A Dissertation

Entitled

THE DRIVERS OF ERP IMPLEMENTATION AND ITS IMPACT ON ORGANIZATIONAL CAPABILITIES AND PERFORMANCE AND CUSTOMER VALUE

By

Woosang Hwang

Submitted as partial fulfillment of the requirements for

the Doctor of Philosophy degree in

Manufacturing Management

Adviser: Dr. Mark A. Vonderembse

Adviser: Dr. T.S. Ragu-Nathan

Graduate School

The University of Toledo

June 2011

Committee Members,	Date of Signature
______________________	______________________
Dr. Jenell Wittmer	
______________________	______________________
Dr. Iryna Pentina	
______________________	______________________
Dr. Abraham Nahm	
______________________	______________________
Dr. Peter Lindquist	

AN ABSTRACT OF

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In a constantly changing global business environment, firms have no other choice but to continually expand their capabilities and sharpen their competitive edge. Toward this goal, an increasing number of organizations are turning to Enterprise Resource Planning (ERP) systems. An ERP system utilizes various kinds of information processing capabilities and places the gathered data into a single database. Thus, an ERP system is often considered to be a vital element in organizational infrastructure for enhanced visibility and improved performance.

ERP implementation, however, brings not only gain but also pain. A growing amount of evidence suggests that ERP system implementation does not always result in enhanced

organizational performance. Implementing an ERP system is expensive and time consuming, and firms often fail to obtain the benefits of ERP investments within the anticipated timeframe.

Because of its impact on the organization, ERP implementation must be viewed and undertaken from the perspective of the entire organization and environment, not just as a software installation. Until now, many researchers have only focused on studying the critical success factors in ERP implementation; little attention has been given to the impact of external and internal factors upon ERP implementation. Moreover, researchers have paid little attention to the impact of ERP implementation on suppliers' capabilities, organizational capabilities, and customer value. In addition, not many researchers emphasize the importance of integration, configuration, adaptation, and user training in the course of implementing an ERP system.

Drawing from the contingency theory, a resource-based perspective, and dynamic capabilities theory, this study develops a conceptual model and empirically examines the impact of external and internal environments upon successful ERP implementation. This research makes a contribution to the literature by proposing a conceptual model that investigates the causal relationships among eight variables: (1) the internal and (2) external factors that influence ERP implementation, (3) actual ERP implementation, (4) supplier capabilities, (5) organizational capabilities, (6) supplier performance, (7) organizational performance, and (8) customer value.

Through the literature review, 37 sub-constructs for external and internal environment, ERP implementation, supplier/organizational capabilities, supplier/organizational performance, and customer value were identified. Potential measurement items were generated through a literature review and from construct definitions. The measurement items developed for these 37 sub-constructs were tested through structured interviews and Q-sort. Final testing of the instruments was performed through responses from 205 Korean manufacturing firms. Structural

equations modeling (PLS) methodology were used for the testing of relationships among constructs.

Research findings support the notion that organizational readiness and resources led by external environment would affect ERP implementation and further organizational capabilities and performance. It also supports the relationship between ERP implementation and organizational capabilities as well as between ERP implementation and supplier capabilities. Organizational capabilities were highlighted as the mediating variable between ERP implementation and organizational performance. This research found out that customer value is the ultimate outcome of ERP implementation. It also identified the key dimensions that firms should consider in the course of implementing ERP systems. It did not support, however, the relationship between external environment and ERP implementation. The nature of this relationship appears to be indirect rather than direct, being mediated through internal environment. Recommendations for future research and implications for academics and practitioners are provided.

ACKNOWLEDGEMENTS

First of all, I thank God for leading me to Toledo to complete my Ph.D study. At the beginning of my study, I did not know what to do but He surrounded me with the most intelligent and supportive faculty members and colleagues, who guided me step by step to finish my degree.

My special thanks go to Drs. Mark A. Vonderembse and T.S. Ragu-Nathan, who led me to finish my dissertation. I especially thank Dr. Vonderembse, who bore my weaknesses and faithfully advised me for more than 4 years, so that I was able to finish my work and obtain this doctoral degree. Without his strong support, guidance, patience, and support throughout the years, I would not have been able to accomplish this.

My special thanks also go to dissertation committee, Drs. Jenell Wittmer, Iryna Pentina, Peter Lindquist, and Abraham Nahm. They were willing to help me by reading through my dissertation manuscript, engaging in lengthy discussions, and making sincere and thoughtful comments that made this dissertation possible. I am also grateful for the wonderful faculty members who had guided me through the doctoral seminars and classes: Drs. Jeen S. Lim, T.S. Ragu-Nathan, William Doll, Paul Hong, Mark A. Vonderembse, Udayan Nandkeolyar, Ram Rachamadugu, and P.S. Sundararaghavan. I really appreciate Drs. Udayan Nandkeolyar and Mesbah Ahmed who co-worked with me to develop the case-based ERP courses. They helped me to have basic understanding of ERP and encouraged me to study more on ERP systems.

I express my profound gratitude to Dr. Paul Hong, my mentor spiritually and academically during my MBA and PhD study. His practical support, help, and advice were very instrumental in the continuous growth of my academic and spiritual career. I also cannot forget the faithful prayers the UBF coworkers offered in my behalf. I thank all leaders in both Hanyang and Toledo UBF who prayed for my dissertation. My special thanks go to Dr. Samuel H. Lee and Okhee Lee, shepherd Joshua Lee in Hanyang UBF and Good shepherd fellowship members (Kirk Kayser, Anthony Coca, Alex Helfrish, Sarah Jeong Jr., and Dr. Ruth Jeong) in Toledo UBF. I really appreciate the help of Drs. Daniel Jeong, Joseph Park, James Roh, and Ruth Jeong. I believe many prayers and support offered by these hidden servants of prayer were the real reason behind my success. Praise and thank God!

Lastly, I thank God for Pauline, Paul, Sarah, and Eunice, who prayed and supported their husband and dad with sacrificial love. Pauline really motivated and supported me to study in MBA and PhD programs, working full time as a nurse and taking care of our three children. May I live up to your expectations as a loving husband and a wonderful dad. I also thank my parents who also motivate me to obtain PhD degree. This degree may be used for the salvation of my family members in Korea including my parents. This degree may also be useful to guide many fellow students and even raise up future leaders.

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CHAPTER 1. INTRODUCTION

In a global business environment, firms are seeking to improve or maintain their competitiveness in the increasingly challenging global marketplace. Information systems are often used as tools to improve customer service, reduce cycle times, increase effectiveness, and decrease cost. Enterprise Resource Planning (ERP) systems have drawn increasing attention because they provide a variety of benefits to a business. ERP, which evolved from Manufacturing Requirements Planning (MRP), is an integrated information system that supports business processes and functions by managing the entire organization‘s resources efficiently and effectively. In other words, ERP involves the planning and managing of the organization‘s resources in the most efficient, productive, and profitable manner (Barker and Frolick, 2003). It enables companies to integrate their business processes and all information relevant to their organization (Nah and Delgado, 2006). Kumar and Van Hillegersberg (2000) define it as configurable information systems packages that integrate information and business processes within and across functional boundaries within an organization. ERP is a comprehensive software solution that seeks to integrate the complete range of business processes and functions, in order to present a company-wide view of the business from a single IT architecture (Al-Mashari et al., 2003). When companies have efficient business processes, they can be more competitive in the marketplace.

The benefits of ERP systems are linked to effectiveness and efficiency of business processes because firms can get more accurate and timely information (Trott and Hoecht, 2004). Through integrating business functions, firms can reduce data collection time and avoid data duplication. With timely information, ERP helps managers improve decision making speed and quality as well as facilitates communication between users. Barriers between business functions and departments are lowered because an ERP system is a vehicle that integrates business processes across functional boundaries. Links with suppliers and customers can be significantly strengthened (Gupta, 2000; Trott and Hoecht, 2004). ERP systems improve coordination and facilitate cooperation with suppliers, and they improve responsiveness to market and customer requirements. ERP systems also allow firms to access electronic commerce. Therefore, implementation and upgrades of ERP systems are identified as one of the top five IT priorities among global chief information officers (CIOs) (Deloitte Touche and IDG Research Services Group Report, 2002; Beatty and Williams, 2006). A recent study by AMR[1] Research indicates that the enterprise application market is expected to grow from $28.8 billion in 2006 to $47.7 billion by 2011. Core ERP license revenue grew to $9.2 billion in 2006, an 18% increase over 2005.

Many researchers have studied the reasons for ERP implementation (Jones et al, 2006; Beatty and Williams, 2006; Shang and Seddon, 2002; Al-Mashari et al, 2003, Finney and Corbett, 2007; Nah and Delgado, 2006; Soja, 2006; Ulrich, 2007): Companies want to (1) integrate financial data; (2) standardize manufacturing processes; (3) standardize human resource (HR) information; (4) have real-time information; (5) generate information for decision making; (6) reduce costs; (7) increase sales; (8) fulfill taxation requirements; and (9) respond to growing global competition. ERP systems can be comprehensive and useful in integrating many kinds of information processing abilities by placing data into a single database. Successful ERP implementation is quite beneficial to firms and provides them with competitive advantages

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[1] Advanced Manufacturing Research, Inc. changed its name to AMR Research to reflect expanded scope(6/30/1998)

(Teece et al., 1997). This explains why an ERP system is generally considered to be a vital element for enhanced business performance.

1.1. Problem statement

ERP implementation, however, brings not only business gain but also business pain (Cissna, 1998). Although ERP systems have many advantages and become a focal point of business and technology planning, implementing ERP systems is expensive and time consuming (Sweat, 1998). The cost associated with ERP implementation is often greater than planned because of many hidden costs such as training, customization, integration, and data conversion. The business managers of organizations with significant ERP experience suggest that the cost of introducing ERP systems is close to the cost to rebuild the firm‘s information infrastructure (Trott and Hoecht, 2004). Firms typically fail to obtain the benefits of ERP investment within the anticipated timeframe (Pollock et al., 2003; Barker and Frolick, 2003). Besides, little attention has been given to the impact of external and internal environmental factors of firms that have implemented ERP. Because of its impact on the organization, ERP implementation must be viewed and undertaken from the perspective of the entire organization and its environment, not just as a software installation.

Despite the need of the comprehensive framework to understand the drivers of ERP implementation and its impacts, many researchers have focused their efforts on studying the critical success factors of ERP implementation (Al-Mashari et al., 2003; Nah and Delgado, 2006; Soja, 2006; Nah et al., 2001; Ulrich, 2007) and the direct relationship between ERP implementation and business performance (Hendricks et al., 2007; Huang et al., 2007). Besides, there is a lack of theoretical framework and large scale empirical research that considers the impact of ERP implementation on both suppliers and organizational capabilities. Recently, researchers have begun to explore how some organizations develop firm-specific capabilities and how they renew competences to respond to a turbulent business environment, and to study the impact of IT capabilities on a firm‘s performance (Li et al., 2006; Sanders and Robert, 2005; Santhanam and Edward, 2003). However, not many researchers pay attention to the impact of ERP implementation on both suppliers and organizational capabilities.

In addition, not many researchers emphasize the importance of integration, configuration, adaptation, and user training in the course of implementing an ERP system (Hong and Kim, 2002; Davenport, 1998). In order to work efficiently and effectively, ERP systems must work with organizational processes (Hong and Kim, 2002; Davenport, 1998; Kim et al., 2005; Klein, 2007). ERP systems do not easily fit into a typical organization which needs to keep moving forward and change its processes and plans to respond to the turbulence of today‘s business environment. Thus, in order to improve the efficiency and effectiveness of an ERP system, there is a growing need to focus on integration, configuration, and adaptation (King and Flor, 2007; Al-Mashari et al., 2003; Hong and Kim, 2002; Finney and Corbett, 2007; Markus and Tanis, 2000). From a human perspective, ERP user training is also a critical issue in ERP implementation (Hong and Kim, 2002; Davenport, 1998; Nah et al., 2001).

Because ERP implementation affects the entire organization, important issues related to ERP implementation should be examined. They are the external and internal environment of ERP implementation, critical issues in actual ERP implementation, and the effects of ERP implementation on both the organization and its suppliers. Therefore, this study intends to provide new perspectives in understanding both the impact of the environments on successful ERP implementation and the role of an ERP in creating sustained competitive advantages for the firm. Drawing from contingency theory, the resource-based view of a firm theory, and the dynamic capabilities theory, this paper proposes that successful ERP implementation enables firms to improve organizational capabilities as well as customer value.

1.2. Research questions

Acknowledging the need to understand the impact of ERP implementation on organizations, this research attempts to answer the following questions.

(1) What are the drivers of ERP implementation?

What makes firms implement an ERP system? This study explores the driving factors of ERP implementation. In a dynamic business environment, organizations need to become globally competitive. The need to accommodate customer demands and provide quality goods and services in the shortest lead time force firms to adopt ERP systems. Organizational readiness, resources and capabilities in the internal environment enable a firm to implement an ERP system. In a sense, environments of organizations can change the way they do business. Therefore, it is critical to study the external and internal environmental factors that influence ERP implementation.

(2) What is the ultimate outcome of ERP implementation?

In the past, firms focused on profit maximization and stockholder wealth maximization. They were the ultimate goals of most firms. But these days, many firms emphasized customer value. Those who really consider customer value can survive in an uncertain business environment. However, many researchers do not see customer value as the ultimate goal or outcome of ERP implementation. It is imperative to examine the outcomes of ERP implementation from the perspective of organizational performance as well as customer value. Therefore, it is valuable to examine the ultimate outcome of ERP implementation.

(3) What are the mediating variable between ERP implementation and performance?

Many researchers have mentioned a direct relationship between IT investment and organizational performance. However, research on the ERP benefits is often contradictory. Better information integration through ERP implementation provides a competitive advantage (Davenport, 1998; Al-Mashari et al., 2003; Hong and Kim, 2002; Finney and Corbett, 2007). Some researchers have reported that firms typically fail to obtain the full benefits of ERP investment (Pollock et al., 2003; Barker and Frolick, 2003). The main reason that benefits are uneven is that research tends to focus on financial performance. That is, business performance is usually quantified in productivity measures or profitability measures such as ROE (Return on Equity), ROI (Return on Investment), and market share. However, there are many factors which affect the financial performance of organizations such as strategy, organizational culture, organizational competences, and financial standing.

On the other hand, organizational capabilities may be important variables that firms should regard as successful outcome of ERP implementation. Recent research has sought to identify and explain how and why information technology creates business value via the inclusion of organizational factors (Shin et al., 2000; Cao et al., 2011). Instead of assuming that information technology directly impacts organizational performance, a mediation model asserts that information technology affects the organizational factors, which in turn impacts organizational performance. Therefore, it is imperative to examine the complementary outcomes that the implementation of an ERP resource can facilitate (resource complementarity). It has been found by some research that the implementation of an ERP system can impact organizational performance directly or indirectly (Ng, 2006; Wade and Hulland, 2004).

(4) What are the critical factors for successful ERP implementation?

In the course of ERP implementation, what factors should firm consider? In this study, the critical sub-constructs in the ERP implementation stage will be examined to better understand the relationships with other constructs such as the firm‘s internal environment and organizational capabilities. Separated from environmental factors, there are some important success factors in the ERP implementation stage. From the perspective of the dynamic capability theory, this study will examine key factors critical to implementing an ERP system in a turbulent and changing business environment.

1.3. Research contributions

This research proposes a conceptual model that investigates the causal relationships among eight variables; (1) the internal and (2) external factors that influence ERP implementation, (3) actual ERP implementation, (4) supplier capabilities, (5) organizational capabilities, (6) supplier performance, (7) organizational performance, and (8) customer value.

This research will contribute to the literature by exploring the relationships among internal and external factors for ERP implementation, actual ERP implementation, supplier and organizational capabilities and performance. Few empirical measures exist to identify the critical factors in ERP implementation most conducive for enhanced organizational capabilities, supplier capabilities, and performance. This research will respond to these needs by using a large sample and test the relationships among these constructs. Another major contribution of this research would be the development of valid and reliable measurement instruments for each construct, such as the external and internal environments for ERP implementation, actual ERP implementation, and supplier/organizational capabilities. The measurement instruments for other constructs in the proposed model are adapted with modification from earlier studies.

From a practitioner‘s point of view, this research provides an organization with important guidelines to better understand ERP implementation issues and its impact on both the organization and its partners including suppliers and customers. This research also identifies the factors for facilitating ERP implementation. Moreover, the measures of organizational performance and customer value provide a valuable tool for organizations to evaluate the results of ERP implementation.

The rest of this paper is organized as follows. In Chapter 2, a brief review of the contingency theory, the resource-based view of the firm, and dynamic capability theory, as well as the overall framework that depicts the relationships among the constructs are presented. The research methodology for generating survey items is discussed in Chapter 3. This study uses interviews with practitioners, Q-sort method as a pilot study, and a large scale survey method. Next, chapter 4 deals with instrument development and exploratory data analysis. This includes large-scale survey methods, validity and reliability results. In chapter 5, the results of hypotheses testing are presented. Chapter 6 concludes with a summary of research findings, major contributions, implications for academics and managers, limitations of the research, and recommendations for future research.

CHAPTER 2. LITERATURE REVIEW AND THEORY DEVELOPMENT

In a turbulent and uncertain business environment, a firm develops its resources and capabilities to improve or maintain its competitiveness. A firm needs to provide a product or service in the right place at the right time at the lowest cost. Many firms are employing ERP solutions to respond to customers‘ demands with speed and accuracy. Using ERP systems effectively is essential to stay competitive and profitable. In order to further understand the impact of ERP systems, different theories have offered insights into finding the critical success factors of ERP implementation and understanding the consequences of it on organizations. The following sections provide a brief introduction of an ERP system, theories that support the rationale of successful ERP implementation, and its impact on organizations. Next, a research model that is grounded in reviewed theories is presented. After that, the literature review is proposed and hypotheses are developed.

2.1. Introduction of ERP

2.1.1. The definition of ERP

Enterprise Resource Planning (ERP) is a useful system to organize activities, decision, and information flows across many different functions and departments in a firm (Jacobs and Weston Jr., 2007; Basoglu et al. 2007; Koh et al., 2008). ERP is the leading approach to integrate business management and information technology. Basoglu et al. (2007) defined ERP systems as ‗integrated software solutions used to manage an organization‘s resources. According to Watson and Schneider (1998), ERP is an integrated, customized, packaged software-based system that handles the majority of an enterprise's system requirement in all functional areas, such as accounting, human resources, finance, sales, marketing, and manufacturing. ERP systems provide a seamless integration of all the information flows in an organization to eliminate cross-functional coordination issues in the business process (Davenport, 1998). Through implementing of ERP system, firms can reduce the overall costs, make accurate data available in real time, and exchange information with customers and suppliers (Umble et al., 2003, Basoglu et al., 2007). Thus, a firm implementing an ERP system can have benefits such as fast and accurate information gathering, quick decision making, low inventory cost, improved interaction with customers, and improved product quality. Therefore, ERP can be defined as an integrated information system that supports the business processes and functions through managing the entire organization's resources efficiently and effectively.

2.1.2. The history of ERP

The evolution of an ERP system dates back to 1960. In the 1960s the primary source of competitiveness was cost. At that time, firms focused on high-volume production, cost minimization, and managing large inventories efficiently (Umble et al., 2003; Basolgu et al., 2007). An information system was designed to forecast inventory needs for companies. The shortcoming of this initial system is that it did not factor in customer demand for products. However, the introduction of a computerized reorder point system (ROP) was enough to satisfy basic manufacturing planning and control.

Material Requirements Planning (MRP)–the predecessor of Manufacturing Resource Planning (MRP II) and ERP—was born in the late 1960s. The MRP system was developed to plan and schedule materials for complex manufacturing processes. MRP was planning the part requirements for products according to the master production schedule (MPS) (Rashid et al., 2002; Umble et al., 2003). Bill of material files identified the specific materials needed to produce each finished items, supporting a master production schedule. For the first time in manufacturing, there was a formal mechanism to keep priorities straight in a manufacturing environment (Basolgu et al., 2007; Ptak and Schragenheim, 2000). MRP systems fit the adoption of target-market strategies with an emphasis on greater production integration and planning quite well because of the integration between forecasting, master production scheduling, procurement, and shop floor control. MRP was essential for implementing the materials planning concept in production management and control (Jacobs and Weston Jr., 2007).

In the 1980s, the MRP system evolved from a simple MRP tool to become standard manufacturing resource planning (MRPII) (Basoglu et al., 2007). MRP II emphasizes optimizing manufacturing processes by synchronizing materials with production requirements. With the change in the scope of software applications, there came a change in manufacturing theory. Competitive firms started to focus more on quality. This gave rise to -the emergence of the quality gurus such as Deming and Juran (Jacobs and Weston Jr., 2007). Manufacturing strategy began to focus on process control, closed-loop scheduling, reduced overhead costs, enhanced shop floor reporting, and detailed cost reporting (Summer, 2005). MRP II systems incorporated the financial accounting and management systems along with the manufacturing and materials management systems (Umble et al., 2003; Basoglu et al., 2007). However, MRP II had shortcomings in managing a production facility‘s orders, production plans, and inventories. It has a few inherent drawbacks such as limited focus to manufacturing activities, forecasting of mass production needs, and poor budgetary controls. The shortcomings of MRP II led to the development of a totally integrated solution called Enterprise Resource Planning (ERP).

In the early 1990s, the term Enterprise Resource Planning (ERP) was first employed by the Gartner Group. This system connected all departments in a firm. Certainly, a major factor in the growth of ERP systems was the year 2000 (Y2K) problem. Small-to medium-sized enterprises (SMEs) as well as large companies were to adopt ERP systems to address needed fixes to legacy systems that were not Y2K compliant. However, Y2K was the single event that enabled the ERP industry to become mature and ERP vendors to be consolidated. ERP is an updated MRP II system that includes relational database management, graphical user interface, and client-server architecture (Basoglu et al., 2007). In addition, ERP systems are useful to integrate inventory data with financial, sales, and human resource data. They enable organizations to set prices on their products and produce financial reports. They also enable firms to effectively manage their resources in areas such as HR, finance and materials (Markus et al., 2000, Basoglu et al, 2007).

ERP systems produced by companies such as SAP gained more interest in the market because they enabled firms to upgrade their capabilities and to improve their business processes and procedures. In the highly competitive and rapidly changing business environment, a firm needs to make right and timely decisions. ERP systems enabled firms to gain competitive advantages through integrating and optimizing business processes (Davenport, 1998). For that reason, ERP has gained importance in the business strategy field.

Initially, ERP systems focused on back office functions, but front office functions such as customer relationship management (CRM), e-business systems, or supplier relationship management (SRM), became integrated by using Electronic Data Interchange (EDI) systems. "ERP II", web-based software, was employed in the early 2000s. Both employees and partners, such as suppliers and customers were allowed real-time access to the system. In a word, current

ERP systems are more incorporated solutions. They integrate the manufacturing process with the supply chain process across the firm. It was designed to integrate the firm's business processes to create a seamless information flow beginning with suppliers, going through the manufacturing process, and finally ending with the customer (Summer, 2005). Figure 2.2.1 shows the historical evolution of ERP systems in detail.

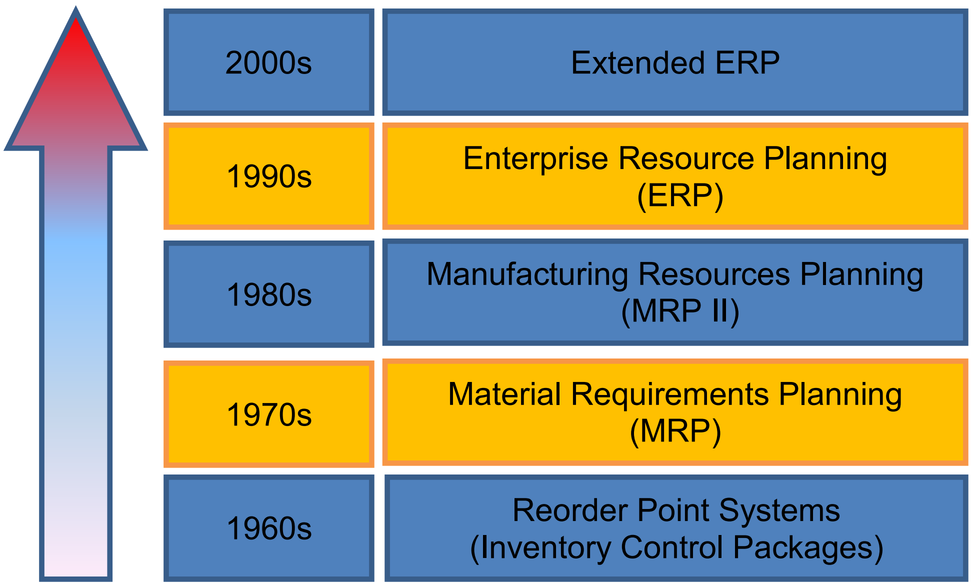


Figure 2.2.1. Evolution of ERP (Rashid et al., 2002)

2.1.3. The key critical success factors of ERP implementation

Researchers who study the key success factors of ERP implementation point to leadership and management commitment as the most important critical success factor of ERP implementation (Bingi et al., 1999). The software selection steps and the implementation procedures are also key success factors in ERP implementation (Umble et al., 2003). All the processes within a firm must coordinate with the ERP system (Al-Mashari et al., 2003). Al-Masahri et al. (2003) presented a new taxonomy of realizing and maximizing ERP benefits through a critical factor approach. They argued that ERP benefits are realized when a tight link between implementation approach and business-wide performance measures is established. They emphasized the importance of top management support, visioning, and planning for setting an ERP system up. In their paper, ERP package selection, communication, process management, training and education, project management, legacy system management, system integration, system testing, and cultural as well as structural changes were stressed for implementation. They also highlighted performance evaluation and proposed a way to manage the evaluation of the system.

