BUSINESS PROCESS VIRTUALIZATION:
AN EMPIRICAL STUDY OF PERFORMANCE IMPLICATIONS AND CONTEXTUAL FACTORS OF SUCCESS

HAU KAI PUN JACKY

Ph.D

The Hong Kong Polytechnic University

2016

The Hong Kong Polytechnic University

Department of Logistics and Maritime Studies

Business Process Virtualization:
An Empirical Study of Performance Implications and
Contextual Factors of Success

Hau Kai Pun Jacky

A thesis submitted in partial fulfilment of the requirements

for the Degree of Doctor of Philosophy

August 2015

CERTIFICATE OF ORIGINALITY

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it reproduces no material previously published or written, nor material that has been accepted for the award of any other degree or diploma, except where due acknowledgment has been made in the text.

_____ (Signed)

Hau, Kai Pun Jacky (Name of student)

To My Lord - Jesus Christ

To My Parents – Sau Yam and Kam To

To My Wife – Pik Yee

Abstract

Following recent advances in information technology, the modes of communications and interactions between people, in general, are changing rapidly. This is also true at the organizational level; the modes of interactions between firms and their stakeholders, particularly customers, are undergoing rapid transformations. In this context, business process virtualization (BPV) is becoming an increasingly important topic for both academics and practitioners. BPV seeks to eliminate the physical interactions traditionally required between people engaged in business processes. However, in light of several operational issues and psychological barriers, questions have remained with respect to how effective BPV has been in practice.

According to social presence theory, physical modes of interaction carry communication cues better than virtual ones. Quality improvement and innovation at the firm level requires effective interactions among the stakeholders. Customer encounters and personal attentiveness can achieve customer delight; customers become more loyal to the firm by getting attached to specific service employees. The poor communication flows and the lack of interpersonal warmth resulting from BPV are likely to reduce customer satisfaction in the long run. However, notwithstanding such problems, BPV is still considered an essential strategic tool in view of its ability to reducing the cost of deploying human resources and physical facilities needed in implementing business processes. Clearly, there is a need to empirically examine whether BPV implementation

has an overall positive impact on firm performance and determine the types of companies or business processes that are more likely to benefit from BPV.

We studied a sample of 323 BPV cases drawn from the period 1989-2011. We found that BPV is associated with increases in labor productivity rather than with sales growth and cost of goods sold. Following an application of the long-horizon event study methodology, we found that BPV is associated with firm performance particularly in terms of return on assets (ROA). We found that, as compared to other processes for internal operations, the adoption of BPV in customer-related or customer-oriented processes could provide stronger abnormal ROA. In particular, firms with extensive customer contact gained more benefits. We also found empirical evidence showing that BPV could help low-market-share firms to penetrate high industry concentration markets (e.g., oligopoly markets). We argue that the removal of physical interactions between firms and their customers does not necessarily create interaction barriers within the business processes conducted on a BPV platform. BPV might also provide a cushioning effect among firm-customer interactions and customer identification with a given firm.

Keywords: Business Process Virtualization, Firm Performance, Customer Relationship Management, Customer Encounter, Innovation, Market Penetration,

Acknowledgements

I would like to give my sincere thanks to my supervisors Prof. Andy Yeung, Prof. Edwin Cheng, and Dr. Chris Lo who gave me the support and the guidance to complete this work. The learning process in the last four years is precious in my life.

I want to thank my parents, who have given me the encouragement. I also need to thank my wife, Pik Yee, for the love and understanding.

Thanks also to my brothers and sisters in church who prayed for me. Finally, I give thanks to my Heavenly Father for His grace in my everyday life.

Table of Contents

Chapter 1: Introduction

1.1 Background

Virtualization is happening in many contexts across societies. Following advancements in information technology, virtualization of business processes is diffusing at an ever quickening pace (Overby, 2008). Business process virtualization (BPV) may be defined as the removal of physical interactions among business processes and process participants (Fiol & O'Connor, 2005; Overby, 2008; Young & Jude, 2004). For example, electronic commerce has virtualized many physical, store-based shopping processes. There is little need for customers to physically visit stores for purchasing products. They do not need to physically interact with a salesperson while paying for their purchases. Likewise, automated teller machines (ATM) and online banking are being performed via virtualized transaction processes hitherto performed physically at bank branches (Overby, 2008). In a virtual mode, customer can place instructions, thus eliminating the need for filling many physical forms or the need for interacting face-to-face with a teller. As a result of all this, BPV has become one of the most important business strategies in recent times (Young & Jude, 2004). It has transformed the networking of firms and influencing their information infrastructures.

Among the investigators of virtualization and the related developments, Overby (2008) was the first to model process virtualization as a social phenomenon regardless of the enabling means. This led to his process virtualization theory. Table 1 summarizes the process examples presented by him. Although IT has been the main enabler of many

contemporary BPV exercises, he points out that BPV should not be interpreted narrowly as IT. Rather, it should be recognized that BPV refers to the actual embrace of a wide range of operational changes cutting across different processes and people in business processes (Fiol & O'Connor, 2005; Huang & Rust, 2013; Overby, 2008). At the same time, since active human intervention continues to be needed even in virtualized processes, BPV must not be confused with process automation (Overby, 2008; Young & Jude, 2004). Human intervention continues to be necessary in processes such as decision-making and coordination. For example, an online sales transaction still requires decision-making on the customer's part whether to buy or not after reviewing product information presented in a virtual setting. Likewise, customers continue to be required to initiate payment transaction so the firm could receive the payment for the product or service provided. In this sense, sales do not happen in an automated manner. This means that BPV can be seen as a transition in the mode of interaction with the process participants and the firms interacting at a transactional level.

Table 1: Process Examples (Overby, 2008)

Process	Physical Process	IT Based Virtualized Process	Not IT Based Virtualized Process
Shopping	Store-based Shopping	Electronic Commerce	Catalog Sales
Education	Classroom-based Education	Online Distance Learning	Correspondence Courses
Banking	Bank teller Interaction	ATMs, Online Banking	Mail Deposit
Friendship Development	Face-to-face Interaction	E-mail, Instant Messaging, Online Dating	Letter-writing between Pen Pals

The volume of transactions relating to retailing BPV has grown by 313% between 2002 and 2013 (Statista, 2014b). It is anticipated that, BPV will grow by at least USD100 billion between 2013 and 2016 (Statista, 2014a). However, a 2012 survey showed that many customers are not satisfied with BPV; 37% of online banking users reported bad experiences with virtualized banking processes (Statista, 2014c). However, it is not yet clear what exactly are the reasons for the observed divergence in customer acceptance of BPV. Social presence theory, categorization theory, and virtualization theory continue to hold different views on a range of aspects of BPV (Breidbach, Kolb, & Srinivasan, 2013; Fiol & O'Connor, 2005; Overby, 2008). Despite the considerable interest expressed by both managers and scholars, there continues a noticeable lack of empirical evidence throwing light on the overall impact of and contextual influences of BPV on firms.

1.2 Objectives and Significances

Our study seeks to extend Overby (2008) to examine virtualization. We employ the long-horizon event methodology of Barber and Lyon (1996) to study 323 companies listed in the U.S. that had undertaken BPV projects. Our study has led to several empirical findings supporting the contention that the application of BPV enhances the viability of business operations. Moreover, processes have different levels of virtualizability (Overby, 2008). Depending on the extent of human intervention required by specific business processes, the impact of BPV can be expected to be different. Therefore, we investigate contextual influences of BPV. Event samples drawn from

Thomson Reuters' archival database are mapped against financial data gathered from COMPUSTAT. Using hierarchical linear analysis, we test our samples at both the process and industry levels. We conclude that BPV does not necessarily create barriers for firm-customer interaction. In addition, we demonstrate that BPV is especially helpful for firms with small market shares while they seek to penetrate an oligopoly market.

1.3 Thesis Layout and the Empirical Methodology

Information Technology (IT) is playing significant roles in many virtualization tools today (Overby, 2008). Virtualization which is the most important change in the mode of human interaction that has occurred since the development of automation (Overby, 2008). Chapter two provides the literature reviews of our BPV study. Chapter three documents our development of hypotheses. Our study aims to extend the application of Process Virtualization Theory to business operations. Results contribute to the field of Operations Management (OM) study. Chapters four and five describe the quantitative analyses of BPV. We adopt the event study methodology, used by Fama and Jensen (1983) to study stock prices, as our quantitative method. The methodology was extended later by Barber and Lyon (1996) to study the long-horizon impact of events. Our study follows the guidelines provided in the latter study with respect to the detection of abnormal performance of the sample firms. An advantage of event study is that it enables researchers to control factors that could influence the main factors as a result of the event. The event in question in our study is defined as the introduction of BPV in a firm. Since the impact of BPV can be moderated by the impacts of other factors, in

accordance with the guidelines of event study, we match our sample and control firms in terms of the industry, firm size, and pre-event performance across a portfolio of control firms. Similar procedures have been used by Yeung, Lo, and Cheng (2011) and Liu, Yeung, Lo, and Cheng (2014). Details relating to our event study and data collection procedures will be discussed in chapter four. Chapter five, six and seven are our results, discussions, and managerial and theoretical implications respectively.

Chapter 2: Literature Reviews of the Study on BPV

The modes of interaction between firms and customers have been changing rapidly in recent times. At the same time, the role of customer is changing from one of being a mere consumer to an active collaborator with the firm (Moeller, Ciuchita, Mahr, Odekerken-Schroder, & Fassnacht, 2013; Nambisan & Baron, 2009). Virtualization tools for different business processes such as online sales, electronic messaging, and electronic commerce are becoming increasingly popular. BPV removes physical and face-to-face interactions between a business process and the corresponding process participants (Fiol & O'Connor, 2005). For instance, online selling has eliminated the need for physical interaction between the salesman and the customer at the store's site. Traditional electronic messaging tools, such as Email, have likewise removed face-to-face interactions among people (Overby, 2008). Mobile messaging tools such as Whatsapp and WeChat are seen as trendy. Studies on transformative and IT-enabled services have found that customers prefer the use of technology, e.g., new virtualization tools for business processes (Wunderlich, Kranz, Totzek, Veit, & Picot, 2013). However, there is still a paucity of empirical evidence clarifying the actual impact of these tools on firm performance.

2.1 Relating IT and OM

The works of Federick Taylor and Peter Drucker on scientific management have been recognized as the major cornerstones of many management theories and practices. Contemporary OM is concerned both with systems and human factors arising in processes. It emphasizes observation of the interaction of systems, methods, and human behaviors in a holistic manner to improve OM process design. In this sense, the works of Taylor and Drucker contain little OM context (Lewis, 2007). As noted by Lewis, a pioneer in the area, contemporary OM studies can be traced back to Charles Babbage. Unlike most works on ordinary management science, those of Babbage consisted of a combination of contextual and biographical factors related to processes. In addition to systems and methods, Babbage saw the interactions and relationships among human participants in the processes, such as co-operation and good relationship between companies and their workers, as a central tenet of effectiveness (Lewis, 2007).

Helped by economic and societal developments, OM has moved away from being material-based to more information-based (Karmarkar & Apte, 2007). During the times of Taylor and Drucker, interactions among process participants and systems were mainly physical. This continued until the advancement of IT after which production operations and services became ever more virtual (Gunasekaran & Ngai, 2011). Virtualization reduced physical interaction. As IT continued to evolve and given that OM objectives started getting entangled more and more with marketing and technology, the increased understanding of the evolution of information chains and market started helping the rise of virtualization as an OM strategy.

In every century, the evolution of OM has been influenced by the evolution of society (Gunasekaran & Ngai, 2011; Karmarkar & Apte, 2007). Gunasekaran and Ngai (2011) consider the development of IT to be an important component of market evolution. They argued that there is a triadic relationship among the evolutions in society, market and OM. Societal expectations such as safety, environment, and sustainability, coinfluence market evolution. They directly influence the evolution of OM objectives. Evolutions in the market, e.g., virtual enterprise, knowledge-based management, IT-driven technology, and globalization, directly influence the evolutionary changes in OM objectives (Gunasekaran & Ngai, 2011).

2.1.1 Era of Information Dependent Economy

Around the world, economies have evolved from being reliant mainly on agriculture to manufacturing, and from manfucturing to services. Another dimension of the evolution is that, in addition to being materials-based, societies are becoming more information-based. Information and material categorization of products and services are equally important today. Since technologies impact processes and firms in term of productivity, value, cost and transformation, a deep understanding of information chains is central to the analysis of competition (Karmarkar & Apte, 2007).

In the history of OM development, the product-service dichotomy is commonly used as the basis in the catergorization of operational problems. It has been demonstrated to be useful in studying process characteristics across firms and sectors. Since economies were becoming ever more information-based, Karmarkar and Apte (2007) introduced

‘material and information’ as a new dichotomy for the study of OM. They also observed that most processes in economies get less physical and become more symbolic. Processes are shifting from atoms to bits. They argue that the management of information chains should not be an issue of management science or information technology. Although technology is the driver, it has a great deal to do with process economics as it impacts the operation and configuration of processes. Therefore the management of operations (OM) cannot separate itself from the management of information technology.

However, the study of information chains could remain challenging in OM; not only because it has no clear catergorization as product and service. Furthermore, the chains often consist of complex systems of operations in firms and sectors. Also, quantities are not measurable. However, as suggested by Karmarkar and Apte (2007), process analysis is a good starting point to tackle operational and tactical issues. They suggest starting by identifying the individual processes to which the technologies are attached. Examples of processes include storing, distribution, transportation, processing, scheduling, tabling and displaying. Studying information flows and observing outputs from specific processes could help in understanding information chains from an OM perspective. Process studies could acheive quality conformance of the information chains. Output studies could indicate the performances of supply chains.

2.1.2 Information, Knowledge, and Organizational Capability

Advancements in information technology (IT) have allowed real-time communcation among people and enterprises belonging to distant geograpical regions. They have

shrunk the dimensions of time and space associated with communications. Firms can now take advantage of these interactions to improve their learning processes and create their own competences. At the same time, the avaliability of IT has made financial, commerical, and production globalization possible. As a result, competition among firms has also become global and more vigorous (da Silva Gonçalves Zangiski, Pinheiro de Lima, & Gouvea da Costa, 2013).

In the early days, scholars and practioners argue the usefulness of IT. However, due the the advances of IT equipment and computing techniques, IT is considered as one of the cost-based measures that could bring saving to organizations (Bharadwaj, 2000). With the interited characteristic from IT and the perspective of resources, BPV is nowadays considered to be an in-imitable resource. It can help organizations to rapidly connect customers in distance in terms of the boundary spanning capability (Wade, 2004). BPV is an prominent organizational capability today (Quirós Romero & Rodríguez Rodríguez, 2010).

Transforming information into knowledge and successfully turning the results into organizational capability have become a pivotal research topic in Knowledge Management (KM). Since it is an interactive process between the internal and external environment of firms, technology by itself does not safeguard the transformation process. In the context of OM, it can be seen as a dynamic process involving comprehending people and relationships, sharing of information, and knowledge diffusion. In other words, effective interaction continues to be the key. It has been said that the types of business processes, activities types, and resources all influence the effectiveness of the

information transformation processes all the way to the formation of organizational competence (da Silva Gonçalves Zangiski et al., 2013). Table 2 summaries the work of Gunasekaran and Ngai (2011) on the evolution of the OM strategies and related technologies.

Table 2: Change in Strategies and Technologies by Period

Stage	Year	Strategies and Technologies
1	Beginning	Craftsman production
2	Post World War II	Automation, TQM, JIT
3	1975 – 1985	QRM, CIM, FMS, and BPR
4	1985 – 1995	LP, AM, and distributed enterprise
5	1995 – 2010	Outsourcing, global manufacturing and market, Internet, SCM, 3PL
6	2010 –	Global SCM, virtual enterprise, RFID-enabled SCM, sustainability

2.2 Divergence in Customer Acceptance on BPV Tools

As business processes get increasingly virtualized (Overby, 2008), many researchers have started to study different aspects of the phenomenon, e.g., electronic commerce, online banking and distant learning (Overby, 2008) and customer interaction, and cost saving (Boyer & Hult, 2006; Hendricks, Singhal, & Stratman, 2007; Rabinovich, Knemeyer, & Mayer, 2007; Subramani & Walden, 2001). Reports published in Statista (2014a) indicate that firms are conducting BPV at an ever-quickening pace. A 2012 survey of online banking reported that 37% of the users had negative experiences with online banking (Statista, 2014c). By contrast, in the same year, online shoppers

expressed high satisfaction with their online buying processes (Statista, 2014e). With respect to online banking, 87% indicated that 'user-friendliness' overrides the 'convenience' resulting from the removal of physical travel to the bank branches (Statista, 2014d). However, the reports also show divergent expectations from and levels of satisfaction with BPV tools. Some users of BPV tools emphasized convenience and friendliness while others were more instrumental and justified the effectiveness of virtualized processes over the traditional ones. Meanwhile, some Internet-based studies have found that younger generations demonstrate higher levels of acceptance of the virtual mode of interactions than older generations (Wasko, Teigland, Leidner, & Jarvenpaa, 2011).

Activities related to customer encounter significantly affect customer's experience with firm's services and products (Tax, McCutcheon, & Wilkinson, 2013). Tax et al. (2013) describe the series of activities experienced by customers while certain service is provided to them, which managers must carefully plan for in their formulation of customer relationship management (CRM) strategies. Customer experience is an important aspect to be taken into account while managing the operations of a firm. As discussed, literature and statistics indicate that satisfaction and acceptance of BPV varies across types of BPV tools (e.g., online banking against online shopping), expectations for BPV tools from the customer diverge quite a bit (e.g., user-friendliness against convenience), and users of different categories demonstrate differing acceptance levels (e.g., young users versus old users).

2.3 Operational Issues and Psychological Barriers

2.3.1 Operational Aspects

In the study of customer encounter and firm-customer interactions, Frei (2006) concerns customer variability in the effective formulation of business processes. Southon, Sauer, and Dampney (1997) concerns whether BPV could effectively solve custom and complex process issues. BPV has transformed the modes of interactions between firms and their customers (Overby, 2008). Studies have shown that effective maintenance of firm-customer relationships strongly influence customer acceptance of BPV. Relationship-based studies of BPV, such as those reported by Zhang et al. (2011), Huang and Rust (2013), Verhagen, Feldberg, van den Hooff, Meents, and Merikivi (2011), and Chong and Zhou (2014), adopt a customer-centric perspective and point out the importance of the maintenance of relationship quality in BPV. In their study of web-based demand chains, Chong and Zhou (2014) emphasize that firms should focus more on collaborative rather than technological structures of BPV tools. They argue that technology on its own does not guarantee quality relationships between firms adopting BPV and their customers. Zhang et al. (2011) opine that the quality of relationships influences customer satisfaction. Subsequent customer satisfaction determines customer retention. Managers should therefore pay may more attention to the effectiveness of customer interaction rather than technology while developing and applying BPV tools (Verhagen et al., 2011). Customer-centric proponents of BPV argue that, in order to maintain the quality of relationships, firms must ensure that the BPV tools utilized suit the needs of customers.

