$$\sum_{j=1}^{M} TC_{Mj} / [\sum_{i=1}^{S}\sum_{j=1}^{M} TC_{Sij} + \sum_{j=1}^{M} TC_{Mj} + \sum_{j=1}^{M}\sum_{k=1}^{D} TC_{Djk}] \leq \Psi_M \quad (21)$$

$$\sum_{j=1}^{M}\sum_{k=1}^{D} TC_{Djk} / [\sum_{i=1}^{S}\sum_{j=1}^{M} TC_{Sij} + \sum_{j=1}^{M} TC_{Mj} + \sum_{j=1}^{M}\sum_{k=1}^{D} TC_{Djk}] \leq \Psi_D \quad (22)$$

5 SUMMARY AND FUTURE STUDY

In this study, we have conducted an analysis on the risk trend in recent 15 years. The analysis showed that outsourcing risk and supply risk were the major focus in the past studies. There was very limited researches on the whole supply chain risk. Therefore, we address this area of research, with the target to integrate all types of risks exist in the supply chain to provide decision makers a comprehensive picture and tool in managing all the risks. Based on the literature review, 20 types of supply chain risks, which belong to four different categories: supply, manufacturing, distribution and external risks, are defined. Using the Delphi method, we investigated the importance of each risk from both the practitioners and academia perspectives. Consensus of the weightings on concerns and importance ratings were attained after two rounds of interviews. These findings provide guidance to practitioners for evaluating the supply chain risk levels and formulating appropriate risk management strategies. To have a better control of risks that lead to the higher return, a profit maximization model is proposed to include both production parameters and risk factors involved in the whole supply chain. The model enables users to obtain an optimal production quantity to achieve the best benefit under the concerning about the wide range of supply chain risks. It is the first model which integrates all production costs and supply chain risks, and quantifies the positive impact of *L-type* and *S-type* of supply chain risks.

5.1 Limitation and Future Study

The major limitation of this study was the small sample size in the Delphi study. As most risk phenomena and cost estimations are collected from the survey, the small sample size limits its representativeness. Despite this limitation, the mathematical model is still valid, as the risks were identified from the literatures. The importance ratings and concern weightings can be further revised when more surveys are collected. Due to this limitation, we did not conduct the analysis on the mathematical model to understand the sensitivities and relationships between different parameters. In the future, a larger scale of survey should be conducted across different supply chain industries, so as to develop a set of risk ratings and risk management effects for analysis and identifying managerial implications. Lastly, a decision support system can be developed to aid the decision making.

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CATEGORIZATION OF SUPPLY CHAIN RISK FACTORS IN HEALTHCARE SERVICE OPERATIONS: APPLICATION OF Q-SORT METHOD

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ABSTRACT
Efficiency of supply chain management is a primary concern of healthcare performance. Supply chain disruptions has caused significant business impact to the healthcare business organizations. Recognition of risk factors can serve as a rigid foundation for achieving supply chain management goals. Hence, the purpose of this study is to determine supply chain risk management (SCRM) factors in the context of healthcare service operations. The research begins with gathering potential risk factors from the literature review. Then, Q-Sort method is employed to classify risk factors. The results lead to classification of five risk categories, which are useful for risk management practice in health care supply chain context.

Keywords: supply chain risk, healthcare, Q-Sort

INTRODUCTION
Recently, there has been a significant increasing demand for healthcare services in Thailand. The value of health care in Thailand has jumped up almost 200% since 2005 (NESDB, 2012). Supply chain management has been focused as one the main issue to improve healthcare organization performance in both cost efficiency and customer satisfaction (Bhakoo et al, 2012). However, managing healthcare supply chain is a challenging task. Healthcare supply chain is much more complex and involve with diverse stakeholders compared to supply chains in other industries (Beirer, 1995 and Shah, 2004). Furthermore, healthcare supply chain environment has been pressured by dynamic changes from multiple sources including new medical products, technological disruption, supplier capacities, regulations and consumer demand. Such complex supply chain network leads to the requirement of risk management (Thun and Hoeing, 2011).

LITERATURE REVIEW
Healthcare Supply Chain
Healthcare sector has several attributes, which challenge to effective supply chain management. Healthcare business operates with variety of products and services. Shah (2004) mentions that pharmaceutical products are characterized by long development cycles that have long lead times have significant impact on capacity planning and supply chain strategies,

particularly inventory management. Furthermore, healthcare business involves with multiple specialized organizations providing different kind of services including catering, laundry cleaning, waste management, and information management (Gattorna, 1998). Regarding to their expertise, these organization work independently hence it is difficult to enhance integrated supply chain management principle. Moreover, healthcare business has difficulty to predict market demand due to patient mix (Jarret, 1998, Scheller and Smeltzer, 2006), and sudden requirements from emergency interventions. Also, threats of healthcare supply chain can be derived from medical errors, patient safety, and spiraling up medical costs (McFadden et al., 2006 and Gowen et al., 2008). Finally, healthcare system has recently been involved with number of different changes ranging form technological innovation, competitions, margin compression, increased regulatory, cost of drug development, operation management and an increase in average lifetime. While on the surface these factors drive complexity in healthcare business, they also create significant damages to supply chain management performance. Failure in managing supply chain risk can lead organizations to face with difficult situations including unable to response to consumers' requirement, significant loss in daily operations (Mitroff and Alpasan, 2003) and downturn in organization's share price (Hendricks and Singhal, 2005). Christpher and Lee (2004) agree that the issue of risk in supply chain is becoming more and more important for many reasons including uncertainty in supply and demand, shorter of product life cycle, and increased use of sourcing. Unexpected changes in supply chain network can cause disrupted in flow of information, goods and capital.

Supply Chain Risk Definition

The term risk is used in various aspects and has been addressed in numerous ways regarding to individual perception of the world. However, Frosdicks (1997) states that basically risks are those events, which if they occurred would affect the expected outcomes. Regarding to Knight's view (1921) *"risk entails uncertain outcomes of known probabilities and differs from uncertainty which entails uncertain outcomes of unknown probabilities"*. The second component is the probability that a particular outcome may occur. ISO 31000 (2009) indicates that risks can be characterized by (I) their nature and origin, (II) the likelihood of them occurring and (III) potential consequences.

Faisal et al. (2006) propose that risk in supply chain relates to variables that cannot be predicted with certainty and that affect the supply chain outcome variables. Christopher and Holweg (2004) provides definition of supply chain risk as "*any risk to the information, material and product flow from originality suppliers to the delivery of the final product*". Hence, it is essential to recognize gathering relevant information to better manage healthcare supply chain. Turban et al. (2004) argues that problems in supply chain management stem from uncertainties concerned with decision-making process. Therefore, the management of supply chain needs to take into consideration information concerning uncertainties relating supply chain activities.

Supply Chain Risk Management

McCromack et al. (2008) argue that supply chain risk management is defined as having the objective to control, monitor and evaluate supply chain risk, optimizing actions in order to prevent disruptions or to quickly recover from them. Risk management has been established to stimulate managers' understanding that risk is to be assessed against the benefits of supply

chain objectives. Tang (2006) further define supply chain risk management is "*the management of supply chain risks through coordination of collaboration among the supply chain partners so as to ensure profitability and continuity"*. Generally, the risk management process consists of four main phases including risk identification, risk assessment, risk response and risk monitoring (AIRMAC, 2002, COSO, 1996 and ISO 3100, 2009).

Among these phases, risk identification is considered to be the utmost important, as risk can only be assessed if they are identified and contextualized (Hillson, 2004). The conceptualization of risk categorization model refers to the various types of risks that are relevant to the supply management, and indicated some managerial challenges pose for a successful process of operation management. Nevertheless, since supply chain management faces many risks. There are several approaches to explore risk factors in supply chain. Cucchiella and Gastaldi (2006) divide supply chain risks into categories of internal issues like capacity variations, regulations, information delays, and organizational factors and external covers several issues including market prices, actions of competitors, manufacturing yield and costs, supplier quality, and political issues. Similarly, Kleindorfer and Sadd (2005) categorized risk into risks arising from coordinating complex systems of supply and demand (internal), and disruptions (external). Cousins et al. (2004) suggest that there are two main types of supply chain risk to which companies can become exposed: technical risk which refers to over reliance on a single or limited source of a product, process or technology; and strategic risk which refers to over reliance on a single or limited number of suppliers. However, Svensson (2002) argues that the term "supply chain vulnerability" has been used to describe the interdependences and risk that exist among organizations as they rise to the challenge of "better, faster, cheaper". Wakolbinger and Cruz (2011) also indicate that supply chain risks can be classified into supply-demand coordination risk and disruption risks. Christopher (2003) argues that managing risks in supply chain should take a holistic view and management of risk at the level of the entire supply chain (Harland et al., 2003).

Although, there are different approaches to conceptualize potential risk factors in supply chain. It is important to recognize that only clear understanding of risk source and their relationship can lead to effective risk response strategies (Singhal et al., 2011). Having risk categories can serve as initial guideline for involved parties to commence fruitful risk discussion (Chapman, 1998). Hence, this study aims to explore potential risk categorization in healthcare supply chain context.

Risks in Healthcare Supply Chain

Effective risk identification requires practical guideline for risk discussion (Chapman, 1998). Risk categorization can be a supportive platform for more effective risk management. Regarding to Singhal et al. (2011), risk categorization can be conducted using supply chain functional aspects with regards change that could impact the achievement of functional objectives. Thamsatitdej et al. (2014) has explored thirty-six articles relating to supply chain risk in healthcare industry and summarized them according to their characteristics and potential impacts to particular objectives. As a result, thirteen risk factors and five risks categories are summarized. These five risk areas are economic risk, network risk, operational risk, institutional risk and safety risk factors. Within these risk categories, there are thirteen risk factors relating to healthcare business inherently hidden. (Table I)

Table 1 – Healthcare Supply Chain Risk Category

Healthcare Supply Chain Risk Category	Brief Description and Risk Issue	Reference
Economic Risk	Economic risk refers to external factors, which can affect healthcare supply chain business financially. These risk factors are financial risk and price/market risk.	Desheng, 2009, Mustafa and Potter, 2009
Network Risk	Network factor refers to risk factors that can affect supply chain performance in term of collaboration with stakeholders both internal and external aspects. These risk factors are supplier performance risk, relationship risk and human resource risk.	Halllikasa et al., 2002, Toba et al., 2008, Kumar et al., 2009
Operational Risk	Operational factor refers to risk factors that can potential affect healthcare service performance. These risk factors are diagnosis, capacity/ work scheduling, waste management risk and medical risks.	Anna et al., 2011, Mustafa and Potter, 2009, Jarrett, 1998, Pan and Pokarel, 2007
Institution Risk	Institutional factor refers to internal organization management risks that can affect organization management performance. These risks are regulatory risk and technological infrastructure risk.	Christian et al., 2011, Dongre et al, 2010
Safety Risk	Safety factor refers to risks involving with patient welfare. These risks are security risk and natural disaster risk.	Thamas, 2005, Shah, 2004, Antani and Mutshinda, 2010

RESEARCH METHODOLOGY

This research consists of two parts. The first is to determine risk categories by reviewing literature and then applies Q-sort method to validate the risk grouping based on expert opinions. In order to determine risk categories in healthcare supply chain, a comprehensive review of risk factors affecting the achievement of supply chain objectives was conducted.

The Q-sort method is an iterative process in which the degree of agreement between judges forms the basis of assessing construct validity and improving the reliability of the construct (Rajesh et al., 2011). The Q-sort method uses the kappa statistic as a measure of agreement among raters, which can be interpreted as the proportion of joint judgment in which there is agreement after chance agreement is excluded (Nahm et al., 2002). If there is complete agreement, $\hat{k} = 1$. If the observed agreement is greater than or equal to chance agreement, $\hat{k} \geq 0$, and if the observed agreement is less than or equal to chance agreement, $\hat{k} \leq 0$. No general agreement exists with respect to required scores. However, several studies have considered scores 0.65 to be acceptable (Li et al., 2005). There are three basic assumptions for the agreement coefficient are as follows: the units are independent, the categories of the nominal scale are independent and mutually exclusive and the judges operate independently

(Nahm et al., 2002). The chance-corrected measure of overall agreement proposed by Fleiss (1971) can be expressed as followed:

$$K = \frac{\sum_{i=1}^{N}\sum_{j=1}^{k} n_{ij}^2 - Nn\left[1 + (n-1)\sum_{j=1}^{k} P_j^2\right]}{Nn(n-1)\left(1 - \sum_{j=1}^{k} P_j^2\right)}$$

where k is Fleiss's kappa statistic, N is the total number of items, *n* is the number of ratings per item, k is the number of categories into which assignments, n_{ij} is the number of raters who assigned the *i*th item to the *j*th category, and p_j is the proportion of all assignments which are to the *j*th category.

An agreement among the *n* raters for the *i*th item may be indexed by the proportion of agreeing pairs out of all the *n*(*n*-1) possible pairs of assignments, proposed by Fleiss is:

$$p_i = \frac{1}{n(n-1)}\left(\sum_{j=1}^{k} n_{ij}^2 - n\right)$$

According to Fleiss (1971), if N is large, the variance of k under the hypothesis of no agreement beyond chance is approximately equal to:

$$Var(K) = \left(\frac{2}{Nn(n-1)}\right)\left(\frac{\sum_{j=1}^{k} p_j^2 - (2n-3)\left(\sum_{j=1}^{k} p_j^2\right)^2 + 2(n-2)\sum_{j=1}^{k} p_j^3}{\left(1 - \sum_{j=1}^{k} p_j^2\right)^2}\right)$$

Under the hypothesis of no agreement beyond chance, k/SE(k) will be approximately distributed as a standard normal variate.

The extent of agreement on a particular assigning an item to category j, an agreement on a particular category is calculated as:

$$K_j = \frac{\sum_{i=1}^{N} n_{ij}^2 - Nnp_j\left[1 + (n-1)p_j\right]}{Nn(n-1)p_j(1-p_j)}$$

The approximate variance of kj is:

$$Var(K_j) = \frac{\left[1 + 2(n-1)p_j\right]^2 + 2(n-1)P_j(1-p_j)}{Nn(n-1)^2 P_j(1-P_j)}$$

The hypothesis may be tested by referring the quantity $K_j/SE(K_j) = K_j/\sqrt{Var(K_j)}$ tables of the standard normal distribution.

Two groups of experts collaborated in this study. The first group consisted of 15 healthcare supply chain management practitioners who have more than 15 years of experience. The second group was scholars who have been involved with healthcare supply chain management studies. A Q-sort questionnaire consisting of five categories with thirteen risk factors was

developed. The Q-sort data were completed by a selected group of experts, in which experts were given detailed category definitions and a list of enabling factors and then they were asked to match each enabling factors with on of the categories.

RESULTS

Table II demonstrates the result of Q-Sort based on 21 experts.

Table II – Q-Sort Result from 21 experts

Healthcare Supply Chain Risk Factors	Risk Category 1	Risk Category 2	Risk Category 3	Risk Category 4	Risk Category 5	Dimension
Market Price Risk	15		3	3		1
Financial Risk	17	1	2	1		1
Relationship Risk		16	2	3		2
Supplier Performance	4	9	5	4		2
Diagnosis Risk	2	1	11		7	3
Capacity/Work Scheduling	2	2	17			3
Technological Infrastructure Risk		8	10		3	3
Service Risk			13		8	3
Human Resource Risk	2	1	14	3	1	3
Institutional Risk	1	3	6	11		4
Medical Risk		1	2		18	5
Waste Management Risk			8	2	11	5
Natural Disaster	2	1	3	1	14	5
C_j	45	42	96	28	62	
P_j	0.165	0.154	0.352	0.102	0.227	

Table III – Kappa Values from 21 experts

	K_j	$Var(K_j)$	$\frac{K_j}{SE(K_j)}$
Overall	0.32329	0.0003156	18.198
Risk Category 1	0.46967	0.0042054	7.243
Risk Category 2	0.32398	0.0039697	5.142
Risk Category 3	0.20667	0.0094961	2.121
Risk Category 4	0.17066	0.0029464	3.144
Risk Category 5	0.43909	0.0056690	5.832

The results indicate that Kapp value is 0.32 which indicates low consensus among experts. Hence, the researchers decided to reduce numbers of experts from 21 to 7.

Table IV – Q-Sort Result from 7 experts

Healthcare Supply Chain Risk Factors	Risk Category 1	Risk Category 2	Risk Category 3	Risk Category 4	Risk Category 5	Dimension
Market Price Risk	6			1		1
Financial Risk	7					1
Relationship Risk		7				2
Supplier Performance	1	5	1			2
Diagnosis Risk			5		2	3
Capacity/Work Scheduling		1	6			3
Technological Infrastructure Risk		1	5		1	3
Service Risk			5		2	3
Human Resource Risk		1	6			3
Institutional Risk				7		4
Medical Risk			1		6	5
Waste Management Risk			1		6	5
Natural Disaster			1		6	5
C_j	14	15	31	8	23	
P_j	0.154	0.165	0.341	0.088	0.253	

Table V– Kappa Value from seven experts

	K_j	$Var(K_j)$	$\frac{K_j}{SE(K_j)}$
Overall	0.62457	0.0016286	15.476
Risk Category 1	0.82993	0.0226670	5.512
Risk Category 2	0.61016	0.0233382	3.994
Risk Category 3	0.44220	0.0388833	2.242
Risk Category 4	0.86179	0.0197407	6.134
Risk Category 5	0.57204	0.0299728	3.304

From table V, overall kappa value is at 0.62 which indicate significant consensus among experts judgement on risk cateogires. Nevertheless, kappa value of risk category 3 is 0.44 which implies middle consensus (Landis and Koch, 1977). Therefore, this category can be excempted when considering risk factors for supply chain management. Considerting risk factors in this category must take cuatious as risk factors within this specific category can be confused with others.

CONCLUSTION

Regarding to this study, supply chain risk factors in healthcare industry can be categorized into five risk areas including economic factor, network factor, operation factor, institution factor and safety factor accordingly. For economic factor, there are primary risk factors including market risk and financial risk. For network factor, there two risks covered including

relationship risk and supplier performance risk. For operation factor, diagnosis risk, capacity risk, technological risk, diagnosis risk and human risk must be taken into consideration. For institutional factor, institutional risk is crucial. Finally for safety factor, waste management risk and natural disaster must be contemplated.