Nah et al. (2003) identified five key success factors from the CIO's perspective, which are (1) top management support; (2) the presence of a project champion; (3) ERP teamwork including the composition of the team; (4) project management including a change of management program; and (5) culture. Many researchers also emphasize organizational fit, internal restructuring, and pre-implementation attitudes (Hong and Kim, 2002; Abdinnour-Helm et al., 2003; Ke and Wei, 2008; Morton and Hu, 2008). Tarafdar and Roy (2003) present the ERP implementation process consisting of distinct stages: planning, implementation, and post-implementation review. They emphasized the importance of four elements in the planning stage: building up a business case for ERP, understanding the specific characteristics of the business implementing the ERP system, assessing the IT readiness of the organization, and project planning. In the implementation stage, management of technical aspects and organizational change management are highlighted. Finally, they underlined the importance of institutionalizing process changes, formalizing organizational benefits, and assimilating learning in the post-implementation review stage. Ehie and Madsen (2005) divided the ERP implementation into five major phases: project preparation, business blueprint, realization, final preparation, and go live and support. Project management principles, feasibility/evaluation of ERP projects, process reengineering, top management support, cost/budget, and consulting services are identified and measured as critical factors for the implementation of ERP systems. Sarker and Lee (2003), in their paper, indicate that three key social enablers – strong and committed leadership, open and honest communication, and a balanced and empowered implementation team are essential conditions for ERP implementation success.

2.2. Theoretical background

2.2.1. Contingency theory

Contingency theory, which was developed in the late 1960s, is one of the behavioral theories that study how environmental variables influence the behaviors of organizations (Lawrence and Lorsch, 1967; Franks, 2000; Chandra and Kumar, 2000). Contingency theory argues that there is no best way to make decisions and to organize a company. Organization‘s decisions and actions are contingent on internal and external situations. In other words, the organizational strategy is dependent on its endogenous and exogenous business environments (Donaldson, 2001). Previous researchers have failed to consider contingency factors, such as technological changes, rapid market changes, and globalization, which in turn influence management techniques, organizational culture, and structure (Donaldson, 2001; Nahm et al., 2003). When a firm‘s environmental turbulence is high, greater effort is required to process information (Sherman et al., 2005; Citrin et al., 2007). In highly turbulent business environments, a firm faces difficulty in interpreting the needs of the customers and in forecasting market trends. As a result, having relevant and accurate information for decision making becomes more critical for the success of the firm (Citrin et al., 2007).

Organizational structures are determined by contingencies in the external environment, such as the degree of environmental uncertainty and technological change (Lawrence and Lorsh, 1967; Parker, 1995). Forms of organizations can be different according to the external environments they are placed in. Attaining goodness of fit between a firm‘s external environment and structure affects its performance significantly (Parker, 1995). Historically, contingency theory in operations management literature has sought to find the best fit for the use of various technologies in a given environment to which an organization must relate (Parker, 1995; Lawrence and Lorsh, 1967; Hong and Kim, 2002). Many researchers have studied the impact of contingency factors such as environmental uncertainty on organizational structure, strategy, and performance. They emphasize the importance of a ―good fit" between business strategy and IT strategy (Nahm and Vonderembse, 2002; March and Simon, 1958; Chandler, 1962).

In their strategic alignment model, Henderson and Venkatraman (1999) stressed the importance of strategic fit and functional integration. They argue that the lack of fit between business and IT strategy can make it difficult for a firm to recognize the actual value of an IT investment. Management information systems researchers generally assume that organizational performance is contingent on a number of variables such as strategy, technology, innovation, environmental change, structure, size, task, and individual characteristics (Cao et al., 2011; Morton and Hu, 2008; Donaldson, 2001). When the fit between these variables is good, better performance is expected, but misalignment results in problems, dysfunctions, and inferior performance (Weil and Olson, 1989).

Applying contingency theory in the context of ERP implementation, ERP systems can be seen to possess characteristics that relate to external environment uncertainty, as well as the internal environment. Examples of these are organizational structure, business process reengineering, organizational culture, IT readiness, and other organizational characteristics. The fit between organizational environments and characteristics of ERP systems has a significant role in the success of ERP implementation within organizations. An organizational culture in which sub-units are inter-dependent can give a better fit to a company that has an ERP with global operation needs (Hong and Kim, 2002). Soh et al. (2000) suggested that the firm-specific requirements that do not match ERP capabilities lead to ERP misfit within an organization. The congruence between the characteristics of an ERP system and its organizational context is critical for ERP implementation success.

Therefore, identification of a set of dimensions of organizational environments internally and externally and ERP system characteristics provides some insights into successful ERP implementation.

2.2.2. The resource-based view of a firm

The resource-based view of a firm (RBVF) argues that firms which possess unique resources achieve competitive advantage and have superior long-term performance (Barney, 1991, Wade and Hulland, 2004; Grant, 1991; Wernerfelt, 1984). Individual and firm-specific resources have significant effects on performance (Wade and Hulland, 2004). Resources are referred as ―all assets, capabilities, organizational process, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive and implement strategies that improve its efficiency and effectiveness" (Barney, 1991). These resources are the ones used to create, produce, and offer its products to a market (Sanchez, 1995).

In this study, resources are defined as assets and capabilities that are available and useful to detect and respond to market opportunities or threats (Wade and Hulland, 2004; Sanchez, 1995). Assets are defined as anything tangible (e.g. computer hardware, software, or network infrastructure), or intangible (software patents, relationship with supplier) the firm can use in its processes to provide product to a market. In contrast, capabilities are repeatable patterns of actions in the use of assets to offer products to a market. Capabilities enable a firm to transform inputs into outputs of greater worth (Amit and Schoemaker, 1993; Wade and Hulland, 2004). In the resource based view of a firm, many researchers mention that not only a firm's assets but also its capabilities are important to gain a competitive advantage (Barney and Clark, 2007; Bharadwaj, 2000; Carmeli and Tishler, 2004).

In the literature, the resource-based view of a firm claims that firms compete on the basis of "unique" corporate resources that are valuable, rare, difficult to imitate, and non-substitutable (VRIN) by competitors (Barney, 1991; Wade and Hulland, 2004). Two characteristics (appropriable and imperfectly mobile) are added in VRIN conditions (Wade and Hulland, 2004). The definitions for the characteristics of resources are summarized in Table 2.2.2. These resource characteristics enable firms to create and sustain competitive advantage and superior long-term performance (Grant, 1991; Penrose, 1959; Wade and Hulland, 2004).

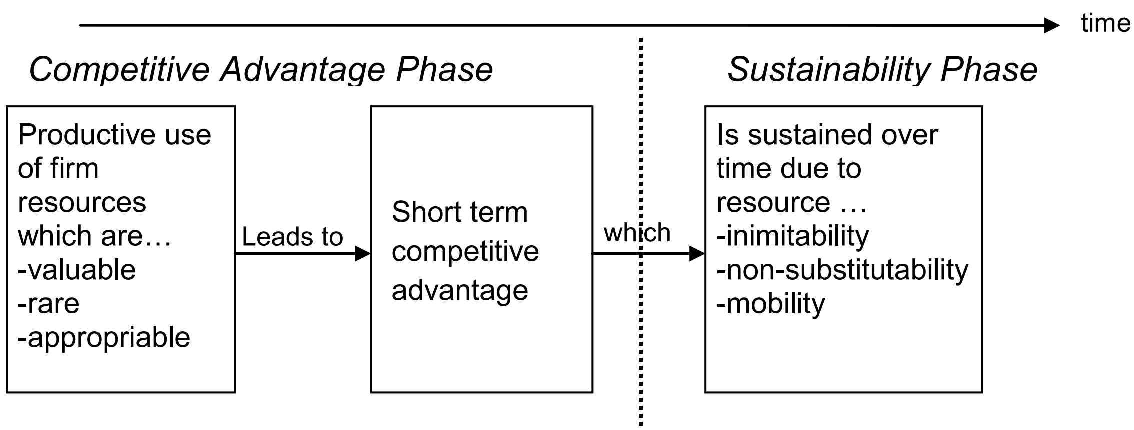
Table 2.2.2. Resource characteristics
(Adapted from Wade and Hulland, 2004)

RBVF Characteristics	Definition
Value (Valuable)	A valuable resource enables a firm to implement strategies that improve efficiency and effectiveness (Barney, 1999). A firm that possesses resources with little value have a limited possibility to have g a sustained competitive advantage (Wade and Hulland, 2004)
Rarity (Rare)	A rare resource is scare and not simultaneously available to a large number of firms (Amit and Shoemaker, 1993). A firm that has resources with little rarity cannot easily create a strategic benefit.
Appropriability (Appropriate)	An appropriate resource is suitable for a particular firm environment (Amit and Shoemaker, 1993; Grant, 1991). Fitting a firm with rare and valuable resources create competitive advantage.
Inimitability (Inimitable)	An inimitable resource is not quickly duplicable (Barney, 1991). Inimitable resources can only be developed over long periods of time. This can include organizational culture, tacit attributes, reputation and trustworthiness.
Non-substitutability (Non-substitutable)	A non-substitutable resource is not replaceable by other elements (Amit and Shoemaker, 1993). The resource should be both rare and inimitable (e.g., excellence in information system product development and systems integration)
Immobility (Imperfectly mobile)	An imperfectly mobile resource is non-tradable (Amit and Shoemaker, 1993; Barney, 1991). Compared to resources such as computer hardware and software that are more easily bought and sold, the resources such as company culture and brand assets are not tradable (Wade and Hulland, 2004)

Wade and Hulland (2004) made the useful distinction between resources that enable a firm to gain a competitive advantage and those that enable a firm to sustain that advantage (Refer Figure 2.2.2.1). In the attaining competitive advantage phase, a firm competes by using a resource that is valuable, rare and appropriate. However, in the sustainability phrase, a firm can sustain over time due to resources that are inimitable, non-substitutable, and imperfectly mobile.

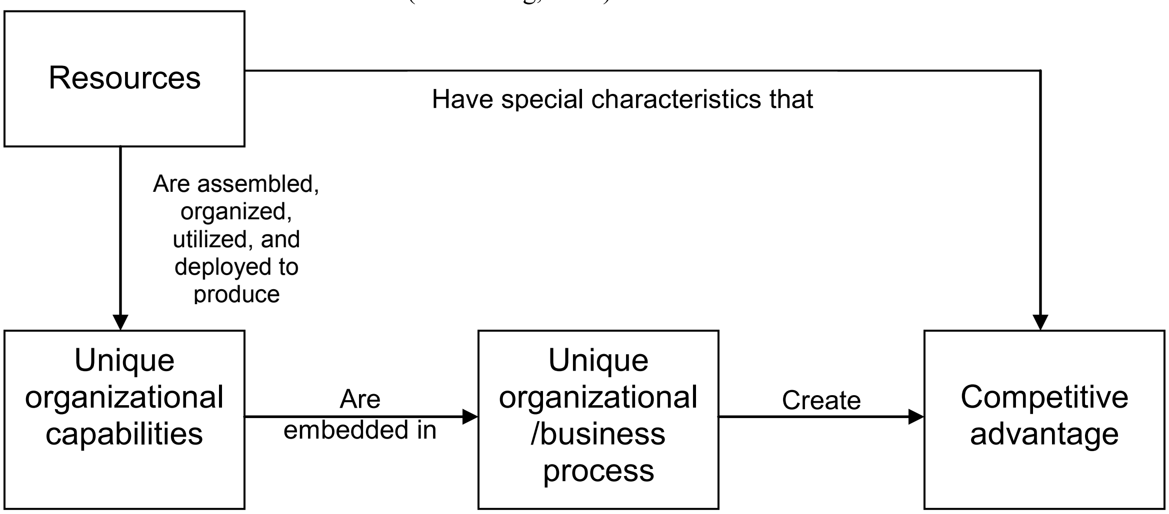
The advantage can be sustained to the extent that the firm can protect against resource imitation, transfer, or substitution. In the theory, Barney (1991) assumes that the resources needed to conceive, choose, and implement strategies are heterogeneously distributed across firms and that these differences remain stable over time." It means that resources must be heterogeneous and immobile. Differences in market performance are basically due to the distinctive resources and capabilities of a given firm (Barney, 1991; Wernerfelt, 1984; Wade and Hulland, 2004).

Figure 2.2.2.1 The resource-based view over time
(Source: Wade and Hulland, 2004)



Ng (2006) presented two different scenarios that give a firm a competitive advantage. Figure 2.2.2.2 illustrates the transformation process of resources to a competitive advantage for a firm. The first scenario is that the resources themselves possess special characteristics that enable a firm to have a competitive advantage by having unique corporate resources. The second case highlights a firm's unique assembly and deployment of the resources to create a competitive advantage. A firm can create unique organizational capabilities by firm-specific and optimal assembling, organization, and deployment of its resources. The unique organizational capabilities that are embedded in unique organizational and business process create a firm's competitive advantage and provide better business efficiency and effectiveness than its competitors (Grant 1991; Ng, 2006). Improved organizational performance leads to better customer service. The second case is useful to explain how a firm creates competitive advantage with resources that are not rare, but imitable and substitutable. A firm can create unique and valuable organizational capabilities and processes via firm-specific assembly, deployment, and utilization of the resources.

Figure 2.2.2.2. Transformation from resources to competitive advantage
(Source: Ng, 2006)



Many information systems researchers generally divided Information Systems (IS) resources into two categories: (1) IS assets (technology-based) and (2) IS capabilities (systems-based) (Wade and Hulland, 2004). Compared to IS capabilities, IS assets are easy to copy and the most fragile source of sustainable competitive advantage for a firm (Teece et al., 1997). However, IS capabilities embedded in a firm through optimal assembly, organization, utilization, and deployment of IS resources over a long period of time is difficult to move and substitute. That is, IS resources alone can rarely meet the VRIN requirements, but when IS resources are developed and deployed or properly combined with other complementary organizational factors, they meet the necessary VRIN conditions and become a source of sustainable competitive advantage.

In short, the resource-based view of a firm theory is very useful to define resource conditions, including Information technology and other organizational factors to be a source of competitive advantage. Information systems may enable companies to obtain competitive advantage when they are valuable for the company, heterogeneously distributed, leveraged, and costly to copy within industry. In addition, the concept of resource complementarity is useful to explain how information technology creates organizational capabilities and competitive advantage and eventually improved organizational performance. ERP systems that fulfill VRIN conditions within the companies and create organizational capabilities enable companies to have sustainable competitive advantage and to improve firm performance.

2.2.3. The dynamic capabilities theory

The dynamic capabilities perspective is an expansion of the resource-based view of a firm focusing on resource integration, reconfiguration, and development in changing environments. Many researchers define dynamic capabilities as an ability to integrate, build, and reconfigure internal and external competencies to address rapidly-changing environments (Teece et al., 1997; Eisenhardt and Martin, 2000). Consistent with the resource-based view of a firm, dynamic capability is a firm's ability to create competitive advantage by leveraging IT and complementary organizational resources to develop unique, change-oriented capabilities. These capabilities enable firms to meet customer needs and respond to competitors (Teece et al, 1997). It is the capacity to renew organizational resources and capabilities which achieve congruence in the changing business environment.

The concept of dynamic capabilities has been introduced in many research areas due to the shortcomings of the resource-based view of the firm (Eisenhardt and Martin, 2000; Teece et al., 1997; Peng et al., 2008). One of weaknesses of the resource-based view of a firm theory is that it does not address how a firm develops, manages, and deploys resources to support both business and IT strategy. That is, the resource-based view of the firm ignores factors surrounding resources, simply assuming their existence. However, the important factors—such as how resources are developed, how they are integrated within the firm, and how they are released—should be considered in the research. While the resource-based view of the firm emphasizes resource choice or the selection of appropriate resources, dynamic capabilities emphasize resource development and renewal.

Dynamic capabilities are strategically imperative for a firm to operate in a rapidly changing business environment due to the necessity of responding and adapting in a timely manner to change. ―Dynamic" is referred to as the concurrency of organizational renewal with environmental change (Teece et al., 1997). Flexibility and innovation are critical for responsive decisions and organizational change to adjust to new market environments. ―Capabilities" is a firm‘s ability to adapt, integrate, and reconfigure endogenous and exogenous organizational skills, resources, and functions to respond to market change. Both definitions are important to understand the characteristics of dynamic capabilities.

The theoretical framework identified by Teece et al. (1997) describes the dimensions of dynamic capabilities: (1) processes, (2) positions, and (3) paths. They argue that the competitive advantage of firms depends on its managerial and organizational processes, shaped by its asset position, and the paths available. Managerial and organizational processes are referred to as ―the way things are done in firms, its routines, or patterns of current practice and learning." (Ibid) Position is defined as ―its current specific endowments of technology, intellectual property, complementary assets, customer base, and its external relationship with suppliers and complementors". Paths refer to ―the strategic alternatives available to the firm."(Ibid)

In general, the literature on dynamic capabilities focuses on process dimensions to integrate, alter, and reconfigure an organization‘s structure or procedures (Chen et al., 2008).

Chen et al. (2008) mentioned that dynamic capabilities lie with many organizational routines, which are tacit and difficult to replicate. Typical routines are resource integration, reconfiguration, acquisition, and elimination (Refer Table 2.2.3.1).

Table 2.2.3.1. Categories of dynamic capabilities

(Source: Chen et al., 2008)

Dynamic capability	**Organizational routines**	**Description**
Resource integration	• Product/system development routines • Strategic decision making for resource integration	• Integrate resources, such as managers combining various expertise to make choices for organizational changes, create products, or systems.
Resource reconfiguration	• Routines for knowledge replication and brokering • Resource allocation routines • Knowledge creation routines • Resource evolution routines • Resource transformation routines	• Reconfigure resources within firms such as managers replicating, transferring, and distributing knowledge assets. • Involve resource evolution routines, which enables the adaptation of existing capabilities and capacity
Resource acquisition and elimination	• Alliance and acquisition routines • Resource elimination routines	• Involve alliance and acquisition routines that bring new resources into the firm form external resources • Involve resource elimination routines that discard resources no longer providing competitive advantage

Most researchers in information systems use the resource-based view of a firm and regard information systems as ―assets" in organizations. The dynamic capabilities theory, which emphasizes renewing, integrating, and configuring information systems, has not been fully shown in the literature to understand how firms develop Information systems and analyze their impacts on organizations, including business strategy. From the dynamic capabilities perspective, the development process of information systems, such as ERP systems, can be seen as integrating, reconfiguring, and adapting specific information technology assets to improve organizational efficiency and effectiveness.

2.3. The identification and discussion of constructs

The research framework in Figure 2.3 depicts the relationship among external environment, internal environment, ERP implementation, supplier capabilities, organizational capabilities, supplier performance, organizational performance, and customer value based on these three research theories: the contingency theory, the resource based view of a firm, and the dynamic capabilities theory. Coping with a highly uncertain, competitive and rapidly changing external environment with internal readiness and support, a firm can integrate and differentiate its organization by using an ERP system. According to Lawrence and Lorsh (1967), the contingency theory seeks to find the best fit for the use of various technologies in a given environment. To deal with a turbulent environment, a firm develops resources, such as an ERP system, that are valuable, rare, difficult to imitate, and non-substitutable by competitors and that increases its competitive advantage (Barney, 1991; Penrose, 1959). Through integrating, configuring, and adapting an ERP system and appropriate user training, a firm can deal with a rapidly-changing environment (Teece et al., 1997; Eisenhardt and Martin, 2000).

The external environment includes technology, level of competition, market change, and uncertainty (Doll and Vonderembse, 1991; Skinner, 1985; Vonderembse et al., 1997; Nahm and Vonderembse, 2002). In their paper, Nahm and Vonderembse (2002) define “an external environment” in the post-industrial era as having a high degree of: (1) heterogeneity in their market; (2) many narrow market segments; (3) short product life cycle; (4) economies of scope as the driving force for adopting manufacturing technology; and (5) multiple criteria for customer satisfaction. Vonderembse et al. (1997) characterize the post-industrial environment as having high levels of global competition, rapid market change, shorter product life cycles, and advances in manufacturing and information technology.

The external environment of a firm drives the changes in the organization's internal environment, which is made up of organizational resources, its capabilities, and competencies. The internal environment, such as top management support, organizational structure, communication, organizational culture, business process reengineering, and IT readiness, plays a crucial role in the corporate strategy of an organization. Top management support includes the recognition, encouragement, and commitment of the top manager for new business strategies or implementation of new technology, such as an ERP system. Top management support reinforces the commitment of all employees and leads to the success of projects in an organization (Ulrich, 2007; Bingi et al., 1999).

Organizational culture includes the organization's approach to managing its internal resources, organization of work, scope of decision-making, and the focus of managing its relationships with customers and suppliers (Clark et al., 1987; Gerwin, 1993; Nahm et al., 2004). Nahm et al. (2004) define organizational culture in a post-industrial environment as having the characteristics of: (1) investments in facilities and equipment for intellectual work; (2) teamwork on integrative tasks; (3) decision making based on an integrated perspective; (4) management based on collaboration and consensus; (5) focus on value to customers; and (6) long-term strategic partnerships with suppliers. Effective communication between managers and workers as well as between workers generates significant benefits in an organization, and eventually leads to successful completion of projects (Loh and Koh, 2004).

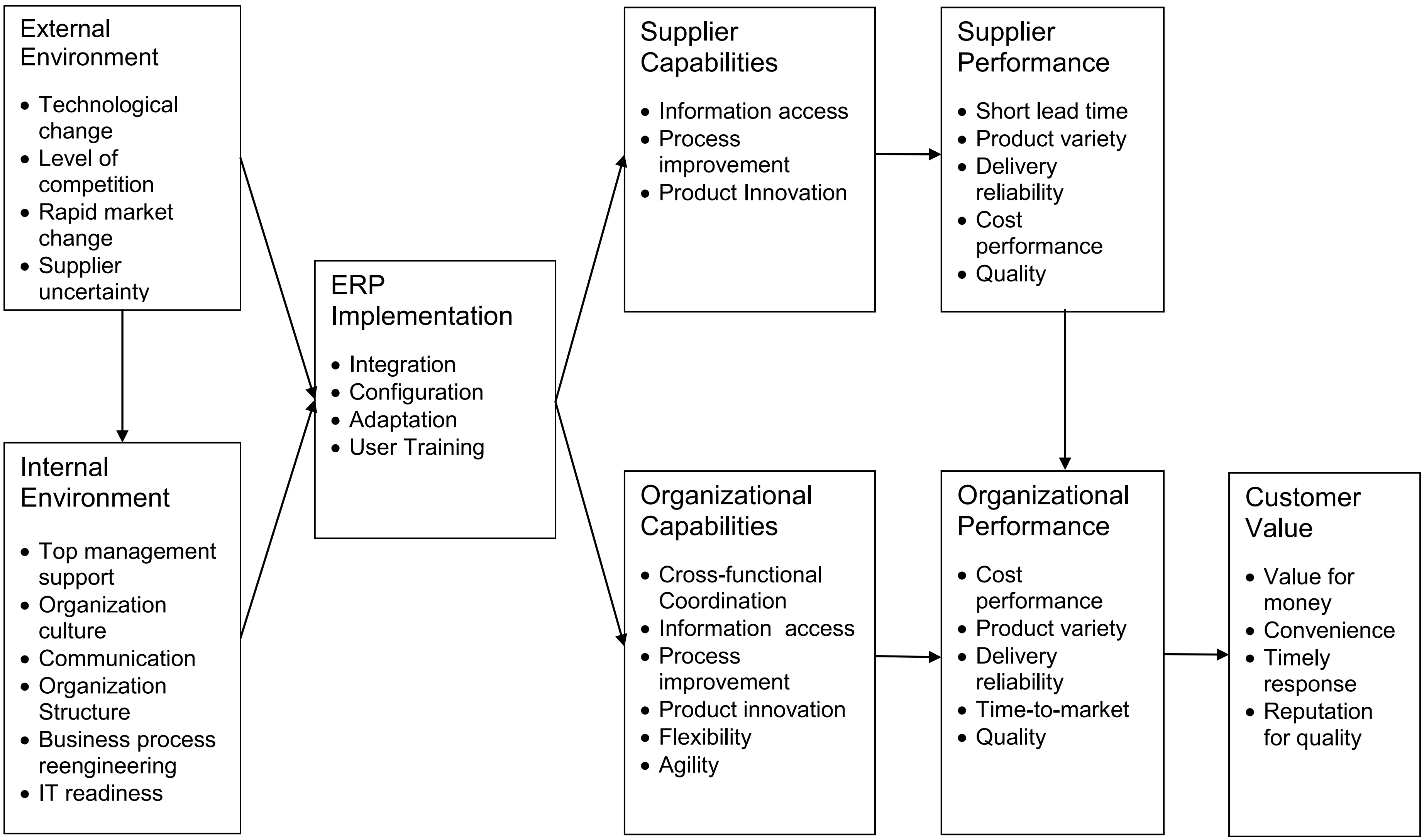
Organizational structure includes the centralization of authority and the degree of formalization (Swamidass and Newell, 1987; Germain et al, 1994; Nahm et al., 2003). An organizational structure, which has the characteristics of (1) decentralized decision making for operational decisions, (2) rules and regulations that encourage creative, autonomous work and learning, (3) few layers in organizational hierarchy, and (4) a high level of horizontal integration is flexible, has a flat structure and can have a positive impact on corporate strategy (Nahm et al., 2003). The fundamental rethinking and radical redesign of business processes enables a firm to achieve successful IT implementation (Davenport, 2000). It is very important to have the technological readiness, such as IT skills and IT infrastructure, for the successful completion of IT projects (Somers and Nelson, 2004)

Internally ready and prepared organizations have the ability to develop and implement strategies or systems that are appropriate for the business environment. ERP implementation includes the extent to which the firm adapts, configures, and integrates information flow and business processes across departments and functions (Davenport, 2000; Abdinnour-Helm et al., 2003; Klein, 2007; Hong and Kim, 2002; Loh and Koh, 2004). In achieving ERP implementation, the important factors are (1) the integration of different modules, software, and legacy systems to achieve unity in an organization, (2) matching the software to the needs of organizational processes, (3) adjusting new technology to cope with changes, and (4) preparing and developing the IT workforce (Morton and Hu, 2008; Hong and Kim, 2002; Davenport, 1998; Somers and Nelson, 2004).