By contrast, Wang, Harris, and Patterson (2013) and Wunderlich et al. (2013) take a customer self-efficacy perspective while assessing customer adoption of BPV tools. They argue that the acceptance of BPV by a customer is influenced by habit rather than satisfaction. In the long run, habit overrides satisfaction. In their study of self-serviced retailing technologies, they distinguish between a sense of satisfaction and habit and believe that the continued use of self-service retailing virtual tools is the result of a learning process. The initial use of self-service retailing technology by customer is instrumental and rationale-driven. Over time, use turns into habit. Sense of satisfaction and friendliness of the BPV tools are just emotional drivers in BPV in the initial stage of adoption. Their influence is often impermanent. Satisfaction does not necessarily assure future usage of BPV tools by customers. The self-efficacy driven studies argue that long-term adoption of BPV tools by customers is trainable.

2.3.2 Psychological Aspects

Social presence theory has long considered the effectiveness cue and attentiveness transmission of different type of communication means. Face-to-face and physical mode of communicate is determined to be the most effective. Text and image related mode are found to be the second best. The virtual mode of communicate is found to be the most ineffective among all the communication mode. It was argued that human beings are predisposed to the physical and face-to-face modes of communications. Therefore, we have natural tendency to resist the virtual mode of communications (Kock, 2004; Short, Williams, & Christie, 1976). The firm-customer bonding is BPV were also

concerned. Whether the process of customer encounter could actual delight customers to general the customer's identification was an issue. In the words of customer relationship management studies and marketing studies, such consequences are concerned to be customer satisfactions (Nambisan & Baron, 2009; Tax et al., 2013).

Convenience and social presence are recurring psychological arguments in BPV-related studies (Arbaugh, 2000; Jarvenpaa & Leidner, 1999; Overby, 2008; Verhagen et al., 2011). Process participants in physical processes are contained in the same physical setting. By contrast, participants in a virtualized process stay physically apart. Traditionally, it is believed that communication of information is more effective in a physically proximate setting. Delays in processing and resolution are expected to be lower in physical environments (Overby, 2008). Arbaugh (2000) describes the psychological outcome of minimal delay as being just "convenient". Established and on-going demonstrations of social presence among the people have also been questioned in the context of BPV (Kehrwald, 2008). Social presence refers to a sense of awareness of existence among process participants. According to social presence theory, both physical and virtual modes carry a sense of social presence but are different in terms of effectiveness. The degree of social presence impacts the interpretation of messages among process participants (Short et al., 1976). Business processes involving physical and face-to-face interactions are associated with the highest degrees of social presence while the opposite is true with virtual modes. Since physical interaction is removed, communication cues such as gestures, postures, and inflections are transmitted less effectively in virtualized business processes than in a traditional one (Kock, 2004).

‘Sense of attentiveness’ and ‘interpersonal warmth’ rely on effective communication cues during interaction (Jarvenpaa & Leidner, 1999; Overby, 2008). They are essential in building relationships between firms and customers (Verhagen et al., 2011). In his study of computer-mediated communications, Kock (2004) argues that humans are predisposed to physical and face-to-face modes of interaction. We are naturally resistant to virtual modes of interaction. ‘Social presence’ influences thinking as well as knowing. It affects the interpretation of characteristics, qualities, and inner states of other parties involved in the interaction process. In other words, perceptions concerning the counter parties could be influenced by a sense of social presence. A heightened sense of contact leads to better perception. It also affects the sense of attentiveness and the feeling of warmth. The perceptual elements that customers are required to characterize and identify with firms are put in question. According to Fiol and O'Connor (2005), the context of communication influences the stability of customer identification. A sense of attentiveness does have a bearing on the psychological attachment of customers to firms in the context of customer encounter. The psychological issues involved could be barriers of customer in their acceptance of BPV.

2.4 BPV Related Theories

2.4.1 Social Presence Theory

Short et al. (1976) is perhaps the first to propose a social presence theory. The theory classifies communication media along a linear continuum in terms of social presence. The degree of social presence equals the degree of awareness of the others persons

engaged in interaction and communication. An effective medium is one that supports the appropriate level of social presence for the participants in the task (Kock, 2004). Physical and face-to-face interactions are associated with the highest possible degrees of social presence and awareness. Customers are easier to develop an identity with a firm if the firm is using the physical mode of interactions. Text-based interactions are associated with lower degrees of social presence. Virtual modes of interaction go with the lowest degrees of social presence and awareness among all communication media (Short et al., 1976). Virtualized interactions are believed to be associated with the lowest order of communication cues and the lowest degree of social presence.

BPV removes physical and face-to-face interactions among people engaged in business processes. According to social presence theory, BPV tools carry very low degree of social presence and awareness among process participants due to the virtual mode of interactions. Therefore, the effectiveness of communication cue transmission in BPV is a matter of debate. Customer encounter and customer categorization with the firm might be affected once a traditional process or transaction is transferred to the virtual mode.

2.4.2 Processes Virtualization Theory

Overby (2008) has developed a process virtualization theory that recognizes that more and more processes are being conducted in the virtual mode. Regardless of the implementation means, virtualization is seen as a social phenomenon. It removes the need for physical interactions among processes and process participants. Unlike with automation, human intervention is still required by transactions associated with

processes conducted in the virtual mode (Fiol & O'Connor, 2005). For example, the initiation of a purchasing action in a buying process still requires decisions on the part of customers. Likewise, payment actions in a payment process (for the exchange of the goods and services) still need to be made by the respective customers. In other words, sales and payment do not happen automatically; human decision-making and intervention continue to support them. Process virtualization theory also states that advances in information technology create a potential for more and more processes to be virtualized. There are four contextual factors of a process affecting the virtualizability of a process: sensory, relationship, control, and synchronism expectations of customers. Note that these are all customer expectation elements.

2.5 Stakeholders and Virtualizability of Business Processes

Business processes involve a variety of interactions between firm and its stakeholders, including firm-customer interactions. Quality improvement and innovation at the firm level requires effective interactions among various stakeholders (Goffin, Lemke, & Szwejczewski, 2006; Nambisan & Baron, 2009; Sanders, 2007; Wiengarten, Fynes, Cheng, & Chavez, 2013). Physical encounters and personal attentiveness could help achieve customer delights to specific firms and attachment to specific service employees. By nature, processes have different degrees of virtualizability. Virtualizability consists of four customer related elements: sensory requirement, relationship requirement, control requirement, and synchronism requirements (Overby, 2008). Virtualizing the different types of business processes can influence the stability of the interactions

among the stakeholder resulting in performance impacts of firms in different degrees. Process virtualization theory states that the effort required to virtualize a process varies across processes.

2.5.1 Quality Improvement and Innovation of Firms

Sanders (2007) has studied the relationship between collaboration and organizational performance. He has found that quality improvement and innovation in firms rely heavily on the effective collaboration among stakeholders of business processes, which in turn helping to achieve organizational performance improvement. Collaboration is a complex process of communication and sharing of information. It involves internal and external collaborations. Stakeholders in the collaboration processes are customers, suppliers and internal staffs. Sanders has also argued that electronic technology improves both internal and external collaborations of firms and organizational performance.

Nambisan and Baron (2009) have studied the relationship of customer and firms in the virtual environments. They have argued that firms should no longer view customers as only consumers of goods and services but co-innovation partners. As an important social capital, customer provides new ideas for product, product services, and quality improvements of firms. In addition, the perceived innovation partnership of customer with firms in expectation of private rewards shapes the contribution a firm makes.

Close firm-supplier relationships are found to benefit manufacturers in cost reduction, quality improvement and new product development (Goffin et al., 2006). Effective internal interactions within organizations can promote leadership, learning, continuous improvement, and employee fulfillment. It has a strong impact on organizational performance characterized by high level of innovativeness (Wiengarten et al., 2013).

2.5.2 Customer Encounter and Delight

Interaction and participation of the customer promote customer's identification firms (Nambisan & Baron, 2009). However study of Specht, Fichtel, and Meyer (2007) has found that the perceptions of the customer and attribution of the effort and abilities of employees carry weight in terms of customer encounter and satisfaction. In the views of customers, it is the responsibility of the organization to provide a connected overall service experience. Therefore, managers must recognize such a reality so as to better serve the customer by understanding the role that firms play in the customer-defined service journey. Managers must be prepared to coordinate their activities in their interactions with customers (Tax et al., 2013).

Customer delight is a prominent human issue in service design (Cook et al., 2002). It has been shown to be a demand side effect that a firm has to achieve in firms' CRM functions for organizational performance (Kalaignanam & Varadarajan, 2011). In a study of online shopping conducted by Huang and Rust (2013), 'delightful experience of the customer' is found to be a critical factor impacting purchase intentions and brand equity.

2.5.3 Sensory Requirements of a Process

Sensory requirements are associated with the five human senses. They stem from the process participants' need for full sensory experiences of the products or services in question, e.g., touching, tasting, seeing, hearing, and smelling. It also involves sensations such as vulnerability and excitement on the part of the participants (Overby, 2008). Virtualizing a car-selling process has a higher sensory requirement than virtualizing a car maintenance booking process with dealers. Before making a high-cost purchase, such as a car, almost all buyers want to physically touch and test-drive the car. They might even want to physically experience the car more than one time. Compare this with making a car maintenance booking where visiting the dealer for making the booking is not a must as long as the customer is able to find a time slot that fits his personal schedule. Therefore, virtualizing a maintenance booking process requires less effort than virtualizing a car sales process. In other words, the sensory requirement is more pronounced in car sales than while making a booking for car maintenance. BPV is conducted in different types of industries and the processes in the industries. The sensory requirements of different processes are therefore different.

The business processes related to a single product (e.g., car sales and car maintenance booking) have different sensory requirements from customers. Sensory requirements vary across products and services (Overby, 2008; Ramus & Nielsen, 2005). Sensory expectation is determined by the need of the customer to manipulate the physical objects involved in the process (Apte & Mason, 1995).

2.5.4 Relationship Requirements of a Process

Relationship requirements define the needs of the customer while interacting in a professional or social context in a given process. Participants depend on interactions to acquire knowledge and to establish trust (Overby, 2008). Virtualizing insurance selling has higher relationship requirements than virtualizing insurance claim processes. In the former case, customers need to interact with the agents to fully appreciate the detailed context of the insurance policy. During interaction, customers need to be assured that the insurance companies and the agents are dependable and trustable when the time comes for collecting the protections on offer. Once the expected level of trust has been established, the insurance agent can proceed to make concrete proposals for potential insurance sales. On the other hand, the relationship requirements are lower while virtualizing the process of insurance claiming. Since the coverage details have already been documented and contracted upon within the insurance policy, passing a claim to the insurance company is a much more routine process. It doesn't make a significant difference to the customer whether the claim is processed in the traditional or a virtualized mode. Media richness (Daft & Lengel, 1986) concerns how accurately the media can mimic the physical objects involved if the transaction was to be conducted in the traditional manner. Social presence (Short et al., 1976) concerns the transmission of presence in the media. It affects relationship building among process participants through interaction media (Overby, 2008).

2.5.5 Synchronism Requirements of a Process

Synchronism requirements refer to the tolerance of delays in the activities contained in a process. For instance, it is important that the activities take place quickly (Overby, 2008). Such a requirement is high in medical or injury treatment processes. Patients expect physical and immediate attention; they have low tolerance for delay. How quickly the patient can receive medical assessment and care is crucial. A delay in treatment could cause serious and irreversible harm. However, a consultation process related to over-the-counter health products (e.g., vitamins, minerals, and proteins) has lower synchronism requirements than one arising when attendants have to be approached. Medical and injury treatment processes have high synchronism requirements. Another example of a selling process with a different synchronism requirement is the selling of perishable, grocery items. Some business processes involve the delivery of a large variety of products and services to different industries, so synchronism requirements among products and services vary.

2.5.6 Control Requirements of a Process

Control requirements are concerned with the need for monitoring the delivery quality of the process on the part of the customer. It refers to the tolerance of deviations in the quality of the product or service (Overby, 2008). Some processes have higher control requirements than others. The process of production in a manufacturing shop requires close internal monitoring and timely reporting so as assure effective problem resolution and compliance with production specification. While the cooking process in the kitchen

of a restaurant has a lower control requirement in terms of specifications than a factory, the quality of the products from a kitchen are still subjected to evaluation by customers. However, the cost involved and the requirements for controlling the quality of processes in a factory and in a kitchen are not at the same level. In terms of the network nodes involved, restaurants have many individual customers, whereas a factory producing for business entities has a smaller number. The impacts of single-incident and long-term failure on quality control on their competitiveness are also different in terms of the natures of the respective customer networks. We can see that the number of contacts in business transactions and the natures of the products involved in the transactions determine to a large extent the control requirements of a service or product delivery process. Likewise, in virtual shopping, the expectation of the customers is to be able to exert direct control over the product just as in physical shopping. Customers may fear running the risk of fraud because they are unable to synchronize with the process (Friedman & Resnick, 2001; Overby, 2008). While virtualizing of their business processes, firms need to consider control expectations from the perspective of customer encounter.

2.5.7 Customer Oriented Business Processes and Interactions

From the perspective of the virtualizability of a process, contextual influences arising from the business nature, the process nature, the relative production size in industry, the targeted market and customers, and competition are all different. Business processes differ in terms of the degrees of interaction among process participants. Bowersox,

Closs, Cooper, and Bowersox (2013) classify business processes into five categories: customer relationship management (CRM), logistics, manufacturing, purchasing, and inventory deployment (table 3). The degree of interaction with customers varies across processes. Some processes involve more customer and supplier interactions while others are more oriented towards internal interaction (Chong & Zhou, 2014). For example, in CRM, order management consists of a range of order taking processes. It therefore requires extensive firm-customer interaction. Production execution and control are shop level processes mainly involving interactions among internal departments. Because business processes have different degrees of virtualizability and consist of different parties, the impact and the contingent influences of virtualization can be expected to vary across process categories.

Table 3: Business Processes Mapping (Bowersox, 2013)

Business Process	Functions
Customer Relation Management	Customer Relationship Management
	Forecasting
	Demand Management
	Collaborative Planning, Forecasting and Replenishment
	Order Management
Inventory Deployment	Integrated Inventory Planning
Logistics	Finished Inventory Management
	Order Processing
	Warehouse Management
	Transportation Management
	Yard Management
	Accounts Receivable Interface
Manufacturing	Manufacturing Resource Planning
	Capacity Management Planning

	Master Production Schedule
	Productions Execution and Control
	Quality Management
Purchasing	Purchase Order Administration
	Materials Requirements Planning
	Supplier Relationship Management
	Accounts Payable Interface

2.6 Conceptual framework for the study of BPV

2.6.1 Model Development

There are complex co-influences among the triadic relationships involved in the evolution of society, market, and OM (Gunasekaran & Ngai, 2011). As an important evolution of OM, BPV has significantly restructured traditional interactions among process participants (Overby, 2008). Overby states that Information Technology (IT) is enhancing the sensory, relationship, synchronism, and control among processes and process participants. As a result, traditional processes, which were previously conducted physically, are now much easily virtualized by means of IT. Following the development of IT, it is realized that the advancement of IT and the desire of customers of BPV tools are acting as society and market forces in pushing and pulling firms to adopt more BPV tools. However, there is little empirical evidence of the impact of BPV on actual organizational performance.

Statistics are available showing that customers are driven by different motives while adopting BPV tools. For example, some customers look for better user-friendliness. Some look for convenience in terms of physical interaction or physical visit while

transacting business processes. Statistics also show variations in the acceptance of different virtualized processes (Statista, 2014c, 2014d, 2014e). Customer categories, such as age groups, have also been examined in previous BPV studies. It has been found that younger customers tend to accept BPV tools more than elder customers (Wasko et al., 2011). Psychological (Arbaugh, 2000; Verhagen et al., 2011) and operational issues (Verhagen et al., 2011; Zhang et al., 2011) are also involved. In fact, it has long been recognized that BPV acceptance and customer satisfaction impact organizational performance significantly (Verhagen et al., 2011; Wang et al., 2013; Wunderlich et al., 2013; Zhang et al., 2011). The nature of the business process also varies across firms; some are customer encounter orientated, some involve more internal interactions, some are supplier interactions, and some are mixed (Bowersox et al., 2013).

We can classify the contingency factors associated with BPV into customer contact and competitive environment aspects. Customer contact aspects can be seen as micro-actors of BPV, while competitive environment aspects can be seen as the macro-factors that could affect the performance of BPV.

2.6.1.1Customer Contact Characteristics (Micro Aspects)

The customer contact characteristics of BPV concern the networking and relationship aspects of business process. They are the micro-aspects related to the daily interactions among systems and peoples in virtualized business processes. If the networks of service firms and manufacturing firms are different in nature as mentioned by Choi and Wu (2009) and network ability can influence the financial performance of firm as stated by

Semrau and Sigmund (2012), the impact of BPV on the networks and on the processes with different extensiveness of customer contact should be different; the interactions among the participants in the service and manufacturing networks are different in nature. For example, service networks consist of more nodes (more customers contact) and links (the processes between firms and their customers) than those in manufacturing networks (Dean, Holmes, & Smith, 1997).

In addition to the network and relationship concerns, Chase and Tansik (1983) distinguishes organizations in term of the extensiveness of customer contact. They argue that the level of customer contact of firm influences the design of organization structure and its operations. The effectiveness of the organization structure and operations would subsequently favor and disfavor the delivery process of firm to its customer. Mersha (1990) further classifies organization into high and low type of customer contact level. He argues that the number of customer contact determines the interactions frequency between firm and customers. Efforts to manage and control firms with different type of customer contact extensiveness are different.

Furthermore, while some business processes are concerned more with customer interactions and relationships with external customers, other processes are concerned more with internal interactions (Chong & Zhou, 2014). It is known that effective maintenance of these interactions impacts the dynamic capabilities of firms (Carlsson, 1989, 1992). In other words, the BPV performance of a firm depends on the corresponding network and extensiveness of customer contact in business processes. Our model (Figure 1) includes both the extensive of customer contact and process

orientation (customer / non-customer oriented) of processes of a firm as micro-influencing factors determining BPV performance.