The results from this study provide healthcare supply chain managers with risk identification perspective, which can be supportive for designing risk management strategy in practice. Though supply chain risk in healthcare industry has been studied but there has not been an attempt to group various risks in such complex industry. This study proposes risk categories in healthcare supply chain, which can be used to support in risk identification phase. Furthermore, these risk categories and risk factors can be beneficial to healthcare supply chain stakeholders to use as guideline during risk discussions, seek effective risk response strategies and allocate suitable risk ownership.

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ROLE OF SUPPLY CHAIN NETWORK FINANCING IN ENHANCING SME OPERATIONS: A TRIANGULATION STUDY IN A CHINESE CONTEXT

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ABSTRACT

Despite their crucial role in sustaining economies, small and medium enterprises (SMEs) are plagued by a critical constraint of risk-free financing. In the Chinese context, while entrepreneurial-oriented SMEs have become major economic entities due to the economic reform of State-Owned Enterprises (SOEs), the 'Finance gap' stands as a significant barrier to the growth and enrichment of this sector. Although the concept of 'supply chain finance' is relatively new, its role in enabling the harmonization of the SME sector is becoming widely recognized. From a network perspective, organizational and supply chain researchers have suggested that a supply chain network is an alternative way to overcome the problem of information asymmetry in financing decisions (Scott and Daniel, 2002; Song and Wang 2013; Wuttke et al., 2013). This means that utilizing the comprehensive network credit or information financing mobile and immobile assets within the supply chain, and the (shared) financing of working capital in order to leverage the best cost of the capital rate within the chain (Gomm 2010). Many SME leaders have only very recently attempted to grasp the paradox of the significant 'power-shift' toward supply chain networks of the SME sector (Yiannaki, 2012; Pinto and De Sa, 2013). The challenge of harmonizing trust-based social capital by mitigating information asymmetry provides a phenomenal opportunity for all the participants to increase their financial strength. Agonizing about the ambiguities of 'information asymmetry' may be pervasive in this sector, but this study demonstrates that this can be overcome.

Theory and Hypotheses

In a perfect market, where complete and costless information is available to both parties, there is no uncertainty regarding present and future trading conditions. However, in the real world, information is neither perfect nor costless, and SMEs financing market is especially characterized by risk and uncertainty regarding future conditions, which means that investors are frequently unable to determine the quality of information distributed asymmetrically between the bank and the firm in the case of potential borrowers (Tucker and Lean, 2003). From the bank's perspective, it has

incomplete information regarding the underlying quality of the project and the management of the SME, giving rise to the problem of adverse selection (Stiglitz and Weiss, 1981). Furthermore, the management of the SME may fail to perform to its full capability, giving rise to the problem of monitoring high cost activities associated with the lending proposition (Tucker and Lean, 2003). This kind of information asymmetry is not only because the good prospect has been rejected but also because the bad prospect has been accepted. To reduce these two kinds of risks, investors have to collect and process the specific information about SMEs. Then the "good" candidates with high profits but low risks would be differentiated from the "bad" ones with low profits but high risks.

In practice, different kinds of lending techniques have been developed by the bank to solve information aysmetry. Berger and Udell (2002) divide them into four kinds: financial statement lending, asset based lending, credit scoring and relationship lending. The former three are classified as transactional technologies, which reflects the arm's length relationship between banks and firms, is primarily based on "hard" quantitative information reported through third channels, such as companies' annual reports, financial statements, regulatory filings, bids and prices, price quotes, contractual stipulations, warranties, and other information made accessible in the public domain (Uzzi and Lancaster, 2003). Different from transaction lending, relationship lending emphasizes the process of collecting the private, customer-specific information of potential borrowers, and using it to engage in profitable financing activities (Boot, 2000). Using much soft information that refers to idiosyncratic and non-standard information through the firm's relationship will complement insufficient hard information (Uzzi and Lancaster, 2003).

In reality, the efficiency of delivering information and the ability to accept it are constrained by different kinds of factors; therefore, the rationality of human behavior is also limited (Simon, 1947). Furthermore, the delivery of information is full of noise and is incomplete; thus, information asymmetry will lead to power asymmetry, which will further intensify information asymmetry (Stiglitz, 2008) and motivate opportunism, which is the seeking of personal profit by means of untruthful threats or

commitment (Williamson, 1975). Therefore, problems caused by information asymmetry not only exist between financial institutions and SMEs, but also among the SMEs themselves. From a network perspective, organizational and supply chain researchers have suggested that a supply chain network is an alternative way to overcome the problem of information asymmetry in financing decisions (Scott and Daniel, 2002; Song and Wang 2013; Wuttke et al., 2013). This means that utilizing the comprehensive network credit or information financing mobile and immobile assets within the supply chain, and the (shared) financing of working capital in order to leverage the best cost of the capital rate within the chain (Gomm 2010). Many SME leaders have only very recently attempted to grasp the paradox of the significant 'power-shift' toward supply chain networks of the SME sector (Yiannaki, 2012; Pinto and De Sa, 2013). The challenge of harmonizing trust-based social capital by mitigating information asymmetry provides a phenomenal opportunity for all the participants to increase their financial strength. Agonizing about the ambiguities of 'information asymmetry' may be pervasive in this sector, but this study demonstrates that this can be overcome.

The following hypotheses are proposed:

H1: Financing information has a positive effect on SMES' financing quality

H1a: Hard information has a positive effect on SMEs' financing quality

H1b: Soft information has a positive effect on SMEs' financing quality

H2: Supply chain network embeddedness has a positive effect on SMEs' financing quality

H3: Financing information mediates the effect of supply chain network embeddedness on SMEs' financing quality

H3a: Hard information mediates the effect of supply chain network embeddedness on SMEs' financing quality

H3b: Soft information mediates the effect of supply chain network embeddedness on SMEs' financing quality

Method and Results

Since every methodology or approach to a research phenomenon is potentially biased and susceptible to invalidity, the rationale is to use dissimilar methods to measure the same unit so that the weaknesses of one method can be overcome by the strengths of another (Cunningham, Young and Lee, 2000). Therefore, this study adopts a cross-sectional research design using a survey in the first stage and multiple case studies with in-depth interviews in the second stage to test and further explain the theoretical model. This combination of methods in a study of the same phenomena is referred to as triangulation (Denzin, 1978; Chen 2012), and triangulation is manifested in several aspects of this study, namely data collection, data sources and methods of analysis.

The first phase of the research project included three rounds of a questionnaire survey of the packaging industry, the rubber toy industry, and the home textiles and shoe-making industry in Wenzhou district, the electrical equipment industry in Leqing, the motorcycle equipment industry in Rui'an, and the electronic industry in the Chu Chiang Delta where there is a cluster of Chinese SMEs. The purpose was to test the theoretical model using a large sample survey. The hypothesized effects in the theoretical model were tested by a structural equation modeling (SEM). The indices show that the model fit the data quite well (χ^2/df=1.958, RMSEA=0.078, IFI=0.935, TLI==0.913, CFI=0.934). Specifically, as hypothesized in H1a and H1b, both hard information and soft information have a significant positive effect on SMEs' financing quality (γ=0.404, p<0.001; γ=0.352, p<0.001, respectively). Although the direct effect of network embeddedness on financing quality is significant (γ=0.220, p<0.001), it is negative, which is the reverse of the direction hypothesized in H2. In addition, network embeddedness affects hard information and soft information positively and significantly (γ=-0.220, p<0.01), which indicates that H3a and H3b are both supported. A *Sobel* test was adopted to further test the mediating effects, and the results show that the indirect effect of network embeddedness on financing quality of both hard information and soft information is significant (z=2.532, p<0.01; z=2.706, p<0.01, respectively).

In the second phase of the research project, a series of cases studies and in-depth interviews were conducted with different types of companies in order to strengthen the empirical results of this study. The purpose of these gatherings was to meet those who participate in supply chain finance for SMEs to explore significant findings in greater detail and check the factors considered by capital lenders. The interviews were conducted with four Chinese companies in the typical industries, namely manufacturing, trade, e-commerce and banking, where supply chain finance as an innovative business model has been developing dramatically. The results of case studies confirms the survey results that higher level of supply chain embeddedness leads to higher level of financing quality. However, the case studies also illustrate the complex mechanisms underlying this simple relationship, relating to ways of risk control during supply chain finance. All the informants emphasize the importance of SMEs' embeddedness in a supply chain network, especially because their relationship with key partners can provide the focal firms with valuable information. However, the informants also indicated the dark side of network embeddedness without information symmetry: related to the vulnerability of network embeddedness and the potential opportunism caused by a high level of network embeddedness. Thus, highly embedded in the supply chain network may not lead to high financing quality, and may even cause high risks. Almost all the informants identified a combination of information, logistics and transaction as being an effective way to control potential risks. Therefore, the key point is whether a high quantity and quality of information is generated from the network where SMEs are embedded.

Contributions and Limitations

This study contributes to research and practice on the interface of logistics and finance in the following aspects. First, based on the theory of information asymmetry, this study distinguishes two different kinds of information-hard information via transaction lending and soft information via relationship lending, both of which are important for explaining the advantages of supply chain network in dealing with SMEs financing problems. Second, adopting a network perspective, this study tries to investigate how financial resources flow together with the materials and information

flow via supply chain network embeddedness in order to optimize the SMEs' availability and cost of capital within a focal firm-centric supply chain. Third, we adopt a triangulation method mixed by a large-scale survey from the debt side, which tests the effects of network embeddedness on SMEs financing quality in the context of supply chain finance; and multiple case studies from the credit side, which confirms the survey results and provides plentiful evidences.

More research is needed to examine and explore the various facets of supply chain finance. Although this study makes an important contribution to the knowledge base, like any study, it has its limitations. Although network embeddedness and hard and soft information were investigated in terms of SMEs' financing, these aspects are not comprehensive. Some are beyond the scope of a single study, such as how industry-level, firm-level issues, especially the fit between SMEs and their upstream and downstream, use of the agency theory impacts supply chain finance. Other financing aspects, such as duration, volume and cost capital should also be examined in the study (Gomm, 2010). It is also important for future research to assess the financial risk, as well as management and contingency factors, which may lessen the overall risk.

CLUSTERING CORPORATE BRANDS BASED ON SOCIAL METRICS: A CASE STUDY OF THE AUTOMOBILE INDUSTRY

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ABSTRACT
Since the Internet provides a way of expressing and sharing Internet users' minds, corporate marketers want to acquire measurable and actionable insights from the web data. In this study we propose a framework for clustering brand names of the automobile industry using social metrics gathered on the social media. We calculated the brand name distances based on the total number that all pairs of brand names are mentioned together. These distances are used to project the brand name onto a 2-dimensional space using multidimensional scaling. After the projection we found the clusters of brand names and identified the characteristics of each cluster.

Keywords: Brand clustering, Social Media, Automobile Industry, Multidimensional Scaling

INTRODUCTION

In the past decade, companies have tried to foster customer profitability by managing relationships with their customers. To enhance their relationships, companies deployed enterprise-wide CRM (Customer Relationship Management) after collecting and analyzing socio-demographic and transaction data.

Nowadays social media such as Facebook, Twitter, and LinkedIn play a crucial role for collecting, transmitting, and sharing opinions of people. Many firms are eager to identify these collective opinions about firms' products or brands. Since customers are likely to share ideas pertaining to firms' products or brand frankly on the web - especially on social media, gathering and mining opinions has become a critical factor for marketers who are trying to identify customer preferences.

In this paper we suggest a framework for clustering corporate brands based on social metrics - the number of brand names mentioned together on microblog and on Twitter. After reviewing the related works of brand positioning and clustering, we propose a framework for clustering corporate brands. To verify our framework, we conduct a case study of the automobile industry. Social metrics of car brand names are extracted and clustered using the suggested framework.

RELATED WORKS

We reviewed researches related to brand and social media.

Brand & Social Media

De Vries et al. (2012) analyzed the effects of social media marketing using the brand posts - video clip, messages, quizzes and information about the brand – found on 11 international

brand fan pages. Their findings explain that many different drivers influence the number of "Like" and the number of comments.
Bifet & Frank (2011) suggested a real-time data mining technique for analyzing sentiment words in Twitter data streams. Khan et al. (2014) suggested a framework for mining Twitter opinion using three hybrid classification schemes. Nagy & Stamberger (2012) proposed a method to extract sentiment words in disaster micro-blogs.

Brand Clustering
Punj & Moon (2002) suggested a psychological categorization framework to support marketing managers in making major positioning decisions. They developed five sets of propositions connecting positioning options for product with the processing of brand-level information. Chintagunta (1994) proposed a heterogeneous logit model for branding positioning. The suggested model is used to analyze data regarding the purchases of liquid laundry detergents.

RESEARCH FRAMEWORK

To consider the users' social media comments about corporate brands we suggest the following procedure.

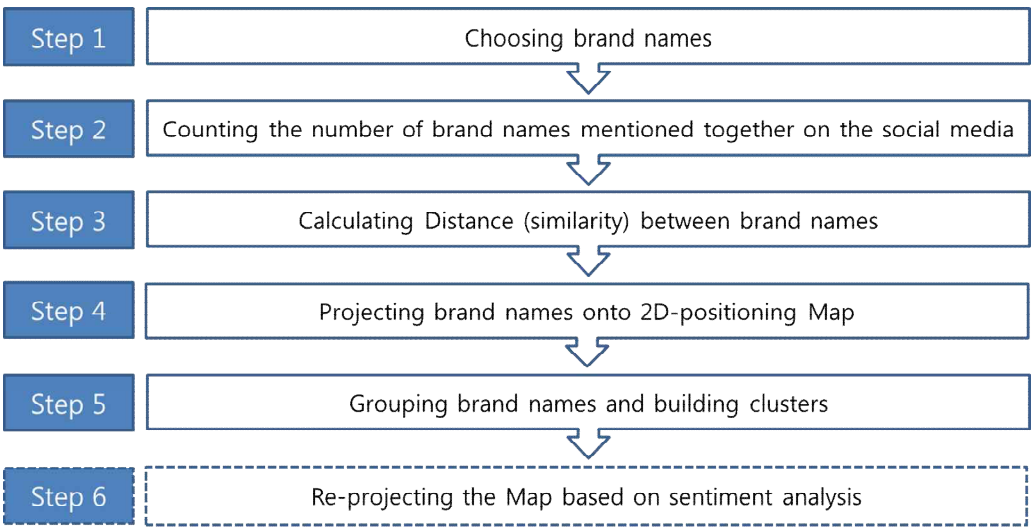

Figure 1 - Research framework

As a first step, we choose brand names to cluster. Secondly, we count the number of brand names mentioned together on the social media sites and build a matrix composing co-mentioned counts. In third step, we convert those counts into distance and created a distance matrix. Lastly, we will project the brand names onto 2D space using multidimensional scaling and identify a group of brand names.

CASE STUDY

To verify the feasibility of the suggested framework, we chose to research the automobile industry. The car names of an automobile firm are chosen as brand names. The social metric data was gathered for 30 days in microblog websites and Twitter. If the i^{th} brand names mentioned in the media, we count how many times the j^{th} brand name are mentioned together

and create a matrix ***C*** which has C_{ij} elements. Table 1 shows some part of co-mention matrix ***C***.

*Table 1 - Co-mention matrix **C***

Brand names	i30	i40	K3	K5	K7	…	Grandeur
i30	0	531	1	559	570	…	1
i40	531	0	1	473	468	…	377
K3	1	1	0	898	669	…	1
K5	559	473	898	0	1178	…	63
K7	570	468	669	1178	0	…	40
…	…	…	…	…	…	…	…
Grandeur	1	377	1	63	40	…	0

And then the distance matrix ***D***, denoting the distance between two brand names, is can be created from ***C*** matrix. Figure 2 shows a formula to create elements in ***D*** matrix from elements in matrix ***C***.

$$d_{ij} = \begin{cases} {Max(\vec{C})}/{c_{ij}}, & where\ c_{ij} > 0\ and\ i \neq j \\ 1, & where\ c_{ij} = 0\ and\ i \neq j \\ 0, & where\ i = j \end{cases}$$

Figure 2 – Matrix conversion

Table 2 denotes the converted distance matrix ***D***.

*Table 2 - Distance matrix **D***

Brand names	i30	i40	K3	K5	K7	…	Grandeur
i30	0	3.4652	1840	3.2916	3.2281		1840
i40	3.4652	0	1840	3.8901	3.9316	…	4.8806
K3	1840	1840	0	2.049	2.7504	…	1840
K5	3.2916	3.8901	2.049	0	1.562	…	29.206
K7	3.2281	3.9316	2.7504	1.562	0	…	46
…	…	…	…	…	…	…	…
Grandeur	1840	4.8806	1840	29.206	46	…	0

We use multidimensional scaling to project brand names onto 2-dimensional space. Multidimensional scaling (MDS) is a statistical tool for plotting entities using a distance matrix of entities. Figure 3 shows the projected results of brand names and identified clusters.