Successful implementation of ERP systems has an impact on the capabilities of both an organization and its suppliers. Through fast and accurate information sharing, firms can increase (1) efficiency including cross-functional coordination, information access, and process improvement, (2) innovativeness including product innovations, and (3) responsiveness to customers including flexibility and agility. These capabilities also have an impact on supplier/organizational performance, such as short lead time, delivery reliability, product variety, cost performance, quality, time-to-market, and customer satisfaction (Shin et al., 2000; Li, 2002; Koufterous, 1995; Tu, 1999; McAfee, 2002; Huang et al., 2007).

Before developing measures for these variables and testing their relationships, it is theoretically sound to first identify, define, and discuss various constructs. Sufficient theoretical support is necessary for hypothetical relationships between these variables. This is achieved through the following review of literature and theoretical rationale.

Figure2. 3 The research model



2.3.1. External environment

Factors affecting the information technology projects of a firm may be viewed in two categories: factors related to the "external environment" and factors related to the "internal environment." This section focuses on the external environment, which is referred to as the exogenous factors (physical and social) that form the context for organizational actions and decision making (Li, 2002). The external environment is an important variable in the research related to organizations and information technology. Organizations do not exist in a vacuum. Most organizations are affected by external environments and vice versa.

Duncan (1972) defined the business external environment as all the factors outside an organization that are taken into consideration by the organization in its decision making. The external environment is a source of uncertainty and influences decisions, organizational structure, and performance (March and Simon, 1958; Chandler, 1962). In today‘s turbulent and competitive business environment, markets are becoming more international, vibrant, and customer-oriented.

Doll and Vonderembse (1991) claim that the driving forces for integration and automation in the post-industrial era are global markets for products, rapid market change and shorter product life cycle, increased market diversity (finely tuned market segments), and the status of technology (advances in flexible design and manufacturing systems). The scope of the market is becoming globalized and customer requirements are becoming more varied. Due to the increase in competition, firms need to satisfy multiple criteria, such as cost, quality, delivery, time, and service, at the same time (Nahm et al., 2003). Due to the rapid change of information technology, the failure to exploit new IT can lead to lost opportunities and can be especially costly. Thus, dealing with technological change is critical for business success (Benamati and

Lederer, 2001). Vonderembse et al. (1997) state that in competitive global markets firms compete fiercely while expanding the dimensions of competition.

External environmental change, such as rapid technological change, market change, and globalization, creates not only opportunities but also threats for individual organizations. Even though an organization will have limitations to change its environment, if the organization understands its environment better, the organization can adapt and develop appropriate strategies and information technology (Lusthaus et al., 1999). In this environment, effective data processing and decision making are very important. Effective information systems that help firms to maintain databases easily and to increase the speed of data processing are also very critical for firms in a rapidly changing environment (Vonderembse et al., 1997).

The external environment is an important variable in relation to organizational change, design, and performance (Nahm et al., 2003). However, there are few papers which consider the effects of the external environment on IT implementation and which have adequately developed and operationalized multiple sub-constructs for the external environment. This paper attempts to identify and verify the various dimensions of the external environment. External factors of ERP implementation are technological change, level of competition, rapid change of the global market, and supplier uncertainty. The list of sub-constructs, along with their definitions and supporting literature, are provided in Table 2.3.1.

Table 2.3.1. List of sub-constructs for external environments

Constructs	Definition	Literature
Technological change	The degree to which technologies are evolving and transforming business practices.	Vonderembse et al, 1997; Nahm and Vonderembse, 2002; Chen and Paulraj, 2004; Porter, 1985; Li, 2002; Chizzo, 1998; Li and Lin, 2006; OECD, 2000; Benamati and Lederer, 2001
Level of competition	The degree to which a firm's rivals attempt to offer greater value to customers.	Vonderembse et al, 1997; Nahm and Vonderembse, 2002; Chen and Paulraj, 2004; Schroeder, 1993
Rapid market change	The degree and rate of change in customer expectations.	Vonderembse et al., 1997; Chen and Paulraj, 2004; Doll and Vonderembse, 1991; Nahm and Vonderembse, 2002; Skinner, 1969; Noble, 1995; Li, 2002
Supplier uncertainty	The degree to which supplier's product quality and delivery performance are unpredictable.	Nahm and Vonderembse, 2002; Vonderembse et al, 1997; Chen and Paulraj, 2004; Burgess, 1998; Li, 2002 ; Davis, 1993; Yu et al., 2001; Shin et al., 2000

2.3.1.1 Technological change

Technological change is referred to as the degree to which knowledge, methods, and equipment are evolving and transforming business practices (Vonderembse et al, 1997; Nahm and Vonderembse, 2002; Chen and Paulraj, 2004; Li, 2002). Introducing a significant technological innovation can allow a firm to lower costs and enhance differentiation at the same time (Porter, 1985). Both new automated manufacturing technology and new information system technology help a firm to identify and pursue economic opportunities with faster analysis of economic trends around the world and collaboration with partners. Information technology is especially widespread today among manufacturing companies seeking to improve competitiveness (Li, 2002). IT provides numerous opportunities for organizations. Improved information systems bring many benefits to an organization and make possible true supply chain and business process integration (Li, 2002; Chizzo, 1998; Li and Lin, 2006). Thus, improved information technology, along with manufacturing technology of the past few decades, has spurred increases in firms‘ investments, because they bring gains in productivity and market share (OECD, 2000). Those considerations have been the principal drivers of globalization.

However, technological change provides not only opportunities, but also threats for organizations. Due to today‘s competitive environment, the failure to capitalize on new technology can lead to lost opportunities and can be especially costly. Thus, dealing with technological change is critical for business success (Benamati and Lederer, 2001). Now the speed of technological change is becoming faster compared to the time when it was introduced. Because the rate of technological change is high, a firm‘s cost leadership and differentiation are not easily sustained. If the competitors introduce new technology quickly, a firm can easily lose leadership. Due to the quick obsolescence of technology, organizations need to periodically check and invest in new systems. In addition to introducing new technology, a firm should transform its business practices to reflect these changes. A firm may have difficulty in managing its operations because keeping up with the technological change is not easy. The rapid change of technology continuously adds pressure on organizations to invest in new, solid and faster information systems such as ERP systems, if they want to survive global competition and to obtain competitive advantages (Li, 2002).

2.3.1.2. Level of competition

Level of competition is referred to as the degree to which a firm‘s rivals attempt to offer greater value to potential customers (Vonderembse et al, 1997; Nahm and Vonderembse, 2002;

Chen and Paulraj, 2004; Li, 2002). Competition is an external factor of prevailing concern to operations. Competition may be reflected in new products, more pressure to control costs, quality differences, and changes in the level of demand. In many of the basic industries of the United States (e.g., steel, textiles, electronics, and autos), foreign competition is a major concern, because the competition is producing better products at lower costs. Not only cost reduction but also continuous improvement of quality, better productivity of labor, less investment with smaller inventories, faster delivery and more varied products are important factors that should be considered to gain a competitive advantage (Schroeder, 1993). In a competitive business environment, business strategy and operations strategy must be modified to provide a defensible competitive advantage for a company. To gain the competitive advantage, firms should be prepared to handle the competition to meet customer needs by offering products with lower prices, higher quality, faster delivery and increased variety.

2.3.1.3. Rapid market change

Rapid market change is referred to as the degree and rate of change in customer expectations (Vonderembse et al, 1997; Nahm and Vonderembse, 2002; Chen and Paulraj, 2004; Li, 2002). Rapid market change causes firms to develop new products and to constantly enhance existing ones (Vonderembse et al., 1997). Customer purchase decisions are changing from single criteria, such as product price and/or quality, to multiple and complicated criteria, such as price, product performance, product features, quality, delivery, and service (Doll and Vonderembse, 1991; Nahm et al., 2003).

The accelerated rate of market change and increased competition result in the shortening of product life cycle. Affluent and discriminating customers demand greater choice in new and different products (Doll and Vonderembse, 1991; Nahm and Vonderembse, 2002). Thus, the volume of customers' demands changes rapidly, and customers often pursue the products with variations in color, shape and price. Because of customers' different preferences, customer demand can fluctuate drastically from week to week, and a manufacturing firm's supply requirement can vary from week to week. In addition, changing customer preferences are shortening the period of product life cycle. This is forcing companies to continually develop new products and improve existing ones.

To handle the fast moving business environment, it is critical to have access to information that is real-time and accurate. Advanced manufacturing technology is enabling firms to overcome the traditional notion of tradeoffs (Skinner, 1969) to exhibit multiple competitive capabilities at the same time (Noble, 1995). Faster information flow enables firms to react quickly to changing customer requirements.

2.3.1.4. Supplier uncertainty

Supplier uncertainty is referred to as the degree to which the supplier's product quality and delivery performance are unpredictable (Vonderembse et al, 1997; Nahm and Vonderembse, 2002; Chen and Paulraj, 2004; Li, 2002). This is due to unexpected changes in suppliers' behavior. A supplier's engineering level, lead-time, delivery dependability, cost performance, and product quality are also sources of uncertainty. Unpredictability caused by suppliers, such as delayed or broken materials, will delay or even stop an organization's production process. It also increases ordering variability, which leads to excess safety stock, increased logistic costs, and inefficient use of resources (Davis, 1993; Yu et al., 2001; Li and Lin, 2006).

Unpredictability of the quality, quantity, and delivery time of a supplier's products will make a firm's environment even more unpredictable. Suppliers may introduce new products unexpectedly. To respond to the unpredictability of suppliers, firms should have fast and real-time information.

2.3.2. Internal environment

Organizations are continually faced with the need to change their structures, processes and technologies to sustain their competitive advantages. Internal environmental factors are referred to as an organization's endogenous tangible and intangible resources and capabilities. The successful implementation of an ERP system cannot be achieved by a mere command of some central authority, such as an executive manager or a senior manager within a business unit. It requires effective, committed, and persistent leadership to achieve the goals of an entire organization. This is because implementing an ERP system is very expensive and time-consuming. Therefore, in order to successfully implement an ERP system, organizations should consider not only their external environment but also organizational readiness and resource capabilities in their internal environments.

In this research, the elements of an internal environment of a firm that affect the success of ERP implementation are as follows: top management support, organizational culture, communication, organizational structure, business process reengineering, and IT readiness. Many researchers emphasize the importance of top management support, business process reengineering, and communication during IT implementation (Bingi et al., 1999; Buckhout et al., 1999). Top management support is critical for an ERP project's success (Buckhout et al., 1999; Shanks et al., 2000; Loh and Koh, 2004). Open communication and information sharing can promote innovative behavior, like ERP implementation in an organization (Motwani et al., 2002). Organizational culture is known to be a critical factor in a project's success requiring significant organizational changes (Stewart et al., 2000). Schneider (1999) reports many companies have paid heavy prices for ignoring corporate culture in their rush to implement an ERP system. An organization's existing culture has profound effects on the planning process, the implementation process and the operation of the completed project (Stewart et al., 2000). Jones et al. (2006) mentioned that organizational culture has an impact on an ERP implementation team's ability to share knowledge and perspectives across diverse functions during ERP implementation.

Different organizational structures can affect an IT system implementation differently, especially in the case of an ERP system. For successful ERP implementation, each department's function and its relationship with others in an organizational structure should be analyzed. This is to ensure clear lines of data and process ownership by each department. This is accomplished by business process reengineering which enables firms to change business processes and plays different important roles in each of the ERP implementation stages. In his paper, Davenport (1998) identified business process reengineering as one of main reasons companies implement ERP systems. A firm with high levels of technical expertise and infrastructure can be expected to implement new technology more successfully than a firm with lower levels of technical expertise and infrastructure (Lee et al., 2007). The list of six sub-constructs, along with their definitions and supporting literature, are provided in Table 2.3.2.

Table 2.3.2. List of sub-constructs for internal Environments

Constructs	Definitions	Literature
Top management support	The degree to which executives understand the benefits and encourage implementation of new technology.	Li, 2002; Finney and Corbett, 2007; Stratman and Roth, 2002; Nah and Delgado, 2006; Loh and Koh, 2004; Stewart et al., 2000; Bingi et al., 1999; Shanks et al., 2000; Soja, 2006; Ulrich, 2007; Holland et al., 1999; Buckhout et al., 1999
Organizational culture	A firm's shared values and beliefs.	Nahm et al., 2004; Hodges and Hernandez, 1999; Hendry, 1999; Hatch, 1993; Sheng et al., 2003; Klein et al., 1995; Stewart et al., 2000; Schneider, 1999
Communication	The degree to which a firm shares decisions, expectations and goals throughout the organization.	Doll and Vonderembse, 1991; Nahm et al., 2003; Al-Mashari et al., 2003; Sarker and Lee, 2003; Holland et al., 1999; Sumner, 1999; Loh and Koh, 2004; Nah et al.,2001; Mendel, 1991; Davenport, 1993; Tarafdar and Roy, 2003
Organizational structure	The relations among functions and members in the firm.	Nahm et al, 2003; Doll and Vonderembse, 1991; Nahm and Vonderembse, 2002; Jones and Price, 2001; Mukherji, 2002; Wheelwright and Clark,1992
Business process reengineering	The degree of which a firm analyzes and designs its workflows and processes.	Grover and Malhotra, 1997; Mertins and Jochem, 2005; Dobriansky, 2004; O'Neill and Sohal, 1999; Attaran, 2004
IT readiness	The degree to which a firm prepares the environment and workforce to accept and configure new technology.	Finney and Corbett, 2007; Soja, 2006; Somers and Nelson, 2004; Loh and Koh, 2002; Stratman and Roth, 2002; Tarafdar and Roy, 2003; Lee et al., 2007; Ravichandran and Lertwongsatien, 2005; Davenport, 1998; Markus and Tanis, 2000

2.3.2.1. Top management support

Top management support is referred to as the degree to which executives understand the specific benefits of an ERP system and encourage implementation of new ideas and policies for implementing the system (Li, 2002; Finney and Corbett, 2007; Stratman and Roth, 2002; Nah and Delgado, 2006; Loh and Koh, 2004). Top management support is identified by many researchers as one of the key internal success factors of ERP implementation (Nah and Delgado, 2006; Loh and Koh, 2004; Stewart et al., 2000; Carmeli and Tishler, 2004). Top management commitment results in organizational commitment, which is a key factor influencing ERP implementation success (Bingi et al., 1999). Top management needs to publicly and plainly recognize the project as a top priority (Shanks et al., 2000; Soja, 2006; Loh and Koh, 2004).

Top management encouragement and support, as a symbol of the companies' prioritization of the project, will strengthen the commitment of all the employees in the company to the project (Ulrich, 2007). Top management must be committed in their own involvement and have a willingness to allocate valuable resources to the implementation effort (Shanks et al., 2000; Holland et al., 1999; Loh and Koh, 2004). This includes provision of required resources for the implementation and giving an appropriate amount of time to get the job done (Loh and Koh, 2004). Top management support is required throughout an ERP implementation. The support of an executive is indispensable to ERP implementation success. The project must receive approval and support from top management (Buckhout et al., 1999; Shanks et al., 2000; Loh and Koh, 2004).

2.3.2.2. Organizational culture

Organizational culture is defined as a firm‘s shared values and beliefs. Organizational culture can be seen as the beliefs, values, and meaning shared by members of an organization (Hodges and Hernandez, 1999; Nahm et al., 2004; Hendry, 1999; Carmeli and Tishler, 2004). ―Culture” is a stable, conservative, and resistant force that is likely to change only through management intervention. The embedded nature of culture is not changed easily (Hendry, 1999).

Organizational researchers presume resistance to change is originated from cultural stability (Hatch, 1993). The existing culture of an organization provides a corporate framework that gives guidance on issues, such as how tasks are done, the use of technology, how people think, and standards for interaction and communication (Sheng et al., 2003). Organizational culture refers to the ―underlying values and beliefs that serve as a foundation for an organization‘s management system as well as the set of management practices and behaviors that both exemplify and reinforce those basic principles” (Denison, 1990). Strategy researchers are interested in organizational culture for the role it has in the creation of competitive advantage. As a valuable, rare, and imperfectly imitable resource, organizational culture is a source of sustainable competitive advantage (Barney, 1991). Klein et al. (1995) considered organizational culture as the heart of an organization‘s actions to enhance its overall effectiveness and the quality of its products and services.

Organizational culture is imperative in the success of projects involving significant organizational change (Stewart et al., 2000). An organizational culture that has low power distance discourages excessive control over the implementation process by management. A highly individualized firm cannot transfer knowledge among project members. A resistant organizational culture has a negative impact on implementation success. A culture of low uncertainty avoidance leads to poor progress in ERP implementation. An organizational culture has profound effects on all business processes including the planning, implementing, and evaluating of a project. Knowledge sharing can be impacted by contextual factors, such as organizational culture.

2.3.2.3. Communication

Communication is referred to as the degree to which a firm shares decisions, expectations, and goals throughout the organization (Doll and Vonderembse, 1991; Nahm et al., 2003; Al-Mashari et al., 2003; Carmeli and Tishler, 2004). The communication factor is seen by a number of researchers in the area as an imperative success factor for an ERP implementation project (Sarker and Lee, 2003; Holland et al., 1999; Sumner, 1999). Somers and Nelson (2004) argue that interdepartmental communication, cooperation, and top management support are the most important success factors for an ERP application to be used within an organization to its fullest potential, along with vendor support and vender partnership. These factors not only affect ERP implementation at the chartering phase, but also at the implementation phase (Loh and Koh, 2004).

Effective communication between managers and workers as well as among workers themselves is important to the success of ERP implementation (Loh and Koh, 2004). Expectations or goals at all levels of an organization need to be communicated (Loh and Koh, 2004). Employees should be informed in advance of the scope, objectives, activities, and updates in the system. They should, as Nah et al. (2001) say, admit and commit to the change which will occur. Effective communication in an organization may generate significant benefits; it enables an organization to begin a dialogue to create awareness, understanding, and appreciation for the firm's strategic goals. Through communication employees feel more involved in the overall implementation process. A feeling of belonging helps produce interested, committed employees, which eventually enhances ERP implementation performance. Communication also includes the formal promotion of project teams and the announcement of project progress to the rest of the organization (Holland et al., 1999). Employees should be notified in advance of the project‘s plan, scope, objectives, activities, and updates (Sumner, 1999).

Through interviews, some researchers found that ERP implementation is likely to fail when dates are not communicated well in advance, especially to stakeholders (Nah et al., 2001). Mendel (1991) mentions ‗communication breakdown'' as a major ‗ERP project hurdle.'' To avoid company-wide uprising, constant communication about the project is necessary throughout its various stages. Getting employees to understand what is changing, why it‘s changing, and how it will help the organization is crucial for acceptance (Sarker and Lee, 2003; Mendel, 1991).

To avoid communication breakdown, one should always give clear instructions and messages to avoid confusion (Loh and Koh, 2004). Clear and honest communication with employees is very important in ERP implementation (Sarker and Lee, 2003). Communication throughout the transition regarding sensitive issues, such as the level and type of personnel reductions that would result from the initiative, must be addressed honestly and openly (Davenport, 1993; Sarker and Lee, 2003). Communication with employees results in greater understanding of the organization‘s needs and, therefore, quicker acceptance of the software (Holland et al., 1999; Davenport, 1993; Tarafdar and Roy, 2003).

2.3.2.4. Organizational structure

Organizational structure is referred to as the relationship between functions and members in a firm (Nahm et al, 2003; Doll and Vonderembse, 1991; Nahm and Vonderembse, 2002).

Organizational structure is another important factor that affects the flow of knowledge in an organization and the rate of learning to which an organization is exposed (Jones and Price, 2001). Organizational structure and information systems are highly interconnected with each other. Both information systems architecture and organizational structures have been altered from centralized to more decentralized forms over the years (Mukherji, 2002). Mukherji (2002) states, ―This was a movement away from functional control to divisionalized control." It is very important for organizations to realize that in many situations, a decentralized form manages the changes in the environment more effectively. Organizations are continually restructured to satisfy customer demands imposed by the environment. This can change the role of individuals within both formal and informal organizations. No matter which organizational structure is finally selected, formal channels must then be developed.

Wheelwright and Clark (1992) define organization structure as a continuum of organizational structures between two extremes, functional organizations and project organizations. Functional organizations are organized according to departments, such as marketing, engineering, manufacturing, accounting, and information technology departments. A project organization consists of projects and teams. Project members leave their functional departments and devote all of their time to different tasks. Different types of organizations can affect IT system implementations differently, especially in ERP implementations. Colak (2004) states in his thesis that high formalization with strict rules and procedures guaranteeing uniformity makes ERP implementation easy and effective in light of business process standardization.

However, Wall and Seifert (2003) state that larger organizations with more hierarchy levels and organizational units have less success than those with less hierarchy and units. They also mention that organizations with less specialization and less formalization tend to have more success than those with more specialization and formalization. Therefore, organizational structure should be analyzed for suitability to an IT system implementation. The functions of corporate organizational units and their interrelationships should be analyzed to ensure that clear lines of data and process ownership are defined and understood.

2.3.2.5. Business process reengineering

Business process reengineering (BPR) is referred to as the degree to which a firm analyzes and designs its workflows and processes (Grover and Malhotra, 1997; Attaran, 2004; Mertins and Jochem, 2005; O'Neill and Sohal, 1999). Many researchers emphasize BPR as one of the critical success factors in ERP implementation (Al-Mashari et al., 2003; Nah et al., 2001; Soja, 2006). Dobriansky (2004) regards business process engineering as the cornerstone of successful enterprise IT systems implementation. Information technology is useful for business process reengineering, as well (Attaran, 2004; Mertins and Jochem, 2005).

In his paper, Attaran (2004) suggests several key steps for BPR: (1) performing a fit analysis, (2) Identifying gaps in business processes with existing mission needs, (3) identifying process improvements using enhanced technological and legal framework capabilities, (4) mapping and documenting the newly reengineered business processes, (5) developing and documenting standard operating procedures that incorporate the reengineered business processes, and (6) drafting and developing new policies, procedures manual, and training plans. Mapping the capabilities of a new enterprise IT system to the new improved business processes is critical to gain relevant and useful information. BPR and IT are partners with potential to create more flexible, coordinative and efficient work capabilities (Attaran, 2004). Without BPR the implementation of new IT systems will just overlay on the existing processes and functions in an organization (Dobriansky, 2004). Real business process reengineering needs to be done for the new enterprise system implementation.

2.2.2.6. IT readiness

IT readiness is referred to as the degree to which a firm prepares the environment and workforce to accept and configure new technology (Finney and Corbett, 2007; Soja, 2006; Somers and Nelson, 2004; Loh and Koh, 2002; Stratman and Roth, 2002). It is imperative to assess the IT readiness of an organization, including their skills and infrastructure (Tarafdar and Roy, 2003; Somers and Nelson, 2004). IT skills refer to an IT staff‗s ability to configure and maintain information systems to support a business (Stratman and Roth, 2002). Regardless of the pervasiveness of IT in modern workplaces, firms fail to optimize organizational effectiveness due to poor employee acceptance of new technologies (Lee et al., 2007). Strong technical expertise and training availability have been identified as essential for firms to improve their core competencies (Ravichandran and Lertwongsatien, 2005). Firms with a higher level of technical expertise and infrastructure can be expected to master the technical aspects of business and contribute more to firm performance than firms with a lower level of technical expertise and infrastructure (Lee et al., 2007).