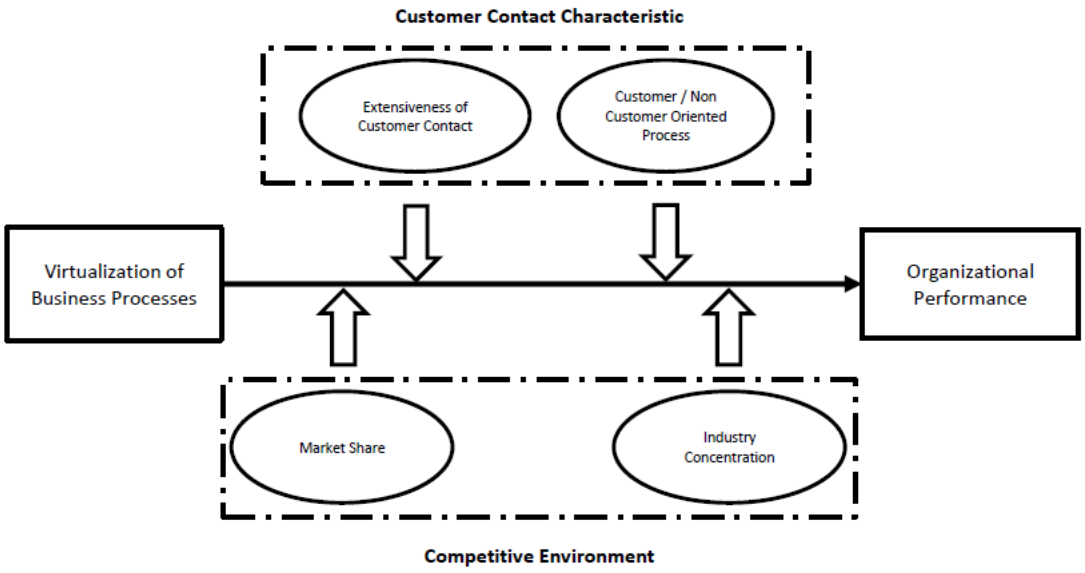
2.6.1.2Competitive Environment (Macro Aspects)

The competitive environment of firms consist of the relative competence and the states of the industry in individual firms. This study is concerned with the effect of changes in interactions among process participants caused by BPV. From a macro perspective, different firms hold different positions in the market they belong to. In their study of virtualization, Wasko et al. (2011) recognize that multinational firms have certain intrinsic advantages over SMEs in the context of larger geographic operations. They suggest that the trend of virtualization of business processes is leveling the advantages of multinational firms and SMEs. Their study covers resource differences between SME and multinational firms with respect to customer encounter and the opening of physical stores at different geographic locations. This implies that the sizes and competence of individual firms are contingent on the benefit derivable from BPV in terms of virtualization of individual business process. However, there is no empirical evidence in support of this contention so far. Firm size and resource competence within a given market are just relative measures. Hendricks and Singhal (2008) and Liu et al. (2014) use industries' concentration to reflect the competitiveness values of individual markets. To reflect the competitive position of firm, Szymanski, Bharadwaj, and Varadarajan (1993) observe both the intrinsic competence of firm and the market situation in firms' specific industries. Accordingly, the macro perspective adopted in the present study

want to reflect the competitive positive of firms in its industry. Therefore, we concern both competitiveness of the individual firms (market share) and the occupancy of its industry (industry concentration).

Figure 1 presents the conceptual framework underpinning our BPV study. It consists of the customer contact characteristics (micro) and the competitive environment (macro) aspects of BPV that will influence the benefit of BPV to the organizational performance of firms. Details of the development of H1, H2, H3, H4, H5, H6, H7, H8, and H9 according to the micro and macro aspects are presented in chapter 3.

Figure 1: Conceptual framework for the study of BPV



Chapter 3: Hypotheses Development

3.1 Paradox of BPV

The advancement of IT is speeding up the diffusion of BPV. Some customers and users view BPV as trendy. It creates a demand force for firms to adopt BPV. According to PVT, IT could increase the virtualizability of processes. In fact, the question of whether the improvement of virtualizability of business processes can induce actual performance improvement for firms is unanswered. Social presence theory states that virtual mode is the poorest interaction mode for the transmission of communication cues. However, we believe that the inherited advantages of IT on BPV might help firm from the aspects of resources saving and business networking. Among the paradoxical issues of BPV, we formulate our hypotheses to investigate the usefulness and the contingent factors of BPV.

3.2 Operational Effectiveness of BPV

3.2.1 Sales Growth

Studies have found that virtualization tools can promote quality improvement and innovation in firms through collaborations with customers, supplier, and internal staffs (Goffin et al., 2006; Nambisan & Baron, 2009; Sanders, 2007; Wiengarten et al., 2013). Process virtualization theory states that IT is able to enhance the virtualizability of processes, i.e., sensory, relationship, synchronism, and control. Therefore, as advocated by Cook et al. (2002) and (Tax et al., 2013), BPV should also be able provide service

journeys promoting customer's personal attentiveness close to the physical mode of interaction, promote customer delight, and facilitate psychological attachment of customers with the firm. Quirós Romero and Rodríguez Rodríguez (2010) have demonstrated that IT investment can improve the sales performance of a firm. With the assistance of IT, graphical representation (physical distance between firms and customer, and ease of assess) and communication among processes participants are becoming ever more effective (Breidbach et al., 2013; Wang et al., 2013). Media richness and social presence are coming ever closer to mimicking actual physical modes (Overby, 2008). Through BPV, stakeholders can receive good psychological feeling of convenience from reduced physical travels, identification with the firm through co-innovation and participation in the firm's quality improvement efforts. Based on the above arguments concerning the operational and psychological benefits provided by BPV in terms of convenience and ease of access, customers' demand should increase. Therefore, we hypothesize that BPV should indeed be capable of assisting sales growth in firms.

H1: The adoption of BPV by a firm is positively associated its sales growth.

3.2.2 Cost of Goods Sold

Contemporary studies found that firms with high IT capability tend to outperform in terms of profit and cost-based performance measures (Bharadwaj, 2000). The study of Nolan (1994) on banks and airline has suggested that IT capability differentiate the performance of firms. Cost-based measure and sales level are common attributes in the determination of the profit of firms. Our hypothesis 1 tests the sales attribute related to

BPV. To confirm the benefit of BPV in terms of profit that might be brought to firms, we further test cost of goods sold for the firms which have conducted BPV. According the finding of Power and Singh (2007) and Zhu, Kraemer, and Xu (2006) on the costs-based benefit of IT tools on the business processes through the reduction of physical operation resources (Bharadwaj, 2000; Power & Singh, 2007; Zhu et al., 2006), we hypothesize that BPV improves cost of goods sold (reduction of cost of goods sold) in business.

H2: The adoption of BPV by a firm is negatively associated with its cost of goods sold.

3.2.3 Labor Productivity

Investment of IT was viewed as paradoxical in the 80s and 90s (Solow, 1987). There were arguments about the ability of IT to organizational productivity and profitability. After decades of technological advancements, cost and power of IT have evolved significantly. Today, IT infrastructure, human IT resources, and IT-enabled intangibles are recognized to be contributing significantly to organizational capabilities (Quirós Romero & Rodríguez Rodríguez, 2010). IT is found to be able to support firms in terms of cost-based measures (Bharadwaj, 2000). Technologies have also allowed suppliers and customers to work and be serviced in a more self-efficacy and self-service based manner (Wang et al., 2013). Empirical data from Atrostic and Nguyen (2005) show that modern IT vehicles are improving the labor productivity of firms. We agree with the heterogeneity view of IT vehicles and BPV. Advances in IT have indeed enhanced the virtualizability of business processes and reduce requirements for physical and human

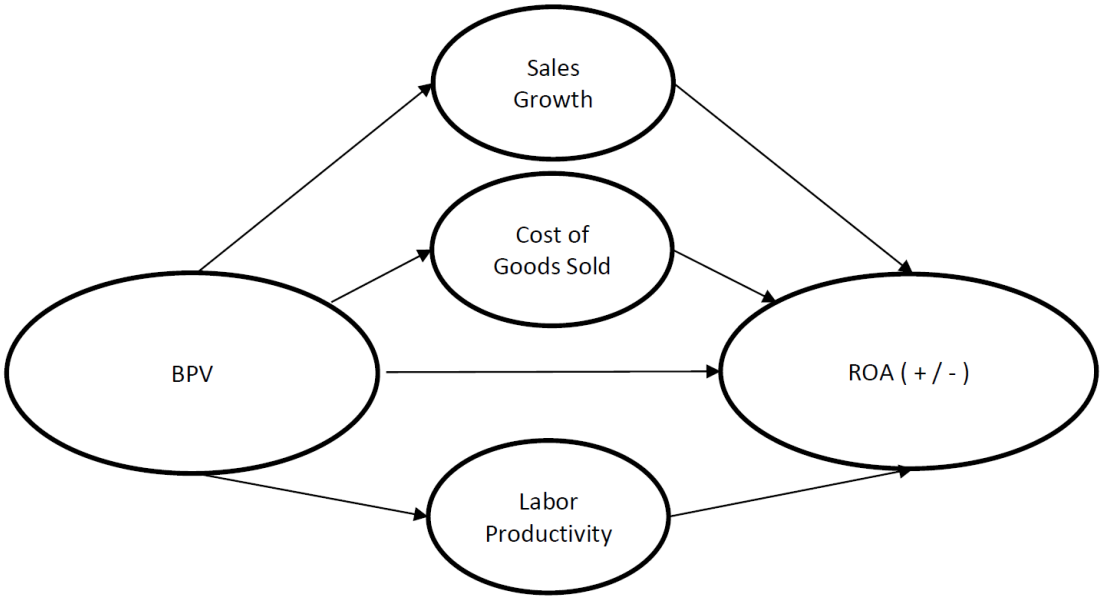
resources (Bharadwaj, 2000; Overby, 2008; Overby & Clarke, 2012). As a result, inputs in terms of labor will be reduced. From the perspectives of transaction efficiency and reduced human and physical resources in processes, we hypothesize that BPV could assist labor productivity of firms in business process.

H3: The adoption of BPV by a firm is positively associated with its labor productivity.

3.2.4 Abnormal Operational Performance

The increase of sales growth, decrease in cost of goods sold, and increase of labor productivity are not sufficient to support that BPV is beneficial to the overall operational performance of firms. Sales and cost-based accounting figure changes could be affected by the economic conditions, such as inflation and deflation. To confirm the relationship of BPV and firm performance, and for the purpose of robustness, we also test the abnormal operational performance of firms in terms of ROA. According to the BPV paradox described in section 3.1, we hypothesize H4 and H5.

Figure 2: Abnormal Operational Performance



3.2.3.1 Abnormal Operational Performance Increase

A survey of 4,200 firms conducted by Boothby, Dufour, and Tang (2010) on the technological tools and productivity shows that firms adopting technological tools exhibit higher productivity than other firms (Boothby et al., 2010). Process virtualization theory states that IT is a positive mediator in today's BPV (Overby, 2008). Another survey conducted by Rabinovich et al. (2007) on 4,733 firms showed that Internet-based commerce does not only improve the transactional and logistic costs to firms, but also improves network relationships between firms and customers. Others (Power & Singh, 2007; Zhu et al., 2006) have argued that IT could reduce transaction costs in business processes and integrate processes and trading partner in cost effective ways (Power & Singh, 2007). The ability to use advanced technologies and the associated skills are contributing significantly to today's business operations. Overby and Clarke (2012) state that, through reduction in human resources and physical facilities, firms with high IT capabilities generally outperform those driven by profit and cost-based performance

measures alone. In addition to sales growth, cost of goods sold, and labor productivity, we seek to confirm the aggregate benefit of BPV on the overall operational performance of firms, we test the relationship of BPV on the overall improvement on the operational performance of firms, relative to other firms (H4 and H5) with the event study methodology.

H4: The adoption of BPV by a firm is positively associated with its operational performance.

3.2.3.2 Abnormal Operational Performance Decrease

However, from a customer encounter perspective, customers demand different levels of experience with respect to service and product delivery. According to process virtualization theory, business processes need to satisfy a variety of sensory, relationship, synchronism, and control expectations from customers. The satisfaction and continued identification with the firm depends highly on the experiences of the customers during the course of the delivery of the services by the firm. A service can be seen as a complex series of activities involving customer-firm interactions (Tax et al., 2013). BPV removes any physical interactions existing. In a virtualized process, transactions are conducted in virtual modes.

According to social presence theory, virtual modes of interaction transmit lower communication cues and carry lower social presence than those arising in traditional physical interactions. Therefore, the removal of physical interactions creates gaps between the sensory, relationship, synchronism, control expectations and the actual

experience of customers in the course of service delivery by firms. IT improves the virtualizability of processes (Overby, 2008). It encourages firms to virtualize more and more business processes. However, whether improvements in virtualizability do indeed lead to improvements in organizational performance is uncertain. Along with the development and evolution of OM, customer is consistently the important factor for formulation of strategies (chapter 2). In other words, if the firm is unable to maintain effective customer-firm interaction after virtualizing the original processes, the operational performance of firm will be at risk. The operational performance of the firm will be affected as a consequence of poor customer retention and disruption of the customer's identification with the firm. Therefore, we also make the following hypothesis (H5).

H5: The adoption of BPV by a firm could be negatively associated with its operational performance.

3.3 Extensiveness of customer contact

A firm's ability to network significantly influences its financial performance (Semrau & Sigmund, 2012). The operation of the network affects the relationship and the bonding between network participants. It correlates with the future business success of the firm (Choi & Wu, 2005). Firms operating in different industries have different network characteristics in terms of nodes and links (Choi & Wu, 2009). Firms in different industries consists of different extensiveness of customer contact (Chase & Tansik, 1983; Mersha, 1990). Usually, networks of service firms have larger numbers of nodes and

links (paths) than those of manufacturing firms (Dean et al., 1997). Firms of higher customer contact level need more networking effort to maintain the relationship with customers and the effectiveness of business transactions (Chase & Tansik, 1983; Mersha, 1990). In addition, extensiveness of customer contact influence effective strategic relationship management and the dynamic capabilities of firms (Carlsson, 1989; Overby & Clarke, 2012; Wang et al., 2013; Wasko et al., 2011). Here, 'dynamic capability' refers to the timely, change-oriented capabilities of firms to renew and redeploy their resources in a manner capable of sustaining competitive advantage. This is an essential factor for consideration by contemporary electronic businesses (Carlsson, 1989; Wu & Hisa, 2008). Kamp (2005) identified the positive influence of network management on business dynamism. Studies on supply chain management systems and knowledge management have shown that network management first affects the dynamics of the firm in question and, subsequently, its performance (Hendricks et al., 2007; Kim, Lee, Chun, & Benbasat, 2014). A study by Breidbach et al. (2013) confirmed that both the quantity and quality of inter-personal relationships determine the success of technology-enabled systems.

Networks of service firms are mostly B (business) to C (customer), each consisting of several individual customers. By contrast, networks of manufacturing firms are more B to B. The nodes of a manufacturing network are mainly made up of business entities with fewer individual customers. Because service networks consist of more nodes and paths than manufacturing networks, the cost savings resulting from a well maintained network should be higher in the former than in the latter. Dean et al. (1997) found that service industries have higher needs for idea exchange than the manufacturing industries

involved in the same business network. While Mersha (1990) and Chase and Tansik (1983) pointed out the extensiveness of customer contact of firm induces the resource difference of the operation of the firm network. Managing and interacting with customers in a physical mode, level of customer contact plays an important part from the networking perspective. Therefore, we argue that a reduction in the physical interactions involved in a business process should benefit high customer contact firms more than for low customer contact firm firms. Keeping in mind the opportunities for leveraging business dynamics and the differences in the natures of the respective networks, we make the following hypothesis:

H6: Firms with extensive customer contact firms benefit more than firms with less extensive customer contact from BPV.

3.4 Customer Oriented / Non Customer Oriented Process

Interactions engaged in by firms can be classified as internal or external. External interactions mainly occur between customers and trading partners (Chong & Zhou, 2014). Both internal and external interactions influence the dynamic capability of the firm (Carlsson, 1989, 1992). The enhancement of the external linkages of firm provide firm with better spanning capability and social connectivity(Breidbach et al., 2013). Customer involvement is becoming ever more important in today's business operations. The role of customer is changing from one of being a mere consumer to an active collaborator with the firm in terms of product innovation and operation enhancement (Moeller, Ciuchita, Mahr, Odekerken-Schroder, & Fassnacht, 2013; Nambisan & Baron,

2009). Many scholars and managers have drawn attention to the importance of value co-creation and partnership between firms and customers (Breidbach et al., 2013; Moeller et al., 2013; Vargo & Lusch, 2008). Breidbach et al. (2013) studied the contribution of technology to such value co-creation processes. They found that technological tools benefit value co-creation in terms of interpersonal, relationships and social connectivity, rather than in terms of processing speed. Different processes in firms engaged in different operational functions, require different degrees of interaction with customers (Bowersox et al., 2013). External processes require extensive customer interaction and customer contact. Enhancements in external relationships improve the social connectivity of the firm and extends the quality and quantity of network paths associated with it (Breidbach et al., 2013). The enhancement of internal relationships improves only the internal operational efficiency. Although external relationships and internal processing speed are both important to firms, the benefits derivable from external relationships create more immediate business opportunities and business connections.

In addition, traditional person-to-person relationship marketing is usually high in cost and small in scale (Huang & Rust, 2013). By removing physical constraints, BPV tools enable firms to build relationships more cost effectively. At the same time, customer participation is increased and the value co-creation processes are better implemented. As customers become more emotionally attached to the firm, the identification of customers with the firm gets increased. The commitment to the firm and, hence, customer retention is also increased. Such an extension of external relationship capability has a higher

influence on firm performance than internal communication enhancement. Therefore, we make the following hypothesis (H7):

H7: Customer oriented business processes benefit from BPV more than internal non-customer oriented processes do.

3.5 Market Share

Studies of the virtual world have found that virtual modes of communication are leveling the advantages enjoyed by multinational firms and SMEs (small and medium manufacturing enterprises). Multinational firms have more resources for building person-to-person relationships in the traditional physical mode, e.g., opening physical stores and branches. They also have resource utilization advantage in term of scale of economy (Wasko et al., 2011). Because of relatively smaller financial resources, SMEs find it difficult to compete with multinational firms in expanding sales forces, branches, and transaction processes (Wasko et al., 2011). A study by Szymanski et al. (1993) discovered certain relationships among market share, firm-specific resources, and firm profitability. Multinational firms have greater advantages while competing in the physical mode. Entrance into a new market is much more difficult for an SME operating in the traditional mode. BPV tools help eliminate such physical constraints. They provide a platform for SMEs to interact and collaborate with their customers and partners. However, the quantity and quality of interactions of SME can be enhanced through improvements in networking. Business can then be expanded with reduced effort. Small firms can expend their networks more cost efficiently on virtual platforms.