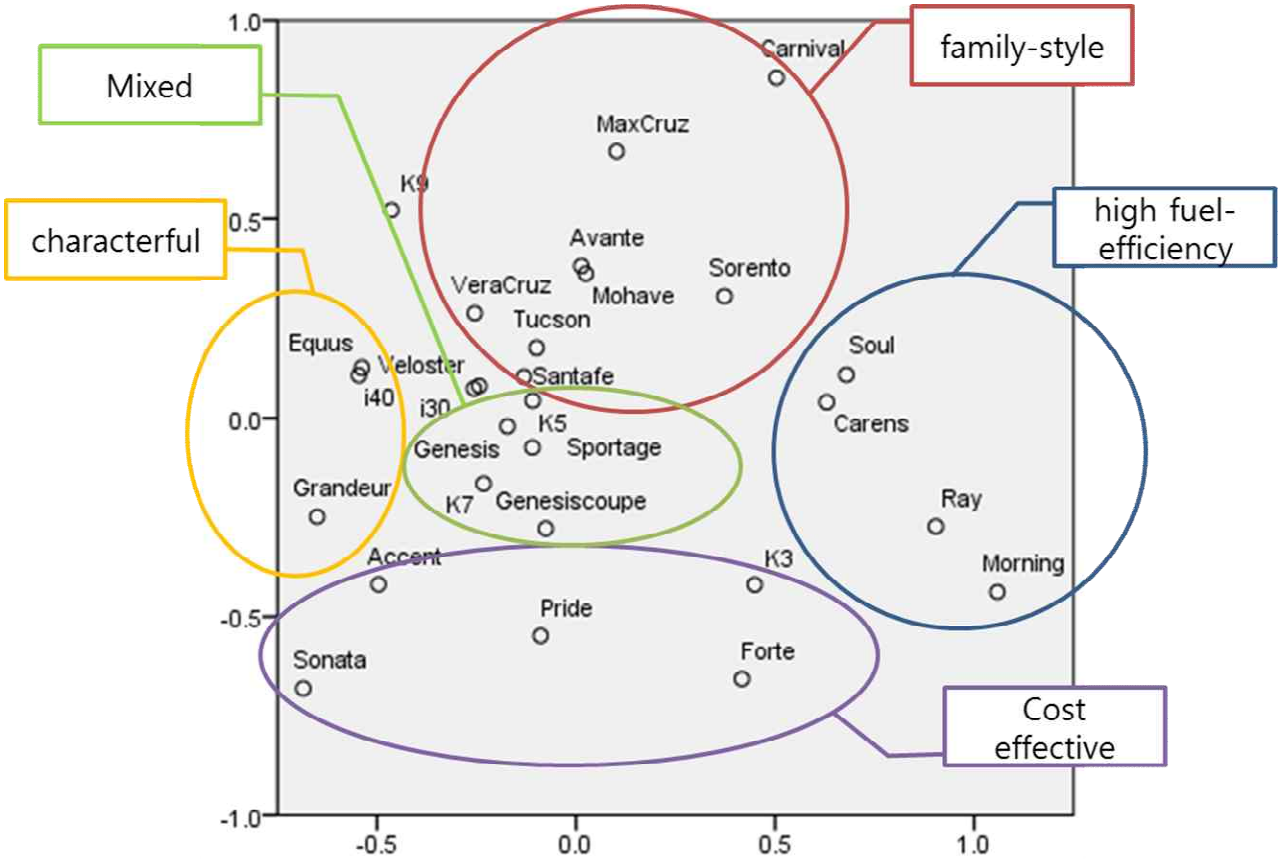

Figure 3 – Projected results of brand names

CONCLUSION & FUTURE RESEARCH PLAN

In this study, we used social media data to suggest a framework for identifying the brand cluster of the automobile industry using social media data. We expect this research will assist marketers to develop additional insight into customer preferences. However, as described below, our study has some limitations and further research needs to be performed: i) The co-mention matrix ***C*** needs to be elaborated. One of the possible compliments is considering sentiment words on the social media as shown in Figure 1. ii) To cluster more correctly we need to use other brand characteristics like mileage, engine displacement and price.

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COMPOSITE FORECASTS ACCURACY FOR AUTOMOBILE SALES IN THAILAND

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ABSTRACT

In this paper we compare the statistical measures accuracy of composite forecasting model to estimate automobile customer demand in Thailand. A modified simple exponential smoothing and autoregressive integrate moving average (ARIMA) forecasting model is built to estimate customer demand of passenger cars, instead of using information of historical sales data. We evaluate our forecasting model by comparing forecasts with actual data using six accuracy measurements, mean absolute percentage error (MAPE), geometric mean absolute error (GMAE), symmetric mean absolute percentage error (sMAPE), Mean absolute scaled error (MASE), median relative absolute error (MdRAE), and geometric mean relative absolute error (GMRAE).

Keywords: composite forecasts accuracy, simple exponential smoothing model, autoregressive integrate moving average.

INTRODUCTION

Automobile Industry

Worldwide automobile industry is growing at a rapid pace as many countries are going through the phase of economic development (Report Linker, 2007). Automobile industry in Thailand is one of the major sections which significantly contribute to the economy of Nation. Two years ago, the export values of automobile and parts of them was the second rank and accounts for the Gross Domestic Products or GDP (Thailand Automotive Industry Association, 2007). Thus Thai Government has been pushing Thailand to be the Detroit of Asia by support funds and tax intensive. In 2012, Thai government had the First Car Policy to support the investment from foreign. The target of policy was to enable at least 500,000 low income people to have their own car. However, at the end of that year, the Ministry of Finance reported 1200000 cars were registered in First Car Policy. By the results, the competition among car manufactures, especially passenger cars, in Thailand is strongly. Nowadays, passenger car reliabilities are not significantly different among brands due to compliance to international standards. Because of there are around 30 brands for passenger cars in Thailand and the top ten in 2012 were Toyota, Honda, Nissan, Mazda, Chevrolet, Ford, Mitsubishi, Benz, Proton, and B.M.W. Their aims to compete on price and assess their strengths and weaknesses for comparison the competitors. The manufacturer focus on reducing production cost to achieve competitive prices as well as to gain the profit. Waste reduction considers about materials, time and production inventory. Passenger car dealers take order based on prior sales data. If they overestimate the order quantities and holding to stocks, the problem is ending of model life. It difficult to

clear out the stock. Thus, if they have a better forecasting model for passenger car's demand of customers, they should be solving that problem.

Composite Forecasts

Composite forecasts or Combining forecasts are a well-established procedure for improving forecasting accuracy which takes the advantage of the availability of both multiple information and computing resources for data-intensive forecasting (Bunn, 1989). Generally, which one evaluates the results of a composite forecast, only looks at measures of accuracy, for example, mean squared error (MSE). This is a remark different procedure from that of analyzing results within any other forecasting technique where the forecast error pattern is also considered. It seems that much of the rig out, which is necessary to generate the individual models' forecasts, is forgotten when evaluating the combination. Furthermore, the output from a combination of forecasts is just still a single point estimate, however, it is no longer sufficient for business planning models (e.g. capital budgeting, resource allocation, policy monitoring) that need to take explicit account of risk and uncertainty. Indeed the increasing use of risk analysis (Cooper and Chapman, 1987) places an additional requirement for high quality estimates of predictive distributions. It seems a little surprising that even Bayesian combining (Clemen and Winkler, 1993), which use the distributional properties of the individual forecasts to construct the combination, do not consider the predictive distribution of the resultant composite forecast.

This paper propose modify forecasting model using the real data of passenger's car sales in Thailand during January 2007 to June 2013 to estimate customer demand. There are many forecasting techniques such as, smoothing methods, classical decomposition, regression analysis, seasonal smoothing methods and Box-Jenkins methodology. We choose the "Single Exponential Smoothing" and "Box-Jenkins" method to modify the method for our time series because both of them are often applied to time series that exhibit trend and seasonality.

After that, we evaluate these methods by comparing the forecasts with the actual data. The error is analyst using six accuracy measurements, mean absolute percentage error (MAPE), geometric mean absolute error (GMAE), symmetric mean absolute percentage error (sMAPE), Mean absolute scaled error (MASE), median relative absolute error (MdRAE), and geometric mean relative absolute error (GMRAE).

FORECASTING MODEL

In related forecasting models, simple exponential smoothing model is discussed in section 2.1 and Box-Jenkins methodology in section 2.2. In section 3 a combination model development is proposed.

A. Simple Exponential Smoothing Model

Exponential smoothing is a forecasting method that focusing on the observed time series values unequally. Exponential smoothing has been found to be most effective when the parameters describing the time series may be changing slowly over time and are not based on any formal statistical model or statistical theory.

Suppose that the time series $Y_1, Y_2, ..., Y_n$ is describes by the model

$$Y_t = \mu_t + \varepsilon_t \tag{1}$$

The simple exponential smoothing (SES) equation is

$$F_{t+1} = F_t + \alpha\left(Y_t - F_t\right) \tag{2}$$

Another way of writing is

$$F_{t+1} = \alpha Y_t + \left(1-\alpha\right) F_t \tag{3}$$

Where

F_{t+1} is forecast value for one- period-ahead at time t.

α is a smoothing constant between 0 and 1.

Y_t is observation at time t.

Autoregressive integrated Moving Average Model

Autoregressive (AR) models can be effectively coupled with moving average (MA) models to form a general and useful class of time series model called autoregressive moving average (ARMA) models. However, they can only be used when the data are stationary. For non-stationary, this model can be extended by allowing differencing of the data series. These are called Autoregressive integrated Moving Average (ARIMA) Models. The Box and Jenkins model (Box and Jenkins, 1970) popularized ARIMA models.

The ARIMA notation, for non-seasonal model is known as ARIMA(p,d,q) and for trend and seasonal model is known as ARIMA(p,d,q)(P,D,Q)$_s$. The general ARIMA(p,d,q)(P,D,Q)$_s$ can be writhing as follows:

$$\left(1-\phi_1 B+\phi_2 B^2+...+\phi_p B^2\right)\left(1-B\right)Y_t = \left(1-\theta_1 B-\theta_2 B^2-...-\theta_q B^q\right)e_t \tag{4}$$

Where ϕ_j is j th autoregressive coefficient , j = 1,2,…,p

θ_k is j th moving average coefficient, k = 1,2,…,q

$e_t = Y_t - F_t$, the error term at tome t, t = 1,2,…,n

B is backward shift operator, $BY_t = Y_{t-1}$.

Model Development

The "simple exponential method" and "Autoregressive integrated Moving Average" method have been selected to modify because both of them are often applied to time series that exhibit trend and seasonality. The forecasts are combined using weighted from variance of error, where

$$W = \frac{\sigma^2_{eF_{2t}} - \sigma_{eF_{1t}eF_{2t}}}{\sigma^2_{eF_{2t}} + \sigma^2_{eF_{2t}} - 2\sigma_{eF_{1t}eF_{2t}}} \tag{5}$$

$\sigma^2_{eF_{1t}}$ is variance of error term from SES method at time t,

$\sigma^2_{eF_{2t}}$ is variance of error term from ARIMA method at time t,

$\sigma_{eF_{1t}eF_{2t}}$ is covariance of error term from the first and the second method at time t.

Thus,

$$CF_{t,} = W_t F_{t,SES} + (1 - W_t) F_{t,ARIMA} \quad (6)$$

After that, the error of a combined forecasted is computed, where

$$e_t = Y_t - CF_{t,} \quad (7)$$

MESUREMENT OF FORECAST ERROR

To evaluate the modified model, a criterion to measure the efficiency of the method in this study are mean absolute percentage error (MAPE), geometric mean absolute error (GMAE), symmetric mean absolute percentage error (sMAPE), mean absolute scaled error (MASE), median relative absolute error (MdRAE), and geometric mean relative absolute error (GMRAE) (Hyndman and Koehler, 2006) .

A. The Mean Absolute Percentage Error (MAPE)

The percentage error is giving by $100(e_t / Y_t)$ that have the advantage of being scale independent. So they are used to compare forecast performance between different data series, where

$$MAPE = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{e_t}{Y_t}\right| \times 100 \quad (8)$$

B. The Geometric Mean Absolute Error (GMAE)

For intermittent-demand data, (Syntetos and Boylan, 2005) recommend the use of GMAE, where

$$GMAE = gmean(|e_t|), \text{ where } e_t = Y_t - F_t \quad (9)$$

The Symmetric Mean Absolute Percentage Error (sMAPE)

Because of the MAPE has another disadvantage, it puts a heavier penalty on positive errors than on negative errors. Then Makridakis and Hibon (2000) proposed the symmetric MAPE, called sMAPE, where

$$sMAPE = mean\left(200 \times \frac{|Y_t - F_t|}{(Y_t + F_t)}\right) \quad (10)$$

Mean Absolute Scaled Error (MASE)

The MASE was proposed by Hyndman and Koehler (2006) as a generally applicable measurement of forecast accuracy without the problems seen in the other measurements. The mean absolute scaled error is simply

$$\text{MASE} = \text{mean}\left(|q_t|\right) \tag{11}$$

where $q_t = \dfrac{e_t}{\frac{1}{n}\sum_{i=1}^{n}|Y_i - Y_{i-1}|}$, a scaled error.

E. The Median Relative Absolute Error (MdRAE)

This criterion is an alternative to percentage for the calculation of scale independent measurements involves dividing each error by the error obtained using some benchmark method of forecasting, in this paper are SES and ARIMA method.

$$\text{MdRAE} = \text{median}\left(\left|\frac{e_t}{e_t^*}\right|\right) \tag{12}$$

where e_t^* is the forecast error obtained from the benchmark methods, for this paper are SES and ARIMA model.

F. The Geometric Mean Relative Absolute Error (GMRAE), where

$$\text{GMRAE} = \text{gmean}\left(\left|\frac{e_t}{e_t^*}\right|\right) \quad \text{GMRAE} = \text{gmean}\left(\left|e_t / e_t^*\right|\right) \tag{13}$$

FORECASTING AUTOMOBILE SALES

In our models, we used the data from the top five of passenger cars (Toyota, Honda, Nissan, Mazda and Chevrolet) during January 2007 to June 2013 for model fitting.

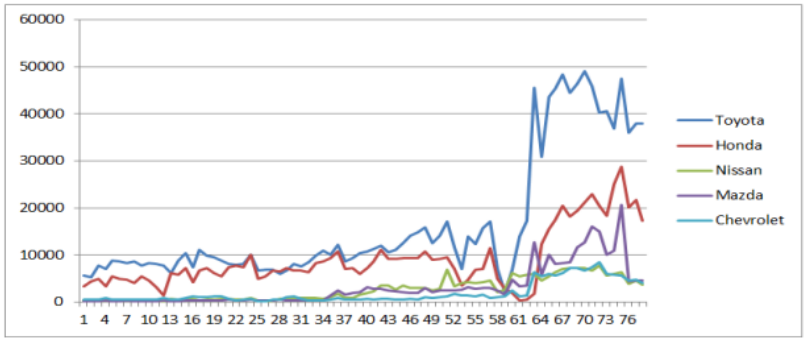

Figure 1 – Actual number of cars sold monthly from January 2007 to June 2013.

Figure 1 shows the pattern of five groups of time series data to use in this paper. It is found that the pattern of time series data after February 2012 is an unusually. To calculate the forecasts from simple exponential smoothing and ARIMA model using SAS programming, two equations are obtained as follows:

For SES, we have

$$F_{t+1,SES} = 0.74Y_t + (1-0.74)F_t \tag{14}$$

For $\text{ARIMA}(0,1,1)(1,0,0)_{12}$, the model is

$$(1-0.3606B^{12})(1-B)Y_t = (1-0.093B)e_t \tag{15}$$

After that, the errors of the combined forecasts were computed. Finally, the modified forecasts is

$$CF_t = W_t(\text{SES}) + (1-W_t)(\text{ARIMA}(0,1,1)(1,0,0)_{12}) \tag{16}$$

Replace (14) and (15) into (16), then

$$CF_t = W_t(0.74Y_t + (1-0.74)F_t) + (1-W_t)((1-0.3606B^{12})(1-B)Y_t = (1-0.093B)e_t) \tag{17}$$

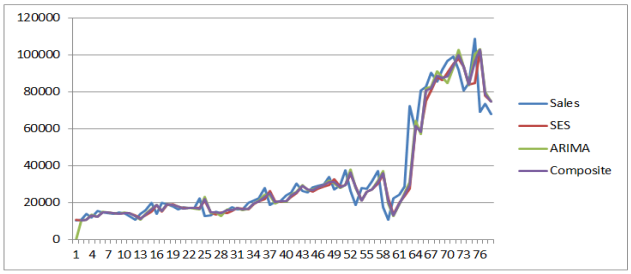

Figure 2 – Comparison of forecasts from simple exponential smoothing, ARIMA $(0,1,1)(1,0,0)_{12}$ and composite method

Table 1 – Comparing the six accuracy measurement of the simple exponential smoothing, autoregressive integrate moving average, and the combination methods.

Criterion	Forecasting Methods		
	SES	ARIMA$(0,1,1)(1,0,0)_{12}$	Combining Forecast
MAPE	16.51	15.67	15.22
GMAE	2,793.51	2,504.94	2,020.16
sMAPE	16.116	15.14	14.74
MASE	1.331	1.27	1.208
MdRAE	1.048	1.005	0.953
GMRAE	1.381	1.239	0.724

CONCLUSION

This study evaluates and compares the performance of various accuracy measurements of the combination method. The individual forecasts are generated from two time series models, simple exponential smoothing and autoregressive integrated moving average. Simple exponential smoothing and

autoregressive integrate moving average method have a long time of application for forecasting demand of automobile in Thailand and both of them are often applied to time series that exhibit trend and seasonality. The environment of automobile marketing changes every year and sometime include unusually data, the forecasting method should be modified to create a new one with better forecasts. These papers propose modify forecasting model using the real data of passenger's car sales in Thailand during January 2007 to June 2013 to estimate customer demand.

The paper evaluates these methods (single and combination model) by comparing the forecasts with the actual data. The error was analyst using six accuracy measurements, mean absolute percentage error (MAPE), geometric mean absolute error (GMAE), symmetric mean absolute percentage error (sMAPE), Mean absolute scaled error (MASE), median relative absolute error (MdRAE), and geometric mean relative absolute error (GMRAE). In performance evaluation, the modified method (composite forecast) yields good performance for all of accuracy measurement. Further research into other advanced combination methods, such as non-linear combination methods, should be considered to evaluate whether they offer improved accuracy over those presented here.

ACKNOWLEDGEMENT

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Patient Cost-Sharing and Healthcare Utilization in Early Childhood: Evidence from a Regression Discontinuity Design

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Abstract

Healthcare for young children is highly subsidized in many public health insurance programs around the world. However, the existing literature lacks evidence on how the demand for young children's healthcare reacts to these medical subsidy policies. This paper exploits a sharp increase in patient cost-sharing at age 3 in Taiwan that results from young children "aging out" of the cost sharing subsidy. This price shock on the 3rd birthday allows us to use a regression discontinuity design to examine the causal effect of cost sharing on the demand for young children's healthcare by comparing the expenditure and utilization of healthcare for young children right before and after the 3rd birthday. Our results show that the increased patient cost sharing at the 3rd birthday significantly reduces total outpatient expenditure. The implied arc-elasticity of outpatient expenditure is around -0.09. However, the demand for inpatient care for young children *does not* respond to a change in cost sharing at the 3rd birthday even though the price variation is much larger. This result implies that the full coverage of inpatient care could improve the welfare of young children.

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1 Introduction

Health conditions and medical treatments in early childhood are widely believed to have a substantial impact on health and labour outcomes in adulthood (Bharadwaj et al., 2013; Almond et al., 2011; Currie, 2009; Almond, 2006; Case et al., 2005; Currie and Madrian, 1999).[1] On the other hand, young children[2] also bring about sizeable medical costs to their parents since they are vulnerable to diseases.[3] In line with this evidence, many public health insurance programs in the world subsidize medical care for young children through providing this age group with relatively low patient cost sharing.[4] For example, the United States regulates the level of patient cost sharing in Medicaid and Children Health Insurance Program (CHIP) to ensure the children from middle and low income families can afford essential medical treatment.[5] Recently, due to tight budgets, many state governments have considered raising the level of patient cost sharing for Medicaid and CHIP, which has led to many debates on the possible impact.[6] Similarly, national health insurance in Japan and Korea offer children under six years of age lower patient cost sharing than those above age six to promote healthy investments in early childhood.[7]

To evaluate the effectiveness of these subsidy policies and the impact of future reform in public health insurance for children, we need to understand healthcare expenditure elasticities for young children. That is, the response of healthcare demand to the change in out-of-pocket costs (referred to as "price" from here on). If the children's price elasticity of healthcare expenditures is zero or very small, then providing full insurance for children's health care could be welfare improving because the lower patient cost sharing does not raise

[1] Several recent studies (Bharadwaj et al., 2013; Almond et al., 2011) present convincing evidence to show early life medical treatments can reduce mortality and even result in better long-run academic achievement in school. That is, health intervention in early childhood could be an investment with high returns.