Technical IT skills are necessary beyond the time of initial installation; post-installation support is generally requisite to refine and adjust specific system attributes on an constant basis (Stratman and Roth, 2002; Davenport, 1998). Since ERP systems operate in a dynamic business environment, they must adapt to changes in the strategic and operational focus of the firm. The ERP project manager and team members should not only be technologically competent, but also understand the business requirements of the firm. During the chartering phase, a project leader‘s expertise is especially critical (Markus and Tanis, 2000). If project leaders do not know what to do at certain decision-making points, it creates a significant problem. The skills and knowledge of the project team during the implementation phase is important in understanding the expertise of consultants in areas where team members lack knowledge. After the installation of an ERP system, IT staff should be able to solve any problems without the help of consultants.

2.3.3. ERP implementation

Not only are there many definitions of ERP, but there are also many papers related to the key success factors of ERP implementation. Few researchers have separated environmental factors from ERP implementation factors (Markus and Tanis, 2000; Tarafdar and Roy, 2003). Markus and Tanis (2000) classified three key success factors of ERP implementation in their process-oriented ERP life-cycle model: preparation-analysis-design, implementation, and maintenance. Tarafdar and Roy (2003) also divided key success factors into three groups: planning, implementation, and post-implementation.

In this paper, ERP implementation is defined as a firm‘s activity to adapt, configure, and integrate the information flow and business processes necessary to support different departments and functions in an organization through the use of IT architecture that collects and stores data in real time. This definition comes from the dynamic capability of a firm‘s perspective. Even though a company may implement ERP, due to market changes and the advent of new information technology, companies should still adapt, reconfigure, and integrate their information flow and business processes. In this context, the concept of adaptation, configuration, and integration is very critical to implementing an ERP system.

Loh and Koh (2004) mentioned the importance of configuration, integration, and user training under uncertainties during the implementation of ERP systems. Problems can arise from false software configuration and system module integration, communication breakdowns, conflicts between business objectives and ERP system objectives, labor shortage, unskilled personnel, and poor data collection.

Davenport (2000) describes the major elements of a rational approach to implementing an ERP system. This approach consists of two parts: (1) preparing the people, and (2) preparing the technical system (Abdinnour-Helm et al., 2003). Preparing the people is about training end users. Preparing the technical system is to adapt, configure and integrate the information system. Therefore, integration, configuration, adaptation, and user training are critical factors in the ERP implementation stage. The list of sub-constructs, along with their definitions and supporting literature, are provided in Table 2.3.3.

Table 2.3.3. List of sub-constructs for ERP implementation

Constructs	Definition	Literature
Integration	The degree to which a firm achieves unity in organizational subsystems by harmonizing the different modules, software and legacy system.	King and Flor, 2008; Duncan, 1995; Al-Mashari et al., 2003; Lawrence and Lorsch, 1969; Vonderembse et al., 1997
Configuration	The degree to which a firm matches ERP software to the needs of organizational processes.	Davenport, 1998; Kim et al., 2005; Abdinnour-Helm et al., 2003 ; Klein, 2007; Hong and Kim, 2002; Davenport, 2000; Livari, 1992; Kanellis et al., 1999; Weil and Olson, 1989; Henderson and Venkatraman, 1993; Marius and Ashok, 1996; Soh et al., 2000; Swan et al., 1999
Adaptation	The degree to which a firm accepts and adjusts new technology and system to cope with changes in the external environment.	Nah et al, 2001; Henfridsson, 2000; Hong and Kim, 2002; Lucas et al., 1988; Tyre and Orlikowski, 1994; Cooper and Zmud, 1991; Markus and Tanis, 2000, Orlikowski, 1992
User training	The degree to which a firm reskills and professionally develops its IT workforce.	Nah et al, 2001; Al-Mashari et al., 2003; Soja, 2006; Finney and Corbett, 2007; Bingi et al., 1999; Stratman and Roth, 2002; Stewart et al., 2000; Gupta, 2000; Bradley, 2008; Sumner, 1999

2.3.3.1. Integration

Integration is referred to as the degree to which a firm achieves unity in organizational subsystems by harmonizing different departments, modules, software, and legacy systems. Integration is about achieving a unity of effort in organizational subsystems (Lawrence and Lorsch, 1969; King and Flor, 2008; Duncan, 1995; Al-Mashari et al., 2003). It is to embrace both a set of physical factors and information flows that span the value chain. The organization possessing higher levels of integration tends to have higher performance (Lawrence and Lorsch, 1969; Vonderembse et al., 1997).

The benefits of an ERP system are limited unless it is seamlessly integrated with other information systems. There are many challenges in ERP integration in organizations: seamlessly integrating with various functional ERP modules, integrating with other business software applications, integrating with legacy systems, and integrating the ERP system with suppliers. First of all, for a successful ERP integration, ERP module integration is imperative. ERP software is made up of many software modules. Each ERP software module imitates a major functional area of an organization. Common ERP modules consist of modules for product planning, purchasing from suppliers, inventory control, manufacturing, product distribution, sales order tracking, finance, accounting, marketing, and human resources. Companies, in general, selectively implement the ERP modules that are appropriate and available in their economic and technical environments. They usually implement modules from the same ERP vendors which initially implement the ERP module(s) in their organizations. On the other hand, not all companies obtain all ERP modules from a single vendor. Therefore, integration of ERP modules can be either the integration of modules from different vendors or different versions of the modules from the same vendor.

Secondly, integration with other business software applications is very important. E-business practice is the combination of strategies, technologies, and processes to electronically coordinate both internal and external business processes and to manage enterprise-wide resources, such as manufacturing executive systems (MES) and advanced planning and scheduling systems (APS), customer relationship management (CRM), supply chain management (SCM), and knowledge management (KM). To maximize the benefits of the ERP system, firms should tightly integrate the system with other internal and external business software. Using standardized data definitions and codes that are shared with other information systems is very important.

Third, integration with legacy systems is also an important factor in ERP integration. Organizations have gathered huge amounts of data over the years, using legacy systems. The data in legacy systems are crucial to the survival, operations, and growth of corporations and non-profit organizations. Therefore, integration of ERP systems with legacy systems is very important, but more complex than the integration of ERP modules. The communication between ERP software systems and legacy systems involves the installation of third-party interface software.

Fourth, integrating an ERP system with the suppliers using communication protocols and standards is also another considerable issue in ERP system integration.

2.3.3.2. Configuration

Configuration is referred to as the degree to which a firm matches the software application packages to organizational processes (Davenport, 1998; Kim et al., 2005; Abdinnour-Helm et al., 2003; Klein, 2007). Configuration is to fit the ERP system to the business and to simultaneously fit the business to the ERP system (Davenport, 2000). Hong and Kim (2002) found in their research that ERP implementation success significantly relies on the organizational fit of an ERP system. ERP implementation may cause drastic organizational changes that need to be cautiously managed. Unlike other software, ERP implementation requires that organizational processes are configured to fit the basic business practices that are embedded in such application packages. When ERP implementation involves configuring the existing business processes to the standard business process of ERP, other organizational components (e.g. organizational structure, performance measurement, compensation, organizational culture, training, etc.) and their interactions must also be changed simultaneously (Hong and Kim, 2002).

Due to the diversity of organizational dimensions, researchers emphasize the fit between organizational structure and information systems (Morton and Hu, 2008; Livari, 1992; Kanellis et al., 1999). In a review of IS contingency research, Weil and Olson (1989) found over seventy percent of studies related to IS implementation followed a model assuming that the better the fit among the contingency variables with a firm, the better the performance. They classified the contingency variables as strategy, structure, size, environment, technology, task, and individual characteristics.

ERP misfit is attributable to firm-specific requirements that do not match the capabilities of ERP (Morton and Hu, 2008; Soh et al., 2000). Organizational misfits of ERP stem from the conflicting interests of ERP vendors and the organization which uses an ERP system (Hong and Kim, 2002). Thus, the concept of organizational fit seems to be an important research topic to measure the level of the IT implementation success.

2.3.3.3. Adaptation

Adaptation is referred to as the degree to which a firm accepts and adjusts new technology and systems to cope with changes in the external environment (Nah et al, 2001; Henfridsson, 2000; Hong and Kim, 2002). Adaptation is to accept new technology in a changing environment (Nah et al, 2001). In a rapidly changing business environment, the ERP implementation process is rarely a simple matter of realizing a plan. Instead, ERP is often a dynamic process of reciprocal adaptation between IT and the surrounding environment. Within the vibrant implementation process, adaptation is necessary because it is unusual for an ERP system to flawlessly match the environment of its users. Technological adaptation is the adjustments and changes during the installation of a new technology in a given setting (Hong and Kim, 2002).

Most organizations adapt ERP to their unique organizational contexts (Swan et al., 1999). Hong and Kim (2002) posit that ERP implementation success relies on the type and extent of ERP adaptation. In the adaptation stage of the IT implementation model, (1) an IT application is developed, installed, and maintained, (2) organizational procedures are revised and developed, and (3) organization members are trained both in the new procedures and in the new IT application (Cooper and Zmud, 1991). The concept and process of adaptation is relevant not only to custom software but also to off-the-shelf software packages (Markus and Tanis, 2000).

Most research on the implementation of IT software packages highlights the important nature of the adaptation process (Lucas et al., 1988). From the dual perspective of technology, ERP is defined as a ―technological artifact bundling material and symbolic properties in some socially recognizable form (e.g. hardware, software, practice)" (Orlikowski, 1992). Therefore, the adaptation of ERP and organizational processes needs an iterative process to involve constant social action which is influenced by both the organizational structure and an ERP system (Hong and Kim, 2002).

2.3.3.4. User Training

The implementation of an ERP system is not only a technical project, but also a people project. User training is referred to as the degree to which a firm reskills and professionally develops the IT workforce (Nah et al, 2001; Al-Mashari et al., 2003; Soja, 2006; Finney and Corbett, 2007; Bingi et al., 1999 ; Stratman and Roth, 2002). The source of ERP implementation success is not only the change of technology, but also the change of tasks, structures, and personnel (Stewart et al., 2000). One of the key challenges in ERP implementation is user training, because a lack of training results in implementation failure (Gupta, 2000). User training is to train, retrain, and develop the IT workforce to understand how the system will change business processes (Nah et al, 2001).

User training is considered an important factor that reduces the resistance of change and positively affects the possibility of a successful ERP system implementation (Bradley, 2008). There will be a higher possibility of successful implementation of ERP systems when systematic and efficient education programs are provided for inside users. User education reduces inside resistance during the implementation process, promotes system understanding, and facilitates the implementation process. Further, training makes it possible to use the ERP systems after ERP is implemented.

User training should be emphasized, with intense investment in the training and reskilling of employees who will be using it (Sumner, 1999). Employees need training to know how the system will make business processes different. Therefore, extra training and on-site support for staff and managers during implementation are necessary.

2.3.4. Supplier capabilities

Supplier capabilities are referred to as the suppliers' abilities to implement plans and programs that support company needs. Advances in information system technology have affected immensely the evolution of supplier capabilities. Because of advanced information technology, suppliers can work closely with the implementing firm's purchasing agents to coordinate and optimize their supply activities. A basic enabler for close coordination and responsiveness is information sharing, which has been greatly facilitated by the advances in information technology. Advances in IT make it possible for firms to exchange information within a variety of parameters. These can be demand, inventory levels, process quality, and feedback from customers.

Firms that coordinate information exchange with supply chain participants by relying on IT-mediated supply chain arrangements experience increased profits, cost reductions, and operational efficiencies (Kulp et al., 2004). These IT-mediated solutions are just in time production (JIT) and vendor managed inventory (VMI). Electronic data interchange enables both an organization and its suppliers to have substantial operational and strategic benefits. Forecasting sharing and collaboration between customers and suppliers reduce inventories and improve resource utilization.

Through information sharing concerning inventory, sales, demand forecast, order status, and production schedules with buyers, suppliers can coordinate functions and access information faster. They can also respond quickly in uncertain business environments and deliver faster and higher quality products to customers.

Compared to downstream members, upstream members gain more from information sharing with their partners. It is because upstream members of supply chain reduce order variability via information sharing than downstream members. In fast-moving business environments, suppliers can increase gains by sharing information with customers and assimilating knowledge of customers' preferences.

Loh and Koh (2004) and Mabert et al. (2003) argue, in their paper, that suppliers that deal with a larger enterprise have better performance in manufacturing and logistics by having an information system like the ERP system. Modern ERP packages include CRM and SCM functionalities which are improving front end operations. Large firms implementing full ERP packages are requiring their suppliers to implement ERP systems as well in order to optimize material management and reduce supply chain cost.

The list of sub-constructs, along with their definitions and supporting literature, are provided in Table 2.3.4.

Table 2.3.4. List of sub-constructs for supplier capabilities

Constructs	Definition	Literature
Information access	The degree to which a supplier supports its organizational production through fast data gathering and processing.	Premkumar et al, 2005 ; Klein, 2007; Moorman and Minor, 1997; Brockman and Morgan, 2003
Process improvement	The degree to which a supplier enhances existing programs and procedures within its organization.	Harkness et al., 1996 ; Ravichandran and Rai, 2000; Powell, 1995; Coskun et al., 2008; Lee and Ahn, 2008
Product innovation	The degree to which a supplier is able to enhance product quality, feature and performance.	Orlikowski, 1993; Koufteros, 1995

2.3.4.1. Information access

Supplier‘s Information access capability is referred to as the degree to which a supplier supports organizational production through fast data gathering and processing (Premkumar et al, 2005; Klein, 2007). Through collaboration work in a supply chain, a supplier can increase its information access capabilities. Through acquiring useful information for products from their customers, suppliers can efficiently find out what products or services they should offer in the future. Suppliers can detect changes in the product and service preferences and fundamental shifts in the purchasing and selling environment. Since ERP systems enable suppliers to access information regarding their products, suppliers can have up-to-the-minute access to information for decision-making and managerial control.

2.3.4.2. Process improvement

Process improvement is defined as ―a series of actions taken to identify, analyze, and improve existing processes within an organization to meet new goals and objectives" (Harkness et al., 1996; Ravichandran and Rai, 2000; Powell, 1995). These actions often follow a detailed methodology or strategic approach to produce successful outcomes. A supplier‘s process improvement is referred to as the degree to which a supplier identifies, analyzes, and enhances existing programs and procedures within its organization.

Advanced communication technologies and data management systems play a vital role in process improvement (Coskun et al., 2008). ERP systems can substantially enhance suppliers‘ manufacturing and logistics planning as well as management process. This is because it enables a firm to have precise and real-time data and information access. Suppliers‘ process improvement is often measured in terms of cycle time, bottleneck, cycle cost, and resource utilization (Lee and Ahn, 2008). Cycle time is the total time needed to complete a business process and is also a measure of process efficiency. Completing each activity involves delays and processing time. The reduction of cycle time for those processes critical to the firm (e.g. time-to-market and faster delivery) is the major driving force for process improvement. Process bottleneck represents a low-capacity part of a system which reduces the capacity of the entire system. While jobs wait for resources, they become bottlenecked. A bottlenecked process increases work-in-process inventory. Manufacturing firms should find and eliminate bottlenecks using information systems.

With fast and correct information, suppliers can continuously reduce order-processing cycle time, new product development cycle times, and overall product delivery cycle times. This information may help reduce paperwork and identify wasted time and costs in all internal processes.

2.3.4.3. Product innovation

Product innovation involves the introduction of a product or service that is new or substantially enhanced (Orlikowski, 1993; Koufteros, 1995). It refers to a company‘s ability to make new products and services and to improve them in order to create and satisfy new markets or customers. Companies should introduce their products more efficiently and at lower costs.

A supplier‘s product innovation is referred to as the degree to which a supplier is able to enhance product quality, features, and performance. Organizations with a greater absorptive capacity usually have a sufficiently developed technology base that enables them to have rich and detailed communications with their suppliers during the knowledge-sharing process. This communication process, in turn, may generate new ideas or solutions for product designs. Further, such firms are more likely to recognize the value of new ideas and effectively integrate them into their product development effort. It is necessary to develop new parts and components to produce significant innovations.

Thus, close collaboration with suppliers is important during the engineering process, in order to shorten development time and ensure the quality of new products. The ERP system enhances suppliers‘ capability to more readily identify market opportunities, generate ideas and concepts, and develop more cost-effective products and services. ERP systems help suppliers develop customized products, products with unique features, better quality, and higher performance.

2.3.5. Organizational capabilities

Organizational capabilities are referred to as a company‘s abilities to perform a set of tasks, while utilizing organizational resources (Helfat, 2003; Carmeli and Tishler, 2004; Peng et al., 2008). Organizational capabilities focus on internal processes and systems for meeting customer needs. Firms develop and manage organizational capabilities in order to gain competitive advantage by creating organizational-specific competencies. Organizational capabilities are abilities that lead a company to perform better than competitors using a unique and difficult to imitate set of business attributes. Continuously used capabilities become stronger and more complicated for competitors to appreciate and imitate. As a source of competitive advantage, a capability should not be so simple to be highly replicable. It should not be so complex that it resists internal steering and control. Through successful ERP implementation, firms can increase efficiency (e.g., cross-functional coordination, information access, and process improvement), innovativeness (e.g., product innovation) and responsiveness to customers (e.g., flexibility and agility).

In this proposed model, six different dimensions for understanding organizational capabilities relating to ERP benefits are suggested. They are cross-functional coordination, information access, process improvement, production innovation, flexibility, and agility. The list of sub-constructs, along with their definitions and supporting literature, are provided in Table 2.3.5.

Table 2.3.5. List of sub-constructs for organizational capabilities

Constructs	Definition	Literature
Cross-functional Coordination	The degree to which a firm achieves goal and consistent action for all departments and work functions.	Sherman, 2004; Eng, 2006; Zhang, 2005; Carr et al., 2008; Grant, 1996; Wernerfelt, 1984; Barney, 1991; Jansen et al., 2005; Pinto et al., 1993; Lawrence and Lorsch, 1967; March and Simon, 1958; Zahra and Nielsen, 2002; Sanchez, 1995; Ahmed et al., 1996; Goldhar and Lei, 1995; Bharadwaj, 2000
Information access	The degree to which a firm supports organizational production through fast data gathering and processing.	Premkumar et al, 2005 ; Klein, 2007; Moorman and Minor, 1997; Brockman and Morgan, 2003; March, 1991
Process improvement	The degree to which a firm enhances existing programs and procedures within its organization.	Harkness et al., 1996 ; Ravichandran and Rai, 2000; Powell, 1995; Peng et al., 2008
Product innovation	The degree to which a firm is able to enhance product quality, feature and performance.	Orlikowski, 1993; Koufterous, 1995; Deloitte Research study, 2004
Flexibility	The degree to which a firm design products to meet the needs of the market without excessive costs, time, organizational disruption, or loss of performance.	Upton, 1994; Chang et al., 2006; Narasimhan et al., 2004; Swamidass and Newell, 1987; Zhang et al., 2003; Zammuto and O'Connor, 1992; Kotha, 1995; Sanchez, 1995; Evans, 1991; Gerwin, 1993; Ahmed et al., 1996; Sambamurthy et al. 2003; McLaren et al., 2004; Duncan 1995; O'Leary, 2000
Agility	The degree to which a firm copes with unexpected changes, to survive unprecedented threats from the external business environment, and to take advantage of changes as opportunities.	Sambamurthy, 2003; Zhang, 2005; Lee et al., 2007; Brown and Eisenhardt, 1997; Gerwin, 1993; Upton, 1994; Sanchez, 1995; Kotha, 1995; Hayes and Pisano, 1994; Teece et al., 1997; Eisenhardt and Martin, 2000; Goldman et al., 1995

2.3.5.1. Cross-functional coordination

Many organizations have begun to realize the benefits of intra-firm integration. When the functional areas in an organization are coordinated, tasks or activities are completed that benefit the entire organization. Cross-functional coordination capability is referred to as the degree to which a firm achieves goal congruence and consistent action for all departments and work functions (Sherman, 2004; Eng, 2006; Zhang, 2005; Carr et al., 2008). This harmonizes the various activities that are performed within a firm to achieve a desired level of effectiveness and efficiency. In other words, cross-functional coordination means the organizational integration of functional areas. Having a capability to integrate functions and departments and to cooperate with other organizations is an imperative resource for the organization (Carr et al., 2008). This is essential when responding to the demands in an uncertain and turbulent business environment (Grant, 1996; Carr et al., 2008). Cross-functional coordination across functional areas can bring a competitive and sustainable advantage to a firm (Wernerfelt, 1984; Barney, 1991). Accumulated knowledge and experience through cross-functional coordination cannot be simply duplicated by competitors.

The successful coordination of activities between functional areas and between organizations enables the functional areas to plan and carry out their activities jointly (Carr et al., 2008). Cross-functional coordination is to have simple rules and procedures, to set departmental goals, and to enhance cross-functional relationships (Carr et al., 2008). Highly turbulent business environments and tasks involving high degrees of interdependence between functional areas and organizations need more cross-functional coordination capability (Jansen et al., 2005; Pinto et al., 1993). Although functional coordination capability has been considered necessary for a world-class operations strategy in the past (Lawrence and Lorsch, 1967; March and Simon, 1958), complex transactions and a variety of ownership systems have increased its importance in achieving a competitive edge (Eng, 2006; Zahra and Nielsen, 2002).

Therefore, cross-functional coordination has been increasingly acknowledged as a vital element to organizational capabilities (Zammuto and O'Connor, 1992; Sanchez, 1995; Ahmed et al., 1996). Indeed, researchers state that tight cross-functional coordination within and across firms facilitates smooth acquirement and sharing of critical information (Zhang, 2005). It also provides knowledge that firms need, in order to quickly identify changes in markets and products, redesign business processes and workflows, and develop new insights and skills (Goldhar and Lei, 1995; Bharadwaj, 2000). Ahmed et al. (1996) even argue that, without well-coordinated functional activities, firms are not able to gain a competitive advantage, because it is difficult to integrate different functional activities and optimize changes internally.

Cross-functional teams need wide-ranging information to make their decisions. They require drawing on information from all parts of an organization's database, including all functional departments. Therefore, system integration and coordination becomes critical because they make all information accessible through a single computer interface. A successful ERP implementation will enhance cross-functional coordination, thus increasing a firm's competitive edge. Fast information accessibility allows employees to work together across functions. They can share resources, ideas, and information in the organization, work together informally as a team, and achieve goals collectively with other employees from different departments.

2.3.5.2. Information access

Information access capability is referred to as the degree to which a firm supports organizational production through fast data gathering and processing (Premkumar et al, 2005;

Klein, 2007). Existing knowledge and information stimulate new ideas and become a source of efficiency for existing processes (Moorman and Minor, 1997). Organizations with a strong existing knowledge base can expect a greater payoff from research and development investments, because they waste less time searching for information that is not useful to a project. Knowledge reduces variability in the time required to complete tasks and in the quality of task performance; work is therefore more reliable (Brockman and Morgan, 2003; March, 1991).

In considering efficiencies, effective information access will have a great impact on business performance. Acquiring useful information for product development with a minimum expenditure of energy, time, or resources will help in finding out what products or services the organization should offer in the future. It also aids in detecting changes in product and service preferences and identifying fundamental shifts in the purchasing and selling environment. Since the implementations of ERP systems enable a firm to establish backbone data warehouses, ERP systems offer better accessibility to data so that management can have up-to-date access to information for decision making and managerial control. Also, an ERP system helps track actual costs of activities and perform activity based costing.

2.3.5.3. Process improvement

Generally, firms expect that their new ERP-based systems environment will facilitate process improvements (Harkness et al., 1996; Ravichandran and Rai, 2000; Powell, 1995; Peng et al., 2008). In some cases, they want to improve specific processes, such as logistics, production scheduling, or customer service, which are cost-driven reasons. In other cases, management is more generally concerned with process standardization to ensure the quality and predictability of global business processes. Through process standardization, these firms expect reduced cycle times from customer order to delivery.

2.3.5.4. Product innovation

Production innovation capability is referred to as the degree to which a firm is able to enhance product quality, feature, and performance (Orlikowski, 1993; Koufterous, 1995). According to a Deloitte Research study (2004), manufacturers now consider new products their primary source of revenue growth, but they are unable to profitably bring new products and services to market. In addition, more than three fourths of new consumer goods product launches fail and less than one-third of manufacturers believe that their new product development process is under control. Companies should introduce their products more efficiently and at lower cost.

An ERP system improves the management and execution of the entire new product innovation process by helping companies more readily identify market opportunities, generate ideas and concepts, and select the most promising projects to pursue (Griffin and Hauser, 1996; Mullins and Sutherland, 1998). ERP systems support the successful design and global marketability of a firm‘s products and services (Mullins and Sutherland, 1998; Koufteros et al., 2002). A critical aspect of product innovation is efficiently managing the flow of ideas from an organization‘s operations across multiple regions and turning these into reality (Andersson and Johansson, 2008; Griffin and Hauser, 1996; Mullins and Sutherland, 1998). ERP systems enhance a firm‘s production innovation capability to develop more cost-effective products and services that are highly demanded by customers. An ERP system helps a firm develop customized products, products with unique features, and better quality products with better performance.