Therefore, we expect BPV to benefit firms with low market share, e.g., of an SME, since their major disadvantages vis-a-vis large firms rich in physical resources can be mitigated significantly through the removal of physical limitations on resources. The virtual platform provided by BPV forms an effective way forward for these in expanding their sales and customer contacts. We argue that small firms should make us of more BPV tools due to the benefit difference between the small firms and the large firms. In view of the above, we make the following hypothesis:

H8: BPV helps firms with low market share more than firms with high market share.

3.6 Competitive Environment

To fully realize the advantages of BPV arising from the removal of physical constraints, we also need to look at the variation in firm performance with industry concentration. An industry with a state of high concentration means that the market is pre-occupied by a small number of firms (Hendricks & Singhal, 2008; Liu et al., 2014). While entering a pre-occupied market, firms need to spend more effort while showcasing their capabilities. Printing and distributing physical catalogs is costly. Virtual platforms allow firms to spread information about themselves around much quicker than in a traditional mode. Access to information from customers will also be much wider than in the traditional, physical mode. As a result, entrance into a highly concentrated market becomes easier. Therefore, we hypothesize that BPV tools are helpful to firms seeking to penetrate a high concentration markets.

H9: BPV is helpful to firms in penetrating high concentration markets.

Figure 1 lists the hypotheses in the conceptual model of our study.

Chapter 4: Methodology

4.1 Event Study Methodology

We adopted the long-horizon event study methodology of Barber and Lyon (1996) and followed the guidelines provided by them with respect to the detection of the accounting-base abnormal performance of sample firms. As a secondary data study method of OM, it overcomes the problems associated with traditional statistical tests when sample firms have performed unusually well or unusually poorly. The method matches sample firms with control firms of similar characteristics in their specific industries. However, instead of testing only pre-event and post-event performances of the sample, one can perform statistical tests on abnormal performances in the sample. Alternatively, one can examine the performances of control firms as benchmarks. The method does not only measure the change of performance of the sample firms within themselves. One can also focus on relative measures with respect to industry benchmarks. The method has the advantage of being able to overcome the economic distortion over the time horizon when the samples are taken.

Barber and Lyon (1996) suggested four general ways of matching sample firms with control firms:

1. Two-digit SIC code,
2. Four-digit SIC code,
3. Two-digit SIC code and similar size,

4. Two-digit SIC code and similar pre-event performance

The industry group for sample firm i in year t is denoted as PI_{it}^{j}. j indexes the difference of industry group. Thus, the expected performances of the sample firms are

$$\mathrm{E}(P_{it}) = PI_{it}^{j}$$

where E(•) is the expectation operator.

In this method, we are comparing the performance of a firm relative to the pre-event industry benchmark, $(P_{i,\,t-1} - PI_{i,t-1}^{j})$, and to the post-event performance measure, $(P_{it} - P_{it}^{j})$.

Restating the method in terms of expected performance with respect to the industry benchmark, we have

$$\mathrm{E}(P_{it}) = P_{i,\,t-1} + (PI_{it}^{j} - PI_{i,\,t-1}^{j})$$

$$= P_{i,\,t-1} + \Delta PI_{it}^{j}, \qquad j = 1, 4.$$

Therefore, the abnormal performance of sample firm i in year t is AP_{it}. It is defined as the realized performance, P_{it}, minus expected performance of the sample firms, $E(P_{it})$:

$$AP_{it} = P_{it} - E(P_{it})$$

4.2 Measurements

4.2.1 Dependent and Independent Variables

4.2.1.1 Sales Growth

Quirós Romero and Rodríguez Rodríguez (2010) found that IT investment improves the sales performance of the firm. Due to the inconsistent view of IT vehicles and BPVs, we believe that BPV will benefit sales performance. We adopt the yearly amount of sales growth of sales performance change of the BPV firms. It is the ratio of yearly sales amount change over the yearly sales amount of the base year. It is a popular measure of sales performance. For example, Yeung et al. (2011) and Hendricks and Singhal (2008) used the sales growth ratio to measure firm performance.

4.2.1.2 Cost of Goods Sold

In addition to sales, cost-based measurement is an important attribute to reflect the effectiveness of IT related tools (Bharadwaj, 2000). We selected cost of goods sold to measure the cost-based performance related to the adoption of BPV. Cost of goods sold is an accounting entry in the financial statements of firms. Sales of the firm minus the cost of goods sold reflects the net profit of a firm. Cost of goods sold has been widely adopted to reflect the cost related performance of firms, such as, the quality improvement practices study of Adam Jr (1994), the enterprise resources planning, supply chain management, customer relationship management system study of Hendricks et al. (2007).

4.2.1.3 Labor Productivity

BPV vehicles enable suppliers and customers to work in a more self-efficacy and self-service mode (Atrostic & Nguyen, 2005; Wang et al., 2013). It also reduces the physical assets and resources required by business process (Bharadwaj, 2000; Overby, 2008; Overby & Clarke, 2012). Based on this rationale, BPV should enhance the labor productivity of firms. We adopt the measure of labor productivity used by Lo, Wiengarten, Humphreys, Yeung, and Cheng (2013). It is the ratio of the operating income of firm to its number of employees.

4.2.1.4 Abnormal Operational Performance

Return on Asset (ROA) is a popular indicator of effectiveness of operational performance in a given firm (Guthrie & Datta, 2008) and is available from its financial reports. ROA is the ratio of the yearly net income to the yearly total asset of firms. Barber and Lyon (1996) suggest abnormal ROA as a measure of operational performance. ROA as a measure of operational performance has also been used as indicated by the study of Yeung et al. (2011) on the operational performance of ISO9000 certification of firms and the study of Szymanski et al. (1993) on profitability. Our study uses abnormal ROA as the dependent variable while measuring and analyzing the operational performance of and the contingency factors associated with BPV.

4.2.1.5 Extensiveness of Customer Contact

Depending on the business nature, the extensiveness of contact with customer vary across firms and industries (Chase & Tansik, 1983; Mersha, 1990). From the perspective of customer contact characteristic, service type of networks and manufacturing type networks are different in nature (Choi & Wu, 2009). They consist of different numbers of nodes and links (Dean et al., 1997). The extensiveness of customer contact as a result is also vary. If the efforts put in and resources spent by service and manufacturing firms to maintain their networks are different due to such networking characteristic difference, we can expect that the performance of BPV will be contingent on the customer contact extensiveness of firms. Therefore, we hypothesize that firms of high customer contact and firms of low customer contacts benefit from BPV differently. The two-digit SIC code of firms can be used for such a purpose. Following the work of Hendricks and Singhal (1997); (Lo, Yeung, & Cheng, 2009; Yeung et al., 2011), we use the two-digits SIC code to distinguish the firm types and customer contact extensiveness level for our samples. For a firm of high customer contact level, we assign a dummy value equaling 1. For a belonging to the low customer contact level type, we assign the value 0.

4.2.1.6 Customer / Non Customer Oriented Process

From the perspective of relationship characteristic, we expect that tasks involving external customer interactions should benefit from BPV more than internal tasks in firms because they are more customer oriented. Bowersox et al. (2013) classify supply chain tasks in firms into 21 types:

1. Customer Relationship Management (Customer Relationship Management)
2. Forecasting (Customer Relationship Management)
3. Demand Management (Customer Relationship Management)
4. Collaborative Planning, Forecasting, and Replenishment (Customer Relationship Management)
5. Order Management (Customer Relationship Management)
6. Integrated Inventory Planning (Inventory Deployment)
7. Finished Inventory Management (Logistics)
8. Order Processing (Logistics)
9. Warehouse Management (Logistics)
10. Transportation Management (Logistics)
11. Yard Management (Logistics)
12. Accounts Receivable Interface (Logistics)
13. Manufacturing Resource Planning (Manufacturing)
14. Capacity Management Planning (Manufacturing)
15. Master Productions Schedule (Manufacturing)
16. Production Execution and Control (Manufacturing)
17. Quality Management (Manufacturing)
18. Purchase Order Administration (Purchasing)
19. Materials Requirement Planning (Purchasing)
20. Supplier Relationship Management (Purchasing)
21. Account Payable Interface (Purchasing)

Some business tasks involve customer-oriented interactions. Some tasks are just internal (Chong & Zhou, 2014). Effective maintenance of internal and external interactions impacts the dynamic capabilities of firms (Carlsson, 1989, 1992). We classify the BPV process in our sample using the guidelines provided by Bowersox:

- Customer Relationship Management → Customer Oriented
- Inventory Deployment → Customer Oriented
- Logistics → Mixed (Non-Customer Oriented)
- Manufacturing → Non Customer Oriented
- Purchasing → Non Customer Oriented

We use the, dummy value, 1 to denote a customer oriented process and 0 to denote a non-customer oriented process.

4.2.1.7 Market Share

Szymanski et al. (1993) discovered the relationships among the market shares, firm-specific resources, and their respective profitability figures. The market share of a firm reflects the relative competence in its specific industry or strategic priority that it places on the industry. SME's own smaller shares of their industries and markets than multinational firms do. Multinational firms have certain resource advantages while opening physical stores and increase sales force in the traditional platform. BPV requires no physical interaction between the salesperson and the customers he/she is serving. A firm with a low market share, such as an SME, can approach customers and expand contacts with them much easily on a virtual platform. Virtual interactions help level the advantages of multinational firms and SMEs (Wasko et al., 2011). This implies

that, for SME initially owning a little piece of the industry's market pie would benefit from BPV more than a multinational firm owning a much larger piece. As a result, the leveraging effect of BPV on SME should be higher than on a multinational firm. We therefore follow the computation of market share of a firm suggested by Szymanski et al. (1993): the total sales of the firm divided by the total sales of the industry to which the firm belongs.

4.2.1.8 Industry Concentration

To reflect the market competitiveness of a firm, Szymanski et al. (1993) do not just look at the market share of the firm. The state of the industry is an important relative measure. Szymanski et al. (1993) also include a measure of industry concentration to reflect the competitive position of the firm in firms' specific industries. Market share is an absolute measure while industry concentration is a relative measure of the overall competition level in an industry (Szymanski et al., 1993). Our study adopts the Herfindahl index, defined as the sum of squares of firms in specific industries, as the relative measure of competition in industries. Similar measures of industry concentration have been used in the studies conducted by Hendricks and Singhal (2008) and Liu et al. (2014).

4.2.2 Control Variables

In their study of the profitability figures of firms, Szymanski et al. (1993) find that the business performance of a firm is moderated by both market factors and the relative competitive positions of firms. This suggests that, by themselves, market factors and the internal competitiveness figures of firms could influence the post-event performance of

the sample firms in BPV. Therefore, in our study, we control the factors influencing the models used in our HLA analysis. From the market perspective, we controlled firm size and employee share in the industry of the samples firms. Large firms possess more assets and are generally believed to have a greater ability to deploy of physical resources, such as opening physical stores and employing salespersons (e.g., employee share), in the generation of sales. Also, the possession of physical assets (Dhawan, 2001; Wasko et al., 2011) and human resources (Chadwick & Dabu, 2009; Wasko et al., 2011), by themselves, are capable of moderating operational performance. As for the robustness of our analysis of the firm performance after BPV, we include pre-event total assets and pre-event percentages of workers hired (i.e. employee share of the industry) by the sample firms as control variables. We also control the pre-event performance and the pre-event financial ability of the sampled firms. Firms exhibiting a good pre-event performance and pre-event financial ability might be exhibiting a superior operational ability by demonstrating an improving performance measure after the event. Therefore, like Liu et al. (2014), we include pre-event ROA of the sampled firms as the control for pre-event operational performance or ability. We also include pre-event Standard & Poor's financial strength (taken from archival database of COMPUSTAT) as the control for financial ability.

Table 4 lists the measures used along with brief indications of how they are computed.

Table 4: HLA Measurements

	Measure	Computation	Variable Type
Sales Growth (H1)	Change in annual sales amount (Hendricks & Singhal, 2008; Yeung et al., 2011)	Ratio of yearly sales amount change over the yearly sales amount of the base year	Dependent Variable
Cost of Goods Sold (H2)	Cost-based performance of BPV tools (Adam Jr, 1994; Hendricks et al., 2007)	The expense related to selling booked on finance accounting	Dependent Variable
Labor Productivity (H3)	Efficiency of labors(Lo et al., 2013) in generating income	Ratio of the operating income of firm number of employees	Dependent Variable
Operational Performance (H4, H5)	Abnormal Return on Asset (ROA) (Barber & Lyon, 1996; Szymanski et al., 1993; Yeung et al., 2011)	Net Income divided by Total Assets	Dependent Variable
Extensiveness of Customer Contact (H6)	Network characteristic difference of firms (Hendricks & Singhal, 1997; Lo et al., 2009; Yeung et al., 2011)	2-digit SIC code (20-49: Low customer contact type dummy = 0; Others: High customer contact type dummy= 1)	Independent Variable
Customer / Non Customer Oriented Process (H7)	Process level indicator to reflect relationship characteristic difference of firms (Bowersox et al., 2013)	Customer Oriented Process: Dummy = 1; Non Customer Oriented Dummy = 0	Independent Variable(Hendricks & Singhal, 1997)
Market Share (H8)	To reflect Relative Competence of firms (Szymanski et al., 1993)	Pre-event Sales of firm divided by total sales of its SIC industries (at t -1)	Independent Variable
Industry Concentration (H9)	Market Competitiveness to indicate the state of Industries (Hendricks & Singhal, 2008; Liu et al., 2014; Szymanski et al., 1993)	Herfindahl Index of each SIC industry(i.e., at t -1)	Independent Variable

Pre Event Performance	Operational Strength (Liu et al., 2014)	Pre-Event ROA (i.e., t - 1)	Control Variable
Firm size	Resource advantage of large firms over the small firms in BPV (Dhawan, 2001)	Natural logarithm of pre-event (i.e., at t - 1) total assets of the firm	Control Variable
Financial Ability	Financial strength (Felton, Hearth, & Pu, 1995)	Pre-event Standard & Poor's Financial Strength Rating (i.e., at t -1)	Control Variable
Year Dummy	Benner and Veloso (2008)	t is event year. (i.e., t-2, t-1, t, t+1, t+2, t+3, t+4)	Control Variable
Percentage of Workers hired in industry	Competitive advantage arising from human resources (Chadwick & Dabu, 2009)	Pre-event number of employees of firm divided by total number of employee of its SIC industries (i.e., in t -1)	Control Variable

4.3 Data Collection

We started by locating cases of BPV from the archival database of Thomson Reuters through the interface of Factiva. According to the definition of process virtualization provided by Fiol & O'Connor (2005) and Overby (2008), a virtualized process is one in which physical and human interactions have been removed. Human interventions continue to exist but have been shifted to virtual platforms. In accordance with the works of Fiol & O'Connor, and Overby on virtualization, we used the following guidelines during sample identification:

1. Listed U.S. companies demonstrate business process changes.
2. Must consist the removal of physical interactions in business function.
3. Human interactions may still exist but should be moved to a different platform.

Table 5 summarizes the natures of the samples and the keywords adopted while searching the Thomson Reuter database.

Table 5: Sample Keywords

E-tailing	Online Catalog	Internet Marketing	Mobile Commerce	Virtual Storefronts
Virtual mall	Newsletter	Blog / Forum	Online Support	Online Customer Communication
Virtual Assistant	Online Assistant	Instant Messaging	Newsgroups	Online Shopping
Online Order Tracking	Online Banking	Tele-conferencing	Social Networking	Catalog Sales
Mail Ordering	Online Sales	Cloud Computing	Online Technical Support	Electronic Commerce

We started by searching news and company announcement articles in the archival database of Thomson Reuters on the basis of BPV related keywords. Since the existence of BPV keywords in the article might not necessarily indicate that the article is describing a BPV case, we studied each article carefully according to a set of sample identification guidelines.

In the first round of data collection, we have 346 BPV cases in the first round. After reviewing the details of the articles, we remove 23 cases due to mismatch to our data collection criteria.

At the end, we have 323 BPV cases of listed companies covering the period 1989 to 2011. As for listed companies, the financial data needed were taken from publicly available sources. We used COMPUSTAT's database as the source for financial data associated with our samples. We analyzed the financial performance of each firm using the guidelines for the long-horizon event study methodology suggested by Barber and Lyon (1996). It takes time for a firm to prepare for BPV implementation and assimilation. Therefore, we use one year before BPV as our base year (i.e., *t*-1) and as the referencing base while evaluating performance change. We observed abnormal changes in the performance of the firms over the next five years (i.e., *t*, *t*+1, *t*+2, *t*+3, *t*+4).

4.4 Assessment of Performance of Firms Using the Event Study Methodology

We employed the event study methodology in our study. Choices with regard to research design normally consist of the balance among external validity (i.e., generalizability), internal validity (i.e., precision of measurement), and control of behavioral variable (i.e., construct validity) (McGrath & Martin, 1982). Long horizon event studies are able to relax the constraints of validities for empirical studies when proper analysis methodology is applied (Fama, 1998). At the same time, they also reduce the number of issues arising from reverse causality of dependent variable and

independent variables (Corbett, 2005; Sharma, 2005). By observing the long horizon abnormal changes of performance over different event periods, while according due respect to the control firms in the industries, we were able to gather evidence in support of the performance of firm after BPV adoption with high precision of measure and validity.

We adopted return on assets (ROA) as our performance measure for assessing each sampled firm's performance. ROA, a base measure related to accounting, is defined as the ratio of the operating income before depreciation, interest, and taxes to the total assets of the firm. It is a widely used indicator of the financial performance of a firm (Guthrie & Datta, 2008). We detected abnormal performances in our sampled and control firms by using the guidelines provided by Barber and Lyon (1996). The event of interest in our study was the introduction of BPV. Abnormal performance is the post-event performance minus the estimated expected performance of the samples. The estimated expected performance of the sample was taken as the pre-event performance plus the median changes in performance of their control groups of the same period. We first tested the mean abnormal ROA using the parametric t-test. In order to minimize the biases caused by outliers, we also analyzed the median abnormal ROA using the non-parametric Wilcoxon signed-rank (WSR) test and the signed test described in Yeung et al. (2011), Liu et al. (2014), and Lo et al. (2009). In fact, Barber and Lyon (1996) recommend non-parametric WSR as the most powerful statistical test for event study duo to the non-parametric distribution of results.

The advantage of using the predicted abnormal performance with sample firms and control firms is that it minimizes the confounding factors caused, for example, by the particular industry as well as by the economy in general, in a specific period (Barber & Lyon, 1996). We adopted the guidelines of Barber and Lyon for matching sample firms with a portfolio of control firms. Barber and Lyon have suggested that the best matching criteria for sample firms and control firms are industry type and 90-110% pre-event performance. Following the procedure outlined in Hendricks and Singhal (2008), we matched sample firms with control firms using a two-digit SIC code, 50%-200% of total assets, and 90%-110% performance (ROA) range in the year before BPV.