[2] The definition of a young children is an individual under age six (before elementary school enrolment).

[3] For example, in Taiwan, outpatient visits for children under three years of age is around 20 per year. Compared with adults (12 visits per year), this age group has especially high demand for healthcare

[4] That is, the share of healthcare cost paid out-of-pocket by the patient is lower.

[5] The federal requirement for Medicaid eligibility varies by children's age. For children under age 6 (young children), Medicaid eligibility requires family incomes to be lower than 133% of the federal poverty level (FPL). For children ages 6-19 (older children), the Medicaid eligibility requires family incomes below 100% of FPL. Thus, the coverage of Medicaid for children under six is much higher than above six.

[6] After the passing of the Deficit Reduction Act (DRA) of 2005, states have the right to increase cost sharing of public health insurance programs, such as Medicaid and CHIP, for specific populations and medial services (Selden et al., 2009)

[7] National health insurance in Japan covers almost all medical service, such as outpatient and inpatient care, for all citizens. The patient cost sharing for children under age six (pre-school age) is 20% of original healthcare cost. For children above age six (school-age), patient cost sharing becomes 30% of medical cost. More details for Japanese national health insurance can be found at this web page. http://www.shigakokuho.or.jp/kokuho_sys/kokuho_en.pdf. In Korea, their national health insurance exempts cost sharing of inpatient service for the children under age six.

the cost from moral hazard of healthcare use[8] but fully protects a household's financial risk arising from out-of-pocket expenses. In addition, lower patient cost sharing can also benefit children's health by increasing their access to necessary healthcare services. If children's healthcare expenditures are sensitive to pricing, then higher patient cost sharing could substantially reduce the loss from moral hazard behaviour and allocate medical resources more efficiently.

To date, very little is known about how the healthcare demand of young children reacts to a changes in patient cost sharing. Most estimates of price elasticity mainly focus on adults' and the elderly's healthcare demands (Cherkin et al., 1989; Selby et al., 1996; Rice and Matsuoka, 2004; Chandra et al., 2010*a*; Chandra et al., 2010*b*; Chandra et al., 2014; Shigeoka, 2014).[9] However, these estimates might not be externally valid for the healthcare demand of young children for two reasons. First, the types of healthcare services (e.g., visit (admission) diagnoses) used by adults and children are quite different. Children's outpatient visits are rarely for chronic diseases and most are for acute diseases, which need timely treatment and should not be sensitive to price change. In addition, the majority of children's inpatient admissions do not require surgery but are treated with bed rest or medication. Shigeoka (2014) found that inpatient admissions for surgery, especially elective surgery (e.g., cataract surgery), are more price sensitive than ones for non-surgery. He also found admissions for the respiratory diseases typically treated with bed rest or medication do not respond to a change in cost sharing at age 70. Card et al. (2008) also had similar findings for Medicare eligibility at age 65 in the United States. Second, the healthcare intervention in early childhood could substantially benefit an individual's later life, which is addressed by recent studies (Bharadwaj et al., 2013; Almond et al., 2011). Given such high returns, parents might not be willing to adjust their children's medical care in response to price changes. Based on the above two reasons, we expect healthcare demand for young children should be less price sensitive than an older demographic group.

Credible estimates of price elasticity for children still rely on evidence from the RAND Health Insurance Experiment (RAND HIE)[10], which was an influential randomized social

[8]Since insured people do not pay full cost of medical service, the optimal utilization of healthcare for individual would be larger than social optimum, which leads to loss of social welfare. Lower patient cost sharing could induce individuals to use more healthcare in inefficient way (moral hazard).

[9]Shigeoka (2014) exploited sharp reduction in patient cost sharing at age 70 in Japan and apply regression discontinuity (RD) design to estimate price elasticity of outpatient and inpatient visits for the elderly. He found both health services respond to price change strongly, namely, have obvious drop at age 70. The estimated price elasticities are around -0.17 (outpatient) and -0.15 (inpatient). Chandra et al. (2014) used cost sharing reform in Massachusetts as an exogenous variation in price and obtained price elasticity of healthcare expenditure is around -0.15 for low-income adults.

[10]Before passing the Deficit Reduction Act (DRA) of 2005, state governments had little right to adjust

experiment conducted in the mid 1970s. Its sample was of people 62 years of age or less and randomly assigned participating households to different levels of patient cost-sharing (ranging from free care to 95% cost-sharing). The RAND HIE provided estimates of price elasticity of healthcare demand for children under 14 years of age (Leibowitz et al., 1985; Manning et al., 1981). RAND HIE found higher patient payments significantly reduced children's outpatient expenditures and utilization but obtain mixed evidence of cost sharing effect on children's demand for inpatient care.[11] The estimated arc-elasticity[12] of the total medical expenses was around -0.12. However, the sample size for children in the RAND HIE was not big. Some estimates or subgroup analysis are not precise enough to confirm the presence or absence of a cost sharing response (Leibowitz et al., 1985).[13] Additionally, the RAND HIE evidence is over 30 years old. Both medical technology and market structure has changed considerably during the past three decades. The varying healthcare environment could affect the way in which demand for healthcare changes in response to the difference in price. Therefore, our paper fills this gap by providing new evidence on the price elasticity of children's healthcare demand.

In this paper, we exploit a sharp increase in patient cost-sharing at the 3rd birthday in Taiwan that results from young children "aging out" of the cost sharing subsidy. On average, turning age three leads to an increase in price per outpatient visit (from 59 to 133 NT$) by more than 100 percent[14] and price per inpatient admission dramatically rises from zero

patient cost sharing for their public insurance program (i.e., Medicaid and CHIP) for children. Thus, there is little evidence on cost sharing effect on healthcare demand of children. To the best of our knowledge, only one recent study (Sen et al., 2012) has used the copay change in the Children's Health Insurance Program in Alabama, USA, to analyse this issue. However, their study mainly relied on pre-/post-policy analysis, which suffers from the estimated bias of uncontrolled trends in children's medical utilization.

[11]For children under age 4, the RAND HIE found that the inpatient care is price sensitive. Children assigned to a free plan had a significantly higher rate of inpatient admission than children assigned to 95% cost-sharing. For children between 5 to 13, they found no consistent pattern of a cost sharing effect on inpatient use (Leibowitz et al., 1985).

[12]The health insurance contracts in RAND HIE adopted non-linear pricing, which cast some challenges of estimating a price elasticity. Specifically, the insurance plans required initial cost-sharing (free care, 25%, 50% and 95%) but have an annual stop-loss (Maximum Dollar Expenditure), namely, the total out-of-pocket medical expense per year cannot exceed 4000 US$. Thus, the patient cost-sharing would fall to zero when annual out-of-pocket medical expense reached 4000 US$. Such non-linear pricing makes patients face a different price for the same health care at different times of the year. To summarize the estimated price elasticity, RAND researchers define four kinds of price that patients respond to when making their health care decision: 1) the current "spot" price; 2) the expected end-of-year price; 3) the realized end-of-year price; 4) weighted-average of the price paid over a year (Aron-Dine et al., 2013). The price elasticity of children's health care mentioned here is calculated by defining price as definition 1).

[13]As Leibowitz et al. (1985) comments: "Because hospitalizations for children are infrequent, our estimates of hospital use have wide confidence intervals and we can be less certain than for outpatient care about the presence or absence of a cost sharing response"

[14]1 US$ is equal to 32.5 NT$ in 2006.

to 1300 NT$. The change in out-of-pocket expenses at the 3rd birthday allows us to use a regression discontinuity (RD) design to examine the causal effect of patient cost sharing on young children's healthcare demand by comparing the expenditure (utilization) of healthcare for young children just before and after the 3rd birthday.

We obtain three key findings. First, the increase in out-of-pocket cost at the 3rd birthday significantly reduces outpatient expenditure by 6.6%. The implied arc-elasticity of outpatient expenditure is around -0.09. Second, the sharp price increase at age 3 not only results in fewer outpatient visits (extensive margin) but also reduces the medical cost per visit, namely, induces patients to switch from high to low quality providers (intensive margin, e.g., substitute teaching hospitals with clinics or community hospitals). We find losing cost sharing subsidy reduces visits to teaching hospitals by 50%.[15] Further investigating possible heterogeneous effects in detail, we also find preventive care and mental health services have larger price responses than acute respiratory diseases. Third, in sharp contrast to outpatient service, the demand for inpatient services does not respond to price change at the 3rd birthday. The estimated arc-elasticity of inpatient expenditure is close to zero. This finding is a surprising result because the variation in the inpatient price at age 3 is much larger than the outpatient price in terms of its level and percentage change. The above findings suggest that the level of patient cost sharing for young children should be different depending on healthcare service. For example, our results imply that full coverage of the medical costs (no cost sharing) of inpatient services for young children could be optimal because the elasticity of the inpatient expenditure is close to zero. Providing full insurance coverage might not stimulate excessive hospital use (moral hazard) but it might substantially reduces financial risk for households.

Our paper contributes to the research on patient cost sharing in three areas. Firstly, our paper provides new evidence on the causal effect of patient cost sharing on the healthcare demand of young children. In particular, many public health insurance programs in developed countries (e.g., the United States, Japan, and Korea) tend to provide relatively low patient cost sharing for young children. However, the literature lacks knowledge about how the healthcare demand of young children reacts to these medical subsidy policies. Our elasticity estimates fill this gap and provides evidence on the price responsiveness of young children's healthcare demand, which could have important implications for evaluating current cost sharing policies and possible reforms in the future. Furthermore, our identification strategy of a regression discontinuity design provides an unique opportunity of getting esti-

[15]This result is due to differential copayment for health providers in Taiwan. We will discuss this issue in more detail in section 2 and 5.

mates in a local randomized experiment. The comparison at the 3rd birthday convincingly isolates the impact of patient cost sharing on healthcare demand from other factors because children right after and before their 3rd birthday should have similar healthcare demands if there is no change in patient cost sharing at age 3.[16] Therefore, our research design gives us highly credible estimates of price elasticity of the healthcare demand of young children.

In addition, our estimates can also avoid the bias from a composition change of enrollees induced by the change in cost sharing. Several recent U.S. studies (Chandra et al., 2010*a*; Chandra et al., 2010*b*; Chandra et al., 2014) use a quasi-experimental design by exploiting the change in the copayment of one health insurance plan and use unchanged insurance plans as a control group. However, the change in cost sharing could also affect people's decision to enroll in insurance plans. Such self-selection behavior could bias the elasticity estimates. For example, a larger proportion of people with less price sensitivity could continue their enrolment after the cost-sharing increase, which may "downward" bias the elasticity estimates in absolute value. However, the Taiwanese National Health Insurance (NHI) is a single payer scheme and every citizen is mandated to join this program.[17] Thus, our elasticity estimates are free of bias from any composition change in enrollees after the cost-sharing change.

Finally, the data we use in this paper is administrative insurance claim data, that contains all NHI records of healthcare payments and use for the children under four years of age in Taiwan[18] during our sample period. Compared with survey data, the administrative data have a number of advantages, such as much less measurement error and a larger sample sizes. These features allow us to get precise estimates of the heterogeniety in the cost sharing effect across different subgroups or types of healthcare (diagnoses) that could not be analysed precisely in the RAND HIE because of its limited sample of children.

The rest of the paper is organized as follows. Section 2 has a brief overview of the institutional background. In Section 3, we discuss our data and sample selection. Section 4 describes our empirical strategy. In section 5, we analyze the main results. Section 6 gives concluding remarks.

[16] In Taiwan, turning age 3 does not coincide with any confounding factors, such as, school starting age or recommended immunization schedule. We will discuss this issue in Section 4.

[17] The only exceptions are citizens who lose their citizenship, die or missing for more than six months.

[18] 99% of Taiwanese population is covered by NHI. Furthermore, NHI covers almost all medical services. We will discuss this issue in more detail later.

2 Policy Background

2.1 National Health Insurance in Taiwan

In March 1995, Taiwan established the NHI. The National Health Insurance is a government-run, single-payer scheme administered by the Bureau of National Health Insurance. Prior to the NHI, health insurance was provided through three main occupational forms – labour insurance for private-sector workers, government employee insurance, and farmer's insurance – and these systems accounted for only 57% of the Taiwanese population (Lien et al., 2008).The remainder of the population were people not employed: people over 65, children under 14, and unemployed workers. The implementation of the NHI raised the coverage rate of health insurance sharply to 92% by the end of 1995, and since 2000, it has stayed above 99%.

Under universal insurance coverage, patients received almost all of the medical services covered by NHI, such as outpatient, inpatient, dental, mental health, prescription drug, and even traditional Chinese medicine. The NHI classifies healthcare providers into four categories based on accreditation: major teaching hospital, minor teaching hospital, community hospital, and clinic.[19] Like most Asian countries, enrollees are free to choose their care providers[20] and do not need to go through a general practitioner (family physician) to obtain a referral. For example, patients can directly access specialists in a major teaching hospital without a referral. In other words, NHI does not adopt a gatekeeper system.[21]

2.2 Patient Cost-Sharing

Patient cost sharing in Taiwan is determined by two parts: 1) NHI copayment (coinsurance)[22]; 2) Other NHI "*uncovered*" medical expense (e.g., registration fee for outpatient visit).[23]

[19]The clinic is similar to physician office in Canada and the U.S.

[20]Most of the hospitals and clinics (97%) have had contracts with NHI.

[21]For example, National Health Service (NHS) in the United Kingdom adopts a gatekeeper system. Patients can not directly obtain outpatient service at hospitals. Instead, they need get referral from general practitioners. Provincial Health insurance in Canada also adopt the similar systems.

[22]Copayment is a fixed fee paid by the insurance enrollee each time a medical service is accessed. Coinsurance is a percentage medical payment that the insured person has to pay. NHI adopts copayment for outpatient care and coinsurance for outpatient prescription drug and inpatient care.

[23]More discretionary healthcare, such as plastic surgery, sex reassignment surgery and assisted reproductive technology, etc., are not covered by NHI. Patients have to pay full cost for these services.

2.2.1 Cost-Sharing for Outpatient Service

With respect to outpatient care, a patient pays a NHI copayment plus a registration fee for each visit.[24] If a physician prescribes drug at a visit and a drug cost is above 100 NT$, a patient also needs to pay the cost-sharing of prescription drug, which is 20% of total drug cost.[25] While, compared with NHI copayment, average out-of-pocket cost for outpatient prescription drug (at age 2) is quite small, only 2.5 NT$ per visit.[26]

The NHI copayments are based on a national fee schedule. In general, a higher copayment is set for the health providers that have higher accreditation.[27] The first rows of Panel A in Table 1 summarize NHI copayment of four types of providers during our sample period (2005 to 2008). A major teaching hospital can charge a patient a copayment of 360 NT$ (12 US$) per outpatient visit, which accounts for 29% of the total medical cost per visit. However, the NHI copayment for one clinic visit is only 50 NT$ (1.7 US$) and covers 13% of the total medical cost of each visit.[28] In other words, the copayments for outpatient services at teaching hospitals are much higher than those for clinics/community hospitals in terms of both their level and their share of the cost.

The spirit of this design is to use the differential copayments to guide patients to properly choose their health providers based on the severity of an illness to better allocate medical resources to the patients who need it most. This design is needed because patients in Taiwan (or other Asian countries) have no restriction on the choice of their healthcare providers. If there is no difference in patient cost sharing between hospitals and clinics, patients might abuse the limited medical resources of the hospitals[29] and crowd out other patients whose illness only can be treated at hospitals.

In addition to the NHI copayment, a patient also needs to pay a registration fee for each outpatient visit, which is not covered by the NHI. The registration fee reflects the health provider's administrative costs and is determined by the provider.[30]

[24] Both are fixed amount.

[25] If drug cost is under 100 NT$, a patient has no out-of-pocket cost.

[26] The average drug cost per visit is only 61 NT$, which is under 100 NT$. Thus, patients do not pay any out-of-pocket cost at most visits.

[27] NHI in Korea also has similar cost sharing policy. Patients have to pay 40-50% of total medical cost when visiting hospitals but only pay 15-30% when visiting clinics.

[28] For more detailed information about NHI copay schedule, please see Note in Table 1. A reimbursement is also paid according to the provider's accreditation. That is, major teaching hospitals can obtain the highest reimbursement for their medical services even though they provide the similar health services as clinics.

[29] For example, patients use hospital outpatient services for the diseases which could be cured in clinic (e.g., cold).

[30] Our main dataset lacks this information. But the NHI has another database that provides information about the registration fees of all health providers during our sample period (2005-2008). Major teaching hospitals usually charge 150 NT$, minor and community hospitals usually change 100 NT$, and clinics

2.2.2 Cost-Sharing for Inpatient Service

For inpatient admissions, the patient cost sharing takes place through coinsurance. Depending on the length of the stay and the type of admission (acute or chronic admission), the coinsurance rate is 10% to 30% of the total medical expense per admission. For example, a patient must pay 10% of the hospitalization costs when they stay in acute admission units for the first 30 days and 20% if they stay an extra 30 days (i.e. 31–60 days). Almost all inpatient admissions for young children (99.5%) are acute admissions and the length of a stay is within 30 days[31]. Thus, coinsurance rates for most admissions are around 10%. Panel B in Table 1 lists the coinsurance rates for inpatient services.

Because inpatient care usually results in larger financial risks than outpatient care, the NHI has a stop-loss policy (maximum out-of-pocket expense) for inpatient admissions. The out-of-pocket cost is up to the stop-loss, which is calculated annually as 10% of the gross domestic product per capita in Taiwan. The NHI covers all expenses above the stop-loss. According to NHI statistics, very few patients (less than 1%)[32] reach this stop-loss, so the non-linearity imposed by the stop-loss should not seriously bias our estimates of price elasticity. Moreover, in contrast to health insurance plans in the United States and other countries, the NHI does not require patients to pay deductibles[33] before insurance coverage begins. The above two features substantially simplifies our computation of price elasticities.