2.3.5.5. Flexibility

Flexibility is referred to as the degree to which a firm meets the needs of the market without excessive costs, time, organizational disruption, or loss of performance (Upton, 1994; Chang et al., 2006; Narasimhan et al., 2004; Swamidass and Newell, 1987; Zhang et al., 2003). Flexibility in an organization is one of the most crucial success factors when pursuing a variety of strategic options in response to the demands of changing markets (Zammuto and O'Connor, 1992; Upton, 1994; Kotha, 1995; Sanchez, 1995). This flexibility is the ability to ‗increase the range of products a production system can process and/or reduce the cost and time required to switch production resources from one product to another'' (Sanchez, 1995).

Product flexibility enables firms to control product variety and change efficiently and speedily. It also gives firms more strategic opportunities to deal with environmental uncertainties (Evans, 1991; Gerwin, 1993; Sanchez, 1995). Compared to other types of flexibilities such as process flexibility, product flexibility enables a firm to satisfy changing customer needs more effectively. For this reason, product flexibility is often viewed as the most significant source of strategic flexibility (Gerwin, 1993; Sanchez, 1995; Ahmed et al., 1996; Hitt et al., 1998).

To support flexibility in business, a firm needs an information system to enable the rapid detection of and response to competitive market opportunities (Sambamurthy et al. 2003; McLaren et al., 2004). Information systems allow a firm to modularize and reconfigure business processes, as well as to share easily information with customers, suppliers, and other business partners (Duncan 1995; Sambamurthy et al. 2003). A few researchers view information systems as inhibitors rather than enablers of flexibility (Allen and Boynton, 1991). However, effective information systems can improve operational flexibility by automating routine tasks and releasing resources to focus on non-routine tasks (O'Leary, 2000; McLaren et al., 2004). "Efficient flexibility" is an important information systems capability in supply chain management (Allen and Boynton 1991; McLaren et al., 2004).

2.3.5.6. Agility

Agility is referred to as the degree to which a firm adapts to a continuously changing and unpredictable business environment (Brown and Eisenhardt, 1997; Sambamurthy, 2003; Zhang, 2005; Lee et al., 2007). It is the ability to proactively respond to changing competitive business environments, thereby developing and maintaining a competitive advantage. In the fields of strategic management, manufacturing management, and IT management, many researchers are showing greater interest in studying the concept of agility. In today‛s turbulent business environment, the agility of a firm is receiving growing recognition (Gerwin, 1993; Upton, 1994; Sanchez, 1995). Sharp et al. (1999) and Coronado et al. (2002) consider Information technology a crucial enabler and facilitator of agility.

A successfully implemented ERP system enables a firm to flexibly assemble requisite assets, knowledge, and business relationships (Goldman et al., 1995; Sambamurthy et al., 2003). Besides, a firm which has this capability takes opportunities for new competitive action in its marketplaces and continually seeks the necessary knowledge and assets for seizing those opportunities. This type of dynamic capability is known as organizational agility, which is a firm‛s high-level capability to detect environmental changes and rapidly as well as flexibly respond to these changes by assembling organizational resources (Goldman et al., 1995; Sambamurthy et al., 2003).

In the literature, several characteristics have been discussed with regard to organizational agility: (1) anticipating and sensing opportunity; (2) responding rapidly; (3) integrating organizational resources effectively and proactively; (4) elevating customer value; and (5) pursuing growth (Goldman et al., 1995; Sambamurthy et al, 2003). This ability allows a firm to accomplish speed, accuracy, and cost economy through utilizing opportunities for innovations and competitive activities. In all, these abilities enable a firm to achieve its innovations and competitive movements through its close interactions with customers, efficient coordination of internal process, as well as synergies with its external business partners. It also enables a firm to respond quickly to emerging opportunities in markets and environmental opportunities. It helps firms respond rapidly to natural, competitive, and operational threats.

2.3.6. Supplier performance

Supplier performance is referred to as the degree to which a supplier is able to deliver materials, components or products to a company in a manner that meets that company‘s needs (Li, 2002; Beamon, 1998; Shin et al., 2000; Vonderembse and Tracey, 1999). It can also be measured by supplier‘s consistency in delivering materials, components, or products to an organization on time and in good condition (Beamon, 1998). Supplier performance has significant impact on a buyer‘s operational success (Davis, 1993; Shin et al., 2000; Vonderembse and Tracey, 1999). Poor supplier‘s quality and delivery performance results in higher levels of inventory and order backlog (Shin et al., 2000). However, a supplier‘s good quality of products and services will enhance organizational performance (Li et al., 2006).

Supplier performance can be described in five major categories: short lead time, product variety, quality, delivery, and cost. In their paper, Shin et al. (2000) defined supplier performance as lead-time, on time delivery, delivery reliability, quality, and cost. The supplier performance construct requires a more extensive review of the literature in order to establish its content validity. From the literature, four different performance characteristics of supplier performance are identified. The following review of the literature describes these supplier performance characteristics and how supplier performance works together in the interaction between suppliers and buyers. The list of sub-constructs, along with their definitions and supporting literature, are provided in Table 2.3.6.

Table 2.3.6. List of sub-constructs for supplier performance

Constructs	Definition	Literature
Short lead times	The degree to which a firm obtains products or services from suppliers within a shorter time.	Shin et al., 2000; McAfee, 2002; Ward and Zhou, 2006; Co et al., 1998; Ward and Zhou, 2006; Apte and Reynolds, 1995; Schmenner and Rho, 1990; Frohlich, 2002; Subramani, 2004; Sanders, 2007; Mason-Jones and Towill, 1997; Dejonckheere et al., 2004; Huber, 1982; Cachon and Fisher, 2000; Lee et al., 2000
Product variety	The degree to which a firm does receive from suppliers new goods and/or services with additional features and improved performance with a wide offering (mix).	Upton, 1995; Da Silveira, 1998; MacDuffie et al., 1996; Lee and Tang, 1997; McCutcheon et al., 1994; Primrose and Verter, 1996; Upton, 1994; Fisher and Ittner, 1999;
Delivery reliability	The degree to which a firm obtains products or services from suppliers according to the schedule promised at the time of the order.	Shin et al., 2000; Koufterous, 1995; Laseter and Ramdas, 2002
Cost performance	The degree to which a firm obtains products or services from suppliers at low price.	Shin et al., 2000; Ward et al., 1995; Lee et al., 2000, Chen, 1998
Quality	The degree to which a firm receives from suppliers products or services which increase the firm's value.	Shin et al., 2000; Rondeau et al., 2000; Li, 2002 ; Mei, 2005; Choi and Hartley, 1996

2.3.6.1. Short lead time

Short lead time is referred to as the degree to which a firm obtains products or services from suppliers within short time. IT investment enhances a firm's performance, including lead time (McAfee, 2002; Ward and Zhou, 2006; Shin et al., 2000). Lead time reduction, which means eliminating unnecessary accumulating of materials within the process and wasting time in non-value added activities, is one important reason to implement information systems (McAfee, 2002; Co et al., 1998; Ward and Zhou, 2006). The importance of cycle time reduction is emphasized as a manufacturing strategy to make a firm more competitive (Ligus, 1992). Many empirical researchers focus on the relationship between lead time and a firm‘s productivity (Rho and Yu, 1998; Cotteleer and Bendoly, 2006; Schmenner and Rho, 1990).

To have shorter processing time, a firm must pay attention to inventory levels, bottlenecks, and confusion. By eliminating unnecessary delays or stoppages in the process flow, a factory can have more output by increased productive time and use less input by reducing wasted resources. This enables a firm to have an increased ratio of output over input.

Schmenner and Rho (1990) also extended their study to include international comparison of the relationships between manufacturing practices and productivity. They report that improved and quickened flow, investment in new technology, and human resource management initiatives are critical to improve productivity.

The connection between a firm and suppliers leads to improved firm performance (Frohlich, 2002; Subramani, 2004; Sanders, 2007). However, there is little research regarding the impact of IT implementation on suppliers. Many researchers have focused on finding relationships between lead time and a buyer company‘s business performance. Between-firm IT integration contributes to reduced lead times, not only for buyers, but also for suppliers. Mason-Jones and Towill (1997) propose a concept called the information–enriched supply chain, which separates the lead time in a supply chain into material movement lead time and information movement lead time (Dejonckheere et al., 2004). Enriched information sharing enable firms to more closely linked both internally and externally. Information sharing also allows a firm to reduce information lead time and total product lead time in a supply chain.

In addition, between-firm IT integration reduces the decision-making process time. Data integration facilitates data to be used as a common language for the events happening in an organization. Insufficient data integration is a source of operational problems such as delays, decreases in communication, and distortion of the facts (Huber, 1982). Between-firm integration aids joint decisions by promoting information exchange, recollection, and standardization. Sharing demand and inventory data can cut down the order processing lead time (Cachon and Fisher, 2000). Sharing current demand variation information enable a firm to reduce inventory levels significantly, which is in general related with reduced lead times (Lee et al., 2000). Because of real-time information sharing, suppliers can deliver products within a short time, improve the speed of service through eliminating waste and non-value added activities, have short processing time, and minimize the time from order placement to the delivery of procured items.

2.3.6.2. Product variety

Suppliers‘ product variety is referred to as the degree to which a firm receives from suppliers new goods and/or services that are value-added and offer a wider mix. The competitive advantage of product variety has been a growing issue in manufacturing performance (Kekre and Srinivasan, 1990; Uzemeri and Sanderson, 1995; Da Silveira, 1998). To remain competitive, firms broaden product lines and increase their product variety (Kekre and Srinivasan, 1990). Remaining flexible is critical for a firm to increase product variety (Primrose and Verter, 1996; Upton, 1995). A supplier‘s performance to provide new goods and/or services with additional features and improved performance with a wide offering is imperative for the organization to increase its manufacturing flexibilities. Through fast information sharing, process improvement, and product innovation, suppliers can develop their abilities to increase the number of their products and to deal with a variety of products through adaptive or flexible strategies.

2.3.6.3. Delivery reliability

Delivery reliability is referred to as the degree to which a firm obtains products or services from suppliers according to the schedule promised at the time of sale (Shin et al., 2000; Koufterous, 1995). This is very important in buyer-supplier interactions. Delivery reliability can be a major determinant in the amount of inventory maintained. If the delivery from suppliers is not reliable, a firm may need more storage to accommodate enough back up inventory as a contingency to such delays. The buyer firm prefers to receive reliable deliveries (e.g., specified and consistent amounts spread over a given time frame). Information integration between suppliers and buyers through an ERP system enables the suppliers to have fast and reliable information. Through fast and reliable communication with buyers, suppliers can deliver the correct number and types of parts, thus meeting the buyer‘s specifications. In a sense, fast communication through ERP integration increases a supplier‘s capability to respond quickly to a buyer‘s orders and enhance delivery reliability.

2.3.6.4. Cost performance

Cost performance is referred to as the degree to which a firm obtains products or services from suppliers at a low price (Shin et al., 2000; Stank et al., 1999; Ward et al., 1995). Sharing demand and inventory data improves the quality of suppliers‘ decision making processes (Lee et al., 2000, Chen, 1998). An ERP system enables a firm to give suppliers valid and stable schedules as well as better business visibility. With fast and real-time information from their customers, suppliers can produce and deliver items more efficiently at a lower cost. This cost saving can be passed back to the buying company to be used either for increased profits or reduced product pricing, which can translate to increased sales and profits.

2.3.6.5. Quality

Quality is referred to as the degree to which a firm is able to obtain products or services from suppliers that increase the firm‘s value (Shin et al., 2000; Rondeau et al., 2000; Li, 2002; Mei, 2005). A firm‘s product quality and value increase because of suppliers‘ products and services. Product quality has always been one of the most key performance criteria in a firm (Shin et al., 2000; Choi and Hartley, 1996). Quality is one of the most critical determinants in selecting suppliers as well (Shin et al., 2000). Overall product quality and costs are determined by the quality of the suppliers‘ products (Chen and Paulraj, 2004). Thus, to respond quickly to customer requirements with high quality products, firms need to receive good quality products from suppliers. With fast information sharing, a supplier can conform to buyer specifications and offer highly reliable and qualified products to them. Therefore, the information sharing between suppliers and buyers through ERP integration is critical for the quality of a supplier‘s product.

2.3.7. Organizational performance

Organizational performance measurement plays an important role in organizational growth. Through measuring performance, a firm can identify and track progress against organizational goals, seek opportunities for improvement, and compare performance against both internal and external standards. A firm can also formulate strategic activities through reviewing its performance. Academics and practitioners are interested in the relationship between information system investment and organizational performance (Devaraj and Kohli, 2003;

Vickery et al., 2003; Ward and Zhou, 2006). Many researchers suggest that IT investment leads to improved firm performance including cost, quality, delivery, product variety, and time-to-market (Li 2002; Koufterous, 1995; Tu, 1999; McAfee, 2002). Most manufacturing firms place ERP implementation as a key technology priority in today‘s increasingly competitive and turbulent business environment. Keeping on top of the various activities and processes involved in product production, sales, and distribution can be a tremendous challenge. Firms must design, build and deliver the highest quality products in the timeliest manner at the lowest costs to win and retain customers.

After implementing an ERP system, the company can use business processes quickly and correctly to stay on top of product quality and timely delivery, which establishes customer confidence. Using the ability to access and analyze information, a company can readily build a customer database and effectively analyze customer information. This enables a firm to understand customer attributes and behaviors, thereby finding the correct position and market segment for the product. This results in customers becoming corporate assets and firms being able to maintain a good relationship with their customers (Huang et al., 2007).

With an ERP system, companies can leverage advanced features and functionality to improve all aspects of their operations – from product development, sourcing and procurement, through manufacturing, quality testing, and to delivery. As a result, they can enhance efficiency and profitability by reducing cost, developing various products, introducing new products faster than competitors, delivering products on time, and improving quality. The list of sub-constructs, along with their definitions and supporting literature, are provided in Table 2.3.7.

Table 2.3.7. List of sub-constructs for organizational performance

Constructs	Definitions	Literature
Cost performance	The degree to which a firm can attract customers primarily at low price.	Koufteros, 1995; Li, 2002; Krause et al., 2007; Ward et al., 1995
Product variety	The degree to which a firm does introduce new goods and/or services with additional features and improved performance with a wide offering (mix).	Kekre and Srinivasan, 1990; Uzemeri and Sanderson, 1995; MacDuffie et al., 1996; McCutcheon et al., 1994; Primrose and Verter, 1996; Upton, 1995; Upton, 1994; Da Silveira, 1998; Fisher and Ittner, 1999; Lee and Tang, 1997
Delivery reliability	The degree to which a firm provides products or services according to the schedule promised at the time of sale.	Cusumano and Takeishi, 1991; Blackburn, 1991; Nahm et al., 2003
Time to market	The degree to which a firm introduces new products faster than its competitors.	Stalk, 1988; Ward et al., 1995; Li, 2002; Griffin, 1997; Ittner and Larcker; Langerak et al., 1999; Sherman et al., 2000
Quality	The degree to which a firm offers a product which creates higher value to its customers.	Rondeau et al., 2000; Shin et al. (2000); Krause et al., 2007; Ward et al., 1995; Li, 2002; Mei, 2005; Garvin, 1988

2.3.7.1. Cost performance

Cost performance is referred to as the degree to which a firm can attract customers primarily at a low price (Koufteros, 1995; Li, 2002; Krause et al., 2007; Ward et al., 1995). The most successful companies identify needs and opportunities to substantially reduce costs in the supporting areas of their businesses. Reducing administrative costs, manual effort, and overhead can lead a firm to be more efficient, effective, responsive, and profitable. Through integrating business processes across departments onto a single enterprise-wide information system, ERP improves cross-functional coordination and increases efficiencies in doing business.

The direct and instant benefit from implementing ERP systems is cost reduction across multiple operations. ERP systems reduce costs in many ways, such as lower marketing costs, lower manufacturing costs, lower purchasing costs, lower inventory control costs, and lower customer service and support costs. In a word, an ERP system drives down selling, general, and administrative expenses. Enhanced worker productivity reduces overtime and related labor as well as payroll expenses. Improved precision in a production floor process decreases the scrap and re-work that can deplete financial resources. Better tracking of components, more accurate forecasting, and turnover of finished goods enable firms to eliminate excessive inventory costs. Furthermore, improved visibility into all financial aspects of production can help identify potential areas for savings and reduce the cost of goods sold. By avoiding duplication of information, an ERP system allows a firm to have opportunities for cost reduction and value-added tasks which result to increased margins.

Implementation of an ERP system enhances a firm‘s ability to reduce operational costs by standardizing and optimizing processes, integrating financial information, controlling system introduction effectively, and increasing financial reporting plausibility. Sharing demand and inventory information will lead to reductions in inventory, overhead cost, and material costs.

2.3.7.2. Product variety

Product variety is referred to as the degree to which a firm introduces new goods and/or services with additional features and improved performance with a wide offering. Product variety aims to deliver variety levels that are compatible with market requirements and to improve the impact of product and part variety on the operations performance (Da Silveira, 1998). The literature on product variety has focused on its importance within competitive strategy (Kekre and Srinivasan, 1990; Uzemeri and Sanderson, 1995), its impact in operations performance (MacDuffie et al., 1996), and the use of flexibility for dealing with product and part variety in operations and strategy (Da Silveira, 1998). The importance of product variety has been increasing since 1990s (Kekre and Srinivasan, 1990; Uzemeri and Sanderson, 1995).

Firms in many businesses broaden their products lines to increase product variety to remain competitive (Kekre and Srinivasan, 1990). Since the early 1980s, flexibility has been studied widely as a response to increased needs of product variety (Primrose and Verter, 1996; Upton, 1995). Upton (1994) developed a framework for the analysis of manufacturing flexibility with the idea of process mobility – the ability to change quickly between products.

Product variety is being extended in many industries. Customers desire broader selections of products and reasonably priced tailor-made solutions. Companies differentiate their products to satisfy customer need. Products are built according to customer orders, and sometimes there are a lot of selections to be made before the product is fully specified. Manufacturing design is a requirement for cost-effective tailoring. Various products cannot be stored in inventory without new methods and approaches. Tightening international competition causes to increase product variety and drives companies to produce various products within a shorter time (Da Silveira, 1998; Fisher and Ittner, 1999; Lee and Tang, 1997). Increased product variety and fast technological changes make the use of buffering inventories more difficult.

Traditional production systems have problems in generating accurate sales forecasts for products and keeping inventory and service levels due to uncertainty of customer demand (Lee and Tang, 1997). Generally, large product variety combined with low volume causes bigger unit costs, due to complexity that causes the overhead costs (Hayes and Wheelwright, 1994). Managing product variety is associated with production issue such as lot sizing and set-up. Management of variety is also a challenge for sales. Through support of an ERP system, firms can configure products efficiently and produce more variety of various products.

2.3.7.3. Delivery reliability

Delivery reliability is referred to as the degree to which a firm provides products or services according to the schedule promised at the time of sale. Shortages and quality problems in supplier parts are additional sources of product delay. Key benefits of an ERP system, such as enhanced control over components inventory, more precise demand planning, smooth production scheduling, and more effective coordination of distribution channels, enable firms to improve on-time delivery of products, a critical performance measure for today‘s manufacturers. Evidence shows that reliable suppliers can help buyers cut processing time, increase quality, and improve manufacturing competitiveness (Cusumano and Takeishi, 1991; Blackburn, 1991; Nahm et al., 2003).

2.3.7.4. Time-to-market

Time-to-market is referred to as the degree to which a firm introduces new products faster than its competitors (Nahm et al., 2003; Qu, 1999; Stalk, 1988; Ward et al., 1995; Li, 2002; Griffin, 1997). In turbulent, rapid changing, and highly competitive markets, products have reduced life cycles. This means that there is a need for companies to reduce the time-to-market of new products that will simultaneously ensure their success in the market. Early product introduction improves profitability by extending a product‘s sales life and allowing development and manufacturing cost advantages. Researchers claim that earlier and faster product development leads to better performance (Griffin, 1997; Ittner and Larcker, 1997). The importance of time-to-market for new products as a factor of competitive advantage is well known. In fact, a considerable number of articles on this subject have been published in the last decade. Griffin (1997) used time-to-market as a dependent variable and analyzed its relationship with the use of multifunctional teams, the use of formal processes of new product development, and the degree of product complexity and originality.

Thus, multifunctional teams were found to be associated with the largest reductions in the development cycle of new products which have the highest degree of originality, while formal processes were associated with the largest reductions in the development cycle of more complex products. On the other hand, time-to-market is significantly related to: (1) the number of suppliers used in the process; (2) the number of organizational functions that were integrated in the team involved in the development of new products; (3) the level of support and involvement of top management people; (4) the simultaneity of activities during the development process; and (5) the definition of time-to-market as the firm's objective (Langerak et al., 1999; Sherman et al., 2000; Alfonso et al., 2008).

ERP systems improve efficient interdepartmental communication which saves time, which can be utilized for identifying business growth opportunities. The improvement in process efficiency and in tactical decision making as well as adaptation to radical environment changes enables firms to more quickly develop new products and introduce them into the market.

2.3.7.5. Quality

Quality is referred to as the degree to which a firm offers a product that creates a higher value for its customer (Shin et al., 2000; Krause et al., 2007; Ward et al., 1995; Rondeau et al., 2000; Li, 2002; Mei, 2005). Firms that can respond faster to customer needs with high quality products and innovative design, as well as excellent after-sales service, build customer loyalty, increase market share, and ultimately achieve increased profits (Mei, 2005). Garvin (1988) proposes eight dimensions of quality. These are performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality, which are comprehensive but difficult to establish to measure. ERP systems make it easier for businesses to check product defects and problems. ERP systems enable firms to identify exactly where the design or production process issue is occurring and to take the needed steps to make sure production of products of the supreme quality. This, in turn, will improve sales, customer satisfaction, and profits.

2.3.8. Customer value

As specified in previous sections, this entire research framework is driven by constantly changing business environments, such as customer demand change, uncertainty and rapid technological change. Thus, the real question is about how an ERP implementation can actually create higher value for customers. For this reason, the measure of the ―customer value" variable is included in this model. Customer value is referred to as the degree of benefits perceived by customers as a tradeoff between what customers receive and what they sacrifice. Customer value is a source of competitive advantage for business firms.

Tu (1999) defined it as the extent to which customers perceive a firm's products as having higher value, as well as their degree of satisfaction with these products. However, the customers' perceived value can easily be confused with customer satisfaction (Sweeney and

Soutar, 2001). While perceived value occurs at various stages of the purchasing process, customer satisfaction and referral are more related to post-purchase and post-use evaluation (Tu, 1999; Woodruff; 1997; Sweeney and Soutar, 2001)

Customer value comes from meeting the current needs of customers more efficiently, from identifying the customer needs proactively, and from meeting new customer needs or new needs of existing customers (Chand et al., 2005). Customer value is also related to improved customer service and more accurate customer invoices. To faster customer service a firm can also connect new systems to the ERP system (e.g. a system optimizing distribution routes). An ERP system enables faster response to customers. For example, a firm reported improvement in the customer response for orders with a fulfillment period of less than one week. The new ERP system helped to meet these delivery terms. It also enabled faster and more accurate customer reports regarding project stages, the tasks of project members, and time spent on performing respective tasks.

Less internal mistakes visible to the customer, better follow-up of customer relationships, and more flexibility in adapting to business changes are also possible. Increased customer satisfaction and more increased value for customers are expected once the company enhances its ERP package with a new module (e.g., the sales and distribution module). Customers who perceived increased benefits and are satisfied with the quality and features of products are likely to refer new customers to purchase the firm‘s products (Tu, 1999). In his paper, Joo (2007) proposed seven customer value factors based on a literature review and the technology acceptance model (TAM): economy, convenience, speed, personalization, community, emotion, and trust. From his model, four important factors for customer value through ERP implementations are identified. They are value for money, convenience, timely response, and reputation for quality. The list of sub-constructs, along with their definitions and supporting literature are provided in Table 2.3.8.

Table 2.3.8. List of sub-constructs for customer value

Constructs	Definitions	Literature
Value for money	The degree to which a customer perceives value because a firm has lowered a product's price.	Nasution and Mavondo, 2008; Joo, 2007; Tu, 1999; Chand et al., 2005; Sweeney and Soutar, 2001; Petrick, 2002; Zeithaml,1988
Convenience	The degree to which a customer perceives value because the firm has provided convenient information and service.	Joo, 2007; Chand et al., 2005; Petrick, 2002
Timely response	The degree to which a customer perceives time saving because a firm quickly acts upon customer needs.	Joo, 2007, Tu, 1999; Chand et al., 2005; Petrick, 2002
Reputation for quality	The degree to which a customer perceives product quality and performance.	Nasution and Mavondo, 2008; Sweeney and Soutar, 2001; Petrick, 2002; Zeithaml,1988

2.3.8.1. Value for money

Value for money is referred to as the degree to which a customer perceives value because a firm has lowered a product's price (Joo, 2007; Tu, 1999; Chand et al., 2005). It is the value that customers perceive the price of a product purchased is lower than average market price. Value for money is related to what a customer sacrifices in order to buy a product (Zeithaml, 1988; Petrick, 2002). Some customers may know the exact price of the product they purchased, but others may only evaluate the price based on their past purchases. Customers feel that they purchased products with high value and quality. This may be perceived due to cost reductions or a lower price. ERP systems enable firms to facilitate quicker data/information flow between departments and offices and helps employees to work faster, save valuable time, and reduce operational costs. As a result, customers can perceive cost saving in their purchases.