4.5 Hierarchical Linear Analysis

We applied hierarchical linear analysis (HLA) to study the contingency factors associated with BPV at the process as well as industry levels. Our study consisted of repeated measures of BPV processes nested within industries. HLA overcomes the weaknesses of traditional methods while analyzing nested data. It has been widely used in multilevel data analyses (Bloom & Milkovich, 1998; Raudenbush & Bryk, 2002). The first model used in our study was the base model, which contained only the control variables. Next we analyzed the independent variables by assimilating them into the base model one-by-one.

According to the guidelines provided by Barber and Lyon (1996) of event study, the dependent variable associated with H1 and HLA is abnormal ROA between the samples and control firms. The possession of resources impacts the performance of firms after

BPV (Tsai, Raghu, & Shao, 2013). To control the effect of company resources on performance, we controlled the assets along with the financial and human resources in four of our other models (Model 1, Model 2, Model 3, model4) in HLA analysis. We included firm size, financial ability, and employee share of industries as control variables (see Table 4).

Chapter 5: Results

5.1 Descriptive Statistics

Table 6 summarizes our data on pre-event total assets (year *t*-1) and the return on assets for the sample firms and the control firms. The figures show that the mean, median, skewness, and kurtosis of the distribution curves for the sample firms and the control firms are very similar. The mean value of all the assets for the sample firms is USD7.87M while that for the control firms is USD6.81M. The median value of total assets is USD1.15M for the sample firms. The median of total assets for the control firms is USD1.20M. Skewness measures the asymmetry of a probability distribution (a negative skewness reading shows that the distribution curve skews to the right, and a positive skewness reading indicates that the distribution is skewing toward the left). Kurtosis describes the peakedness of a distribution (A normal distribution curve has a value of 0 kurtosis). The skewness of the distribution of total assets of the sample firms is 6.479. The skewness of the distribution curve for total assets of the control firms is 6.678. The kurtosis of total assets of the samples firms is 50.234 and that for the control firms is 50.872.

The mean of ROA for the sample firms is 0.091 and that for the total assets of the control firms is 0.09. The median of ROA is 0.132 for the sample firms. The median of ROA for the control firms is 0.134 while the skewness of the distribution of ROA of the sample firms is -3.208. The skewness of the distribution curve of ROA of the control firms is -13.236. The kurtosis of the distribution of ROA of the samples firms is 204.975.

The kurtosis of total assets of the control firms is 205.613. These figures demonstrate that the population and the distribution of sample firms are essentially similar. We see that our sample firms match well with our control firms in the respective industries. As required by the guidelines of Barber and Lyon (1996), pre-event firm size (total assets) and pre-event performance (ROA) also exhibit a close match (Table 6).

Table 6: Descriptive Statistics – Pre-event Data of Sample and Control Firms for year t-1

	N	Mean	Median	Minimum	Maximum	Std. Dev.	Skew-ness	Kurtosis
Sample firms								
Total Assets (USD)	323	7.87B	1.15B	0.253	237.55B	23.34B	6.479	50.234
Return on assets (ROA ratio)	323	0.091	0.132	-6.320	0.506	0.401	-13.208	204.975
Control firms								
Total Assets (USD)	323	6.81B	1.20B	0.291	191.20B	19.19B	6.678	54.872
Return on assets (ROA ratio)	323	0.090	0.134	-6.319	0.462	0.401	-13.236	205.613

Table 7 shows the pre-event descriptive statistics (year *t*-1) for the control and independent variables in our HLA analysis. In our sample of 323 firms, we were able to map 226 financial ability rankings (S&P rankings) as recorded in the database of COMPUSTAT. The ranking ranges from 1 to 8 with 1 standing for the strongest pre-event financial ability and 8 for the weakest pre-event financial ability. The mean value of financial ability is 3.956. The corresponding median is 4.000, standard deviation 1.873, skewness 0.400, and kurtosis -0.595.

Employee share is the percentage (ratio) of workers in the sample firms are hiring in their respective industries. We were able to compute this percentage for 312 sample firms. A higher percentage indicates that the sample firms are hiring more workers relative to the industry and therefore they have a higher advantage in terms of human resources. The mean of employee share for the sample firms is 0.025 (2.5% of the worker population of the industry). The median of employee share for the sample firms is 0.007 (0.7% of the worker population of the industry), the standard deviation 0.055 (0.55%), the skewness 4.773, and the kurtosis 29.747.

Market share is the ratio of the sales figures of the sample firms to the corresponding total sales at year *t* -1. We have been able to obtain the sales volumes for all of our 323 samples. The mean of market share is 0.025 (2.5% market share) and the median of sales share is 0.006 (0.06% market share). The standard deviation is 0.056. Clearly, the samples exhibit enough variance to draw plausible conclusions from statistical analyses. The skewness of market share is 4.502 and the kurtosis 25.848.

A popular measure of industry concentration is the H-index (Herfindahl index). The mean of H for our sample is 0.025 and the median 0.006. An H-index close to 1 indicates that the market is controlled by a small number of firms while a figure close to 0 indicates that there are many players in the market. In our case, the standard deviation of industry concentration is 0.056. This shows that we have good variance on industry concentration to justify our statistical analysis. The skewness is 5.594. The kurtosis is 36.286.

Among the 323 samples, 106 were service firms while 217 were manufacturing firms. 169 business processes were related mainly to customer orientation; 55 were not. 99 were mixed (involving customer, supplier, and internal interactions) or we were unable to determine from the announcements contained in the database of Thomson Reuter.

Table 7: Descriptive Statistics – Control and independent variables for year t-1

	N	Min.	Max.	Mean	Med.	Std. Dev.	Skew-ness	Kurtosis
Financial Ability - S&P Ranking (1 strong - 8 weak)	226	1.000	8.000	3.956	4.000	1.873	0.400	-0.595
Percentage of Workers Hired in Industry (ratio)	312	0.000	0.491	0.025	0.007	0.055	4.773	29.747
Market Share - Sales Share (ratio)	323	0.000	0.510	0.025	0.006	0.056	4.502	25.848
Industry Concentration (H Index)	323	0.000	1.000	0.031	0.002	0.107	5.594	36.286

	High	Low	Mixed / Undetermined
Extensiveness of Customer Contact	106	217	-
Customer Oriented / Less Customer Oriented Process	169	55	99

5.2 Impact of BPV on Firm Performances

Before we test the sales growth, cost of goods sold, labor productivity, and abnormal ROA of our sample firms for each of our event period (t-1 to t; t-1 to t+1; t-1 to t+2; t-1 to t+3; t-1 to t+4), we first observe this performance measures for the period of t-2 to t-1. This provides us more evidences to draw conclusion whether the performance changes happen after t-1 are induced by BPV. Table 8 summarized the result of paired sample test. Labor productivity, ROA, and abnormal ROA of firms show no significant change ($p = 0.121$; $p = 0.311$; $p = 0.084$). We found significant sales growth ($p = 0.015$) and significant cost of goods sold ($p = 0.034$) for the period of t-2 to t-1. There is possibility

that such sales growth and cost of goods sold could be due to the inflation of the economy.

Table 8: Performance Check on t-2 to t-1

	Mean	Std. Dev	Std Err.	p-Value (1-tailed)	
Sales Growth	500.720	4092.179	229.118	0.015 *	T-Test
Cost of Goods Sold	313.682	2750.623	147.661	0.034 *	T-Test
Labor Productivity	2.886	42.333	2.469	0.121	T-Test
ROA	-0.009	0.317	0.012	0.311	T-Test
Abnormal ROA	-0.020	0.539	0.033	0.084	WSR

* p<0.05 ** p<0.01*** p<0.001

5.2.1 Sales Growth

As for hypothesis 1, we test five periods of sales growth figures for the BPV firms. The base year of our test is *t*-1. It is the year of BPV implementation. Table 9 shows the tests of sales growth of the BPV firms from the year of BPV implementation up to the fifth year. The mean value of the sales growth figures for our 322 BPV sample firms in the first year (t-1 to t) of BPV implementation is 0.902. Both the results from the WSR Test and the Signed test show that BPV firms have significant sales growth in the first year of BPV implementation ($p < 0.000$, $p < 0.000$). For the second year of BPV performance (t-1 to t +1), our 289 sample firms with mean sales growth of 1.146 have significant sales growth with the p value being smaller than 0.000 for both the WSR and Signed tests. In the third year (t-1 to t+2), 262 sample firms demonstrate significant sales growth with mean value of 0.306 in WSR test and Sign test ($p < 0.000$, $p < 0.000$). For the fourth year of BPV implementation, we have 239 firms (t-1 to t +3). The samples have a mean value of 0.402 of sales growth. The sales growth in this period is found to

be significant, following both WSR and Signed tests ($p < 0.000$, $p < 0.000$). In the fifth year of BPV, 208 sample firms also demonstrate significant sales growth ($p < 0.000$, $p < 0.000$) following WSR and Signed tests. However, for the pre-event period (t-2 to t-1), we also observed significant sales growth (WSR test $p = 0.000$; Signed test $p = 0.000$) and we cannot confirm the causal relationship of BPV to sales growth. Therefore, hypothesis 1 is not supported. We have no clear evidence to support that the adoption of BPV by a firm improves its sales growth.

Table 9: Sales Growth

									p-Value (1-tailed)	
Period	N	Mean	Std. Dev.	Skew-ness	Kurt.	Med.	25th %	75th %	WSR Test	Signed test
t-2 to t-1	322	0.180	0.688	8.400	91.174	0.067	-0.025	0.199	0.000 ***	0.000 ***
t-1 to t	322	0.902	13.526	17.860	319.929	0.075	-0.008	0.075	0.000 ***	0.000 ***
t-1 to t+1	289	1.146	16.081	16.973	288.390	0.152	-0.034	0.286	0.000 ***	0.000 ***
t-1 to t+2	262	0.306	0.708	4.728	37.567	0.187	-0.008	0.396	0.000 ***	0.000 ***
t-1 to t+3	239	0.402	0.688	2.958	13.900	0.274	0.023	0.566	0.000 ***	0.000 ***
t-1 to t+4	208	0.493	0.654	1.337	2.972	0.377	0.057	0.734	0.000 ***	0.000 ***

* p<0.05 ** p<0.01*** p<0.001
t is the year of BPV

5.2.2 Cost of Goods Sold

Table 10 shows the tests of cost of goods sold of the BPV firms. The mean value of the sales growth figures for our 323 BPV sample firms in the first year (t-1 to t) of BPV implementation is 550.629 million. Both the results from the WSR Test and the Signed test show that BPV firms have significant sales growth in the first year of BPV implementation ($p < 0.000$, $p < 0.000$). For the second year of BPV performance (t-1 to t +1), our 290 samples with mean cost of goods sold of 629.675 million have significant cost of goods sold change with the p value being smaller than 0.000 for both the WSR

and Signed tests. In the third year (t-1 to t+2), 263 samples demonstrate significant sales growth with mean value of 956.100 million in WSR test and Sign test ($p < 0.000$, $p < 0.000$). For the fourth year of BPV implementation, we have 240 samples (t-1 to t +3). The samples have a mean value of 1686.045 million of cost of goods sold. The cost of goods sold in this period is found to be significant, following both WSR and Signed tests ($p < 0.000$, $p < 0.000$). In the fifth year of BPV, 209 sample firms also demonstrate significant cost of goods sold increase ($p < 0.000$, $p < 0.000$) following WSR and Signed tests. Therefore, hypothesis 2 is not supported. Our samples firms actually demonstrate increases in cost of goods sold after the adoption of BPV.

Table 10: Cost of Goods Sold Change

									p-Value (1-tailed)	
Period	N	Mean	Std. Dev.	Skew-ness	Kurt.	Med.	25th %	75th %	WSR Test	Signed test
t-2 to t-1	323	313.682	2750.623	7.120	79.677	31.024	-8.998	166.993	0.000 ***	0.000 ***
t-1 to t	323	550.629	2429.922	4.958	31.402	32.049	-3.225	210.500	0.000 ***	0.000 ***
t-1 to t+1	290	629.675	5733.949	-5.003	78.034	63.291	-11.801	369.726	0.000 ***	0.000 ***
t-1 to t+2	263	956.100	6279.676	-2.420	55.608	100.388	-6.711	720.900	0.000 ***	0.000 ***
t-1 to t+3	240	1686.045	7437.903	0.091	36.572	159.749	-0.036	1037.342	0.000 ***	0.000 ***
t-1 to t+4	209	2394.482	8970.043	2.261	28.520	275.581	11.181	1471.000	0.000 ***	0.000 ***

* p<0.05 ** p<0.01*** p<0.001
t is the year of BPV

5.2.3 Labor Productivity

As for hypothesis 3, we also tested the first five consecutive years of BPV performance in labor productivity (Table 11). In the first period, *t*–1 to t, the mean labor productivity increase of our 322 sample firms is 0.901. They demonstrate significant increase of labor productivity in our WSR test and Signed test ($p < 0.000$, $p < 0.000$). In the second year of BPV implementation (*t*-1 to *t*+1), we find significant labor productivity increase

in WSR test and Signed Test ($p < 0.000$, $p < 0.000$) for our 289 samples. In the third year of BPV (*t*-1 to *t*+2), 262 samples with a mean labor productivity growth of 0.306 demonstrates significant increase supported by $p = 0.012$ and $p < 0.007$ in WSR Test and Signed Test respectively. We have 239 sample firms for our year four testing (*t*-1 to *t*+4) period. They have a mean labor productivity increase of 0.402. The result is significant in WSR test and Signed test ($p < 0.000$, $p < 0.000$). In the fifth year of BPV implementation (*t*-1 to *t*+4), 208 sample firms showed a mean labor productivity increase of 0.493. They are significant both in our WSR and Signed tests ($p = 0.000$, $p = 0.000$). We found five consecutive years of significant labor productivity increase from our BPV sample and there is no significant labor productivity increase in the period of t-2 to t-1 (WSR Test p=0.120; Signed Test p=0.080). Therefore, H3 is supported. We can confirm that the adoption of BPV can improve labor productivity of firms.

Table 11: Labor Productivity

									p-Value (1-tailed)	
Period	N	Mean	Std. Dev.	Skew-ness	Kurt.	Med.	25th %	75th %	WSR Test	Signed test
t-2 to t-1	322	2.974	41.704	7.409	102.721	0.804	-2.783	5.748	0.120	0.080
t-1 to t	322	0.901	13.526	17.860	319.929	0.075	-0.008	0.170	0.009 **	0.000 ***
t-1 to t+1	289	1.146	16.081	16.973	288.390	0.152	-0.034	0.286	0.015 **	0.000 ***
t-1 to t+2	262	0.306	0.708	4.728	37.567	0.187	-0.008	0.396	0.012 **	0.007 **
t-1 to t+3	239	0.402	0.688	2.958	13.900	0.274	0.023	0.565	0.000 ***	0.000 ***
t-1 to t+4	208	0.493	0.654	1.337	2.972	0.377	0.057	0.734	0.000 ***	0.000 ***

* p<0.05 ** p<0.01*** p<0.001
t is the year of BPV

5.2.4 Abnormal Operational Performance

Table 12 shows the results pertaining to the testing of hypothesis 4 (H4). The base year in our study is one year before BPV implementation (i.e., *t*-1). The mean values of abnormal ROA from the first to the fourth year of BPV implementation are -0.120, -0.027, -0.011, 0.009 and 0.010 respectively. The corresponding standard deviations are 0.257, 0.360, 0.346, 0.098 and 0.009, respectively. However, the skewness and the kurtosis values for the distribution mean of abnormal ROA are highly negative (-10.508, -11.277, -11.267, -1.513, -1.387) as well as highly positive (151.950, 147.228, 230.531, 8.180, 7.746). The skewness and kurtosis values are particularly strong in the first three event periods (*t*-1 to *t*-0, *t*-1 to *t*+1, and *t*-1 to *t*+2). This suggests that the distributions of the abnormal ROA follow non-parametric distributions. Since the t-test is a parametric test, we needed to use non-parametric tests such as Wilcoxon's signed-rank (WSR) test and the signed test to assess the medians of abnormal ROA in each event period, in addition to the t-tests on means and medians. In fact, observing abnormal performance by using the value of median is the norm in event studies. Median and percentile analyses are believed to be statistically more meaningful than just the mean values while reflecting upon the results of event studies (Yeung et al., 2011).

The median values for abnormal ROA from the first to the fourth year of BPV implementation are 0.002, 0.010, 0.001, 0.010 and 0.016, respectively. The results from the WSR test show that there are significant positive abnormal ROA figures in the second year (*t*+1) and the third year (*t*+2) of BPV ($p < 0.05$). The significantly positive abnormal ROA continues into the fourth (*t*+3) and the fifth (*t*+4) years at $p < 0.005$.

These WSR results are supported by results from the signed test with significant positive abnormal ROA median for all event periods. The p-values associated with the signed test conducted on abnormal ROA data, from the first (*t*+0) to the fifth (*t*+4) year following BPV introduction are 0.019, 0.004, 0.027, 0.002 and 0.005, respectively. These WSR results indicate significant positive performances (ROA) on the part of the firms; starting from year one subsequent to the introduction of BPV. The sign test even shows significant positive performance starting from the year of BPV. In the period of t-2 to t-1, there is no significant ROA changes among the sample firms (WSR test p=0.084; Signed test p=0.121). These results from WSR and the sign test confirm that the adoption of BPV is associated with the operational performance of firms, particularly in terms of ROA. Therefore, H4 is supported and we reject H5.

Table 12: Results Relating to Abnormal ROA testing

									p-Value (1-tailed)	
Period	N	Mean	Std. Dev.	Skew-ness	Kurt.	Med.	25th %	75th %	WSR Test	Signed test
t-2 to t-1	323	-0.020	0.539	-6.854	110.368	-0.004	-0.035	0.024	0.084	0.121
t-1 to t	323	-0.120	0.257	-10.508	151.950	0.002	-0.022	0.032	0.113	0.019 **
t-1 to t+1	290	-0.027	0.360	-11.277	147.228	0.010	-0.030	0.047	0.017 **	0.004 ***
t-1 to t+2	263	-0.011	0.346	-14.698	230.531	0.001	-0.032	0.050	0.021 **	0.027 **
t-1 to t+3	240	0.009	0.098	-1.513	8.180	0.010	-0.025	0.051	0.002 ***	0.002 ***
t-1 to t+4	209	0.010	0.009	-1.387	7.746	0.016	-0.034	0.060	0.004 ***	0.005 **

* p<0.05 ** p<0.01*** p<0.001
t is the year of BPV

5.3 Results from HLA with Predicted Controls

Prior to performing our HLA analysis, we conducted a linear collinearity test for the independent variables in our regression models (Table 13a). Note that extensiveness of customer contact, process orientation (customer/non-customer oriented process), market

share, and industry concentration do not exhibit significant linear collinearity with our dependent variable (abnormal ROA). Only firm size and financial ability are linearly correlate with abnormal ROA. Firm size and financial ability are included as the control variables in the regression models used in our analysis. From the VIF analysis (Table 13b), extensiveness of customer contact in model 1 and process orientation in model 2 both exhibit low VIF value associated with independent variable – abnormal ROA. On the other hand, market share in model 3 (8.967) and model 4 (15.501) exhibit high VIF. However, consider its part correlations in all model are, and it has no significant linear correlation with abnormal ROA, we therefore confirm to employ all of our predicted dependent variables, including market share, with regard to the dependent variable (abnormal ROA) in our HLA analysis.