2.3 Change in Patient Cost Sharing at 3rd Birthday

To reduce the financial burden on parents and ensure that every child obtains essential medical treatment in his/her early childhood, in March 2002, the Taiwan government enacted the Taiwan Children's Medical Subsidy Program (TWCMS). This program, through subsidies, exempts all NHI copayments and coinsurance for outpatient visits, outpatient prescription drugs, inpatient admissions, and emergency room visits for children under the age of three. A patient would lose eligibility for subsidies at his/her 3rd birthday. After the implementation of TWCMS, a patient under three years of age only pays the medical costs not covered by NHI (e.g., registration fee for outpatient care and other uncovered medical services).[34]

charge 50 NT$. We use this information to impute the registration fee for four types of providers.

[31] In our empirical analysis, we limit our estimated sample for inpatient service to the cases with acute admissions and inpatient days within 30 days

[32] This is because NHI waives the cost-sharing for patients with catastrophic illness (e.g., cancer). These people had a greater probability of reaching the stop-loss if their cost sharing were not waived.

[33] In health insurance, the deductible is the amount that a insured person has to pay before a insurer (e.g., insurance company) starts to pay the expense.

[34] If they use medical services not covered by NHI, they will have to pay all expenses. However, NHI has already covered most of health services. As mentioned before, very few services are not covered by NHI. Most

Figure 1 plots the observed age profile of average out-of-pocket cost per outpatient visit[35] and inpatient admission (180 days before and after the 3rd birthday). Figures 1a and 1b reveal that patients would experience sharp increase in price for both outpatient and inpatient service at the 3rd birthday. Especially for inpatient service, the out-of-pocket expense per admission suddenly rises from zero to almost 1300 NT$, which could bring about sizeable financial risk to a household with young children turning three years old.

Note that the observed price changes per visit/admission at the 3rd birthday are endogenous. Especially for outpatient services, the price change at the 3rd birthday is larger for the visits to a teaching hospital than to a clinic or community hospital. For example, the price per visit for major teaching hospital at 3rd birthday increase by 240% (from 150 to 510 NT$) and price for minor teaching hospital rises by 240% (from 100 to 340 NT$). However, the visit price for clinic only increase by 100% (from 50 to 100 NT$). In other words, TWCMS indeed subsidizes outpatient services in teaching hospitals much more than those in clinic or community hospitals. Therefore, patients might also change their choices of providers at the 3rd birthday, which could make the observed out-of-pocket cost per visit after the 3rd birthday endogenous (i.e., already reflect the change in choices of providers). To obtain the exogenous price change at the 3rd birthday, we need to fix the utilization of each type of provider.

Table 2 presents the weighted average out-of-pocket cost per visit/admission before and after the 3rd birthday.[36] The weights are the average daily utilization of each type of providers 90 days before the 3rd birthday. Thus, the numbers in the first row are actual weighted average out-of-pocket costs per visit/admission before the 3rd birthday and the numbers in the second row are counterfactual weighted average out-of-pocket costs per visit/admission after the 3rd birthday, which uses the share of utilization of providers at age 2 (i.e., 90 days before the 3rd birthday) as weights. In this way, we can compute the difference between rows (1) and (2) to obtain the exogenous change in out-of-pocket costs per visit/admission at the 3rd birthday. Table 2 shows that the average price of outpatient visits rise by more than 100% (from 58.9 to 132.7 NT$) at the 3rd birthday, and the average price of inpatient admission sharply jumps from zero to 1296 NT$. To sum up, in terms of both the level and the percentage change, the out-of-pocket cost for each inpatient admission

of them are quite discretionary healthcare, such as plastic surgery, sex reassignment surgery and assisted reproductive technology, etc. Patients have to pay full cost for these services.

[35] Each dot represents the mean (10-day cells) of outpatient (inpatient) price at given age (measure in day). The line is from fitting a linear regression on age variables fully interacted with a dummy indicating age 3 or older.

[36] The bandwidth is 90 days. Thus, we use out-of-pocket cost per visit/admission within 90 days before and after the 3rd birthday to obtain the estimates in Table 2

has a much larger increase than for each outpatient visit.

3 Data and Sample

3.1 Data

To implement our empirical analysis, we need the following information: 1) the enrollee's exact age to the day at the time of a visit[37]; 2) the utilization of the outpatient or inpatient services; 3) the medical expenses of the outpatient or inpatient services. We use unique claims data from Taiwan's National Health Insurance Research Database (NHIRD), which contains detailed information about out-of-of pocket costs, total medical costs and healthcare use for all NHI enrollees in Taiwan.[38] In addition, NHIRD also includes the exact date of outpatient visits (inpatient admissions) and exact birth date of enrollees, which allows us to precisely measure children's age in days for our RD design.

For our purposes, we linked information from four types of files in NHIRD: outpatient claims files, inpatient claims files, enrolment files, and provider files. First, outpatient (inpatient) claims files record the information about payments and medical treatments for each visit. These files contain the enrollee's ID and birth date, hospital/clinic ID, date of visit, total medical expenses, total out-of-pocket costs, diagnosis[39], and the medical treatment.[40] Second, we use enrollee ID to merge the enrolment files to get each enrollee's demographic information, such as enrollee's gender, household monthly income, number of siblings, and town of residence. Finally, we use hospital/clinic ID to link information (e.g., provider's accreditation) in the provider files.

3.2 Sample

To avoid the effect of the variation in the cohort size on our estimation, we focus on the healthcare use from the same cohort (fixed panel). Our original sample is all NHI enrollees born between 2003 and 2004. The original sample size is 435,206 (see Table 3).[41] We further restrict our sample to the enrollee who continuously register in NHI at age 2 and 3, which

[37] That is, we measure age in days.

[38] Due to privacy concern, NHIRD only allows at most 10% sampling for each research application. Thus, we only use claims data of sample with age 2 and 3 during 2005-2008 and 1997-2001.

[39] Diagnoses are recorded in five digits of ICD9 (International Classification of Diseases, Ninth Revision, Clinical Modification)

[40] Inpatient claims files also have information about length of stay

[41] Since 99% of Taiwanese are covered by NHI, these samples represent nearly the entire population of children born between 2003 and 2004 in Taiwan.

reduces the sample size by 8,619. In addition, we eliminate the sample with cost sharing waivers, such as, children with catastrophic illness and children from very low income families since these children do not experience any price change when turning three. The above sample selection reduces our original sample by 5.7% and the final sample size for estimation becomes 410,517. Table 3 provides summary statistics of the characteristics of enrollees at age 3 before and after the sample selection. We find that the selected characteristics are quite similar between the original sample and the final samples used in our empirical analysis.

We use 2005–2008 NHIRD data to obtain all records of outpatient visits and inpatient admissions when these children are age 2 and 3.[42] Following Lien et al. (2008), we also excluded visits of dental services, Chinese medicine, and health check up with copay waiver.[43]

Table 4 provides the descriptive statistics of outpatient visits and inpatient admissions and compares their characteristics within 90 days before and after the 3rd birthday.[44] We can find children before their 3rd birthday use more outpatient and inpatient care. Most young children visit clinics for outpatient services. However, they tend to visit teaching hospitals more frequently before their 3rd birthday.

4 Empirical Specification

Our identification strategy is similar to the the recent studies utilizing "age discontinuity" to identify the insurance coverage effect (Card et al., 2008; Card et al., 2009;Anderson et al., 2012) or patient cost-sharing effect (Shigeoka, 2014) on medical utilization for adults or elderly. We are the first applying RD design to study the impact of patient cost sharing on healthcare utilization and expenditures for young children. The general form of our RD regression is as follows:

$$Y_i = \beta_0 + \beta_1 Age3_i + f(a_i; \gamma) + \varepsilon_i \tag{1}$$

where Y_i is the outcome of interest for the child i, such as 1) the number of outpatient visits or inpatient admissions; 2) total medical cost of outpatient or inpatient care at a given age. The variable a_i is children i's age and is measured in days from her or his 3rd birthday, which is the 1096th day after birth.[45] The $Age3_i$ is a treatment dummy that captures the

[42] Because children born in 2003 are age 2 in 2005-2006 and children born in 2004 are age 3 in 2007-2008.

[43] NHI provides nine health check up with copay waiver for the children under age 7. Since patient cost sharing for these visits will not change at 3rd birthday, we eliminate these visits to avoid biased estimation.

[44] This choice is because our main results use 90-day as bandwidth.

[45] The calculation is 365 x 3 + 1 = 1096. We need to plus one due to lunar year

higher cost patient sharing (losing cost sharing subsidy) at the 3rd birthday and is equal to one if child i is age 3 or older ($a_i \geq 1096$). The key assumption of RD design is that the age profile of the healthcare demand is smooth (continuous). Thus, we assume $f(a_i;\gamma)$ is a smooth function of age with parameter vector γ that accommodates the age profile of outcome variables. The ε_i is an error term that reflects all of the other factors that affect outcome variables. Our primary interest is β_1, that measures any deviation from the continuous relation between age and outcomes Y_i at child i's 3rd birthday (the treatment variable switches from 0 to 1). If no other factors also change discontinuously around child's 3rd birthday, that is, $E[\varepsilon_i|a_i]$ is continuous at age 3, β_1 can represent causal effect of higher patient cost sharing on expenditure and utilization of young children's healthcare. In general, there are two ways to estimate β_1, typically referred to as the global polynomial approach and the local linear approach (Lee and Lemieux, 2010).

In the global polynomial approach, we can use all available data[46] to capture age profile of healthcare demand $f(a_i;\gamma)$ by using a flexible parametric function (e.g., a third order polynomial of age used in our analysis). One caveat of this approach is that an incorrect regression functional form could create a biased estimate of β_1. To avoid a misspecification bias, we adopt a local linear regression as our main specification and present the global polynomial estimates for comparison.

In the local linear approach, we capture the age trend of the healthcare use $f(a_i;\gamma)$ by estimating a linear function over a specific narrow range of data on either side of the threshold (3rd birthday). The local linear estimates of the treatment effect are differences between the estimated limits of the outcome variables on each side of the discontinuity. Our baseline specification is the following local linear regression:

$$Y_i = \beta_0 + \beta_1 Age3_i + \gamma_1(a_i - 1096) + \gamma_2 Age3_i(a_i - 1096) + \varepsilon_i \tag{2}$$

In practice, we obtain the estimated treatment effect β_1 by allowing that the slope of the age profile to be different on either side of the 3rd birthday by interacting the age variable fully with $Age3_i$ and estimating (2) via weighted least squares using a triangular kernel (i.e., giving more weight for the sample (data point) close to 3rd birthday).[47] We restrict our sample within 90 days before and after the 3rd birthday. The choice of bandwidth and the computation of standard errors of discontinuity estimates are important issues for local linear

[46] We have all NHI records of medical utilization within 365 days before and after individual's 3rd birthday (2nd birthday to 4th birthday).

[47] As mentioned before, the 1096th day is the children's 3rd birthday.

estimation. In Table A3, we will show that our main estimates are robust to the various choices of bandwidth and different methods of calculating standard errors.[48]

Following Card et al. (2009), Anderson et al. (2012) and Lemieux and Milligan (2008), we collapse the individual level data into age cells(measured in day), which gives us the same estimates as the results from the individual level data, but substantially reduces computational burden. Therefore, our regressions are estimated on day level means at each day of age:

$$Y_a = \beta_0 + \beta_1 Age3 + \gamma_1(a - 1096) + \gamma_2 Age3(a - 1096) + \varepsilon_a \tag{3}$$

We also take the log of our dependent variables to allow β_1 to be interpreted as a percentage change in the dependent variables. That is, the dependent variables for RD estimation are the log of total outpatient (inpatient) expenditure, total number of outpatient visits (inpatient admissions), and outpatient (inpatient) expense per visit at each day of age.

The most important assumption for our RD estimation is that except for the higher patient cost sharing, there is no change in any other confounding factors that affect the healthcare demand at the 3rd birthday. For this age group, the potential confounding factors could be take-up of vaccines and pre-school attendance. The recommended immunization schedule could mechanically increase the healthcare spending and use of young children at age 3. However, this concern could be alleviated since children in Taiwan do not need to take vaccines while age 3 and indeed take most vaccines before two years-of-age(Center of Disease and Control, 2013).[49] On the other hand, entering preschool could increase the chance of

[48]Deciding how "narrow" range of data, namely, choice of bandwidth, is critical to local linear estimation. If bandwidth is too wide, local linear estimate β_1 could be bias due to misspecification. That is, linear function is unable to capture age profile over such "wide" range of data. If bandwidth is too narrow, there is not enough data for estimation to get precise local linear estimate. Thus, the optimal bandwidth needs to balance bias and precision (variance) for the estimates of β_1. This is a quite active filed in nonparametrics literature and there are many competing methods to select optimal bandwidth, such as, plug-in approach (Imbens and Kalyanaraman, 2012; Cattaneo et al., 2013) and cross-validation approach (Ludwig and Miller, 2007). In Table A3, we will show that our main estimates are robust across various optimal bandwidth selectors. In addition, standard error of discontinuity estimate is also an important issue for local linear estimation since the available bandwidth selectors tend to give a "large" bandwidth and lead to biased local linear estimates. One solution is to use bias-correction estimates, however, the conventional standard error of bias-correction estimates fail to consider variability of additional second order bias estimates, which result in too small standard error and makes false conclusion of statistical inference. Cattaneo et al. (2013) proposes a method to account for this variability to obtain the robust standard error and confidence internal. In Table A3, we will show the statistical inference of our main estimates are still valid even we take this conservative way to compute our standard error.

[49]http://www.cdc.gov.tw/professional/page.aspx?treeid=5B0231BEB94EDFFC&nowtreeid=1B4BACA0D1FDDB84

getting diseases (e.g., the flu) for young children and then affect children's healthcare use. This factor might not confound with the cost sharing change at age 3 because the age of entry for "public" preschool is four years-of-age and government does not enact statutory attendance age for "private" kindergartens. Most importantly, we measure children's age at a daily level, so our RD design will be invalid only if these factors also change abruptly within one or two days of the 3rd birthday. This fact substantially alleviates the concern that our estimates would be biased by other factors. We will conduct several placebo tests to further confirm the validity of our RD design (e.g., using pre-reform data).

5 Results

In this section, we examine the impact of the children's 3rd birthday (higher cost-sharing) on the healthcare expenditure and utilization. As mentioned above, our sample are the children born between 2003 and 2004 and continuously enrolled in NHI at age two and three. We follow this fixed panel of sample across their 3rd birthday to estimate the change in healthcare demand at age three. We will examine outpatient care first and then impatient care.

5.1 Outpatient Visits and Expenditures

From Section 2, we know the average out-of-pocket cost for each outpatient visit increases more than 100% when children pass their 3rd birthday. Our main question is how children's healthcare demand respond to this exogenous price change. We begin with a graphical analysis.

5.1.1 Graphical Analysis

Figure 2a shows the actual and fitted age profiles of total outpatient expenditure for children born between 2003 and 2004. The dots in the figure represent total outpatient expenditure per 10,000 person years[50] by patient's age (measured in days) at visit.[51] The solid line gives the fitted values from a local linear regression that interacts age variables fully with a dummy indicating after 3rd birthday.[52] Corresponding to a sharp increase in patient cost

[50] We compute the total outpatient expenditure per 10,000 person years by dividing the total outpatient expenditure at a particular age by the number of the enrollees born between 2003 and 2004 and then times 10,000. This is a common way to present data in the health economics and the public health literatures and can help us compare the estimated results across different sample period and subgroups.

[51] The dots represent means of the dependent variable for 10-day cells

[52] We use 90 days as our bandwidth.

sharing at the 3rd birthday (treatment), there is an obvious discrete reduction in outpatient expenditure when children turn three. The change in total outpatient expenditure could decompose into the change in the number of visits and outpatient expenditures per visit. Figures 2c and 2e represent actual and fitted age profiles of outpatient visits per 10,000 person years[53] and outpatient expenditures per visit, respectively. We find both variables also suddenly jumping down right after the children's 3rd birthday. On the other hand, we use pre-reform period data (1997-2001) to plot the related outcome variables in Figure 2b, 2d and 2f. In sharp contrast to the graphs presented above, We do not find any visible discontinuity at the 3rd birthday.

5.1.2 Main Results

Table 5 presents the estimated impact of the 3rd birthday on outpatient expense and visits before (1997-2001) and after (2005-2008) introducing TWCMS. Each panel (row) displays results for a different dependent variables of interest. Odd numbered columns present RD estimates from a nonparametric local linear regression and even numbered present RD estimates from a parametric OLS regression (cubic spline). Column (1) of Table 5 is our main results for outpatient services and displays the estimates from a local linear regression with a triangular kernel function and a bandwidth of 90 days of age.[54] Corresponding to the sharp drop in outpatient expenditure at the 3rd birthday in Figure 2a, Panel A shows that higher patient cost-sharing at the 3rd birthday causes overall outpatient expenditures to significantly decrease by 6.6%. The implied arc-elasticity of outpatient expenditure is around -0.09.[55]

The change in total outpatient expenditure comes from two margins: 1) the number of visits (extensive margin); 2) the outpatient expense per visit (intensive margin). Panel B reveals the number of outpatient visits decreases by 4.5% at the 3rd birthday, which is smaller than the change in total expenditure. The remaining change comes from change in medical cost per visit. Panel C reveals outpatient expense per visit significantly decrease

[53] Again, each dot represents outpatient visits per 10,000 person years at given age and then take 10 days average.

[54] restricting estimated sample within 90 days before and after 3rd birthday

[55] The standard formula for price elasticity of demand is $((Q_2 - Q_1)/Q_1)/((P_2 - P_1)/P_1)$, where Q_1 and P_1 denote the baseline healthcare demand and patient cost sharing, respectively and Q_2 and P_2 are the healthcare demand and patient cost sharing after change in cost sharing. However, in the health economics literature, many studies (Leibowitz et al., 1985; Manning et al., 1981; Chandra et al., 2010*a*) also use arc-elasticity, which defines percent change is relative to the average, since P_1 could be zero in some cases (e.g., free plan in Rand HIE or this paper: zero out-of-pocket cost for inpatient care) and the denominator of price elasticity is undefined in this case. That is, elasticity is calculated as $((Q_2-Q_1)/((Q_1+Q_2)/2))/((P_2-P_1)/((P_1+P_2)/2)$

by 2.1% at the 3rd birthday. In fact, this result is a combination of two forces. First, higher cost sharing at 3rd birthday could change the composition of patients and results in higher outpatient expense per visit at age 3. Assuming that the marginal patients are not as sick as those who enter hospitals/clinics regardless of cost sharing subsidy eligibility, the average health of patients may drop discretely at the 3rd birthday, which leads to higher medical costs per visit.[56] Second, losing the cost sharing subsidy at the 3rd birthday could also affect patients' choices of providers (quality of each visit) and causes lower outpatient expense per visit at age 3. As mentioned in section 2, TWCMS indeed subsidizes more out-of-pocket costs for teaching hospital patients than clinic/community hospital patients and would encourage patients to use outpatient services in teaching hospitals before the 3rd birthday. By doing so, patients not only can extract more subsidies but also receive the better quality of medical service.[57] Therefore, when patients lose their eligibility for the cost sharing subsidy at the 3rd birthday, they would reduce the visits to teaching hospitals, which results in lower medical cost per visit.[58] Our estimates in Panel C imply the latter force dominates the former one, which causes the outpatient expenditures per visit to exhibit a discrete drop at the 3rd birthday. In the section 5.1.4, we will discuss this issue in more detail.