2.3.8.2. Convenience

Convenience is referred to as the degree to which a customer perceives value because the firm has provided convenient information and service (Joo, 2007; Chand et al., 2005; Petrick, 2002). Customers experience convenience due to timely and updated information. Valid delivery promises and fulfilling customer orders on time through using an ERP system improves customer service. An ERP system enables a firm to develop customer order quotations faster and even more accurately, improve job estimating, and shorten delivery lead times. As a result, customers can perceive convenience in their purchases. Convenience along with timely response is included in non-monetary costs.

2.3.8.3. Timely response

Timely response is referred to as the degree to which a customer perceives time saving because a firm quickly acts upon customer needs (Joo, 2007; Tu, 1999; Chand et al., 2005). Through the experience of quick services, such as order fulfillment and delivery, customers can perceive time savings. ERP systems enable the organizations to respond to any challenges in real time, so that a firm is able to respond in a timely fashion to any customer demands. ERP systems also allow for timely and accurate responses to customer problems and priorities.

2.3.8.4. Reputation for quality

Reputation for quality is referred to as the degree to which a customer perceives product quality and performance (Nasution and Mavondo, 2008; Sweeney and Soutar, 2001; Petrick, 2002). It is based on the customer‘s perception about the superior quality of a product. Customers‘ perception of product quality leads to their intentions to purchase products later. In his research, Zeithaml (1988) states that perceived quality is different from objective or actual quality and higher in level of abstraction. He also mentions that perception comes from consumers‘ evoked judgment. An ERP system enables a firm to provide quality products to customers through checking and examining customers‘ preferences more often. This leads customers to perceive that the firm provides quality products.

2.4. Theoretical Model and Hypotheses

In the previous section, the literature is reviewed to establish the content validity of each construct and associated scales. This research focuses on the relationships among external environment, internal environment, ERP implementation, supplier capabilities, organizational capabilities, supplier performance, organizational performance, and customer value, as depicted in Figure 2.1. The successful ERP implementation, which is affected by external and internal environments, should have positive impacts on organizations, suppliers and even customers. Based on this research design, the following nine hypotheses are developed to empirically examine the relationship between each construct.

2.4.1. External environment and internal environment

The external environment, as perceived by the managers, has an effect on internal factors regarding ERP Implementation. That the external environment affects internal environments is obviously related to the claim that organizations, in general, are affected by their environments (Gordon, 1991; Nahm et al., 2003). Many researchers posit that the external environment and the internal environment of an organization are loosely coupled (Gordon, 1991). Decision maker‵s perceptions of the external environment have a significant relationship with an organization‵s characteristics (Lawrence and Lorsch, 1967; Duncan, 1972). The perception affects top manager‵s reactions toward the business environment.

In their paper, Swamidass and Newell (1987) empirically demonstrated that environmental uncertainty is positively related to top management pursuit of flexibility and centralized decision making. Organizational structure is also substantially determined by the external environment (Duncan, 1972; Lawrence and Lorsch, 1967). Organic structures, which are less formalized and more flexible, are needed to deal with a more complex and diverse array of departments and functions (Lawrence and Lorsch, 1967). It is imperative to have a fit between the nature of the external environment and organizational structure (Ward et al., 1995; Nahm et al., 2003). Doll and Vonderembse (1991) posit that self-organized and self-directed work groups learn more from each other and respond flexibly to the changing market.

Duncan (1972) and Lawrence and Lorsch (1967) state departments facing a changing environment should have more communication than those in stable environments. Through increasing the amount of work-related communication, firms can respond to turbulent environments. Due to unpredictable technological change, technological readiness for an information system is critical to optimize organizational effectiveness (Lee et al., 2007). In technologically uncertain environments, strong technical expertise is necessary to improve core competence (Ravichandran and Lertwongsatien, 2005). Therefore, it is expected that:

Hypothesis 1: A firm which operates in a highly uncertain, competitive, and rapidly changing environment will have a high level of adjustment and improvement in internal environments.

2.4.2. External environment and ERP implementation

Many researchers have considered the external business environment to be an important driver for the implementation of information systems (Lawrence and Lorsch, 1967; Franks, 2000; Chandra and Kumar, 2000; Li, 2002). In a highly uncertain and rapidly changing environment, organizations internalize their resources and capabilities, such as information systems to establish a competitive edge (Li, 2002; Vonderembse et al., 1997). Fast and correct information sharing is critical to business success, even to supply chain partners. Technological advances offer opportunities for firms to capture flexibility and efficiency (Doll and Vonderembse, 1991; Vonderembse et al., 1997). The investment in information technology results in fast communication, improved productivity, efficiency, and eventually enhanced performance. This is especially true of organizations that implement an ERP system to increase organizational responsiveness, manufacturing efficiency, and to reduce the risk associated with uncertainty.

Menzer et al. (2000) suggest that technological uncertainties will drive organizations to share information with their suppliers as technological change is not controllable by individual firms. The high level of competition will compel organizations to adopt more resources to enhance customer satisfaction through effectively managing customer complaints and building long-term relationships with customers (Li, 2002). Grover and Goslar (1993) found that the companies in competitive environments are more likely to adopt and implement information systems (Kim and Lee, 2008). To proactively deal with the rapidly changing external environment, many firms have changed their information system (IS) strategies by implementing application software packages (Hong and Kim, 2002). To respond to the unpredictability of customers, suppliers, and competitors, firms need fast and real-time information. Therefore, here it is expected that:

Hypothesis 2: The more a firm operates in a highly uncertain, competitive and rapidly changing environment, the more successful the ERP implementation will be.

2.4.3. Internal environment and ERP implementation (organizational readiness)

Not only the external environment but also the internal environment of a firm affects the success of ERP implementation. Without organizational readiness and proper change management in the uncertain external environment, the implementation of ERP systems can cause considerable problems for companies (Motwani et al., 2002). A cautious, evolutionary, bureaucratic implementation process for implementing the system is desirable. Internal environmental factors, such as top management support, organizational culture, communication, organizational structure, and IT readiness can, lead to successful ERP implementation.

In their paper, Zhang et al. (2002) classified critical factors for successful ERP implementation: (1) organizational environments, including top management support; (2) people characteristics, including education, training and user involvement; (3) suitability of software, hardware and data accuracy; (4) ERP vendor commitment; and (5) organizational culture. Top management support and commitment encourage firms to accept organizational change if the existing system does not alter basic values and goals and is not seen as beneficial (Kwahk and

Lee, 2008). Top management's willingness to expend more effort on behalf of the organization has varying effects on its readiness for change and, furthermore, the implementation of an ERP system.

An organization's existing culture has profound effects on planning and implementing organizational resources (Stewart et al., 2000). A culture that fosters and rewards communication and interaction is more likely to contribute to successful ERP implementation (Jones and Price, 2001; McNurlin 2001; Stewart et al., 2000). Effective communication, along with education, is critical to the success of ERP implementation (Loh and Koh, 2004). Organizational structures with "fluid job descriptions, loose organizational charts, high communication and few rules" are more conducive to innovation, because they promote flexibility and the exchange of knowledge and ideas (Brown and Eisenhardt, 1997).

Firms that have been the most successful in implementing innovative technology have a structure that enable organizational members to focus on important issues, facilitate extensive communication across units to enable members to share knowledge, support enough flexibility in the design process itself so that members can freely exchange ideas, and implement changes where appropriate as the process proceeds (Brown and Eisenhardt, 1997). Highly centralized, hierarchical structures tend to inhibit the type of knowledge sharing required for organizational learning during periods of extensive change; whereas more decentralized structures facilitate such learning (Leonard and Sensiper, 1998; Jones and Price, 2001).

Structures that combine clear responsibilities and priorities with extensive communication seem to be the most successful in promoting the exchange of innovative ideas (Willcocks and Smith, 1995). The IT staff's ability to configure and maintain information systems to support the business helps firms to consider the need to change technologies, identify technological positions, and consider strategic directions for implementing innovative information technology (Stratman and Roth, 2002). Therefore, it is expected that:

Hypothesis 3: The more a firm is internally ready for change because of a turbulent external environment, the more successful the ERP implementation will be.

2.4.4. ERP implementation and supplier capabilities

Sharing information between suppliers and buyers to coordinate processes and transactions leads suppliers to increase their capabilities and their performance (Shin et al., 2000). Successful ERP implementation which connects a firm to its suppliers will enhance information integration between this firm and its suppliers. Through information integration with customer companies, suppliers can share operational, tactical, and strategic information. Because of top management‘s willingness to implement an ERP system, suppliers may even change their systems or improve their capabilities by introducing information technology to their firms.

Seidmann and Sundarajan (1997) posit that operational information sharing can leverage economies of scale and expertise across organizations. Information sharing allows suppliers to improve forecasts, synchronize production and delivery, coordinate inventory-related decisions, and develop a shared understanding of performance bottlenecks (Lee and Whang 2000; Simchi-Levi et al. 2000). Formal and informal information sharing between trading partners improves visibility and decreases uncertainty (Brennan and Turnbull, 1999; Handfield and Bechtel, 2002). It allows firms to access data across their supply chains, allowing them to collaborate in activities, such as sales, production, and logistics.

Thus, ERP implementation in the purchasing firm encourages supplier firms to enhance their capabilities as well. When fast and real- time information becomes available, suppliers can take advantage of this increased visibility to modify existing actions or improve future operations (process improvement). Sharing production and delivery schedules enhances suppliers' operational efficiencies through improved coordination of allocated resources. Through fast and real-time information sharing, suppliers can more readily identify market opportunities, generate ideas and concepts, and develop more cost-effective products and services (product innovation). Fast and real-time information sharing enable suppliers to change product volume in a relatively short time, change product mix in a relatively short time, consistently accommodate the buying firm's requests, and provide quick inbound logistics to the firm. The ERP system enables suppliers to increase their response to an unpredictable and changing business environment. Thus, fast and real-time information sharing through ERP implementation enables a firm to increase suppliers' capabilities in the areas of information access, process improvement, and product innovation. Therefore, it is expected that:

Hypothesis 4: The higher the level of ERP implementation, the higher the level of supplier capabilities.

2.4.5. ERP implementation and organizational capabilities

ERP systems have had a huge impact on businesses and organizations (Howcroft and Truex, 2001; Hedman and Borell, 2003). A firm implements an ERP system to improve organizational effectiveness. Many researchers argue that ERP systems improve integration and coordination between business units and increase productivity (Davenport, 2000; Hedman and Borell, 2002; Hitt et al., 2002; Howcroft and Truex, 2002; Shang and Seddon, 2002). Shang and

Seddon (2002) stated that ERP systems are beneficial to achieve goals regarding strategic, organizational, managerial, operational, and IT infrastructure. ERP systems integrate every procedure of the business while simultaneously enhancing the quality of several areas such as human resources, marketing, accounting and operations. In addition, ERP systems enable firms to increase production levels and control costs as well as to make the entire enterprise more efficient.

Additionally, ERP systems support the coordination of supply and demand information throughout a supply chain. Coordination reduces the "bullwhip effect" between suppliers and customers, which increases uncertainty in demand and lead times (Lee et al. 1997). ERP systems enable firms to coordinate more accurate and timely information, which reduces inventory and administrative costs as well as improving responsiveness to market demands (Horvath 2001; Lee et al. 1997; van Hoek 2001). Reducing buffer inventory stocks and lead times increases the efficiency and flexibility of organizations. Effective use of an ERP system can even increase sales and enhance customer service (Mentzer et al., 2000). Therefore, with both theoretical and practical perspectives, it is very important to appraise the impact of ERP systems.

Several researchers have studied various organizational capabilities which can be enabled by information systems in general (Sethi and King, 1994). Information system integration makes all information accessible and enhances the cross-functional coordination, increasing a firm's competitive edge. Fast information accessibility makes employees work together across functions. They can share resources, ideas, and information in the organization, informally work together as a team, and achieve goals collectively with other employees from different departments. A successfully implemented ERP system enables a firm to flexibly assemble requisite assets, knowledge, and business relationships (Goldman et al., 1995; Sambamurthy et al., 2003). Moreover, a firm having this capability can better sense opportunities for new competitive action in its marketplaces and seek the necessary knowledge and assets to seize those opportunities. This capability allows firms to detect environmental changes and rapidly and flexibly respond to changes by assembling organizational resources (Goldman et al., 1995; Sambamurthy et al., 2003).

Implementation of an ERP system also nurtures the establishment of backbone data warehouses so that management can have fast access to information for decision making and managerial control. A majority of firms expect their new ERP-based system environment will enable process improvements. ERP systems improve the management and execution of the entire new product innovation process through enabling companies more readily identify market opportunities, generate ideas and concepts, and decide the most promising projects to pursue.

An information system allows a firm to modularize and reconfigure business processes. It also eases information sharing with customers, suppliers, and other business partners (Duncan 1995; Sambamurthy et al., 2003). Thus, a successfully implemented ERP system enhances organizational capabilities including cross-functional coordination, information access, process improvement, product innovation, agility, and flexibility. Therefore, it is expected that:

Hypothesis 5: The higher the level of ERP Implementation success, the higher the level of organizational capabilities will be.

2.4.6. Supplier capabilities and supplier performance

Information integration and sharing with buyers through an ERP system enables a supplier to increase its capabilities and further improve its operational performance by reducing inventory costs, enhancing capital and cash flow utilization, and improving cycle times. By improving the precision of demand estimation through collaborative forecasting, a supplier facilitates supply and demand alignment. Information sharing can strengthen customer relationships and generate increased revenues from existing products and new products (Anderson et al., 1994). In this study, 3 capabilities developed through sharing fast and precise information with buyers who implement an ERP system are examined: Information access, process improvement, and product innovation.

Through inter-firm cooperation and collaboration, suppliers improve organizational processes and activities and they subsequently enhance organizational performance (Bello and Gilliland, 1997; Hunt, 1995). Knowledge and information from buyers stimulate suppliers' new ideas and become sources of efficiency in existing processes (Moorman and Minor, 1997). Acquiring useful information for product development with a minimum expenditure of energy, time, or resources improves organizational efficiency. Higher levels of information sharing practices can lead to an improved supplier network, which enhances supplier performance (Thatte et al., 2008).

Accordingly, information access, process improvement, and product innovation are unique capabilities that contribute to supplier competitiveness and market success. Subsequently, this paper proposes that supplier capabilities enhance their performance outcomes. Therefore, it is expected that:

Hypothesis 6: The higher the level of supplier capabilities, the higher the level of supplier performance.

2.4.7. Organizational capabilities and organizational performance

Barney (1991) and Wernerfelt (1984) suggest that in the resource-based view of a firm theory, a firm develops organizational resources and capabilities to manage its environment and enhance performance. A firm‘s resources and capabilities include tangible and intangible factors, such as physical assets, human capital, and organizational routines and procedures. In this study, six capabilities developed through the implementation of an ERP system are examined: cross-functional coordination, process improvement, product innovation, information access, agility, and flexibility. These capabilities contribute to performance outcomes, because they embody dynamic routines. These routines can be manipulated into unique configurations, enabling a firm to make product and service different (Teece et al., 1997; Sinkovics and Roath, 2004).

In an uncertain and turbulent business environment, cross-functional coordination is essential to respond to demands quickly and to have a competitive and sustainable advantage and, furthermore, to obtain better outcomes. These are fast delivery, time-to-market, and product variety (Grant, 1996; Carr et al., 2008; Wernerfelt, 1984; Barney, 1991).

Many researchers have focused on how firms utilize and exploit their distinctive resources by managing relationships to encourage inter-firm collaboration and cooperation (Anderson and Narus, 1990; Borys and Jemison, 1989; Hamel, 1991). The implication is that firms utilize relationship management in order to encourage integration of organizational processes and activities. Doing so augments the firm's unique resources that would subsequently enhance organizational performance (Bello and Gilliland, 1997).

Existing knowledge and information stimulate new ideas and become sources of efficiency in existing processes (Moorman and Minor, 1997). Acquiring useful information for product development with a minimum expenditure of energy, time, or resources improves organizational efficiency. In considering efficiencies, effective information access will have a great impact on business performance.

Information systems allow firms to have better performance with new customized products that have unique features and better quality. Organizational responsiveness has been argued to be the most important attribute or ability that firms need to operate effectively in competitive environments. Organizational responsiveness provides firms with the ability to respond promptly to fluctuating market demands (Sanchez, 1995). Organizational responsiveness increases the effectiveness of communications, plans, and strategies, which should lead to improved firm performance. A firm‘s successful efforts to develop organizational responsiveness have been shown to enhance firm performance (Evans, 1991). Accordingly, cross-functional coordination, information access, process improvement, product innovation, agility, and flexibility are unique capabilities that contribute to a firm's competitiveness and market success. Subsequently, this paper proposes that these manufacturers' capabilities enhance performance outcomes. Higher levels of information sharing practices can lead to reduced time-to-market of a firm (Thatte et al., 2008). Therefore, it is expected that:

Hypothesis 7: The higher the level of organizational capabilities, the higher the level of organizational performance.

2.4.8. Supplier performance and organizational performance

In the literature, supplier performance is considered one of the significant elements for the company‘s operational success (Shin et al., 2000; Davis, 1993; Levy, 1997). Better supplier performance reduces costs. It also improve lead time, quality, delivery and cost performance as well as a company's overall quality delivery time, and product variety (Shin et al., 2000; Li et al., 2007; Vonderembse and Tracey, 1999; Kaynak, 2003; Buvik and Gronhaug, 2000). The buying firm strengthens its competitive edge through having capable suppliers. Improvements in performance will occur within the unique exchange relationships developed between buyer and supplier firms (Shin et al., 2000; Li et al., 2007). This results in unique resources and capabilities for the buying firm (Chen et al., 2006). Hence, ultimately, the buying firm will obtain benefits from information sharing with its supplier.

Choi and Hartley (1996) argue that supplier performance impacts a buying firm's activities, such as inventory management, production planning and control, cash flow requirements, and product quality. Shin et al. (2000) found that poor vendor quality and delivery performance cause higher levels of inventory and order backlogs. Improved supplier quality and lead times lead to lower production and quality costs for a buying firm. Improved supplier performance also leads to lower costs (Carter, 2005). JIT purchasing, which is operationalized as reduced order sizes (less inventory), shorter lead times, and the use of quality control measures, leads to significantly lower logistics costs, including the costs of purchased materials, for buying organizations (Dong et al., 2001). In manufacturing literature, researchers have found that improvements in internal scrap rates, defect rates, and related quality practices lead to increased profits and decreased product costs (Adams et al., 1997; Fynes and Voss, 2002). Thatte et al. (2008) found that supplier responsiveness in addition to supplier quality has become a key factor in time-to-market performance. Therefore, it is expected that:

Hypothesis 8: The higher the level of supplier performance, the higher the level of organizational performance.

2.4.9. Organizational performance and customer value

From an operational perspective, improved production performance can affect customer value, especially cost reduction, convenience, timely response, and reputation for quality. Because of effective communication with customers and suppliers and effective decision making, organizations can provide convenient information to customers. Easy maintenance of databases and increased user-friendliness of information systems can affect customization of products. Therefore, it is expected that:

Hypothesis 9: The higher the level of organizational performance, the higher the level of the customer value.

Chapter 3. Research Methodology

This research was carried out in three stages; a pre-pilot stage, a pilot study, and a large scale survey. In the pre-pilot stage, potential survey items were generated through theory development and a literature review. Many discussions were carried out to reach a confident level of content validity for each sub-construct of the eight main constructs; (1) external environment, (2) internal environment, (3) ERP implementation, (4) supplier capabilities, (5) organizational capabilities, (6) supplier performance, (7) organizational performance, and (8) customer value. Then, items were examined and evaluated through structured interviews and the Q-sort method.

The last stage is conducting a large-scale survey for exploratory data analysis. Developed measurement items were used to ask respondents to indicate the level of their agreement in their companies. Items were measured using a five-point likert scale, beginning with (1) strongly disagree to (5) strongly agree. The 6^{th} provision was given as non-applicable. In the large-scale analysis, a structural equation modeling using PLS was conducted to test the model. Refer appendix E.

3.1. Item generation

The object of item generation is to create a pool of items that would cover the sampling domain of each construct (Churchill, 1979). The generated items should ensure content validity to have valid and reliable empirical research (Nunally, 1994). Content validity is usually achieved through intensive and comprehensive literature review and feedback from practitioners and academicians. Item generation was first carried out by searching the literature for previously developed items that can measure the sub-constructs in the research model. When there were no such items found, measurement items were developed based on the definition of sub-constructs as provided in Tables 2.3.1 - 2.3.8. In the following sections, theoretical discussions from supporting literature are presented to detail how items were generated.

3.1.1. Item generation for external environment

Measuring external environment is a persistently difficult task (Buchko, 1994; Nahm, 2002). In addition, there is no consistency in the literature (Li, 2002). The scale developed by Duncan (1972) is composed of two dimensions: complexity and dynamism, but they are weak when it comes to measuring external environment properties (Buchko, 1994; Nahm, 2002). Pagell and Krause (2004) and Vickery et al. (1999) used a simplified scale (total 4-5 items) for environmental uncertainty. Paswan et al.'s (1998) scales, widely applicable and useful in diverse areas of research, have limitations when applied to manufacturing specific external environments.

Ho (1996) used scales for environmental uncertainty in developing a theoretical contingency model of manufacturing strategy, but his study is limited to manufacturing strategy and performance. Thus, in this study, some of his items were used to create new items for technological change, level of completion, and rapid market change. Chen and Paulraj (2004)'s and Li (2002)'s measurements focus on supply chain management, making them inappropriate for directly measuring external environment. Therefore, the scales of technological change, rapid market change, and supplier uncertainty have been adopted and revised. Scales developed by Nahm (2002) are limited to manufacturing companies. Jean et al. (2008) point out that external environment incorporates demand uncertainty, technological uncertainty, environmental turbulence, and environmental dynamism.

As seen in this literature review, most of the existing scales neither fit the definition of sub-constructs for external environment in an information technology implementation context as provided in Table 2.3.1, nor do these scales fit this research design. Therefore, new measurement items were constructed or revised from previously used items, using the definitions of sub-constructs and their supporting literature as provided in Table 2.3.1.

3.1.2. Item generation for internal environment

Using a process theory approach, Markus and Tanis (2000) classified critical success factors and conceptualized four phases in an ERP life cycle. These are (1) chartering, (2) project, (3) shakedown, and (4) onward and upward phases. Loh and Koh (2004) suggested critical elements for a successful ERP implementation in small and medium-sized companies through a literature review and some interviews. Their ten constituents for critical success factors are having a project champion, project management, business plan and vision, top management support, effective communication, ERP teamwork/composition, BPR, minimum customization, having a change management program, software development, testing/trouble shooting, and monitoring/evaluation of performance. Their research, however, appears to need validation. Through their literature review, Finney and Corbett (2007) found out that research which focuses on the identification of critical success factors (CSFs) important to key stakeholders is limited. Nah and Delgado (2006) conducted a case study of two organizations that implemented and upgraded ERP systems. Seven critical success factors identified by them were: business plan/vision, change management/culture, communication, ERP team composition/skills, management support, project management, and system analysis/selection.

Soja (2006), in his field research, proposed an ERP implementation success factor model based on his literature review and also feedback from ERP adopters. His research, however, needs further verification of success factors. Stratman and Roth (2002) defined and operationalized eight ERP competence constructs. These are strategic IT planning, executive commitment, project management, IT skills, business process skills, ERP training, learning, and change readiness. Ehie and Madsen (2005) identified six important factors that affect successful ERP implementation. These factors are: project management principles, feasibility and evaluation of an ERP project in the firm, top management support, business process reengineering, consulting services, and cost/budget issues.

Ke and Wei (2008) theorize and propose that ERP implementation success is positively related with organizational culture and managerial leadership. Morton and Hu (2008) developed a set of propositions about the relationships between ERP systems and organizational culture based on structural contingency theory. Zhou-Sivunen (2005) validated the impact of organizational culture on ERP implementation in China. Abdinnour-Helm et al. (2003) discussed the importance of assessing employee attitude and organizational readiness for implementing an ERP system.

As seen in this literature review, most of the existing scales do not fit the definition of sub-constructs for the internal environment in an information technology implementation context as can be seen in Table 2.3.2. Also, they do not fit the design of this research. Therefore, new measurement items were constructed or revised from previously used items, using the definitions of sub-constructs and their supporting literature in Table 2.3.2.

3.1.3. Item generation for ERP implementation

Loh and Koh (2004) discussed the importance of configuration, integration, and user training in an uncertain environment during the implementation of an ERP system, but their propositions are not validated. Davenport (2000) mentioned the two major elements in implementing an ERP system: (1) preparing the people and (2) preparing the technical system (Abdinnour-Helm et al., 2003). He pointed out that while preparing the people is about training end users, the technical system requires adapting, configuring and integrating the information systems. His research also needs validation, however. Abdinnour-Helm et al., (2003) emphasized and examined the importance of configuration for successful ERP implementation. Hong and Kim (2002) found that ERP adaption is a quasi-moderator of the relationship between organizational fit of ERP and ERP implementation, but they did not measure the level of ERP adaption and its direct impact on ERP implementation success. Swafford et al. (2008) examined the positive impact of IT integration on supply chain agility and business performance. Stratman and Roth (2002) used the enterprise resource planning training scale to measure ERP user training. Kim et al. (2005) mentioned the importance of ERP software configuration and features in the ERP implementation phase.