Table 13a: Linear Collinearity Analysis

		Firm Size	Financial Ability	Employee Share	Year Dummy	Extensiveness of Customer Contact	Process Orientation (customer/non-customer oriented process)	Market Share	Industry Concentration
Abnormal ROA	Pearson Correlation	0.186 **	0.120 **	0.036	0.049	0.320	0.101	0.029	0.022
	Sig. (2-tailed)	0.000	0.000	0.199	0.075	0.250	0.002	0.283	0.420
	N	1325	975	1276	1325	1325	907	1325	1325
Firm Size	Pearson Correlation		0.485 **	0.456 **	0.054	-0.146 **	-0.250 **	0.470 **	0.170 **
	Sig. (2-tailed)		0.000	0.000	0.051	0.000	0.000	0.000	0.000
	N		975	1276	1325	1325	907	1325	1325
Financial Ability	Pearson Correlation			0.275 **	0.054	0.004	-0.172 **	0.287 **	0.138 **
	Sig. (2-tailed)			0.000	0.051	0.912	0.000	0.000	0.000
	N			1276	1325	975	658	975	975
Employee Share	Pearson Correlation				0.006	0.102 **	-0.067 *	0.902 **	0.614 **
	Sig. (2-tailed)				0.831	0.000	0.050	0.000	0.000
	N				276	1276	868	1276	1276
Year Dummy	Pearson Correlation					-0.033	-0.035	0.011	0.013
	Sig. (2-tailed)					0.233	0.292	0.686	0.627
	N					1325	907	1325	1325
Extensiveness of Customer Contact	Pearson Correlation						0.128 **	0.142 **	.197**
	Sig. (2-tailed)						0.000	0.000	0.000
	N						907	1325	1325
Process Orientation (customer/non-customr oriented process)	Pearson Correlation							-0.033	0.062
	Sig. (2-tailed)							0.323	0.062
	N							907	907
Market Share	Pearson Correlation								0.688 **
	Sig. (2-tailed)								0.000
	N								1325

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 14b: Multicollinearity and VIF Analysis

	Control Model			Model 1			Model 2			Model 3			Model 4		
	Correlation	Multicollinearity		Correlation	Multicollinearity		Correlation	Multicollinearity		Correlation	Multicollinearity		Correlation	Multicollinearity	
	Part	Tolerance	VIF	Part	Tolerance	VIF	Part	Tolerance	VIF	Part	Tolerance	VIF	Part	Tolerance	VIF
Firm Size	0.179	0.664	1.505	0.189	0.648	1.543	-0.010	0.592	1.691	0.184	0.648	1.543	0.020	0.517	1.935
Financial Abillity	0.029	0.762	1.312	0.027	0.762	1.312	0.169	0.747	1.339	0.030	0.720	1.312	0.164	0.743	1.345
Employee Share	-0.065	0.800	1.250	-0.080	0.765	1.307	-0.290	0.808	1.237	0.023	0.115	8.691	0.024	0.076	13.149
Year Dummy	0.034	0.998	1.002	0.036	0.998	1.002	0.085	0.997	1.003	0.033	0.998	1.002	0.083	0.997	1.003
Extensiveness of Customer Contact				0.081	0.949	1.054							0.028	0.931	1.074
Process Orientation (customer/non customer oriented process)							0.122	0.889	1.112				0.115	0.889	1.125
Market Share										-0.051	0.011	8.967	-0.061	0.065	15.501
Industry Concentration													0.073	0.346	2.892

Table 15: Results of HLA Analysis

	Control Model				Model 1				Model 2				Model 3				Model 4			
	B	Std Err	Beta		B	Std Err	Beta		B	Std Err	Beta		B	Std Err	Beta		B	Std Err	Beta	
Intercept	-0.263	0.038		***	-0.272	0.040		***	-0.050	0.019		**	-0.271	0.039		***	-0.061	0.020		***
Firm Size	0.033	0.006	0.219	***	0.035	0.006	0.235	***	-0.001	0.002	-0.013		0.034	0.006	0.229	***	0.001	0.003	0.028	
Financial Ability (S&P Ranking)	0.005	0.006	0.034		0.005	0.006	0.031		0.009	0.002	0.195	***	0.005	0.006	0.034		0.009	0.002	0.190	***
Percentage of Worker Hired in Industry	-0.355	0.174	-0.072	***	-0.450	0.178	-0.091	**	-0.045	0.060	-0.032		0.334	0.459	0.068		0.120	0.196	0.085	
Year Dummy	0.007	0.007	0.034		0.008	0.007	0.036		0.006	0.002	0.085		0.007	0.007	0.033		0.005	0.002	0.083	
Extensiveness of Customer Contact (H6)					0.053	0.021	0.083	**									0.006	0.008	0.029	
Customer Oriented / Non Customer Oriented Process (H7)									0.027	0.008	0.129	***					0.025	0.008	0.025	***
Market Share (H8)													-0.745	0.459	-0.154	*	-0.344	0.219	-0.239	***
Industry Concentration (H9)																	0.091	0.049	0.123	**
R Square	0.047				0.053				0.044				0.049				0.052			
Anova Significance	0.000				0.000				0.000				0.000				0.000			

* p <0.1 ** p <0.05 *** p< 0.005

Table 14 reports the results from our HLA analysis. The dependent variable is abnormal performance (abnormal ROA) of the sample firms that had implemented BPV. Firm size, financial ability, employee share, and year dummy are the control variables. We first test BPV performance at the industry-level by including extensiveness of customer contact using the control variables adopted in Model 1. Results show extensiveness of customer contact has significant predictive power with respect to the abnormal performance of the BPV firms (beta = 0.083, $p < 0.05$). Recall that we had assigned a dummy value equal to 0 to firms with lower extensiveness of customer contact with 2-digit SIC codes a dummy value of 1 for high extensiveness of customer contact firms with other SIC codes. The results show that extensive customer contact firms (extensiveness of customer dummy = 1) benefit more from BPV than firms with low customer contact extensiveness. Therefore, H6 is supported.

To test the predictive power of customer and non-customer orientated processes on BPV performance, we removed the customer contact intensity variable. Instead, we included the process orientation in the regression model to determine process level non-

observation in Model 2. As for customer orientaed processes, we used a dummy value of 1. For non-customer oriented processes, we used a dummy value of 0. As for mixed and undetermined types, we simply excluded them. The application of Model 2 confirmed that process orientation has significant predictive power with respect to abnormal performance (beta = 0.129, $p < 0.005$). Therefore, Model 2 can be taken to have been validated and that customer oriented processes is associated with better BPV performance. Therefore, H7 is supported.

Model 3 tests market share as a contingent factor while predicting BPV performance. We had tested market share (industrial sales share) with the control variables. We found that market share has significant negative prediction relationship (beta = -0.154, $p < 0.1$) with regard to the BPV performance of firms. Although 0.05 is general adopted as the level of statistical significant, to prevent type I error and as a ground work for future research, we choose to adopt a looser significant level of 0.1. Result shows that firms with lower market shares in the respective industry benefit more from BPV. H7 is supported. Since we are adopting a lower statistical significance, we will also rely on the result of model 4 for the robustness of the observation regarding market share.

Model 4 is the full model in our HLA analysis. With a view to controlling the pre-possession of company resources from assets, financial, and human resources (i.e., firm size, financial ability, and employee share), we had included industry concentration (Herfindahl Index) values together with extensiveness of customer contact, process orientation, and market share in our full regression model. Following the model, process orientation ($p < 0.005$), market share ($p < 0.005$), and industry concentration ($p < 0.05$)

significantly predict the performance of BPV. Since the beta and p-values of the process orientation, market share, and industry concentration remain significant (beta = 0.025, p < 0.005; beta = -0.239, p < 0.005; beta = 0.123, p = <0.005), the full model provides additional support to H7 and H8). Model 4 also indicates that industry concentration has a positive, significant prediction relationship with BPV performance. A Herfindahl index value close to 1 suggests that the industry is controlled by a small number of firms (higher concentration). Therefore, a positive value of beta shows that firms in industries with higher concentration benefit more from BPV. Therefore, H9 is supported.

5.4 Results from HLA with Further Control on Pre-event Performance

Although we have controlled pre-event resources (firm size in terms of pre event total asset), financial strength (financial ability in terms of pre event S&P's financial rating), and the human resources of firms (pre-event employee share in the industry), it must be recognized that the soft sides of operational and managerial abilities could also influence post-event performances of BPV firms. With regard to robustness, following Liu et al. (2014), we performed another set of HLA analysis that included pre-event performances (pre-event ROA values) of firms as controls. Table 16 shows that R^2 values associated with all models after including pre-event performances have improved (control model: 0.047, model 1: 0.053, model 2: 0.044, model 3: 0.049, model 4: 0.052 and Table 16 (control model: 0.312, model 1: 0.314, model 2: 0.070, model 3: 0.318, model 4: 0.089). Although the R^2- values for models 2 and 4 in Table 16 are lower than those for the control model; they are larger than the values for the corresponding models in Table 14.

This suggests that each model is describing higher populations of the samples arising from the addition of pre-event performances (pre-event ROA values) as control variables.

Table 16a: Linear Collinearity Analysis (Include Pre event Performance)

		Pre Event Performance	Firm Size	Financial Ability	Employee Share	Extensiveness of Customer Contact	Process Orientation (customer/non-customer oriented process)	Market Share	Industry Concentration
Abnormal ROA	Pearson Correlation	0.721 **	0.218 **	0.100	0.039	0.039	0.107	0.034	0.033
	Sig. (2-tailed)	0.000	0.000	0.133	0.491	0.484	0.111	0.542	0.558
	N	323	323	226	312	323	224	323	323
Pre Event Performance	Pearson Correlation		0.349 **	0.181 **	0.070	0.015	-0.070	0.057	0.003
	Sig. (2-tailed)		0.000	0.007	0.221	0.790	0.295	0.307	0.958
	N		323	226	312	323	224	323	323
Firm Size	Pearson Correlation			0.492 **	0.460 **	-0.153 **	-0.237 **	0.468 **	0.181 **
	Sig. (2-tailed)			0.000	0.000	0.006	0.000	0.000	0.001
	N			226	312	323	224	323	323
Financial Ability	Pearson Correlation				0.297 **	0.026	-0.152	0.302 **	0.155 *
	Sig. (2-tailed)				0.000	0.692	0.058	0.000	0.020
	N				222	226	156	226	226
Employee Share	Pearson Correlation					0.085	-0.060	0.900 **	0.608 **
	Sig. (2-tailed)					0.134	0.381	0.000	0.000
	N					312	215	312	312
Extensivess of Customer Contact	Pearson Correlation						0.148 *	0.121 *	0.176 **
	Sig. (2-tailed)						0.026	0.030	0.001
	N						224	323	323
Process Orientation (customer/non-customer oriented process)	Pearson Correlation							-0.022	0.057
	Sig. (2-tailed)							0.745	0.397
	N							224	224
Industry Concentration	Pearson Correlation								0.690 **
	Sig. (2-tailed)								0.000
	N								323

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 17b: Multicollinearity and VIF Analysis (Include Pre event Performance)

	Control Model			Model 1			Model 2			Model 3			Model 4		
	Correlation	Multicollinearity		Correlation	Multicollinearity		Correlation	Multicollinearity		Correlation	Multicollinearity		Correlation	Multicollinearity	
	Part	Tolerance	VIF	Part	Tolerance	VIF	Part	Tolerance	VIF	Part	Tolerance	VIF	Part	Tolerance	VIF
Firm Size	0.039	0.619	1.614	0.046	0.602	1.681	-0.019	0.589	1.698	0.041	0.601	1.663	0.031	0.515	1.943
Financial Abillity	-0.021	0.755	1.324	-0.021	0.755	1.324	0.115	0.665	1.604	-0.020	0.755	1.324	0.088	0.644	1.554
Employee Share	-0.021	0.792	1.263	-0.023	0.755	1.324	-0.023	0.806	1.240	0.009	0.115	8.698	0.020	0.076	13.153
Year Dummy	0.013	0.997	1.003	0.015	0.996	1.004	0.079	0.995	1.005	0.013	0.997	1.003	0.072	0.993	1.007
Pre Event Performance	0.514	0.883	1.133	0.510	0.879	1.138	0.134	0.837	1.194	0.511	0.878	1.138	0.175	0.717	1.395
Extensiveness of Customer Contact				0.048	0.945	1.058							0.047	0.919	1.088
Process Orientation (customer / non customer oriented process)							0.115	0.897	1.115				0.098	0.881	1.135
Market Share										-0.015	0.111	9.012	-0.082	0.064	15.745
Industry Concentration													0.132	0.299	3.348

We also conducted linear collinearity check for the independent variables in our regression models (Table 15a). Our independent variables (extensiveness of customer contact, process orientation, market share, and industry concentration) for regression exhibit no significant linear correlation with our dependent variable (abnormal ROA). From the VIF analysis (Table 15b), market share and employee share in model 4 both exhibit high VIF value (15.745, 13.153) associated with independent variable – abnormal ROA. Since model is for the purpose of robust test, and we consider the part correlations of process orientation in all others model are low, we therefore decided continue to include it as predicted dependent variables with regard to the dependent variable (abnormal ROA) in our HLA analysis.

Table 18: Results of HLA Analysis (Further Control Pre event Performance)

	Control Model				Model 1				Model 2				Model 3				Model 4			
	B	Std Err	Beta		B	Std Err	Beta		B	Std Err	Beta		B	Std Err	Beta		B	Std Err	Beta	
Intercept	-0.125	0.033		***	-0.144	0.035		***	-0.052	0.019		***	-0.142	0.034		***	-0.074	0.020		***
Firm Size	0.007	0.005	0.049	*	0.009	0.005	0.060	***	-0.001	0.002	-0.025		0.010	0.005	0.067	**	0.002	0.003	0.043	
Financial Ability (S&P Ranking)	-0.004	0.005	-0.024		-0.004	0.005	-0.025		0.007	0.002	0.141	***	-0.004	0.005	-0.023		0.005	0.002	0.110	**
Percentage of Worker Hired in Industry	-0.071	0.149	-0.015		-0.129	0.152	-0.026		-0.035	0.060	-0.025		-0.557	0.223	-0.113	**	0.104	0.193	0.074	
Year Dummy	0.003	0.006	0.013		0.003	0.006	0.015		0.005	0.002	0.079	**	0.003	0.006	0.012		0.005	0.002	0.073	**
Pre Event Performance	0.626	0.033	0.547	***	0.622	0.033	0.543	***	0.128	0.036	0.146	***	0.632	0.033	0.552	***	0.180	0.039	0.207	***
Extensiveness of Customer Contact (H6)					0.031	0.018	0.049	**									0.010	0.008	0.049	*
Customer Oriented / Non Customer Oriented Process (H7)									0.025	0.008	0.121	***					0.022	0.008	0.104	**
Industry Concentration (H9)													0.332	0.114	0.121	***	0.179	0.051	0.241	***
Market Share (H8)																	-0.468	0.216	-0.326	**
R Square	0.312				0.314				0.070				0.318				0.089			
Anova Significance	0.000				0.000				0.000				0.000				0.000			

* p <0.1 ** p <0.05 *** p< 0.005

Even after adding pre-event performance as a control variable, extensiveness of customer contact continues to exhibit significant predictive power with regard to the abnormal performance of the BPV firms (beta = 0.049, $p < 0.05$ in Model 1, and beta = 0.049, $p < 0.1$ in model 4) as shown on table 16. Therefore, we can further confirm that

firms with higher extensiveness of customer contact (extensiveness of customer contact dummy = 1) benefit more from BPV than firms with lower extensiveness of customer contact. Thus H6 continues to be supported and, arguably, has been shown to be quite robust.

Model 2 results shown in Table 16 confirm that the process orientation has significant predictive power with respect to abnormal performance (beta = 0.121, $p < 0.005$) when pre-event performance is controlled. Thus, H7 is further supported. H8 and H9 are also further supported when pre-event performance is controlled ($p < 0.05$; $p < 0.005$) in models 3 and 4 respectively (see Table 16).

The new full models (Model 4), which have pre-event performance as control (Table 16) and without it as a control (Table 14), show similarly significant results with respect to the predicting variables as well. Together with control of the pre-possession of company resources in terms of assets, finances, and human resources (i.e., firm size, financial ability, and employee share), process orientation (beta = 0.104, $p < 0.05$), market share (beta = -0.326, $p < 0.05$), and industry concentration (beta = 0.241 $p < 0.005$) continue to predict the performance of BPV at a significant level.

5.5 Results from HLA to include Adoption Year (Additional Analysis)

According to Prof. Timon Du, BPV before year 2000 are more internal focused (e.g., ERP system) while BPV after year 2000 are more customer focused. Therefore, we created an additional hypothesis - H10. We hypothesize that the late adopter of BPV

(more customer focused) benefits firms more that the early adopters (more internal focused). A new dummy variable - adoption year is introduced. For BPVs before year 2000, we assigned value of 0. For BPVs after year 2000, we assigned value of 1. In model 1, adoption year demonstrate significant value of $p < 0.005$ and beta = 0.091. In model 5, adoption year demonstrate significant value of $p < 0.001$ and beta = 0.092. Extensiveness of customer contact continues to exhibit significant predictive power with regard to the abnormal performance of the BPV firms (beta = 0.049, $p < 0.05$ in Model 2, and beta = 0.016, $p < 0.05$ in model 5) as shown on table 17. Therefore, we have more evidence to indicate that customer related BPVs (late BPV after year 2000 are more customer focused) are positively associated with the operational performance of firms.