5.1.3 Validity and Robustness Checks

Columns (3) and (4) in Table 5 display a placebo test using pre-reform data (1997-2001). The results reveal there is no discontinuity of our outcome variables at the 3rd birthday before 2002 (introducing TWCMS). The point estimates are insignificant and close to zero, which substantially reduces concerns about the impact of other confounding factors on our estimates. In Table A1, we conduct another placebo test by examining any discontinuity at other age cut-off. We find our outcome variables (log of outpatient expenditure and number of visits) are smooth across selected age cut-offs, except 3rd birthday (1096 age of days)[59].

For the robustness checks of our main specification, we use an alternative way (global polynomial approach) to estimate the discontinuity of outcome variables at 3rd birthday using all available data (365 days before and after 3rd birthday) and the third order poly-

[56] Assuming that healthcare providers spend more costs on treating less healthy patients.

[57] Every three to four year, Ministry of Health and Welfare evaluates every NHI contracted hospitals/clinics to determine the accreditation of the evaluated providers. The category of major teaching hospital is seen as the best quality among the providers.

[58] Because the teaching hospitals may provide more medical service at each visit, such as health checks or medical treatments, it would cost more for each visit.

[59] There are several "significant" discontinuities at other age cut-offs. However, their magnitudes are quite small.

nomial age function with different slopes on the either side of the 3rd birthday. The results in column (2) present very similar estimates as our main results. In Table A2, we systematically examine the sensitivity of our RD estimates to different bandwidth and order of polynomial. The estimates are quite stable across different specifications. In Table A3, we presents various local linear estimates from three different bandwidth selectors and kernel functions to show our main results are robust to these choices.

One caveat could threaten the validity of our RD design. Because every child eventually "ages out" of his/her cost sharing subsidy, parents may anticipate the sharp increase in medical price after children's 3rd birthday and "stock up" on children's outpatient care.[60] This behavioural response represents inter-temporal substitution of health care (i.e., substitute future health care with current health care) and does not indicates "real" change (increase) in demand for healthcare induced by cost sharing subsidy, which is our main interest. Thus, such behavioural response tends to bias upward our estimates of change in healthcare demand at 3rd birthday (i.e., price elasticity of healthcare demand). From Figures 2a and 2c, we indeed find outpatient expenditures and visits suddenly rise at 20 days before the 3rd birthday. In order to account for the possible anticipation effect, we conduct a "donut" RD (Barreca et al., 2011; Shigeoka, 2014) by systematically excluding the outpatient expenditures and visits within 3-21 days before/after 3rd birthday (see Table A4 in appendix). Although there is no consensus for optimal size of a donut hole and eliminating the sample around threshold seems to contrast with the spirit of RD design, this type of estimation still can give us some sense of the "stock-up" effect on our estimates. The estimates from different "size" of donut hole give us very similar results as our main RD estimates.

5.1.4 Change in Choice of Providers at 3rd birthday

NHI in Taiwan (or other Asian countries) does not adopt a gatekeeper system to restrict patient's choices of providers. Instead, NHI sets different cost sharing (copayment) for four types of providers to lead patients to choose the suitable provider according to their understanding of the seriousness of illness and then rectify possible moral hazard behaviors of choosing providers. As mentioned before, TWCMS exempts all NHI copayment for children under age 3, which gives us an unique opportunity to examine the impact of differential copayment on patient's choice of providers by comparing the choice right before the 3rd

[60] Although most of outpatient visits for young children are acute diseases (e.g., 74% of visits are for respiratory diseases), it is hard to believe parents can substitute children's outpatient care for the care after one month. However, it is possible to substitute outpatient care within few days.

birthday (uniform copayment[61]) and right after the 3rd birthday (differential copayment).

Figures 3a to 3d present age profiles of outpatient visits by type of providers. We find outpatient visits for major and minor teaching hospitals have the strikingly discrete reductions just after the 3rd birthday. However, the number of visits for community hospitals has the opposite pattern, namely, jumps at the 3rd birthday and there is a little and less obvious drop in visits to clinic after the 3rd birthday. Most decline in the overall outpatient visits indeed comes from teaching hospitals. The visual evidence suggests the change in relative prices at the 3rd birthday results in a significant redistribution of caselaods across different types of providers.

Coinciding with the graphical evidence, the RD estimates in Panel A of Table 6 show that turning age 3 substantially reduces outpatient visits to major and minor teaching hospitals by 57.6% and 44%, respectively. But outpatient visits to community hospitals increases by 19% and caseloads of clinics decrease slightly by 1.6%. This result indicates patients are quite sensitive to the relative price (cost sharing) between different types of providers and can switch their providers easily. The following question is what kind of healthcare can substitute easily between teaching hospitals and clinics (community hospitals) ?

In Panel B of Table 6, we use outpatient expense per visit as a proxy for severity of illness.[62] The estimates in Panel B reveal that turning age 3 substantially increase medical cost per visit for major and minor teaching hospitals by 19.1% and 7.1%, respectively. This result implies that most of the reduced visits to teaching hospitals at the 3rd birthday are actually for less severe diseases. Since patients reduce their utilization of teaching hospitals right after the 3rd birthday, we suspect these missing visits are not necessary to be cured at teaching hospitals but could also be treated at clinics/community hospitals, which implies substantial moral hazard of abusing outpatient services in teaching hospitals before the 3rd birthday. The above results suggest the relative level of copayment is an important factor to determine patient's choice of providers. Maintaining differential copayment between different types of providers could be a powerful tool to allocate medical resources efficiently.

5.1.5 Heterogeneous Effect

In this section, we investigate the heterogeneity of price response across different types of diagnoses and various subgroups of young children. Each row displays a different type of diagnosis and subgroup. The first column in Table 7 presents the rate of outpatient

[61] Before the 3rd birthday, patients still need to pay registration fee. However, registration fee does not vary a lot across different providers.

[62] Assuming more severe diseases would require more costs for each visit.

visits per 10,000 person years 90 days before the 3rd birthday to give us some insights about the relative size of outpatient visits across different types of diagnoses and subgroups before a child's 3rd birthday. The second column in Table 7 displays the RD estimates of outpatient visits (take log). Panel A in Table 7 presents the results for selected diagnoses. The first three rows in Panel A list the top three common visit diagnoses for young children and all of them are acute respiratory diseases: upper respiratory infection (URI), acute bronchitis, and acute sinusitis, which accounts for 40% of total outpatient visits.[63] For some diseases, such as, acute bronchitis and sinusitis, receiving proper outpatient care could be beneficial to children's health. Column (2) in Panel A shows that the outpatient visits for these common diagnoses significantly decline after the 3rd birthday. However, the estimated sizes of the discontinuity (reduction) at the 3rd birthday for these diseases are smaller than estimates from overall outpatient visits. The implied arc-elasticities are only -0.02 to -0.05 for outpatient visits, which reveals patients (parents) are not price sensitive to outpatient visits to acute respiratory diseases.[64]

The remaining rows in Panel A presents RD estimates for other selective diagnoses that may be less serious but need timely treatment to improve living quality, such as, skin diseases. Losing cost sharing subsidy causes a 11.8% reduction in outpatient visits for skin diseases, which is much larger than the overall decline in outpatient visits. Much larger decrease can also be found for outpatient care that are more discretionary but could reduce future healthcare cost, such as mental health service and preventive care. Turning three substantially reduces outpatient visits for mental diseases by 23.6% and for preventive care by 33.3%. The implied arc price elasticities for this type of healthcare are quite large (-0.34 for mental health service and -0.51 for preventive care).[65] Early detection and treatment for children's mental disorders (e.g., Autism) could result in better treatment outcomes. Our results suggest cost sharing subsidy encourages more children to use these preventive care before age 3, which might substantially reduce future medical costs.

Panels B to D in Table 7 examine the distinct price response across various subgroups of young children. Panel B displays the results by birth order. In general, 1st born children have a lower rate of outpatient visits and are also less price sensitive. Panel C presents RD estimates by gender. Compared with females, males have more outpatient visits and a slightly larger decrease in outpatient visits at the 3rd birthday. Panel D presents RD

[63] $(119+51+48)/542 = 0.40$

[64] We use the same method mentioned in section 2 to obtain exogenous price change at the 3rd birthday for each disease and then calculate price elasticity.

[65] We use the same method mentioned in section 2 to obtain exogenous price change at 3rd birthday for each disease and then calculate price elasticity

estimates based on household income. We find children from low income families have fewer outpatient visits (column (1)) and have a slightly larger price response (column (2)) than those from high income families.

5.2 Inpatient Admissions and Expenditures

For young children, inpatient admissions are much less common than outpatient visits. Among our sample at age 2, the average annual number of outpatient visits is 19.8 but average annual inpatient admission is only 0.14. Nevertheless, the expense of one inpatient admission is 29 times more expense per outpatient visit (the expenditure of one inpatient admission is equal to the expense of 29 outpatient visits) and 17 percent of healthcare spending for young children is attributed to inpatient care. More importantly, patient cost sharing for inpatient admission at the 3rd birthday experiences a much larger increase than the one for outpatient visits in terms of both level and percentage change[66]. That is, inpatient care could have substantial impacts on overall healthcare spending and individual's out-of-pocket medical expense. Hence, understanding how young children's demand for inpatient care responds to cost sharing has important policy and welfare implications.

However, the effect of turning age 3 (losing cost sharing subsidy) on the utilization of inpatient care is theoretically ambiguous. On one hand, children may have fewer inpatient admissions and expenditures when they turn three since patient cost sharing for inpatient care also increases sharply at the 3rd birthday. On the other hand, the type of inpatient care that young children usually use could be less price sensitive. Most admission diagnoses in early childhood, such as pneumonia and acute gastroenteritis, can be treated with medication or bed rest. Previous studies (Card et al., 2008; Shigeoka, 2014) found patient cost sharing (or insurance coverage) has less impact on this type of diagnosis for the elderly. In addition, for the admissions requiring surgery, such hospital stays for young children are seldom selective (e.g., osteoarthritis, hip and knee replacement) but could be life threatening and necessary (e.g., congenital heart disease). Thus, we should expect inpatient care for young children should be less sensitive to price changes at the 3rd birthday.

5.2.1 Graphical Analysis

Figure 5a shows the actual and fitted age profiles of inpatient admissions for children born between 2003 and 2004. Similar to the graphs for outpatient care (Figure 2), The markers

[66] Average patient cost sharing for one inpatient admission increases by 1296 NT$ at 3rd birthday. However, average price for one outpatient visit only rise by 74 NT$.

represent total inpatient expenditure per 10,000 person years at given age, which is measured in days from the 3rd birthday. The solid line gives the predicted values from a local linear regression that interacts age variables fully with a dummy indicating ages after the 3rd birthday. Surprisingly, in contrast to the sharp drop in outpatient expenditure, Figure 5a shows that inpatient expenditure exhibits no change at the 3rd birthday. Similarly, Figures 5c and 5e represent actual and predicted age profiles of inpatient admissions and inpatient expenses per admission. We also find there is little visual evidence of any discontinuity in inpatient admissions and inpatient expenses per admission at the 3rd birthday. Compared with the graphs plotted by using pre-reform data (1997-2001), we find the outcome variables during pre/post period have quite similar age profiles.

5.2.2 Main Results

Table 8 presents the estimated effect of the 3rd birthday on inpatient expenditures and admissions before (1997-2001) and after (2005-2008) introducing TWCMS. Like Table 5 for outpatient service, each panel (row) displays results for a different dependent variables of interest. Odd numbered columns presents RD estimates from nonparametric local linear regression and even numbered present RD estimates from parametric OLS regression (cubic spline). Consistent with graphical evidence in Figure 5, all RD specifications in Table 8 suggest there is no statistically significant impact of turning age three on inpatient expenditures and utilization. The point estimates in column (1) of Table 8 (our baseline estimation) is close to zero and insignificant. It reveals losing cost sharing subsidy reduces the total inpatient expenditure by only 0.10% and the number of inpatient admissions by 0.11%. The implied arc elasticity of inpatient expenditure is close to 0.

There is little evidence on the impact of patient cost sharing on the demand of inpatient service. Our results are in sharp contract to the existing evidence. For example, Shigeoka (2014) find elderly (at age 70) inpatient demand is price sensitive and the estimated price elasticity of inpatient admission is around -0.15. On the other hand, Previous studies (Card et al., 2008; Shigeoka, 2014) also found the admissions treated with bed rest and medication are not price sensitive. Since most admissions for young children are belong to these types of inpatient care, our results suggest utilization of inpatient care for young children could have very limited response to patient cost sharing, which implies young children's demand for inpatient care may not be discretionary but necessary. According to our estimates, providing full insurance coverage of young children's inpatient service should be welfare improving since it will not cause moral hazard but substantially reduce financial risk brought by inpatient admissions.

6 Conclusion

Many developed countries subsidize young children's healthcare by providing this demographic group relatively low patient cost sharing in their public insurance programs. The rationale of these medical subsidy policies is that young children are heavy user of healthcare, which might bring sizeable financial risk to young households. More importantly, these early life health interventions are widely believed to be beneficial to individual's future life. To assess the efficacy of these subsidy policies, understanding how young children's healthcare demand respond to patient cost sharing is essential. Yet the existing literature is very little known about this issue.

In this paper, we provide the convincing evidence on the price response of healthcare for young children. We exploit a sharp increase in patient cost-sharing at age 3 in Taiwan that occurs when young children "aging out" of the cost sharing subsidy, which results in higher patient cost sharing for the children just after their 3rd birthday than the ones just before their 3rd birthday, and apply an RD design to estimate the impact of cost sharing on healthcare demand in early childhood. We reach three conclusions. First, the demand for outpatient service significantly respond to copayments change, but the estimated are elasticity of outpatient expenditure is modest (around -0.09). Second, differential copayments of outpatient service between hospitals and clinics is a powerful policy tool to allocate patients to the suitable providers based on their seriousness of illness. According to our estimates, due to the differential copayments, the number of visits for teaching hospitals is reduced by 50% and most of decreased visits are for less server diseases. Finally, the demand for inpatient service *does not* respond to price change. The implied arc elasticity of inpatient expenditure is close to zero. Rand HIE found mixed evidence on this issue and cannot strongly draw conclusion from them. Our results largely support the view that inpatient service for young children is not price sensitive. Taken together, theses results suggest the level of patient cost sharing for young children should be different by healthcare service (providers). For example, NHI should fully cover the medical cost of inpatient care for young children since it will not generate excess spending induced by moral hazard but fully protect patient's risk from out-of-pocket expenses. On the other hand, NHI should set higher patient cost sharing for outpatient service at teaching hospital to reduce possible moral hazard behavior when patients choose providers.

Several important questions have not been analysed in this paper, such as the long-run health impact of this cost sharing subsidy program. Future research could focus on this issue and will give us more complete picture of the effect of similar programs in the world.

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7 Tables and Figure

Table 1:
Patient Cost-Sharing in Taiwan NHI

	Patient Cost-Sharing			
	Major Teaching Hospital	Minor Teaching Hospital	Community Hospital	Clinic
Panel A:				
Outpatient service: copayment (NT$)				
NHI Copay	360	240	80	50
Register Fee	150	100	100	50
Panel B:				
Inpatient service: coinsruance				
1-30 days		10%		
31-60 days		20%		
after 61 days		30%		

Note: 1 US$ is 32.5 NT$ in 2006. For outpatient service, patient cost-sharing is through copyment. A patient pays NHI copayment plus registration fee for each visit. Information about NHI Copay is from National Health Insurance Research Database codebook (2012). NHI implements this fee schedule since July 2005. Since our sample period is from Janunary 1st 2005 to December 31st 2008, most of ourpatient visits in our sample, except visits on Janunary 1st 2005 to June 30th 2005, are based on the above fee schedule. Before July 1st 2005, NHI Copay for outpatient service is according to the following fee scheme: 210 NT$ for major teaching hospital, 140 NT$ for minor teaching hospital, 50 NT$ for community hospital, and 50 NT$ for clinic. Information about registration Fee is from an online database of NHI registration fee survey: http://www.nhi.gov.tw/amountinfoweb/Search.aspx?Q5C1_ID=2&Q5C2_ID=900002&Hosp_ID=1131100010&rtype=2 For inpatient care, patient cost-sharing takes place through coinsurance. Depending on the days of stay and the type of admission (acute or chronic admission), a patient is required to pay 10% to 30% of the total medical expense per admission. The above fee schudle is only for acute admission since we eliminate all chronic admissions, which only accounts for 0.3% of inpatient admissions.

Table 2:
Weighted Average Out-of-pocket cost per visit/admission

	Out-of-pocket cost per visit/admission	
	Before 3rd birthday	After 3rd birthday
Type of Service		
Outpatient service	58.9	132.7
Inpatient service	0	1296

Note: Data are pooled NHI claims records 2005-2008. Weighted average out-of-pocket costs per visit/admission are reported in New Taiwan Dollar (NT$). 1 US$ is 32.5 NT$ in 2006.

Table 3:
Selected characteristics at age three before and after sample selection

	(1) Original Sample	(2) Continuous enrollment at age two and three	(3) Eliminating cost-sharing waiver
Male	0.525	0.525	0.524
Birith year: 2003	0.510	0.509	0.509
Birith year: 2004	0.490	0.491	0.491
1st birth	0.519	0.520	0.520
2nd birth	0.368	0.370	0.370
3rd birth (above)	0.113	0.112	0.110
Number of siblings	1.761	1.760	1.759
	(0.671)	(0.671)	(0.669)
Number of children	435,206	426,587	410,517

Note: Column (1) presents the selected characteristics for original sample: all NHI enrollee born in 2003 and 2004. Column (2) restrict sample to enrolee who continuously register in NHI at age 2 and 3. Column (3) eliminates sample with cosh-sharing waiver, such as, children with catastrophic illness (e.g., cancer) and children from very low income families since these children do not experience any price change when turning three.