As seen in this literature review, most of the existing scales did not fit the definition of sub-constructs for ERP implementation in an information technology implementation context as seen in Table 2.3.3. Neither do these scales fit this research design. Therefore, new measurement items were constructed or revised from previously used items, using the definitions of sub-constructs and their supporting literature as provided in Table 2.3.3.

3.1.4. Item generation for supplier and organizational capabilities

Organizational capabilities are critical to measure the impact of the investment in information technology on organizational performance. Since many researchers usually focus on finding a direct relationship between ERP implementation and organizational performance, there is a lack in the study of increased organizational capabilities by IT investment. Grant (1996) develops a knowledge-based theory of organizational capabilities, based on the resource-based view of a firm. In his research, he illustrates the concept of the hierarchy of capabilities by providing hierarchically arranged organizational capabilities of manufacturing companies such as cross-functional integration and operations capabilities including manufacturing, management information systems (MIS), process engineering, material management, and product engineering capabilities. Yet, the paper was not empirically developed and tested.

Ding et al. (2009) developed a scale to measure the relationship between a firm's business investment and organizational capabilities exploitation. They suggested management, marketing, and technology-specific capabilities as organizational capabilities. However, in the paper, IT investment was not specified and it was studied in the context of international strategic alliances. Mishra and Agarwal (2010) used technological opportunism and technological sophistication scales to measure the organizational capabilities, but the research found moderating effects of organizational capabilities on the relationship between technological frames and IT use. Chaveerug and Ussahawanitchakit (2008) used the scales to measure the innovation capability of a firm. Some of their factors were used in this research as the basis of creating new factors and items for both supplier and organizational capabilities.

Davis (2005) studied the impact of ERP customization on strategic alignment and system agility, but he did not empirically test his hypotheses. Eng (2006) empirically found that cross-functional information sharing increases cross-function coordination in a supply chain management context. Carr et al. (2008) validated that cross-functional coordination capability within the firm improves product quality and the firm‘s financial performance. Swafford et al. (2008) indicated that IT integration enables firms to have higher supply chain agility. Srivardhan and Pawlowski (2007) proposed that an ERP system is an enabler of sustained business process innovation predicated on a knowledge-based view, but they never tested it. Zhang (2005) validated that information system support for strategic flexibility (product flexibility and cross-functional coordination) has a positive impact on business performance.

El Sawy and Pavlou (2008) suggest three types of IT-enabled business capabilities that influence strategic advantage in turbulent environments. These are operational capabilities, dynamic capabilities and improvisational capabilities. This research was not empirically tested, either. Spathis and Constantinides (2003) evaluated usefulness of ERP systems in challenging business environments. Their research found five beneficial factors of an ERP system: effective logistics, effective communication, effective decision-making, effective data processing, and effective information systems. Powell (1995) used scales to measure process improvement in total quality management.

As seen in this literature review, most of the existing scales do not fit the definition of sub-constructs for both supplier and organizational capabilities in information technology and manufacturing contexts as provided in Tables 2.3.4 and 2.3.6 and are limited to one or two variables. Therefore, new measurement items were constructed or revised from previously used items, using the definitions of sub-constructs and their supporting literature as provided in Tables 2.3.4 and 2.3.6. The supplier capabilities sub-construct and the organizational capabilities sub-construct have the same items, but work in a different context. Therefore, the development of both these items has been explained in this section.

3.1.5. Item generation for supplier and organizational performance

Organizational performance measurement plays an important role in measuring organizational growth. Usually an organizational performance measure includes both financial performance and operational performance (Chen and Paulraj, 2004; Velcu, 2007; Joshi et al., 2003; Shin et al., 2000). This research has focused on operational performance in measuring organizational performance.

In general, operational performance is measured along the dimensions of cost, quality, flexibility, and delivery (Vickery et al., 1993; Miller and Roth, 1994; Devaraj et al., 2007). In the literature, however, performance measures for both suppliers and organizations are not consistent. Shin et al. (2000) used cost, delivery reliability, lead-time, on-time delivery, and quality to measure supplier performance. They also used quality, delivery, flexibility, and cost to measure a buyer firm‘s performance. Joshi et al. (2003) used accuracy of work, quality of work, productivity of the group, customer satisfaction, operating efficiency, quality of work, timeliness in responding to customer needs, and on-time delivery schedules to measure the manufacturing unit‘s performance. Forza et al. (2008) proposed a form postponement typology without developing a specific questionnaire to conduct a study. Constructs such as inventory holding costs, delivery lead times, processing costs, order specification flexibility, transportation costs, and quality conformance are suggested to measure operational performance.

Chen and Paulraj (2004) developed performance measurements for both supplier and buyer performance in supply chain. In their study, the supplier performance construct is measured in terms of quality, cost, flexibility, delivery, and prompt response. For measuring operational performance in the buyer performance, flexibility, delivery, quality, cost, customer responsiveness, and customer satisfaction are used. Vonderembse and Tracey (1999) rate supplier performance through such items as raw material availability, timeliness, in-transit damage, and incoming quality dimensions. They used six questions to measure the manufacturing performance, such as rework costs, unit costs of finished products, quality of outgoing products, level of work-in-process inventory, on-time delivery of outgoing products, and material handling costs. Li (2002) also developed measures for supplier performance. Some of their items were used in this research as the basis for creating new items to measure both supplier and organizational performance. Devaraj et al. (2007) used eight questions to measure the operational performance in the e-business environment. The research items they used are percent product returned by the customer, percent defects during production, delivery speed, delivery reliability, production costs, production lead time, inventory turnover, and the flexibility of the process.

As seen in this literature review, most of the existing scales neither fit the definition of sub-constructs for both supplier and organizational performance in information technology and manufacturing contexts as provided in Tables 2.3.5 and 2.3.7, nor do these scales fit the research design. Therefore, new measurement items were constructed or revised from previously used items, using the definitions of sub-constructs and their supporting literature as provided in Tables 2.3.5 and 2.3.7. The supplier performance sub-construct and the organizational performance sub-construct have the same items, but work in a different context. Therefore, the development of both these items has been explained in this section.

3.1.6. Item generation for customer value.

Recent operations strategy research focuses on creating value for the customers through reducing cost, enhancing quality, and increasing speed of delivery (Ward et al., 1998; Sawhney and Piper, 2002). Woodruff (1997) argued that customer value must be the focus of business activities and that it offers several useful prescriptions for businesses to position themselves. He presents a framework related to customer value, customer value learning, and customer value strategies (Slater, 1997).

Ulaga (2003) developed items, regarding customer value as ―relationship value" from the viewpoint of relationship marketing. Smith and Colgate (2007) present a framework for marketers to create customer value. It is useful to design market strategy, to recognize new product development opportunities, and to measure customer value for market research. Tu et al. (2001 and 2006) measured perceptions of the value of product variety, customer satisfaction, and customer loyalty as well as customer referrals.

Sweeney and Soutar (2001) discussed value creation and developed items to assess customer‘s perceptions of product value at the brand level in a retail purchase situation, presenting four distinct value creation dimensions. These are emotional, social, quality/performance, and price/value for money. Petrick (2002) developed a multiple-dimensional scale to measure the perceived value of a service for the recreation and tourism field. Nasution and Mavondo (2008) developed 3 sub constructs to measure customer value. These are reputation for quality, value for money, and prestige. This combines the scales of Petrick (2002) and Sweeney and Soutar (2001). This scale focuses on the service industry (hotel management), makes it inappropriate for use directly in information technology and manufacturing contexts. In his research, Velcu (2007) discovered that the customer-perceived benefits of ERP are timely response and accuracy. He reached this conclusion by using an ERP scorecard framework.

However, as seen in this literature review, most of the existing scales do not fit the definition of sub-constructs for customer value in information technology and manufacturing contexts as provided in Table 2.3.8. Besides, they do not fit the design of this research. Therefore, new measurement items were constructed or revised from previously used items, using the definitions of sub-constructs and their supporting literature as provided in Table 2.3.8.

3.2. Structured interviews

After creating the item pools, items for each sub-construct were reexamined through structured interviews with two academicians and four practitioners from different manufacturing firms with ERP systems. The main purpose was to check the relevance of each sub-construct‘s definition, clarity of words, and structure of the model. Since the measurement items for all constructs were developed or modified from previous literature, the measurement items for the sub-constructs of all eight variables were reevaluated.

Based on the comments and feedback from the academicians and practitioners, redundant or ambiguous items were either modified or eliminated. One sub-construct (business process reengineering) in the internal environment construct and its items were added. As a result, a total of eight constructs, 37 sub-constructs, and 196 items were created. The list of items developed for external environment, internal environment, ERP implementation, supplier capabilities, organizational capabilities, supplier performance, organizational performance and customer value is reported on appendix A. The results were the following number of items in each sub-construct organized for a Q-sort analysis.

External environment			
Technological change	5		
Level of competition		5	
Rapid market change	5		
Supplier uncertainty		7	
Sub-total			**22**
Internal Environment			
Top management support		5	
Organizational culture	10		
Communication		5	
Organizational structure		6	
Business process reengineering		4	
IT readiness		7	
Sub-total			**37**
ERP implementation			
Integration		5	
Configuration		5	
Adaptation		6	
User training		5	
Sub-total			**21**
Supplier capabilities			
Cross-functional coordination	4		
Information access		5	
Process improvement	5		
Product innovation		5	
Flexibility		5	
Agility		6	
Sub-total			**30**
Organizational capabilities			
Cross-functional coordination		4	
Information access		5	
Process improvement	5		
Product innovation		5	
Flexibility		5	
Agility		6	
Sub-total			**30**
Supplier performance			
Short lead time		4	
Product variety		3	
Delivery reliability		5	

Cost performance	4	
Quality	5	
Sub-total		**21**
<u>Organizational performance</u>		
Cost performance	4	
Product variety	3	
Delivery reliability	5	
Time-to-market	4	
Quality	5	
Sub-total		**21**
<u>Customer value</u>		
Value for money	3	
Convenience	3	
Timely response	4	
Reputation for Quality	4	
Sub-total		**14**
Total		**196**

3.3. The Q-sort method

For the pilot study, the Q-sort methodology was used. The purpose of the Q-sort method is to assess the convergent and discriminant validity of each construct by observing how the items were sorted into various sub-construct categories. Items placed in a common pool were subjected to two or three Q-sorting rounds by two independent judges per round. In the Q-sort, practitioners from the manufacturing industry act as judges and sort the items into separate sub-constructs, based on the definition of each sub-construct. The convergence and divergence of items within the categories indicates construct validity. For example, if the judges consistently place an item within a particular category, it is determined to show convergent validity with related constructs. It also shows discriminant validity with the others. Through analysis of inter-judge disagreements about item placement, bad items for each sub-construct are identified. Based on the results, inappropriate or ambiguous items could be modified or deleted.

The measurement items entering the Q-sort are presented in Appendix A. Since the measurement items for all constructs were developed or modified, the measurement items for the sub-constructs of all eight variables were reevaluated. The measurement items for the sub-constructs of supplier capabilities and supplier performance are excluded in the Q-sort due to their similarity with those for the sub-constructs of organizational capabilities and performance. For example, the items of the sub-constructs of supplier capabilities such as information access, process improvement, and product innovation capability are similar to those of the sub-constructs of organizational capabilities. They exist in different contexts, however.

Because of a large number of subcontracts (37 sub-constructs), the Q-sort was divided into two parts. The first part includes (1) external environment, (2) internal environment, and (3) ERP implementation. The second part involves (4) organizational capabilities, (5) organizational performance, and (6) customer value.

The two judges for the first round were from the first group that participated in the structured interview, and the second two judges were new judges who were not involved previously. The judges were:

- A senior manager of a mid-size mechanical engineering firm (1st round for 1st part)
- An operations manager of an aircraft parts manufacturing firm (1st round for 1st part)
- An operations manager of a semiconductor manufacturing firm (2nd round for 1st part)
- A senior supervisor of a major automobile firm (2nd round for 1st part)
- A business systems analyst for a county information system. (1st round for 2nd part)
- An operations manager of a chemical manufacturing firm (1st round for 2nd part)
- A plant manager of an automobile parts manufacturing firm (2nd round for 2nd part)
- A senior supervisor of an aircraft parts manufacturing firm (2nd round for 2nd part)

- An executive operations manager of a 1st tier automobile parts supplier (3rd round for 2nd part)
- A marketing and production manager of a small-size manufacturing firm (3rd round for 2nd part)

3.3.1. Sorting procedures

The Q-sort begins with a brief explanation to the judges of the sorting procedures. The definitions of constructs and sub-constructs were presented and explained. Each item was printed on a 3 x 5 -inch index card. Cards shuffled into random order were presented to the judges. Then each judge sorted the cards into categories. Judges were allowed to ask as many questions as necessary to ensure their understanding of the procedure and the definitions of sub-constructs. After all the cards were sorted, inter-rater reliabilities and hit ratios were calculated. The items were modified or dropped for the next round.

3.3.2. Inter-Rater reliabilities

The reliability of the Q-sort was analyzed through measuring inter-rater reliabilities. It was tested by three different methods. The first method was to calculate the inter-judge raw agreement score for each pair of judges in each sorting step (Nahm, 2000; Li, 2002). This was computed by dividing the number of items that both judges agree to place in certain categories by the total number of items. One of the weaknesses of this method is that an item which is sorted together by both judges but not put into the originally intended category may be included as an item with false agreement.

The second method was to calculate Moore and Benbasat‘s hit ratio. This hit ratio was calculated by counting all the items that were correctly sorted into the theoretical category by each of the judges and dividing them by twice the total number of items (Moore and Benbasat, 1991). The third method was to use Cohen‘s Kappa (Cohen, 1960; Nahm, 2000). It measured the level of agreement between the two judges in categorizing the items. The Cohen‘s Kappa index was for eliminating chance agreements and evaluating the true agreement score between two judges. A description of the Cohen‘s Kappa concept and methodology is included in Appendix B.

3.3.3. Results of the first sorting round for the 1st part of the Q-sort

Results of the first sorting round for the 1st part of the Q-sort are presented in this section. In the first round, the average of the inter-judge raw agreement scores was 0.96 (Table 3.3.3.1). The initial overall hit placement ratio of items within the target constructs was 90 % (Table 3.3.3.2) and the Kappa scores averaged 0.96.

is the percentage of items on the diagonal (that is the percentage of items agreed on by two judges). is the percentage of items in the i^{th} row of the table. is the percentage of items in the i^{th} column of the table. The calculation of the K is based on Table 3.3.3.1. (See Appendix B for the description of this methodology)

A summary of the first round inter-judge agreement indices is shown in Table 3.3.3.3. Following the guidelines of Landis and Koch (1977) for interpreting the Kappa coefficient, the value of 0.95 indicates an excellent level of agreement within satisfactory statistical limits for the judges in the first round. This value is almost the same as the value for raw agreement, which is 0.96 (Table 3.3.3.1). The level of item placement ratios averaged 90%. For instance, the lowest item placement ratio value was 43% for the ―uncertainty" sub-construct, indicating a low degree of construct validity. On the other hand, several sub-constructs ("Level of competition", ―Top management support", and "organizational culture") obtained a 100% item placement ratio, indicating a high degree of construct validity. The reason is that items for uncertainty sub-constructs were sorted identically by both judges but not put into the originally intended category.

Table 3.3.3.1. Inter-judge raw agreement scores: the first sorting round for the 1st part the Q-sort

		Judge 1													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Judge 2	1	4	1												
	2		5												
	3		1	7											
	4				4										
	5					5									
	6						11								
	7							6							
	8								4						
	9									4					
	10										7				
	11											5			
	12												5		
	13												1	5	
	14														5
Total Items Placement: 80						Number of Agreements:77						Agreement Ratio: 0.96			

1. Technological change
2. Level of competition
3. Rapid market change
4. Supplier uncertainty
5. Top management support
6. Organizational culture
7. Communication
8. Organizational structure
9. Business process reengineering
10. IT readiness
11. Integration
12. Configuration
13. Adaptation
14. User training

Table 3.3.3.2. Items placement ratios: the first sorting round for the 1st part of the Q-sort

		Actual Categories															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	T	%
Theoretical	1	9	1													10	90%
	2		10													10	100%
	3			8	2											10	80%
	4		1	7	6											14	43%
	5					10										10	100%
	6						20									20	100%
	7							10								10	100%
	8						2	2	8							12	67%
	9									8						8	100%
	10										14					14	100%
	11											10				10	100%
	12												10			10	100%
	13												1	11		12	92%
	14														10	10	100%

Total Items Placement: 160	Number of Hits: 144	Overall Hit Ratio: 90%

1. Technological change
2. Level of competition
3. Rapid market change
4. Supplier uncertainty
5. Top management support
6. Organizational culture
7. Communication
8. Organizational structure
9. Business process reengineering
10. IT readiness
11. Integration
12. Configuration
13. Adaptation
14. User training

Table 3.3.3.3. Inter-judge agreements (the 1st part of the Q-sort)

Agreement measure	**Round 1**	**Round 2**
Raw agreement	**0.96**	**0.94**
Cohen's Kappa	**0.95**	**0.93**
Placement ratio summary		
Technological change	90%	100%
Level of competition	100%	100%
Rapid market change	80%	80%
Supplier uncertainty	43%	100%
Top management support	100%	100%
Organizational culture	100%	100%
Communication	100%	100%
Organizational structure	67%	92%
Business process reengineering	100%	100%
IT readiness	100%	100%
Integration	100%	100%
Configuration	100%	80%
Adaptation	92%	100%
User training	100%	100%
Average	**90%**	**97%**

In order to increase the Cohen‘s Kappa measure of agreement, the off-diagonal entries in the placement matrix (Table 3.3.3.2) were examined. Any ambiguous items fitting in other categories were reworded. Overall, 7 items were reworded. The remaining number of items for each sub-construct after the first round of Q-sort was as follows:

External Environment			
Technological change	5		
Level of competition		5	
Rapid market change	5		
Supplier uncertainty	7		
Sub-Total			**22**
Internal Environment			
Top management support		5	
Organizational culture	10		
Communication		5	
Organizational structure		6	
Business process reengineering		4	
IT readiness		7	
Sub-Total			**37**
ERP Implementation			
Integration		5	
Configuration		5	
Adaptation		6	
User training		5	
Sub-Total			**21**
Total			**80**

3.3.4. Results of the second sorting round for the 1st part of the Q-sort

Two new judges were involved in the second sorting round, which included the reworded items revised after the first sorting round. In the second round the inter-judge raw agreement scores averaged 0.93 (Table 3.3.4.1), the initial overall placement ratio of items within the targets constructs was 97 % (Table 3.3.4.2), and the Kappa scores averaged 0.93. A summary of the second round inter-judge agreement indices is shown in the second column of Table 3.3.3.3.

The value for the Kappa coefficient of 0.93 is higher than the value obtained in the first round, and indicates an excellent fit, based on the guidelines of Landis and Koch (1977) for interpreting the Kappa coefficient. The level of item placement ratios averaged 97%. The lowest item placement ratio value was that of 80% for the ―Rapid market change” and ―Configuration” sub-constructs, indicating a low degree of construct validity. Again several sub-constructs ("Technological change,” ―Level of competition," ―Uncertainty,” ―Top management support,” ―Organizational culture,” ―Communication,” ―Business process reengineering,” ―IT readiness”, ―Integration”, ―Adaptation,” and ―User training”) obtained a 100% item placement ratio, indicating a high degree of construct validity.

In order to further improve convergent and discriminant validity, an examination of the off-diagonal entries in the placement matrix (Table 3.3.4.2) was conducted. Again, any ambiguous items (fitting in more than one category) were either deleted or reworded. Overall, 3 items were reworded. The remaining number of items for each sub-construct after the second round of Q-sort was as follows:

Table 3.3.4.1. Inter-judge raw agreement scores: the second sorting round for the 1st part of the Q-sort

		Judge 3													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Judge 4	1	5													
	2		5												
	3			3	1										
	4			1	7										
	5					5									
	6						10								
	7							5	1						
	8								5						
	9									4					
	10										7				
	11											5	1		
	12												3		
	13												1	6	
	14														5
Total Items Placement: 80						Number of Agreements:75						Agreement Ratio: 0.93			

1. Technological change
2. Level of competition
3. Rapid market change
4. Supplier uncertainty
5. Top management support
6. Organizational culture
7. Communication
8. Organizational structure
9. Business process reengineering
10. IT readiness
11. Integration
12. Configuration
13. Adaptation
14. User training

Table 3.3.4.2. Items placement ratios: the second sorting round for the 1st part of the Q-sort

	Actual Categories															
Theoretical		1	2	3	4	5	6	7	8	9	10	11	12	13	14	T	%
	1	10														10	100%
	2		10													10	100%
	3			8	2											10	80%
	4				14											14	100%
	5					10										10	100%
	6						20									20	100%
	7							10								10	100%
	8							1	11							12	92%
	9									8						8	100%
	10										14					14	100%
	11											10				10	100%
	12											1	8	1		10	80%
	13													12		12	100%
	14														10	10	100%

Total Items Placement: 160	Number of Hits: 155	Overall Hit Ratio: 97%

1. Technological change
2. Level of competition
3. Rapid market change
4. Supplier uncertainty
5. Top management support
6. Organizational culture
7. Communication
8. Organizational structure
9. Business process reengineering
10. IT readiness
11. Integration
12. Configuration
13. Adaptation
14. User training

External Environment			
Technological change	5		
Level of competition		5	
Rapid market change	5		
Supplier uncertainty	7		
Sub-Total			**22**
Internal Environment			
Top management support		5	
Organizational culture	10		
Communication		5	
Organizational structure		6	
Business process reengineering		4	
IT readiness		7	
Sub-Total			**37**
ERP Implementation			
Integration		5	
Configuration		5	
Adaptation		6	
User training		5	
Sub-Total			**21**
Total			**80**

At this point, we stopped the Q-sort method at round two, for the raw agreement score of 0.938, Cohen‘s Kappa of 0.93, and the average placement ratio of 97% were considered as an excellent level of inter-judge agreement, indicating high level of reliability and construct validity.

3.3.5. Results of the first sorting round for the 2nd part of the Q-sort

The Q-sort procedure of the 2nd part of the Q-sort is the same with that of the 1st part. In the first round, the inter-judge raw agreement scores averaged 0.68 (Table 3.3.5.1), the initial overall placement ratio of items within the target constructs was 76 % (Table 3.3.5.2), and the Kappa scores averaged 0.65. A summary of the first round inter-judge agreement indices is shown in Table 3.3.5.3. Following the guidelines of Landis and Koch (1977) for interpreting the Kappa coefficient, the value of 0.65 indicates a moderate, but not excellent level of agreement within satisfactory statistical limits for the judges in the first round. This value is lower than the value for raw agreement, which is 0.68 (Table 3.3.5.1). The level of item placement ratios averaged 76%. For instance, the lowest item placement ratio value was 50% for the ―Flexibility”, ―Product variety”, ―Quality”, ―Reputation for quality” sub-constructs, indicating a low degree of construct validity. On the other hand, several sub-constructs ("Information access” and "Convenience") obtained a 100% item placement ratio, indicating a high degree of construct validity.