Table 19: Results of HLA Analysis (Include Adoption Year)

	Control Model				Model 1				Model 2				Model 3				Model 4				Model 5			
	B	Std Err	Beta		B	Std Err	Beta		B	Std Err	Beta		B	Std Err	Beta		B	Std Err	Beta		B	Std Err	Beta	
Intercept	-0.121	0.032		***	-15.004	4.396		***	-0.138	0.033		***	-0.043	0.018		***	-0.138	0.032		***	-5.112	2.233		**
Firm Size	0.007	0.005	0.049		0.006	0.005	0.039		0.009	0.005	0.060	*	-0.001	0.002	-0.025		0.010	0.005	0.067	*	0.001	0.003	0.028	
Financial Ability (S&P Ranking)	-0.004	0.005	-0.023		-0.003	0.005	-0.020		-0.004	0.005	-0.024		0.007	0.002	0.142	***	-0.004	0.005	-0.023		0.005	0.002	0.106	**
Percentage of Workers Hired in Industry	-0.072	0.149	-0.015		-0.690	0.148	-0.014		-0.130	0.152	-0.026		-0.037	0.060	-0.026		-0.559	0.223	-0.114	**	0.093	0.039	0.227	***
Pre Event Performance	0.626	0.033	0.547	***	0.638	0.033	0.557	***	0.623	0.033	0.544	***	0.131	0.037	0.150	***	0.632	0.033	0.552	***	0.198	0.039	0.227	***
Adoption Year (H10)					0.007	0.002	0.091	***													0.003	0.001	0.092	**
Extensiveness of Customer Contact (6)									0.031	0.018	0.049	*									0.012	0.008	0.061	*
Customer Oriented / Non Customer Oriented Process (H7)													0.025	0.008	0.119	***					0.016	0.009	0.078	*
Industry Concentration (H9)																	0.333	0.114	0.121	***	0.177	0.051	0.239	***
Market Share (H8)																					-0.470	0.216	-0.327	**
R Square	0.309				0.316				0.314				0.340				0.318				0.091			
Anova Significance	0.000				0.000				0.000				0.000				0.000				0.000			

* p <0.05 ** p <0.01 *** p< 0.005 (1-tailed)

Chapter 6: Discussion and Conclusions

6.1 BPV and Organizational Performance

Virtualization is spreading rapidly across business processes. Many physical and face-to-face interactions between firms and customers are being virtualized. Firms are employing new virtualization vehicles in order to keep up with market trends. The cost base reduction aspects of BPV are attractive to managers for adopting BPVs (Bharadwaj, 2000; Power & Singh, 2007; Zhu et al., 2006). Firm-customer interactions in a virtual mode run the risk of being unable to maintain interpersonal warmth and attentiveness. Satisfaction with and long-term adoption of BPV by customers have been uncertain. On the other hand, BPV allows firms to operate with fewer physical resources and increase in productivity, such as facilities and human resources. The usefulness and subsequent impact of BPV on firm performance have received little empirical attention so far. Our study has extended the work of Overby (2008) on process virtualization theory. By studying 323 virtualization cases, drawn from the period 1989−2011, we have found that virtualization of business processes can improve the operational performance of a firm in terms of labor productivity and ROA. Counter-intuitively, our empirical evidence indicates that virtualization is helpful particularly in promoting firm-customer interactions.

For a very long time, humans have been used to physical and face-to-face interactions. Humans are naturally resistant to virtual modes of interaction. Because it offers maximum social presence, we psychologically enjoy the transmission of communication

cues in some physical mode (Kock, 2004; Short et al., 1976). A sense of social presence does influence the psychological attachment of customers to firms. The absence of physical interaction in the virtual interactions have been criticized for holding a low sense of social presence (Kock, 2004). A lack of social presence affects the psychological attachment of customers to firms. It lowers customer identification with the firm and hence impacts the firm's business. Therefore, retention of customer commitment is put in jeopardy. However, our empirical evidence with respect to long-horizon events has shown that the operational performances of firms had not been decreased after the introduction of BPV. In fact, we have found that firm performance (labor productivity, ROA) improves after the introduction of BPV.

6.2 BPV and Contingency Factors

6.2.1 Customer Contact Characteristic Aspects

To better understand the effect of removing physical customer-firm interactions in BPV, we performed cross-section analyses of the BPV performances of firms at both the industry and process levels. Counter-intuitively, both results have shown that BPV does actually benefit firm-customer interactions. Service firms differ from manufacturing firms in terms of networking characteristics and orientations of customer-firm interactions. The operational networks of service firms are associated with higher numbers of nodes and links with customers whereas those of manufacturing firms relate to other business entities (Dean et al., 1997), such as the supplying companies. Even if some manufacturing firms had established direct selling paths to the respective markets,

traditionally, the numbers of their firm-customer links are smaller than those of services firms. At the organizational level, the extensiveness of such customer contact influences the maintenance and operations of firm-customer interaction with due regard to cost and effectiveness. By analyzing performance differences among firms with different customer contact extensiveness, we have been able to arrive at a first level evidence of the effects of BPV on firm-customer interaction. Our results show that BPV performs better in the more complex and more customer dependent networks, such as of the high customer contact extensiveness firms. In contrast to common intuition, we found that BPV does not negatively influence firm-customer interaction.

With a view to further examining firm-customer interaction in BPV, we analyzed our samples at the process-level according to the process classification of Bowersox et al. (2013). We have found that customer orientated processes perform better than non-customer oriented ones. Traditional relationship building methods are costly since they generally rely on sales persons and physical facilities to connect with the customers. BPV allows customers to engage with the firm's processes more extensively than possible with the traditional ways (Payne & Frow, 2005). Customers can approach firms and enquire about the services and products on offer in an environment encumbered by fewer restrictions with regard to access time and physical distance. This creates a stronger psychological attachment between customers and the firm, thus improving customer identification with the firm (Wang et al., 2013). Our process-level finding has supplemented our industry-level finding that BPV enhances firm-customer interactions. BPV reduces traditional costs of human and physical resources deployed by firms for the purpose of customer relationship maintenance. Our empirical evidences show that

BPV helps labor productivity, and overall operational performance in terms of abnormal ROA. In the absence of physical constraints dominating traditional interaction modes, firms today are able to expand their external networks with customers more extensively and quickly. From the perspective of the costs associated with relationship maintenance, customer engagement, as well as spanning capability and network expansion, BPV improves firm-customer interactions; it facilitates value co-creation on the part of the firm and its customers.

6.2.2 Competitive Environment Aspects

Possession of superior physical resources traditionally allows large firms to enjoy superior competitive advantages over smaller firms operating in the market. In general, due to resource advantages, large firms usually exhibit a greater capability to employ more sales persons and open more branches to connect with customers and to improve marketing. Therefore, while operating in the physical mode in terms of physical networking, smaller firms find it difficult to compete with large firms in terms of economic of scale and possession of resource. By contrast, BPV provides leveraging benefit to small firms to compete better against large firms by enabling virtual interactions with customers. Our results have shown that, by employing BPV, firms with low market shares realize higher increases in operational performance than firms with higher market shares. Wasko et al. (2011) argue that, relative to SMEs, the emerging virtual mode of interaction is leveling the competitive advantage of multinational firms. Our study has provided empirical evidence in support of this contention. While

connecting with their customers and showcasing their products, smaller firms adopting BPV need fewer physical resources such as hiring sales persons, opening store branches, and printing and mailing catalogs. Therefore, they can concentrate more on the development of innovative products and services. This helps them gain extra market share. Virtual platforms reduce physical constraints while connecting their products and services to the market. As a result, smaller firms are better able to compete with much larger firms in terms of market share by demonstrating superior operational performance.

Market concentration also impacts the efforts required by a firm while it seeks to enter the industry of interest and compete for increased market share. Markets with high industry concentrations (high Herfindahl index values) are dominated by small numbers of firms. When the market is substantially pre-occupied, customers exhibit a tendency to attach with existing firms with which they have been interacting historically. Switching from or starting a new relationship involves cost and time. It can also involve risk in view of possible failure of the new relationship. First of all, so as to induce the customers to switch, the products and the services offered by newly entering firms need to be superior in terms of cost and quality. Furthermore, firms seeking to build new networks within a high concentration market require exceptional firm-customer interaction while showcasing their products and services. This is why we had to include industry concentration in our full model (Model 4). Our empirical data have demonstrated that, firms adopting BPV outperform existing firms, particularly in highly concentrated markets. BPV is especially helpful to low-market-share firms operating in an oligopoly.

Chapter 7: Managerial and Theoretical Implications

7.1 An Effective Business Trend and Strategy

Following advancements in information technology, new BPV tools have kept emerging in recent times. In particular, younger customers are demanding ever-greater use of virtual tools. To adopt BPV, firms need to step beyond traditional ways of effecting firm-customer interactions. Instead of relying on physical, face-to-face interactions, firm-customer interactions need to embrace the virtual mode. Moves towards virtual modes of firm-customer interaction should be seen by everyone as the ones of great strategic significance. Starting from the assessment stage, human resource re-allocation, training, changes in operating procedures, and revamping other corporate resources need to be continued until BPV has been internally institutionalized. The journey is referred to as the assimilation process of a firm (Fichman, 2001; Zhu et al., 2006). Business managers should not abandon BPV in view of the assimilation efforts needed. Although business processes can have different degrees of virtualizability and different levels of effort needed during virtualization, our study has demonstrated that BPV does enhance operational performance especially with respect to customer oriented business processes. Older customers may not respond to BPV initially as well as younger ones (Wasko et al., 2011), but we need to remember that young customers will mature in time. Therefore, the numbers of customers demonstrating high BPV adoption can be expected to keep increasing. By monitoring the acceptance of BPV among different customer groups and

providing effective assistance, training, and care for each customer segment, BPV can turn into an effective strategy for improving business performance.

Basing on intuition, many studies have argued that human beings resist virtual modes of interactions. Physical modes of interaction are believed to build better attachments among people. However, our empirical findings have shown that this is not necessarily true with respect to business processes. Virtual modes of firm-customer interactions are quite effective in terms of speed and quality. Physical, face-to-face interaction may provide communication cues at a high speed and quality, but that may not be actually beneficial to all business process participants. For example, while gathering customer enquiries on products, customers generally prefer to make the problem known to the firm and receive a solution in the shortest time. Face-to-face communications with the firm's support staff can achieve better attentiveness on the part of the customers. However, in the physical interaction between the support staff and the customer, both are involved emotionally in the resulting dynamics and uncertainty. The quality of the services provided by support staff can emotionally affect customers. On the other hand, although training could improve the performance of the supporting staff, high speed and real time interactions impact supporting staff at an emotional level too. Over time, this will affect the performance of the staff and the quality of support being received by customers.

7.2 Protection of Relationships

Physical, face-to-face interactions between a firm and its customers get eliminated in virtualized business processes. Customers and firms do not exchange gestures, postures, or inflections during interactions. Although the quality of communication cues may have been lowered (Kock, 2004), the emotions experienced by the parties are not transmitted. Because customers and firms are not in the same physical setting and have no face-to-face interaction (Bloomfield, 2007), the emotional states of the customers and servicing staff do not interfere as much as they do in the physical mode. As a result, interactions become more focused on the product and issue resolution. Even though the speed of information transmission might have been lowered in comparison to physical modes, a protection barrier is also formed between customers and firms. Unlike with traditional relationship building, BPV acts as a cushion blocking unnecessary emotional communication cues and allowing participants to focus on the context of the business process.

Communication theories and interpersonal deception theory state that facial expressions communicate emotions such as anger and sadness in universally recognized manners across cultures (Burgoon, Buller, Dillman, & Walther, 1995). However, individuals are not always able to control facial expressions in face-to-face interpersonal communications. Further, the display and the use of facial expressions also varies across cultures (Burgoon & Buller, 1996). Scholars have also found that non-face-to-face interaction could sometimes reduce hurting actions and verbal conflicts between communication participants. It could also preserve and enforce relationships by

protecting process participants from getting into conflict (Griffin, 2012). Along with open communications, the quality of products and services are prominent elements in any business process. Effective firm-customer interaction does not depend just on openness, but also on many psychological factors and customer categorization with firms (Loken, 2006). The removal of face-to-face and physical interaction following the adoption of BPV should protect firms and customers from conflicts arising from verbal and physical interactions.

Our findings on BPV support the above views. The removal of physical interaction in business processes through BPV could have affected the performance of service firms as they rely a lot on effective firm-customer interaction. Counter-intuitively, our evidences show that virtual mode of interaction is helping both firms with extensive customer contact and customer oriented processes to achieve better operational performance. It is suggested that virtual mode of interactions in business processes is not necessarily ineffective. On the other hand, it can protect the firm from conflicts that might arise if the firm had continued with the traditional way of physical interaction in business processes.

Finally, our study confirms the general value of BPV and we found that it is helpful in the external relationship of firms. Distinguished from the study of e-commerce, IT, and automation, we study BPV as a phenomenon of the removal of human physical interaction in the business sector. We tried to under BPV from the perspectives of market competition, stakeholder interaction and boundary spanning capability.

Chapter 8: Limitations and Suggestions for Further Study

By measuring BPV at the industry-level using SIC-codes and the guidelines provided by Bowersox et al. (2013) with regard to customer orientation at the process-level, we have found that service firms (firm type) and customer oriented business processes (process type) perform well by implementing virtualization. We believe that service firms engage more intensively than manufacturing firms in customer related business processes. Following supplemental findings cutting across firms of the process type to service type, we conclude that BPV does not necessarily harm customer encounter. Our study has relied on SIC-codes to distinguish between service firms and manufacturing firms. While a firm type is a self-declaration on the part of the firm, the distinction between manufacturing and services is becoming less clear-cut. Hence, future researchers may consider identifying a new industry-level base to distinguish between firm types.

Our samples were based on announcements and news collected from the archival database of Thomson Reuters. Since the announcements and the news might not have appeared subsequent to BPV introduction, we arrived at our process classifications on the basis of keywords contained in the announcements or news in accordance with the guidelines provided by Bowersox et al. (2013). Future studies may consider other methodologies; such as surveys of firms adopting BPV. Further, data repositories in other countries might not be as reliable as those in the U.S. While studying cultural differences with regard to the effects of BPV in other developing countries, such as China and India, future researchers might want to study other forms of interviews and

surveys. In addition to cultural influences in the implementation of BPV, markets are growing rapidly in China and India. Many new businesses of all sizes are starting in these countries. Due to the prevailing business practices and cultural differences, it is not unlikely that the findings of our BPV studies base on U.S. data do not fully apply elsewhere.

Our study has extended the work of Overby (2008) and provided empirical evidence supporting the assertion that BPV is helpful especially to low-market-share firms while penetrating an oligopoly market. We have studied both firm level and process level. However, Wasko et al. (2011) have suggested that customer age also determines the acceptance level of BPV. Since customers of different ages exhibit different levels of adaptability and preferences with regard to products and processes, the resulting influence of the conjunction of age, product, and process have not been studied in the context of BPV. Specific firms might provide products and services targeted for individual customer generations. These factors have not been included within the scope of our study. Further studies could do well by looking at product type—for example, perishable, and grocery—and age groups of customers to further generalize the applicability of process virtualization theory.

BPV is perhaps the most important phenomenon affecting changes in human interactions since the advent of automation (Overby, 2008). We have discussed the positive abnormal performance and contingency findings associated with BPV from the perspective of changing physical interactions. We have also utilized communication theories while examining relationships among process participants. Many contemporary

BPV projects are facilitated by IT. Therefore, researchers might do well by studying BPV from system and human interaction perspectives, e.g., from the perspective of systems theory. Systems theory concerns interactions among artifacts and other resources like human resources (Ducq, Chen, & Doumeingts, 2012). Future studies could extend our dyadic study of firm-customer interaction into the triadic space (firm-customer-supplier) in the sense of supply chain by including other plausible factors, such as customer variability, sensory requirement, relationship requirement, control requirement, and synchronizing requirement that might influence virtualization in the business sector.

Appendix A - Sample Classification Guideline (Bowersox et al., 2013)

Business Process	Tasks	Process Orientation Type
Customer Relation Management	Customer Relationship Management	Customer
	Forecasting	
	Demand Management	
	Collaborative Planning, Forecasting and Replenishment	
	Order Management	
Inventory Deployment	Integrated Inventory Planning	Customer
Logistics	Finished Inventory Management	Mixed (Customer/Internal/Supplier)
	Order Processing	
	Warehouse Management	
	Transportation Management	
	Yard Management	
	Accounts Receivable Interface	
Manufacturing	Manufacturing Resource Planning	Internal
	Capacity Management Planning	
	Master Production Schedule	
	Productions Execution and Control	
	Quality Management	
Purchasing	Purchase Order Administration	Supplier
	Materials Requirements Planning	
	Supplier Relationship Management	
	Accounts Payable Interface	

Appendix B – Mapping of Extensiveness of Customer Contact

Sic Code	Industry	Extensiveness of Customer Contact
01-09	Agriculture, Forestry	Low
10-14	Mining	Low
15-17	Construction	Low
20-39	Manufacturing	Low
40-49	Tranportation & Public Utillities	Low
50-51	Wholesale Trade	High
52-59	Retail Trade	High
60-67	Finance, Insurance	High
70-89	Services	High
91-99	Public Administration	High

References

Adam Jr, E. E. (1994). Alternative quality improvement practices and organization performance. *Journal of Operations Management, 12*(1), 27-44. doi:http://dx.doi.org/10.1016/0272-6963(94)90004-3

Apte, U. M., & Mason, R. O. (1995). Global Disaggregation of Information-intensive Services. *Management Science, 41*(7), 1250-1263.

Arbaugh, J. B. (2000). Virtual classroom versus physical classroom: An exploratory study of class discussion patterns and student learning in an asynchronous Internet-based MBA course. *Journal of Management Education, 24*(2), 213-233.

Atrostic, B. K., & Nguyen, S. V. (2005). IT AND PRODUCTIVITY IN U.S. MANUFACTURING: DO COMPUTER NETWORKS MATTER? *Economic Inquiry, 43*(3), 493-506. doi:10.1093/ei/cbi033

Barber, B. M., & Lyon, J. D. (1996). Detecting abnormal operating performance: The empirical power and specification of test statistics. *Journal of Financial Economics, 41*(3), 359-399. doi:http://dx.doi.org/10.1016/0304-405X(96)84701-5

Benner, M. J., & Veloso, F. M. (2008). ISO 9000 practices and financial performance: A technology coherence perspective. *Journal of Operations Management, 26*(5), 611-629. doi:10.1016/j.jom.2007.10.005

Bharadwaj, A. S. (2000). A RESOURCE-BASED PERSPECTIVE ON INFORMATION TECHNOLOGY CAPABILITY AND FIRM PERFORMANCE: AN EMPIRICAL INVESTIGATION. *MIS Quarterly, 24*(1), 169-196.