Table 4:
Descriptive Statistics

	Outpatient Service		Inpatient Service	
	Before 3rd birthday	After 3rd birthday	Before 3rd birthday	After 3rd birthday
Utilization				
Average annual visits	19.8	19.0	0.14	0.13
Average out-of-pocket cost per visit (NT$)	58.9	123.1	0	1289.7
Average medical expenditure per visit (NT$)	443.5	438.7	12980.6	13013.9
Choice of providers				
Major Teaching Hospital	4.1%	2.3%	28.4%	29.8%
Minor Teaching Hospital	5.6%	3.7%	58.6%	58.2%
Community Hosptial	3.8%	4.6%	12.8%	11.9%
Clinic	86.5%	89.4%	0%	0%
Number of children (visits > 0)	375,493	364,075	13,252	12,666
Number of children-visit	2,003,097	1,954,591	19,356	18,163

Note: Data are pooled NHI claims records 2005-2008. The above descriptive statistics is based on records about outpatient(inpatient) service happened within 90 days before 3rd birthday and 90 days after 3rd birthday. For inpatient care, bandwidth is 238 days and we use all inpatient admissions happened within 238 days before and after 3rd birthday. Average annual visits is calculated by average visits at each age (measured in day) times 365. Average out-of-pocket costs and medical expenditures are reported in New Taiwan Dollar (NT$). 1 US$ is 32.5 NT$ in 2006.

Table 5:
Change at 3rd birthday in Outpatient Expenditure and Visits: before and after reform

	2005-2008		1997-2001	
	(1)	(2)	(3)	(4)
Specification	Nonparametric Local linear	Parametric Cubic spline	Nonparametric Local linear	Parametric Cubic spline
Visits rate at age 2 (per 10,000 person-years)	542		568	
Bandwidth (days)	90	365	90	365
Panel A: **Log(outpatient expense)**				
After 3rd birthday (X100)	-6.63***	-6.79***	0.17	0.36
	[0.44]	[0.40]	[0.24]	[0.21]
Panel B: **Log(number of visits)**				
After 3rd birthday (X100)	-4.54***	-4.67***	0.26	0.24
	[0.32]	[0.29]	[0.17]	[0.17]
Panel C: **Log(outpatient expense per visit)**				
After 3rd birthday (X100)	-2.12***	-2.12***	-0.04	0.11
	[0.26]	[0.27]	[0.11]	[0.13]

Note: Our RD estimation is based on age cells rather than individual level. Age is measured in days. Each observation (age cell) represent outpatient utilization from 410,517 children. Odded column use data within 90 days before and after 3rd birthday (bandwidth is 90 days) and report the difference in local linear regression estimates just before and after 3rd birthday by using a triangular kernel, which gives higher wieght on the data close to 3rd birthday. Asymptotic standard errors in parentheses. Evened columns present estimated regression discontinuties by using all available data (365 days before and after 3rd birthday) and flexible polynominal regression (cubic spline), allowing different slope on the either side of 3rd birthday. We use the same selection criteria to create pre-reform sample: enrolee born between 1995 and 1997 (when they are age 2 and 3). Therefore, we use 1997-2001 NHI data to obtain the above estimated results. Robust standard error in parentheses. *** significant at the 1 percent level, ** significant at the 5 percent level, and * significant at the 10 percent level

Table 6:
Change at 3rd birthday in Outpatient Visits and Spending: By choice of providers

Providers	(1) Major teaching hospital	(2) Minor teaching hospital	(3) Community hospital	(4) Clinic
Visits rate at age 2 (per 10,000 person-years)	22	30	21	469
Panel A:				
Log(number of visits)				
After 3rd birthday (X100)	-57.64***	-44.03***	18.97***	-1.61***
	[2.40]	[1.47]	[1.48]	[0.26]
Panel B:				
Log(outpatient expense per visit)				
After 3rd birthday (X100)	19.07***	7.13***	-0.75	-0.18**
	[2.34]	[1.75]	[1.56]	[0.09]

Note: Our RD estimation is based on age cells rather than individual level. Age is measured in days. Each observation (age cell) represent outpatient utilization from 410,517 children. Column (1)-(4) present estimated regression discontinuties of each interested outcome for four types of health provides by using data within 90 days before and after 3rd birthday and report the difference in local linear regression estimates just before and after 3rd birthday by using a triangular kernel, which gives higher wieght on the data close to 3rd birthday. Asymptotic standard errors in parentheses. *** significant at the 1 percent level, ** significant at the 5 percent level, and * significant at the 10 percent level

Table 7:
Change at 3rd birthday in Outpatient Expenditure and Visits: By diagnoses, birth order, gender, and household income

	(1) Visits rate at age 2 (per 10,000 person-years)	(2) Log of visits
Panel A: By visit diagnoses		
URI	119	-1.89***
		[0.53]
Acute bronchitis	51	-2.55***
		[0.71]
Acute sinusitis	48	-3.72***
		[0.84]
Gastroenteritis diseases	31	-6.22***
		[0.93]
Skin diseases	20	-11.82***
		[1.18]
Mental disorder	4	-23.61***
		[2.80]
Preventive care	2	-33.28***
		[5.47]
Panel B: By birth order		
1st birth	535	-4.15***
		[0.37]
2nd birth (above)	549	-4.95***
		[0.40]
Panel C: By gender		
Male	570	-4.68***
		[0.35]
Female	511	-4.29***
		[0.51]
Panel D: By household income		
Low	525	-5.23***
		[0.38]
High	562	-3.77***
		[0.43]

Note: Our RD estimation is based on age cells rather than individual level. Age is measured in days. Each observation (age cell) represent outpatient utilization from 410,517 children. Panel A to D report estimated regression discontinuties of each interested outcome (column (2)) for various subgroups. Low income household in Panel D is defined as monthly household income is below 40,000 NT$. High income refers households with monthly household above 40,001 NT$ We use data within 90 days before and after 3rd birthday (bandwidth is 90 days) and report the difference in local linear regression estimates just before and after 3rd birthday by using a triangular kernel, which gives higher wieght on the data close to 3rd birthday. Asymptotic standard errors in parentheses. *** significant at the 1 percent level, ** significant at the 5 percent level, and * significant at the 10 percent level

Table 8:
Change at 3rd birthday in Inpatient Expenditure and Visits: before and after reform

Specification	2005-2008		1997-2001	
	(1) Nonparametric Local linear	(2) Parametric Cubic spline	(3) Nonparametric Local linear	(4) Parametric Cubic spline
Visits rate at age 2 (per 10,000 person-years)	3.9		2.5	
Bandwidth (days)	90	365	90	365
Panel A: **Log(inpatient expense)**				
After 3rd birthday (X100)	-0.10	0.74	1.36	2.72
	[2.78]	[4.00]	[2.38]	[2.20]
Panel B: **Log(number of admission)**				
After 3rd birthday (X100)	-0.11	-1.20	1.14	3.12
	[5.15]	[2.41]	[2.89]	[3.13]
Panel C: **Log(inpatient expense per admission)**				
After 3rd birthday (X100)	0.01	1.94	0.20	-0.40
	[3.45]	[3.03]	[2.36]	[2.48]

Note: Our RD estimation is based on age cells rather than individual level. Age is measured in days. Each observation (age cell) represent inpatient utilization from 410,517 children. Odded column use data within 90 days before and after 3rd birthday (bandwidth is 90 days) and report the difference in local linear regression estimates just before and after 3rd birthday by using a triangular kernel, which gives higher wieght on the data close to 3rd birthday. Asymptotic standard errors in parentheses. Evened columns present estimated regression discontinuties by using all available data (365 days before and after 3rd birthday) and flexible polynominal regression (cubic spline), allowing different slope on the either side of 3rd birthday. We use the same selection criteria to create pre-reform sample: enrolee born between 1995 and 1997 (when they are age 2 and 3). Therefore, we use 1997-2001 NHI data to obtain the above estimated results. Robust standard error in parentheses. *** significant at the 1 percent level, ** significant at the 5 percent level, and * significant at the 10 percent level

Table A1:
Placebo Test for Other Age Cutoff

Log(outpatient expenditure)

Cutoff Age (days)	Coefficient on cutoff	Cutoff Age (days)	Coefficient on cutoff
886	0.66	1186	-0.63
	[0.42]		[0.39]
916	0.09	1216	-0.31
	[0.37]		[0.42]
946	-0.55	1246	0.85*
	[0.39]		[0.50]
976	-0.46	1276	-0.59
	[0.38]		[0.42]
1006	0.01	1306	-0.22
	[0.38]		[0.42]
1096	-6.64***	1336	0.51
	[0.44]		[0.44]

Log(outpatient visits)

Cutoff Age (days)	Coefficient on cutoff	Cutoff Age (days)	Coefficient on cutoff
886	0.24	1186	-0.80***
	[0.25]		[0.30]
916	-0.21	1216	-0.23
	[0.29]		[0.27]
946	-0.21	1246	0.59*
	[0.27]		[0.30]
976	-0.26	1276	-0.60**
	[0.25]		[0.26]
1006	-0.26	1306	-0.12
	[0.22]		[0.31]
1096	-4.54***	1336	0.19
	[0.32]		[0.31]

Note: Our RD estimation is based on age cells rather than individual level. Age is measured in days. Each observation (age cell) represent outpatient utilization from 410,517 children. Column (1) and (3) indicates different cutoff age (measured in days) used in RD estimation. Note that 1096th age day is 3rd birthday and its estimate is corresponding to our main result in Table 5. Column (2) and (4) present estimated regression discontinuties of each interested outcome using data within 90 days before and after 3rd birthday and report the difference in local linear regression estimates just before and after 3rd birthday by using a triangular kernel, which gives higher wieght on the data close to 3rd birthday. Asymptotic standard errors in parentheses. *** significant at the 1 percent level, ** significant at the 5 percent level, and * significant at the 10 percent level

Table A2:
Sensitivity to Bandwidth and Polynomial Selection in Parametric RD Regressions

	Log(outpatient expenditure)					
Bandwidth (days)	60	120	180	240	300	360
Polynominal						
1	-6.69***	-6.19***	-5.54***	-5.10***	-4.54***	-4.65***
	[0.48]	[0.33]	[0.28]	[0.24]	[0.23]	[0.20]
2	-6.58***	-6.90***	-6.61***	-6.24***	-6.06***	-5.29***
	[0.74]	[0.51]	[0.40]	[0.37]	[0.32]	[0.30]
3	-7.07***	-6.68***	-7.04***	-6.98***	-6.85***	-6.94***
	[1.11]	[0.70]	[0.56]	[0.47]	[0.42]	[0.40]
	Log(outpatient visits)					
Bandwidth (days)	60	120	180	240	300	360
Polynominal						
1	-4.55***	-3.92***	-3.39***	-2.88***	-2.35***	-2.52***
	[0.34]	[0.24]	[0.20]	[0.18]	[0.17]	[0.15]
2	-4.33***	-4.97***	-4.36***	-4.12***	-3.89***	-3.04***
	[0.53]	[0.37]	[0.29]	[0.26]	[0.23]	[0.23]
3	-4.86***	-4.41***	-5.07***	-4.72***	-4.68***	-4.84***
	[0.83]	[0.49]	[0.41]	[0.33]	[0.30]	[0.29]

Note: Our RD estimation is based on age cell rather than individual level. Age is measured in days. Each observation (age cell) represent outpatient utilization from 410,517 children. Each row indicates different order of polynominals used in RD estimation and each column denotes various bandwidth choice. We obtain RD estimates using OLS regression with uniform kernel function (similar to the parametric estimation in Table 5) Robust standard error in parentheses. *** significant at the 1 percent level, ** significant at the 5 percent level, and * significant at the 10 percent level

Table A3:
Sensitivity to Bandwidth Selector and Kernel Function Selection in Nonparametric RD Regressions

	Log(outpatient expenditure)			Log(outpatient visits)		
Bandwidth selector	CCT	IK	CV	CCT	IK	CV
Kernel function						
Triangular	-6.64***	-6.63***	-6.56***	-4.48***	-4.51***	-4.45***
	[0.48]	[0.44]	[0.40]	[0.39]	[0.35]	[0.45]
Bandwidth	81	89	105	67	79	54
Uniform	-6.68***	-6.69***	-6.58***	-4.46***	-4.46***	-4.40***
	[0.47]	[0.46]	[0.52]	[0.36]	[0.36]	[0.37]
Bandwidth	65	66	54	56	56	54
Epanechnikov	-6.64***	-6.64***	-6.64***	-4.45***	-4.49***	-4.43***
	[0.47]	[0.44]	[0.42]	[0.39]	[0.35]	[0.42]
Bandwidth	75	82	88	61	70	54

Note: Our RD estimation is based on age cells rather than individual level. Age is measured in days. Each observation (age cell) represent outpatient utilization from 410,517 children. Each row indicates the specific kernel function used in nonparametric RD estimation and each column denotes the optimal bandwidth selector for choosing bandwidth. CCT is an optimal bandwidth selection method proposed by Matias D. Cattaneo, Sebastian Calonico and Rocio Titiunik (2013). IK is an optimal bandwidth selection procedure proposed by imbens and kalyanaraman (2012). LM is an optimal bandwidth selection procedure proposed by Ludwig and Miller (2007). The above table present estimated regression discontinuties of each interested outcome using data within specific bandwidth before and after 3rd birthday and report the difference in local linear regression estimates just before and after 3rd birthday by using a triangular kernel, which gives higher wieght on the data close to 3rd birthday. Asymptotic standard errors in parentheses. *** significant at the 1 percent level, ** significant at the 5 percent level, and * significant at the 10 percent level

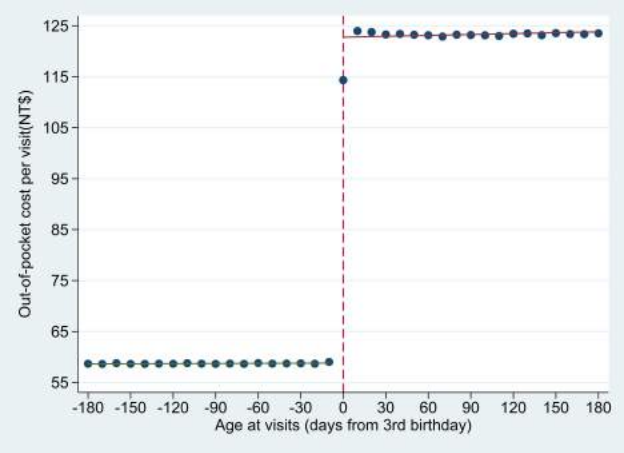
Table A4:
Donut RD for Outpatient Expenditure and Visits

	Log(outpatient expenditure)							
Size of Donut around 3rd birthday	0	3	6	9	12	15	18	21
After 3rd birthday (X100)	-6.63***	-6.81***	-6.76***	-6.67***	-6.49***	-6.44***	-6.74***	-6.38***
	[0.44]	[0.43]	[0.46]	[0.48]	[0.45]	[0.49]	[0.49]	[0.58]
	Log(outpatient visits)							
Size of Donut around 3rd birthday	0	3	6	9	12	15	18	21
After 3rd birthday (X100)	-4.54***	-4.60***	-4.53***	-4.49***	-4.65***	-4.68***	-5.00***	-4.84***
	[0.32]	[0.29]	[0.29]	[0.34]	[0.35]	[0.40]	[0.39]	[0.39]

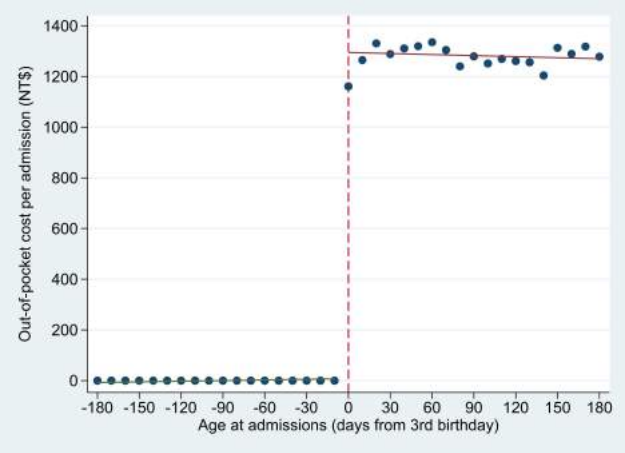
Note: Our RD estimation is based on age cells rather than individual level. Age is measured in days. Each observation (age cell) represent outpatient utilization from 410,517 children. *** significant at the 1 percent level, ** significant at the 5 percent level, and * significant at the 10 percent level

Figure 1: Age profile of out-of-pocket cost

(a) Average price per outpatient visit (NT$)



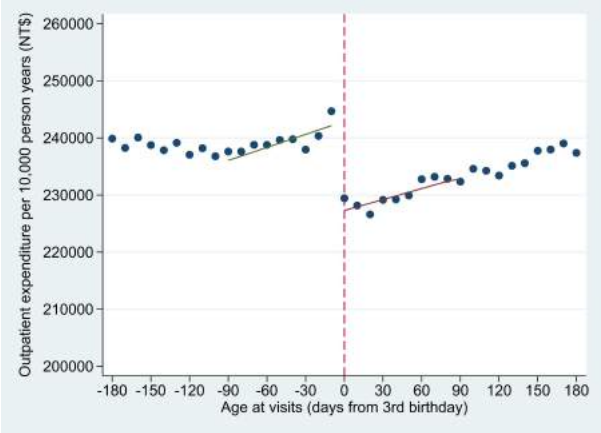
(b) Average price per inpatient admission (NT$)



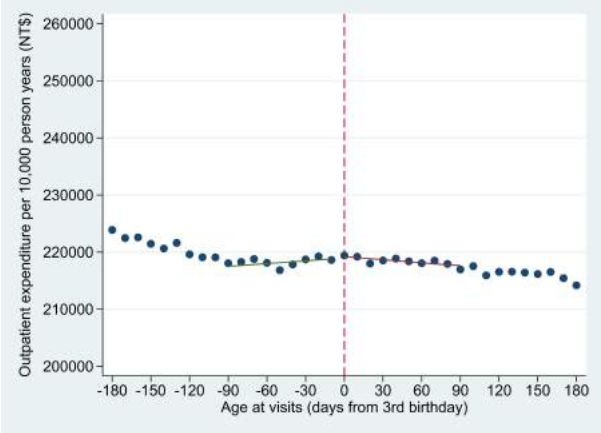
Notes: The line is from fitted a linear regression on age variables fully interacted with $Age3_i$, a dummy indicating after 3rd birthday. The dependent variable are average price per outpatient visit (inpatient admission) by patient's age at visit (measured in days, 180 days before and after 3rd birthday). Each dot represents the mean (10-day cells) of the dependent variable.