Bloom, M., & Milkovich, G. T. (1998). RELATIONSHIPS AMONG RISK, INCENTIVE PAY, AND ORGANIZATIONAL PERFORMANCE. *Academy of Management Journal, 41*(3), 283-297. doi:10.2307/256908

Bloomfield, R. J. (2007). Worlds for study: Invitation—Virtual worlds for studying real-world business (and law, and pol- itics, and sociology, and...). *Johnson Graduate School of Management, Cornell University, Ithaca, NY.*

Boothby, D., Dufour, A., & Tang, J. (2010). Technology adoption, training and productivity performance. *Research Policy, 39*(5), 650-661. doi:10.1016/j.respol.2010.02.011

Bowersox, D., Closs, D., Cooper, M., & Bowersox, J. C. (2013). *Supply Chain Logistics Management* (Fourth ed.). New York: McGraw-Hill.

Boyer, K., & Hult, G. (2006). Customer behavioral intentions for online purchases: An examination of fulfillment method and customer experience level. *Journal of Operations Management, 24*(2), 124-147. doi:10.1016/j.jom.2005.04.002

Breidbach, C. F., Kolb, D. G., & Srinivasan, A. (2013). Connectivity in Service Systems: Does Technology-Enablement Impact the Ability of a Service System to Co-Create Value? *Journal of Service Research, 16*(3), 428-441. doi:10.1177/1094670512470869

Burgoon, J. K., & Buller, D. B. (1996). Interpersonal Deception Theory. *Communication Theory, 6*(3), 311-328. doi:10.1111/j.1468-2885.1996.tb00132.x

Burgoon, J. K., Buller, D. B., Dillman, L., & Walther, J. B. (1995). Interpersonal Deception. *Human Communication Research, 22*(2), 163-196. doi:10.1111/j.1468-2958.1995.tb00365.x

Carlsson, B. (1989). Flexibility and the theory of the firm. *International Journal of Industrial Organization, 7*(2), 179-203. doi:http://dx.doi.org/10.1016/0167-7187(89)90018-0

Carlsson, B. (1992). Management of flexible manufacturing: An international comparison. *Omega, 20*(1), 11-22. doi:http://dx.doi.org/10.1016/0305-0483(92)90052-9

Chadwick, C., & Dabu, A. (2009). Human Resources, Human Resource Management, and the Competitive Advantage of Firms: Toward a More Comprehensive Model of Causal Linkages. *Organization Science, 20*(1), 253-272.

Chase, R. B., & Tansik, D. A. (1983). THE CUSTOMER CONTACT MODEL FOR ORGANIZATION DESIGN. *Management Science (pre-1986), 29*(9), 1037.

Choi, T., & Wu, Z. (2005). Supplier–supplier relationships in the buyer–supplier triad: Building theories from eight case studies. *Journal of Operations Management, 24*(1), 27-52. doi:10.1016/j.jom.2005.02.001

Choi, T., & Wu, Z. (2009). Taking the leap from dyads to triads: Buyer–supplier relationships in supply networks. *Journal of Purchasing and Supply Management, 15*(4), 263-266. doi:http://dx.doi.org/10.1016/j.pursup.2009.08.003

Chong, A. Y.-L., & Zhou, L. (2014). Demand chain management: Relationships between external antecedents, web-based integration and service innovation performance. *International Journal of Production Economics, 154*, 48-58. doi:10.1016/j.ijpe.2014.04.005

Cook, L. S., Bowen, D. E., Chase, R. B., Dasu, S., Stewart, D. M., & Tansik, D. A. (2002). Human issues in service design. *Journal of Operations Management, 20*, 159-174.

Corbett, C. (2005). *Outsourcing: The Next Ten years*. Retrieved from

da Silva Gonçalves Zangiski, M. A., Pinheiro de Lima, E., & Gouvea da Costa, S. E. (2013). Organizational competence building and development: Contributions to operations management. *International Journal of Production Economics, 144*(1), 76-89. doi:10.1016/j.ijpe.2013.01.021

Daft, R. L., & Lengel, R. H. (1986). ORGANIZATIONAL INFORMATION REQUIREMENTS, MEDIA RICHNESS AND STRUCTURAL DESIGN. *Management Science, 32*(5), 554-571.

Dean, J., Holmes, S., & Smith, S. (1997). Understanding Business Networks: Evidence from the Manufacturing and Service Sectors in Australia. *Journal of Small Business Management, 35*(1), 78-84.

Dhawan, R. (2001). Firm size and productivity differential: theory and evidence from a panel of US firms. *Journal of Economic Behavior & Organization, 44*(3), 269-293. doi:http://dx.doi.org/10.1016/S0167-2681(00)00139-6

Ducq, Y., Chen, D., & Doumeingts, G. (2012). A contribution of system theory to sustainable enterprise interoperability science base. *Computers in Industry, 63*(8), 844-857. doi:http://dx.doi.org/10.1016/j.compind.2012.08.005

Fama, E. (1998). Market efficiency, long-term returns, and behavioral finance1. *Journal of Financial Economics, 49*(3), 283-306. doi:http://dx.doi.org/10.1016/S0304-405X(98)00026-9

Fama, E., & Jensen, M. (1983). Separation of ownership and control. *Journal of Law and Economics, 26*(2), 301-325.

Fichman, R. G. (2001). THE ROLE OF AGGREGATION IN THE MEASUREMENT OF IT-RELATED ORGANIZATIONAL INNOVATION. *MIS Quarterly, 25*(4), 427-455.

Fiol, C. M., & O'Connor, E. J. (2005). Identification in Face-to-Face, Hybrid, and Pure Virtual Teams: Untangling the Contradictions. *Organization Science, 16*(1), 19-32.

Frei, F. X. (2006). BREAKING THE TRADE-OFF Between Efficiency and Service. *Harvard Business Review, 84*(11), 92-101.

Friedman, E. J., & Resnick, P. (2001). The Social Cost of Cheap Pseudonyms. *Journal of Economics & Management Strategy, 10*(2), 173-199.

Goffin, K., Lemke, F., & Szwejczewski, M. (2006). An exploratory study of 'close' supplier–manufacturer relationships. *Journal of Operations Management, 24*(2), 189-209. doi:10.1016/j.jom.2005.05.003

Griffin, E. A. (2012). *A first look at communication theory* (8th ed.). New York, N.Y.: McGraw-Hill.

Gunasekaran, A., & Ngai, E. W. T. (2011). The future of operations management: An outlook and analysis. *International Journal of Production Economics*. doi:10.1016/j.ijpe.2011.11.002

Guthrie, J. P., & Datta, D. K. (2008). Dumb and Dumber: The Impact of Downsizing on Firm Performance as Moderated by Industry Conditions. *Organization Science, 19*(1), 108-123.

Hendricks, K. B., & Singhal, V. R. (1997). Does implementing an effective TQM program actually improve operating performance? Empirical evidence from firms that have won quality awards. *Management Science, 49*(3), 1258.

Hendricks, K. B., & Singhal, V. R. (2008). The Effect of Product Introduction Delays on Operating Performance. *Management Science, 54*(5), 878-892. doi:10.1287/mnsc.1070.0805

Hendricks, K. B., Singhal, V. R., & Stratman, J. K. (2007). The impact of enterprise systems on corporate performance: A study of ERP, SCM, and CRM system implementations. *Journal of Operations Management, 25*(1), 65-82. doi:10.1016/j.jom.2006.02.002

Huang, M. H., & Rust, R. T. (2013). IT-Related Service: A Multidisciplinary Perspective. *Journal of Service Research, 16*(3), 251-258. doi:10.1177/1094670513481853

Jarvenpaa, S. L., & Leidner, D. E. (1999). Communication and Trust in Global Virtual Teams. *Organization Science, 10*(6), 791-815.

Kalaignanam, K., & Varadarajan, R. (2011). Offshore outsourcing of customer relationship management: conceptual model and propositions. *Journal of the Academy of Marketing Science, 40*(2), 347-363. doi:10.1007/s11747-011-0291-0

Kamp, B. (2005). Formation and evolution of buyer–supplier relationships: Conceiving dynamism in actor composition of business networks. *Industrial Marketing Management, 34*(7), 658-668. doi:10.1016/j.indmarman.2005.04.006

Karmarkar, U. S., & Apte, U. M. (2007). Operations management in the information economy: Information products, processes, and chains. *Journal of Operations Management, 25*(2), 438-453. doi:10.1016/j.jom.2006.11.001

Kehrwald, B. (2008). Understanding social presence in text-based online learning environments. *Distance Education, 29*(1), 89-106. doi:10.1080/01587910802004860

Kim, T. H., Lee, J.-N., Chun, J. U., & Benbasat, I. (2014). Understanding the effect of knowledge management strategies on knowledge management performance: A contingency perspective. *Information & Management, 51*(4), 398-416. doi:10.1016/j.im.2014.03.001

Kock, N. (2004). The Psychobiological Model: Towards a New Theory of Computer-Mediated Communication Based on Darwinian Evolution. *Organization Science, 15*(3), 327-348.

Lewis, M. A. (2007). Charles Babbage: Reclaiming an operations management pioneer. *Journal of Operations Management, 25*(2), 248-259. doi:10.1016/j.jom.2006.08.001

Liu, X., Yeung, A. C. L., Lo, C. K. Y., & Cheng, T. C. E. (2014). The moderating effects of knowledge characteristics of firms on the financial value of innovative technology products. *Journal of Operations Management, 32*(3), 79-87. doi:10.1016/j.jom.2013.11.003

Lo, C. K. Y., Wiengarten, F., Humphreys, P., Yeung, A. C. L., & Cheng, T. C. E. (2013). The impact of contextual factors on the efficacy of ISO 9000 adoption. *Journal of Operations Management, 31*(5), 229-235. doi:10.1016/j.jom.2013.04.002

Lo, C. K. Y., Yeung, A. C. L., & Cheng, T. C. E. (2009). ISO 9000 and supply chain efficiency: Empirical evidence on inventory and account receivable days. *International Journal of Production Economics, 118*(2), 367-374. doi:10.1016/j.ijpe.2008.11.010

Loken, B. (2006). Consumer psychology: categorization, inferences, affect, and persuasion. *Annu Rev Psychol, 57*, 453-485. doi:10.1146/annurev.psych.57.102904.190136

McGrath, J. E., & Martin, J. (1982). *The study of research choices and dilemmas*. Newbury Park, CA: Sage.

Mersha, T. (1990). Enhancing the customer contact model. *Journal of Operations Management, 9*(3), 391-405. doi:http://dx.doi.org/10.1016/0272-6963(90)90162-7

Moeller, S., Ciuchita, R., Mahr, D., Odekerken-Schroder, G., & Fassnacht, M. (2013). Uncovering Collaborative Value Creation Patterns and Establishing Corresponding Customer Roles. *Journal of Service Research, 16*(4), 471-487. doi:10.1177/1094670513480851

Nambisan, S., & Baron, R. A. (2009). Different Roles, Different Strokes: Organizing Virtual Customer Environments to Promote Two Types of Customer Contributions. *Organization Science, 21*(2), 554-572. doi:10.1287/orsc.1090.0460

Nolan, R. (1994). Note on Estimating the Value ofthe IT Asset. *Harvard Business School Note, 9*, 195-197.

Overby, E. (2008). Process Virtualization Theory and the Impact of Information Technology. *Organization Science, 19*(2), 277-291. doi:10.1287/orsc.1070.0316

Overby, E., & Clarke, J. (2012). A Transaction-Level Analysis of Spatial Arbitrage: The Role of Habit, Attention, and Electronic Trading. *Management Science, 58*(2), 394-412. doi:10.1287/mnsc.1110.1494

Payne, A., & Frow, P. (2005). A Strategic Framework for Customer Relationship Management. *Journal of Marketing, 69*(4), 167-176. doi:10.1509/jmkg.2005.69.4.167

Power, D., & Singh, P. (2007). The e-integration dilemma: The linkages between Internet technology application, trading partner relationships and structural change. *Journal of Operations Management, 25*(6), 1292-1310. doi:10.1016/j.jom.2007.01.006

Quirós Romero, C., & Rodríguez Rodríguez, D. (2010). E-commerce and efficiency at the firm level. *International Journal of Production Economics, 126*(2), 299-305. doi:10.1016/j.ijpe.2010.04.004

Rabinovich, E., Knemeyer, A. M., & Mayer, C. M. (2007). Why do Internet commerce firms incorporate logistics service providers in their distribution channels? *Journal of Operations Management, 25*(3), 661-681. doi:10.1016/j.jom.2006.05.012

Ramus, K., & Nielsen, N. A. (2005). Online grocery retailing: what do consumers think? *Internet Research, 15*(3), 335-352.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and Data Analysis Methods*. Thousand Oaks: Sage Publications.

Sanders, N. (2007). An empirical study of the impact of e-business technologies on organizational collaboration and performance. *Journal of Operations Management, 25*(6), 1332-1347. doi:10.1016/j.jom.2007.01.008

Semrau, T., & Sigmund, S. (2012). Networking Ability and the Financial Performance of New Ventures: A Mediation Analysis among Younger and More Mature Firms. *Strategic Entrepreneurship Journal, 6*(4), 335-354. doi:10.1002/sej.1146

Sharma, D. S. (2005). The association between ISO 9000 certification and financial performance. *The International Journal of Accounting, 40*(2), 151-172. doi:http://dx.doi.org/10.1016/j.intacc.2005.01.011

Short, J., Williams, E., & Christie, B. (1976). *The Social Psychology of Telecommunications*. London, England: John Wiley.

Solow, R. M. (1987). "We'd better watch out". *New York Times Book Review*.

Southon, F. C. G., Sauer, C., & Dampney, C. N. G. (1997). Information Technology in Complex Health Services: Organizational Impediments to Successful Technology Transfer and Diffusion. *Journal of the American Medical Informatics Association, 4*(2), 112-124.

Specht, N., Fichtel, S., & Meyer, A. (2007). Perception and attribution of employees' effort and abilities: The impact on customer encounter satisfaction. *International Journal of Service Industry Management, 18*(5), 534-554. doi:10.1108/09564230710826287

Statista. (2014a). B2C e-commerce sales in the United States from 2011 to 2016. Retrieved 2014 http://www.statista.com/statistics/241389/b2c-e-commerce-sales-in-the-united-states/

Statista. (2014b). Retail e-commerce sales in the United States from 2002 to 2013. Retrieved 2014, from Statista http://www.statista.com/statistics/273424/retail-e-commerce-sales-in-the-united-states/

Statista. (2014c). Share of retail banking customers that had a positive experience with online banking in 2012, by region. Retrieved from http://www.statista.com/statistics/243880/online-retail-banking-customer-satisfaction-by-region/

Statista. (2014d). Top consumer reasons for joining a bank in the capactiy of a virtually domiciled customer*, in percent. Retrieved 2014

http://www.statista.com/statistics/258636/top-consumer-reasons-for-joining-a-bank-as-a-virtually-domiciled-customer/

Statista. (2014e). U.S. customer satisfaction with internet retail from 2000 to 2013 (index score). Retrieved from http://www.statista.com/statistics/296989/us-customer-satisfaction-with-internet-retail/

Subramani, M., & Walden, E. (2001). The Impact of E-Commerce Announcements on the Market Value of Firms. *Information Systems Research, 12*(2), 135-154. doi:10.1287/isre.12.2.135.9698

Szymanski, D. M., Bharadwaj, S. G., & Varadarajan, P. R. (1993). An analysis of the market share-profitability relationship. *Journal of Marketing, 57*(3), 1.

Tax, S. S., McCutcheon, D., & Wilkinson, I. F. (2013). The Service Delivery Network (SDN): A Customer-Centric Perspective of the Customer Journey. *Journal of Service Research, 16*(4), 454-470. doi:10.1177/1094670513481108

Tsai, J. Y., Raghu, T. S., & Shao, B. B. M. (2013). Information systems and technology sourcing strategies of e-Retailers for value chain enablement. *Journal of Operations Management, 31*(6), 345-362. doi:http://dx.doi.org/10.1016/j.jom.2013.07.009

Vargo, S. L., & Lusch, R. F. (2008). Service-dominant logic: continuing the evolution. *Journal of the Academy of Marketing Science, 36*(1), 1-10.

Verhagen, T., Feldberg, F., van den Hooff, B., Meents, S., & Merikivi, J. (2011). Satisfaction with virtual worlds: An integrated model of experiential value. *Information & Management, 48*(6), 201-207. doi:10.1016/j.im.2011.02.004

Wade, M. H., J. (2004). The resource-based view and information systems research: Review, extension, and suggestions for future research. *MIS Quarterly, 28*(1), 107-142.

Wang, C., Harris, J., & Patterson, P. (2013). The Roles of Habit, Self-Efficacy, and Satisfaction in Driving Continued Use of Self-Service Technologies: A Longitudinal Study. *Journal of Service Research, 16*(3), 400-414. doi:10.1177/1094670512473200

Wasko, M., Teigland, R., Leidner, D., & Jarvenpaa, S. (2011). STEPPING INTO THE INTERNET: NEW VENTURES IN VIRTUAL WORLDS. *MIS Quarterly, 35*(3), 645-652.

Wiengarten, F., Fynes, B., Cheng, E. T. C., & Chavez, R. (2013). Taking an innovative approach to quality practices: exploring the importance of a company's innovativeness on the success of TQM practices. *International Journal of Production Research, 51*(10), 3055-3074. doi:10.1080/00207543.2012.752609

Wu, J., & Hisa, T. (2008). Developing E-Business Dynamic Capabilities: An Analysis of E-Commerce Innovation from I-, M-, to U-Commerce. *Journal of Organizational Computing and Electronic Commerce, 18*(2), 95-111. doi:10.1080/10919390701807525

Wunderlich, P., Kranz, J., Totzek, D., Veit, D., & Picot, A. (2013). The Impact of Endogenous Motivations on Adoption of IT-Enabled Services: The Case of Transformative Services in the Energy Sector. *Journal of Service Research, 16*(3), 356-371. doi:10.1177/1094670512474841

Yeung, A. C. L., Lo, C. K. Y., & Cheng, T. C. E. (2011). Behind the Iron Cage: An Institutional Perspective on ISO 9000 Adoption and CEO Compensation. *Organization Science, 22*(6), 1600-1612. doi:10.1287/orsc.1110.0652

Young, M., & Jude, M. (2004). *The case for virtual business processes : reduce costs, improve efficiencies, and focus on your core business*. Indianapolis, Ind.: Cisco Press.

Zhang, Y., Fang, Y., Wei, K.-K., Ramsey, E., McCole, P., & Chen, H. (2011). Repurchase intention in B2C e-commerce—A relationship quality perspective. *Information & Management, 48*(6), 192-200. doi:10.1016/j.im.2011.05.003

Zhu, K., Kraemer, K. L., & Xu, S. (2006). The Process of Innovation Assimilation by Firms in Different Countries: A Technology Diffusion Perspective on E-Business. *Management Science, 52*(10), 1557-1576.