Figure 2: Age profile of outpatient expenditure and visits

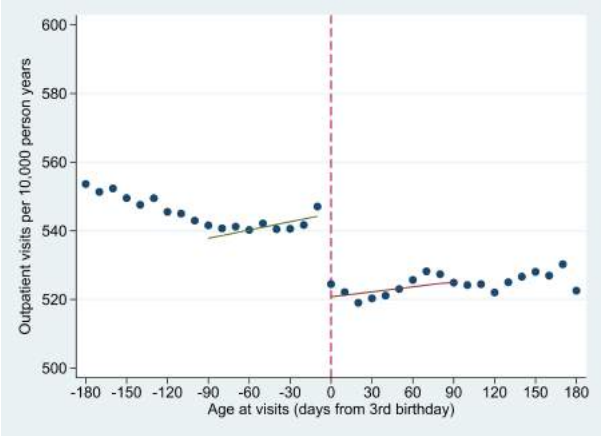
(a) Outpatient expense per 10,000 person years: 2005-2008



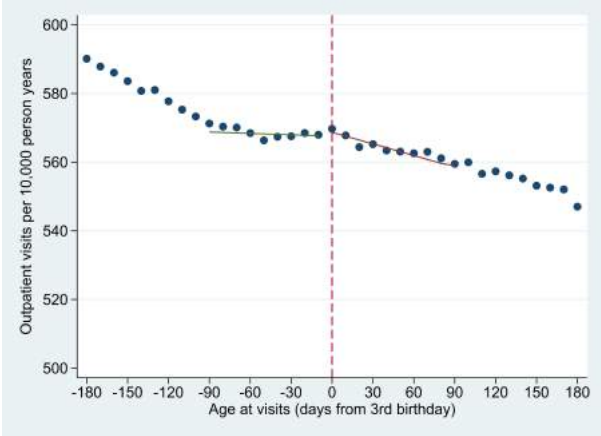
(b) Outpatient expense per 10,000 person years: 1997-2001



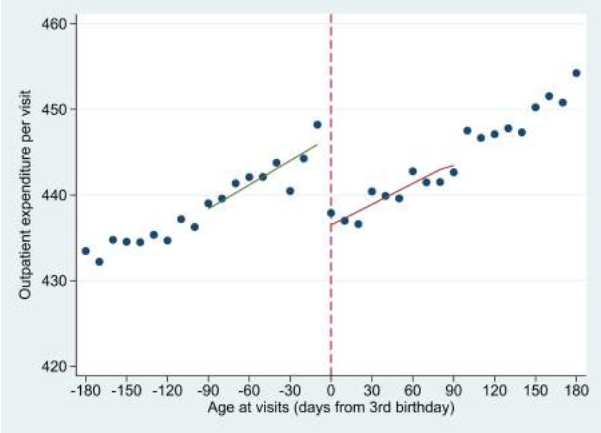
(c) Outpatient visits per 10,000 person years: 2005-2008



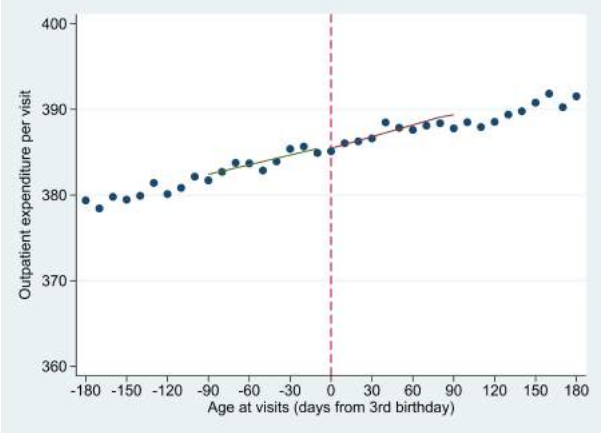
(d) Outpatient visits per 10,000 person years: 1997-2001



(e) Outpatient expense per visit: 2005-2008



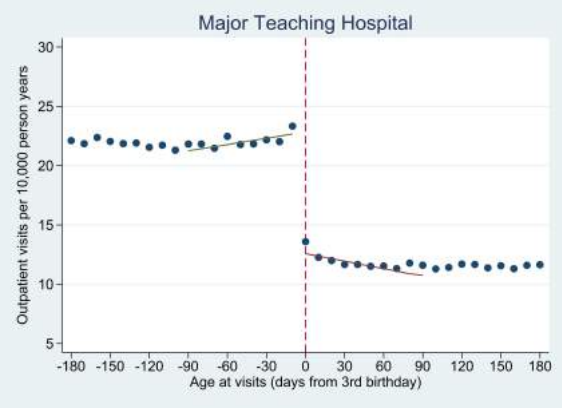
(f) Outpatient expense per visit: 1997-2001



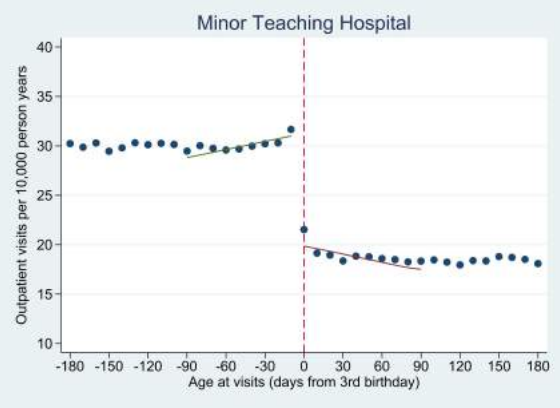
Notes: The line is from fitted a linear regression on age variables fully interacted with $Age3_i$, a dummy indicating after 3rd birthday (90 days bandwidth). The dependent variables are outpatient expenditure and visits per 10,000 person years, outpatient expenditure per visit by patient's age at visit (measured in days, 180 days before and after 3rd birthday). Each dot represents the mean (10-day cells) of the dependent variables.

Figure 3: Age profile of outpatient visits per 10,000 person years by type of provider

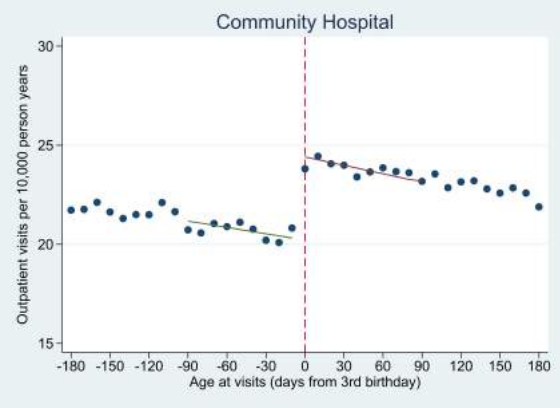
(a) Major Teaching Hospital



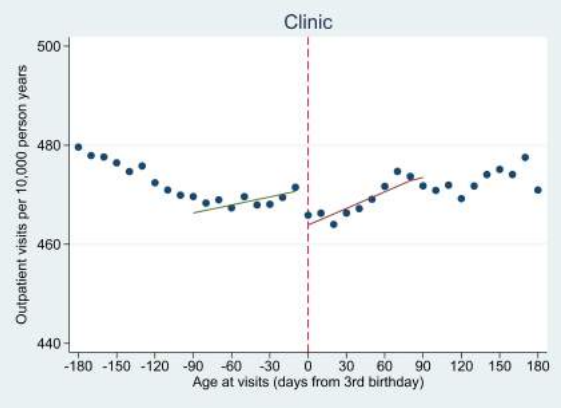
(b) Minor Teaching Hospital



(c) Community Hospital



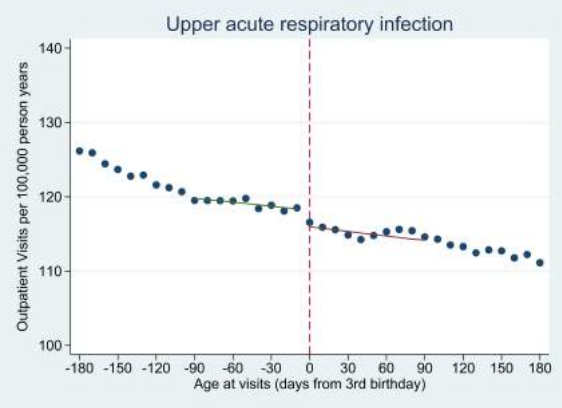
(d) Clinic



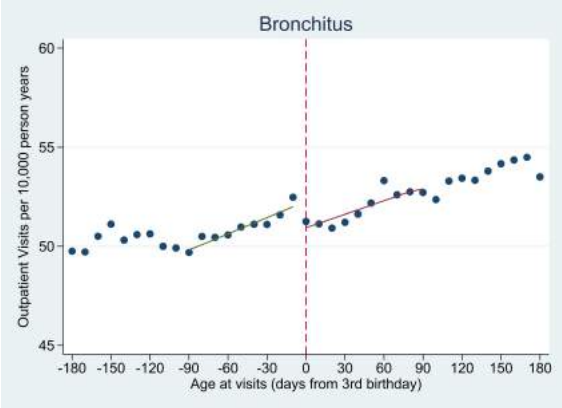
Notes: Please see Notes under Figure 2

Figure 4: Age profile of outpatient visits per 10,000 person years by diagnosis

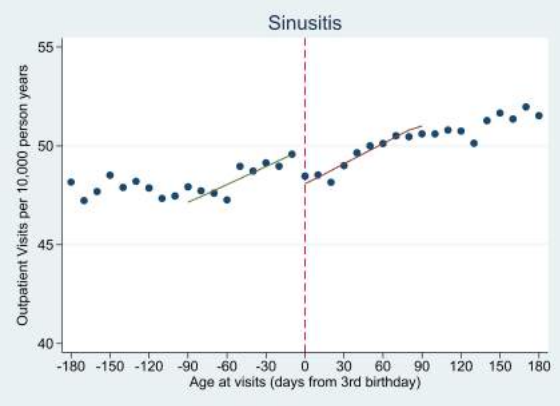
(a) Acute upper respiratory infection



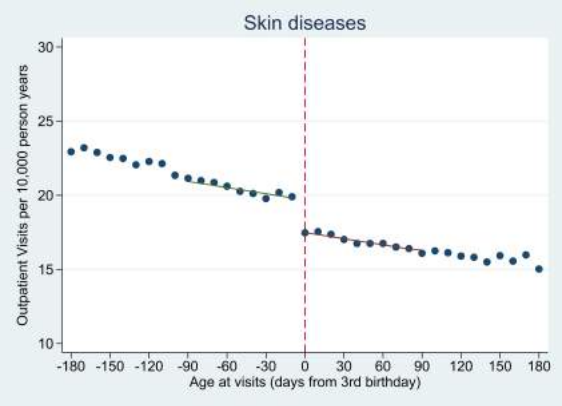
(b) Bronchitus



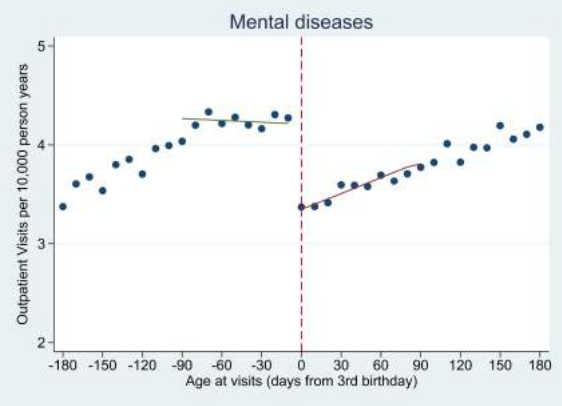
(c) Sinusitis



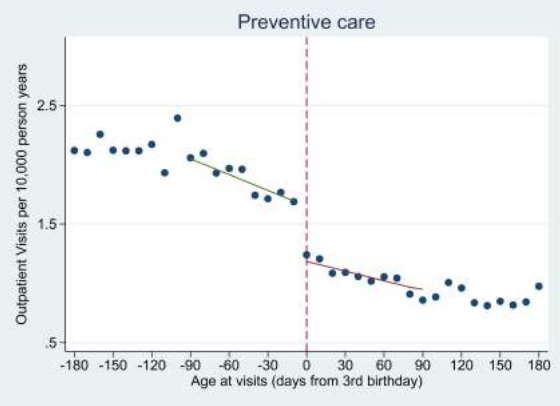
(d) Diseases of the skin



(e) Mental diseases



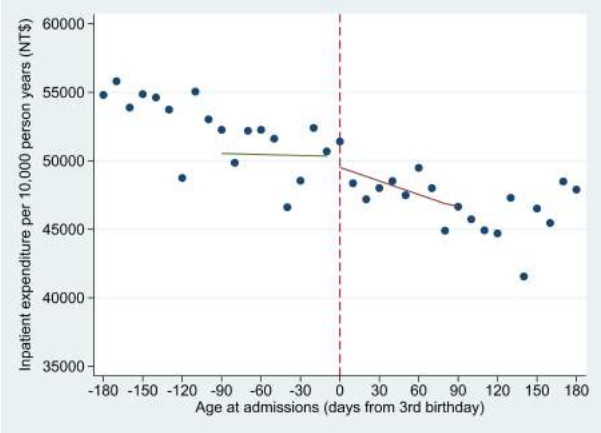
(f) Preventive care



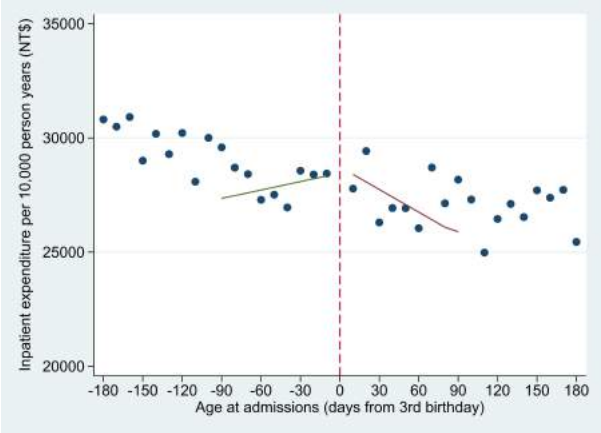
Notes: Please see Notes under Figure 2

Figure 5: Age profile of inpatient expenditure and visits

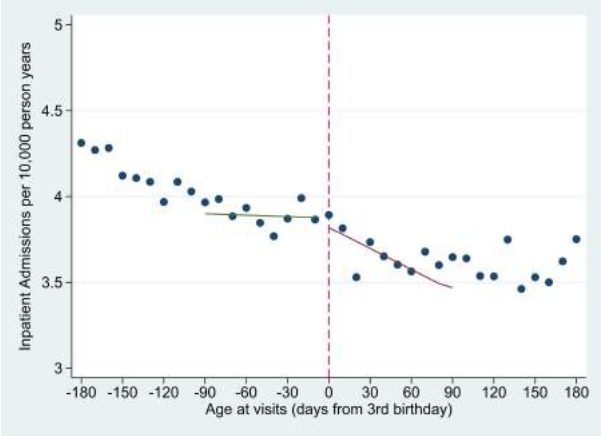
(a) Inpatient expense per 10,000 person years: 2005-2008



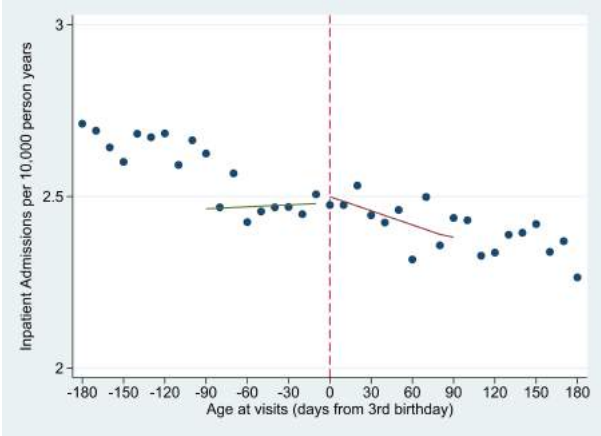
(b) Inpatient expense per 10,000 person years: 1997-2001



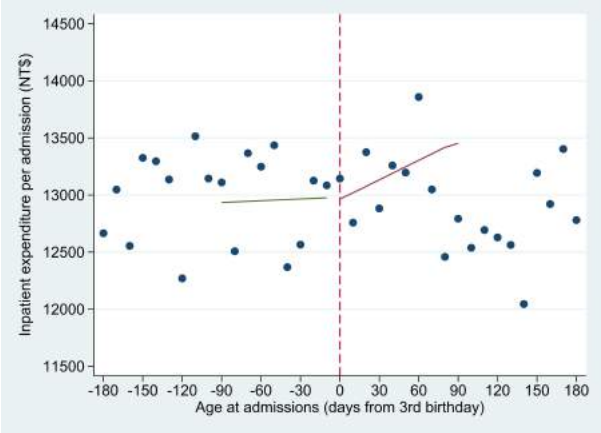
(c) Inpatient admissions per 10,000 person years: 2005-2008



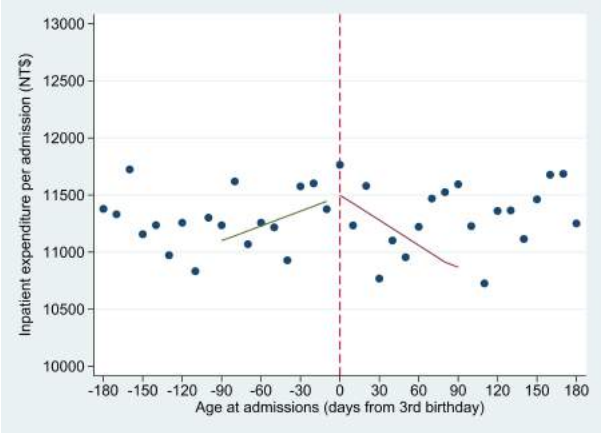
(d) Inpatient admissions per 10,000 person years: 1997-2001



(e) Inpatient expense per admission: 2005-2008



(f) Inpatient expense per admission: 1997-2001



Notes: Please see Notes under Figure 2