Table 3.3.5.1. Inter-judge raw agreement scores: the first sorting round for the 2nd part of the Q-sort

	Judge 1															
Judge 2		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
	15	2	2													
	16		5													
	17		1	3												
	18				4				1							
	19					2		1								
	20		1			1	5									
	21	1		1				2								
	22				2				3	2						
	23									3		1				
	24			1					1		4					
	25											2				1
	26												2			
	27													4	1	
	28													1	2	
	29												1	1		1
Total Items Placement: 65						Number of Agreements:44						Agreement Ratio: 0.68				

15. Cross-functional coordination
16. Information access
17. Process improvement
18. Product innovation
19. Flexibility
20. Agility
21. Cost performance
22. Product variety
23. Delivery reliability
24. Time-to-market
25. Quality
26. Value for money
27. Convenience
28. Timely response
29. Reputation for quality

Table 3.3.5.2. Items placement ratios: the first sorting round for the 2nd part of the Q-sort

		Actual Categories																
Theoretical		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	T	%
	15	6	2														8	75%
	16		10														10	100%
	17		1	8							1						10	80%
	18				9				1								10	90%
	19				1	5	1		1		2						10	50%
	20		1				11										12	92%
	21	1		1				6									8	75%
	22				1	1		1	3								6	50%
	23								2	8							10	80%
	24								1		7						8	88%
	25								4	1		5					10	50%
	26												5			1	6	83%
	27													6			6	100%
	28													2	6		8	75%
	29											1		3		4	8	50%
Total Items Placement: 130							Number of Hits: 99						Overall Hit Ratio: 76%					

15. Cross-functional coordination
16. Information access
17. Process improvement
18. Product innovation
19. Flexibility
20. Agility
21. Cost performance
22. Product variety
23. Delivery reliability
24. Time-to-market
25. Quality
26. Value for money
27. Convenience
28. Timely response
29. Reputation for Quality

Table 3.3.5.3. Inter-judge agreements (the 2nd part of the Q-sort)

Agreement measure	Round 1	Round 2	Round 3
Raw agreement	**0.68**	**0.82**	**0.83**
Cohen's Kappa	**0.65**	**0.82**	**0.82**
Placement ratio summary			
Cross-functional coordination	75%	100%	100%
Information access	100%	90%	80%
Process improvement	80%	90%	90%
Product innovation	90%	90%	80%
Flexibility	50%	75%	83%
Agility	92%	75%	92%
Cost performance	75%	75%	88%
Product variety	50%	67%	83%
Delivery reliability	80%	90%	100%
Time-to-market	88%	100%	88%
Quality	50%	80%	100%
Value for money	83%	67%	83%
Convenience	100%	100%	100%
Timely response	75%	88%	88%
Reputation for quality	50%	88%	100%
Average	**76%**	**85%**	**90%**

In order to improve the Cohen‘s Kappa measure of agreement, an examination of the off-diagonal entries in the placement matrix (Table 3.3.5.2) was conducted. Any ambiguous items (fitting in more than one category) were either deleted or reworded. Overall, 7 items were deleted, 12 items were reworded, and 8 items were added. The remaining number of items for each sub-construct after the first round of the 2nd part of the Q-sort was as follows:

Organizational Capabilities			
Cross-functional coordination	4		
Information access		5	
Process improvement	5		
Product innovation		5	
Flexibility		6	
Agility		6	
Sub-Total			**31**
Organizational Performance			
Cost performance		4	
Product variety		3	
Delivery reliability		5	
Time-to-market		4	
Quality	5		
Sub-Total			**21**
Customer Value			
Value for money		3	
Convenience		3	
Timely response		4	
Reputation for quality	4		
Sub-Total			**14**
Total			**66**

3.3.6. Results of the second sorting round for the 2nd part of the Q-sort

Two new judges were involved in the second sorting round, which included the reworded items developed after the first sorting round. In the second round the inter-judge raw agreement scores averaged 0.82 (Table 3.3.6.1), the initial overall placement ratio of items within the targets constructs was 85 % (Table 3.3.6.2), and the Kappa scores averaged 0.82. A summary of the second round inter-judge agreement indices is shown in the second column of Table 3.3.6.3. The value for Kappa coefficient of 0.82 is higher than the value obtained in the first round, and indicates an excellent fit, based on the guidelines of Landis and Koch (1977) for interpreting the Kappa coefficient. The level of item placement ratios averaged 85%. The lowest item placement ratio value was that of 67% for the “Product variety” and “Value for money” sub-constructs, indicating a low degree of construct validity. Again several sub-constructs ("Cross-functional coordination” “Time-to-market", and "Convenience”) obtained a 100% item placement ratio, indicating a high degree of construct validity.

In order to further improve convergent and discriminant validity, an examination of the off-diagonal entries in the placement matrix (Table 3.3.6.2) was conducted. Again, any ambiguous items fitting in more than one category were either deleted or reworded. Overall, 1 item was further deleted, and 23 items were reworded. The remaining number of items for each sub-construct after the second round of Q-sort was as follows:

Table 3.3.6.1. Inter-judge raw agreement scores: the second sorting round for the 2nd part of the Q-sort

		Judge 3														
		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Judge 4	15	4														
	16		4													
	17			4			1	2								
	18		1		5											
	19				1	4										
	20						4									
	21							3								
	22								2							
	23									4						
	24			1		2					4					
	25									1	1	4				
	26												3			
	27													3		
	28														3	
	29				1										1	3

Total Items Placement: 66	Number of Agreements:54	Agreement Ratio: 0.82

15. Cross-functional coordination
16. Information access
17. Process improvement
18. Product innovation
19. Flexibility
20. Agility
21. Cost performance
22. Product variety
23. Delivery reliability
24. Time-to-market
25. Quality
26. Value for money
27. Convenience
28. Timely response
29. Reputation for quality

Table 3.3.6.2. Items placement ratios: the second sorting round for the 2nd part of the Q-sort

		Actual Categories																
		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	T	%
Theoretical	15	8															8	100%
	16		9		1												10	90%
	17			9							1						10	90%
	18				9	1											10	90%
	19					9		2			1						12	75%
	20			1		1	9				1						12	75%
	21			2				6									8	75%
	22				2				4								6	67%
	23									9		1					10	90%
	24										8						8	100%
	25											8	2				10	80%
	26										1	1	4				6	67%
	27													6			6	100%
	28														7	1	8	88%
	29				1											7	8	88%
Total Items Placement: 132						Number of Hits: 112							Overall Hit Ratio: 85%					

15. Cross-functional coordination
16. Information access
17. Process improvement
18. Product innovation
19. Flexibility
20. Agility
21. Cost performance
22. Product variety
23. Delivery reliability
24. Time-to-market
25. Quality
26. Value for money
27. Convenience
28. Timely response
29. Reputation for Quality

Organizational Capabilities			
Cross-functional coordination	4		
Information access		5	
Process improvement	5		
Product innovation		5	
Flexibility		6	
Agility		6	
Sub-Total			**31**
Organizational Performance			
Cost performance		4	
Product variety		3	
Delivery reliability		5	
Time-to-market		4	
Quality	4		
Sub-Total			**20**
Customer Value			
Value for money		3	
Convenience		3	
Timely response		4	
Reputation for quality	4		
Sub-Total			**14**
Total			**65**

3.3.7. Results of the third sorting round for the 2nd part of the Q-sort

Due to the lowest item placement ratio value (67% for the “product variety” and “value for money” sub-constructs), the third sorting round was conducted. Again, two judges were involved in the third sorting round, which included the reworded items developed after the second sorting round. In the third round the inter-judge raw agreement scores averaged 0.83 (Table 3.3.7.1), the initial overall placement ratio of items within the target constructs was 90 % (Table 3.3.7.2), and the Kappa scores averaged 0.82. A summary of the third round inter-judge agreement indices is shown in the second column of Table 3.3.7.3. The value for the Kappa coefficient of 0.82 is higher than the value obtained in the first round, and indicates an excellent fit, based on the guidelines of Landis and Koch (1977) for interpreting Kappa coefficient. The level of item placement ratios averaged 90%. The lowest item placement ratio value was that of 80% for the “Information access” and “Product innovation” sub-constructs, indicating a good degree of construct validity. Again several sub-constructs ("Cross-functional coordination”, “Delivery reliability”, “Quality”, “Convenience, and “Reputation for quality”) obtained a 100% item placement ratio, indicating a high degree of construct validity.

In order to further improve convergent and discriminant validity, an examination of the off-diagonal entries in the placement matrix (Table 3.3.7.2) was conducted. Again, any ambiguous items fitting in more than one category were either deleted or reworded. Overall, 6 items were reworded. The remaining number of items for each sub-construct after the second round of Q-sort was as follows:

Table 3.3.7.1. Inter-judge raw agreement scores: the third sorting round for the 2nd part of the Q-sort

		Judge 3														
		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Judge 4	15	4														
	16		3	1												
	17			5				1								
	18			1	3				1							
	19				1	5										
	20		2	1			5									
	21			1				3								
	22								2							
	23									5						
	24										3	1				
	25											4				
	26												2			
	27													3		
	28													1	3	
	29												1			4
Total Items Placement: 65						Number of Agreements:54						Agreement Ratio: 0.83				

15. Cross-functional coordination
16. Information access
17. Process improvement
18. Product innovation
19. Flexibility
20. Agility
21. Cost performance
22. Product variety
23. Delivery reliability
24. Time-to-market
25. Quality
26. Value for money
27. Convenience
28. Timely response
29. Reputation for quality

Table 3.3.7.2. Items placement ratios: the third sorting round for the 2nd part of the Q-sort

	Actual Categories																
Theoretical		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	T	%
	15	8															8	100%
	16		8				2										10	80%
	17		1	9													10	90%
	18			1	8	1											10	80%
	19			1		10		1									12	83%
	20			1			11										12	92%
	21			1				7									8	88%
	22				1				5								6	83%
	23									10							10	100%
	24										7	1					8	88%
	25											8					8	100%
	26												5			1	6	83%
	27													6			6	100%
	28													1	7		8	88%
	29															8	8	100%

Total Items Placement: 130	Number of Hits: 117	Overall Hit Ratio: 90%

15. Cross-functional coordination
16. Information access
17. Process improvement
18. Product innovation
19. Flexibility
20. Agility
21. Cost performance
22. Product variety
23. Delivery reliability
24. Time-to-market
25. Quality
26. Value for money
27. Convenience
28. Timely response
29. Reputation for quality

Organizational Capabilities				
Cross-functional coordination	4			
Information access		5		
Process improvement	5			
Product innovation		5		
Flexibility		5		
Agility		6		
Sub-Total			**30**	
Organizational Performance				
Cost performance		4		
Product variety		3		
Delivery reliability		5		
Time-to-market		4		
Quality	5			
Sub-Total			**21**	
Customer Value				
Value for money		3		
Convenience		3		
Timely response		4		
Reputation for quality	4			
Sub-Total			**14**	
Total				**65**

At this point, we stopped the Q-sort method at round three, because the raw agreement score of 0.83, Cohen's Kappa of 0.82, and the average placement ratio of 90% were considered as an excellent level of inter-judge agreement, indicating a high level of reliability and construct validity. In addition, there was no sub-construct for which the placement ratio value was less than 80%.

3.4. Pre-testing of questionnaire

Having generated 195 questionnaire items for the eight major variables, these items were distributed to academic reviewers, who reviewed each item and indicated to keep, delete, or modify them. The focus of this analysis was to assess whether the items were thought to accurately measure the proposed sub-constructs according to the definitions provided, and if any additional domains needed to be covered.

Based on the feedback from the reviewers, 3 sub constructs and 41 items were further deleted. As a result, the number of items for each sub-construct was as follows:

<u>External environment</u>		
Technological change	4	
Level of competition	4	
Rapid market change	4	
Supplier uncertainty	3	
Sub-total		**15**
<u>Internal Environment</u>		
Top management support	5	
Organizational culture	11	
Communication	4	
Organizational structure	4	
Business process reengineering	4	
IT readiness	4	
Sub-total		**32**
<u>ERP implementation</u>		
Integration	5	
Configuration	5	
Adaptation	4	
User training	4	
Sub-total		**18**
<u>Supplier capabilities</u>		
Information access	4	
Process improvement	4	
Product innovation	4	
Sub-total		**12**
Organizational capabilities		
Cross-functional coordination	4	
Information access	4	
Process improvement	4	
Product innovation	4	

Flexibility	6	
Agility	4	
Sub-total		**26**
Supplier performance		
Short lead time	4	
Product variety	3	
Delivery reliability	4	
Cost performance	4	
Quality	4	
Sub-total		**19**
Organizational performance		
Cost performance	4	
Product variety	3	
Delivery reliability	4	
Time-to-market	4	
Quality	4	
Sub-total		**19**
Customer value		
Value for money	3	
Convenience	3	
Timely response	4	
Reputation for quality	4	
Sub-total		**14**
Total		**155**

Added to this were 8 items for contextual variables. Overall, 163 questionnaire items were ready to be sent out for the large scale survey. The measurement items for 8 contextual variables are listed in Appendix C.

CHAPTER 4. INSTRUMENT DEVELOPMENT PHASE II: EXPLORATORY DATA ANALYSIS

As a result of the Q-sort study, the original 145 questionnaire items were purified and reduced into 124 items: 15 for external environment, 32 for internal environment, 18 for ERP implementation, 26 for organizational capabilities, 19 for organizational performance, and 14 for customer value. For supplier capabilities and performance, the items of organizational capabilities and performance are used in supplier context respectively. The total number of questionnaire items is 155. These items are listed in Appendix E. 8 contextual variables are listed in Appendix C. To obtain a list of Korean large manufacturing companies, Kospi and Kosdaq stock market listings from the website http://www.daum.net were utilized. The telephone numbers for 593 of the organizations listed at the time were obtained from this website. Managers in operations or the IT departments were initially contacted via telephone (McFadden et al., 2009). Only those who were able to be personally spoken to receive the survey via email. These questionnaire items were administered from eighty industries: SIC code 20 ―Food and kindred Products", 26 ―Paper and allied products", 28 ―Chemicals and allied products", 32 ―Stone, clay, glass, and concrete products", 34 "Fabricated metal products," 35 ―Industrial machinery and equipment," 36 "Electronic and other electric equipment," and 37 ―Transportation equipment".

In this study, a web survey was used to collect data. The designing of the website was done with the assistance of the office of Institutional Research (IR) at the University of Toledo. IR provides a website (http://www.vovici.com) to aid in designing a professional, high quality survey that facilitates the answering of questionnaires. In addition, the website is useful for sending and reminding those who were contacted to complete the survey. It also stores response data and provides it in an electronic file in SPSS or Excel format.

The web survey was presented in multi-page format so that the respondents could not see the entire questionnaire and get discouraged by the total number of questions presented at once. The response sheet was equally distributed in order, so the respondent might not be confused because of the differing length of questions in it. The online survey was designed to be as simple as possible in terms of format and navigation. The survey was administered for two months, resulting in 205 responses (response rate: 34.6%).

4.1. Sample demographics

Sample characteristics are shown on Table 4.1. Respondents coming from eight manufacturing industries (SIC 20, 26, 28, 32, 34, 35, 36, and 37) account for 100% of the respondents. SIC code 34-37 accounted for 59% of respondents.

Table 4.1 Description of Sample

(1) RESPONDENTS BY SIC CODE:

SIC Code	Name	Percent
20	Food And Kindred Products	8%
26	Paper And Allied Products	6%
28	Chemicals and Allied Products	20%
32	Stone, Clay, Glass, And Concrete Products	7%
34	Fabricated Metal Products, Except Machinery And Transportation	18%
35	Industrial And Commercial Machinery And Computer Equipment	14%
36	Electronic And Other Electrical Equipment And Components,	14%
37	Transportation Equipment	13%
	TOTAL	100%

(2) RESPONDENTS BY POSITION:

Position	Percent
Directors	1%
General manager	10%
Deputy General Manager	16%
Managers	46%
Assistant manager	26%
Staff	1%
TOTAL	100%

(3) FIRMS BY SIZE:

Number of Employees	Percent
Less than 100	8%
100 to 249	25%
250 to 499	26%
500 to 999	20%
1,000 to 2,499	10%
2,500 and over	11%
TOTAL	100%

(4) PRODUCT COMPLEXITY:

Product Complexity	Percent
Very low	4%
Low	7%
Moderate	38%
High	38%
Very high	13%
TOTAL	**100%**

4.1.1. Sample characteristics of the respondent

The respondents were asked to identify their positions within the firm. The majority of the respondents stated their position as managers (46%), assistant managers (26%), or deputy general managers (16%), while 12% stated they are directors or general managers. 10% of the respondents are general managers, and only 1% of the respondents are directors of their organizations. More than 88% of respondents are actively using ERP systems in their organizations (Refer Figure 4.1).

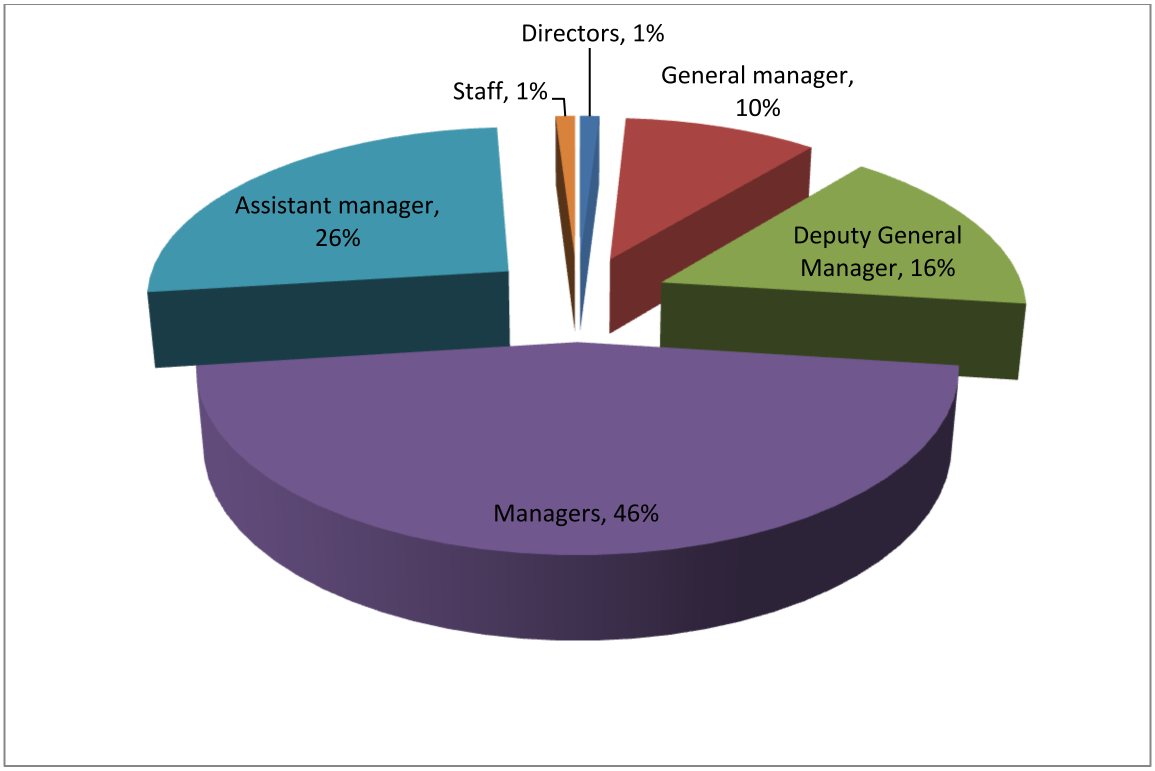


Figure 4.1. Respondents by job title

The respondents also identified the size of their firm. Eight percent (8%) of the organizations have Less than 100 employees and twenty five percent (25%) of the organizations have 100 to 249 employees. Organizations that have between 250 and 499 employees accounts for 26% of the sample while organizations with between 500 and 999 employees account for 20% of the sample. 10% of the organizations have between 1,000 and 2,499 employees and 11% of the organizations have more than 2,500 employees.

In the United States, the current definition of company size categorizes companies with fewer than 100 employees as ―small,‖ and those with fewer than 500 as ―medium‖ By contrast, in Korea, when small business is defined by the number of employees, it often refers to those with less than 50 employees, while medium-sized business often refers to those with less than

200 or 300 employees. The majority of the firms were large size; about 56% of the responding firms had between 250 and 999 employees. Firms with more than 1,000 employees accounted for 21% of the sample (Refer Figure 4.2).

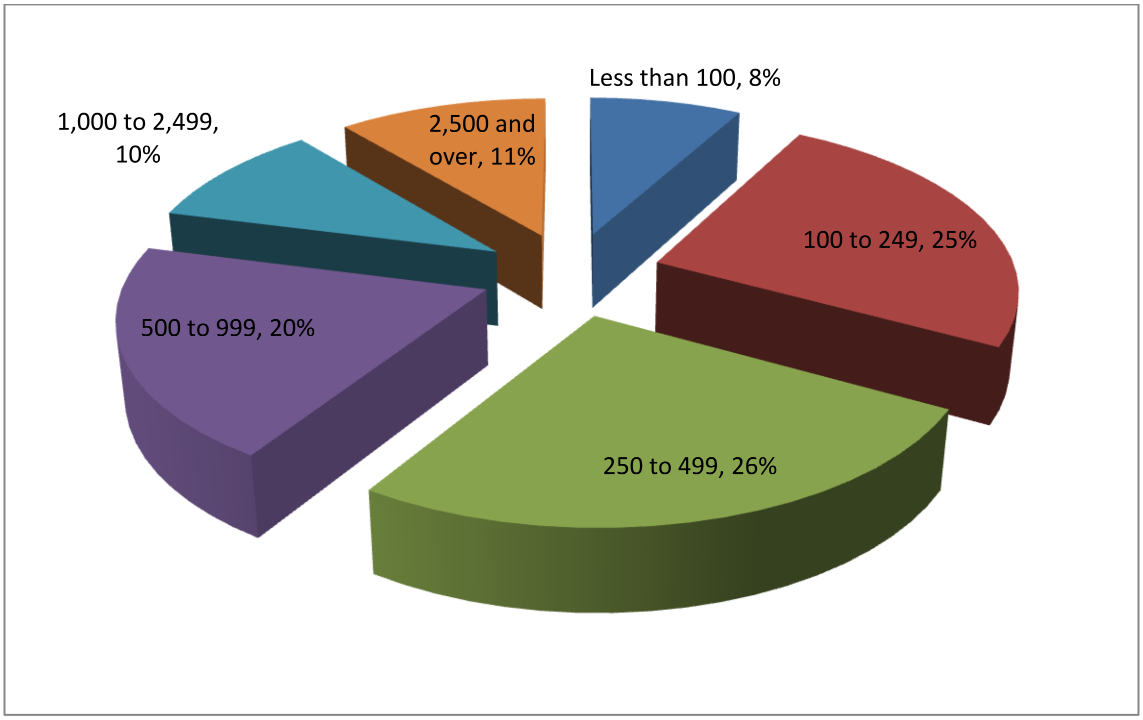


Figure 4.2. Respondents by firm size (# of employees)

51% of the respondents said the level of complexity of their products was above average (―high"- 38% or ―very high"-15%). 38% of the respondents work in an environment of moderate product complexity. 11% of the respondents work in the low level of product complexity environment. Product complexity is reflected by the number of product variants a firm produces. A firm typically increases the number of component and production process variations in the products it produces over time. This product complexity means that the majority of the respondents work in a complicated working environment. Figure 4.3 displays the organizations by product complexity.

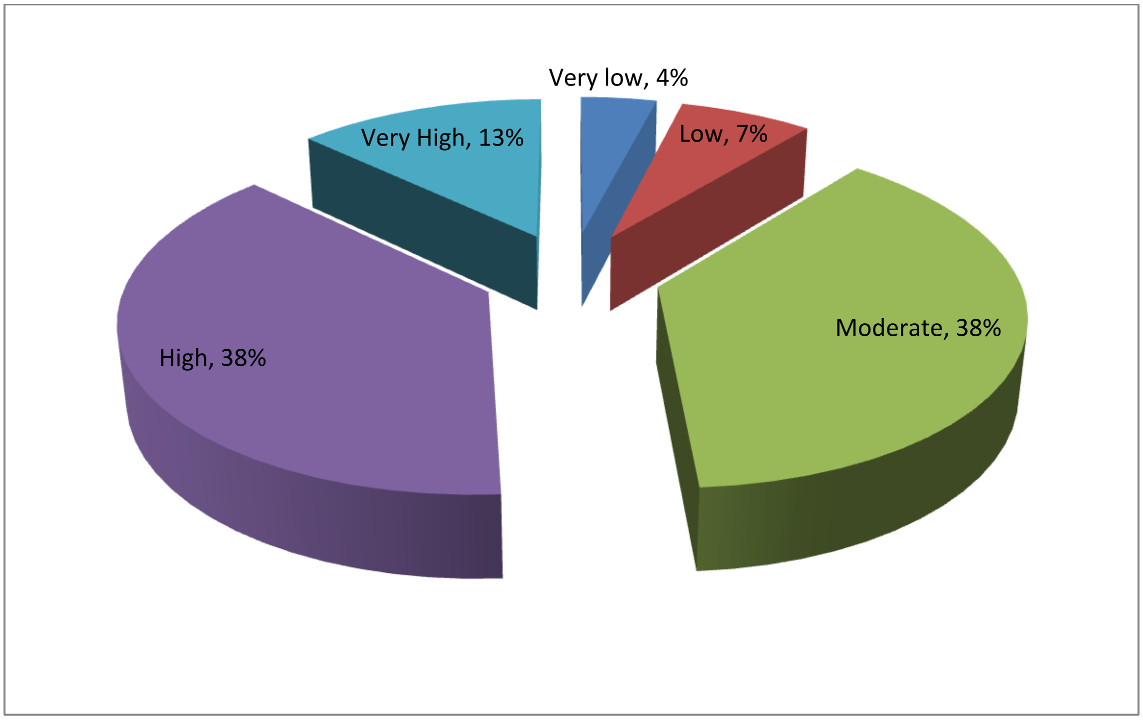


Figure 4.3 Respondents by product complexity

Response biases were checked by comparing the SIC group distribution for the sample population and total responses, using the chi-square test of homogeneity. The results are shown in Table 4.2. The analysis indicates that total responses were unbiased with respect to the SIC group. The non-response bias was not checked because of the lack of information from the firms contacted (Refer Figure 4.4).

Table 4.2. Chi-square test of response bias

SIC	Total Sample Distribution	Response	Expected Frequency	Chi-square
20	0.061	17	12	1.67
26	0.040	13	8	2.67
28	0.216	41	44	0.24
32	0.052	14	11	1.01
34	0.185	36	38	0.11
35	0.196	28	40	3.65
36	0.103	29	21	2.97
37	0.147	27	30	0.31
Total	**1.000**	**205**	**205.00**	**12.62**

Sample population and response group are homogeneous in SIC code distribution at df = 7, $\alpha = 0.05$ (Chi-square critical value = 14.067).

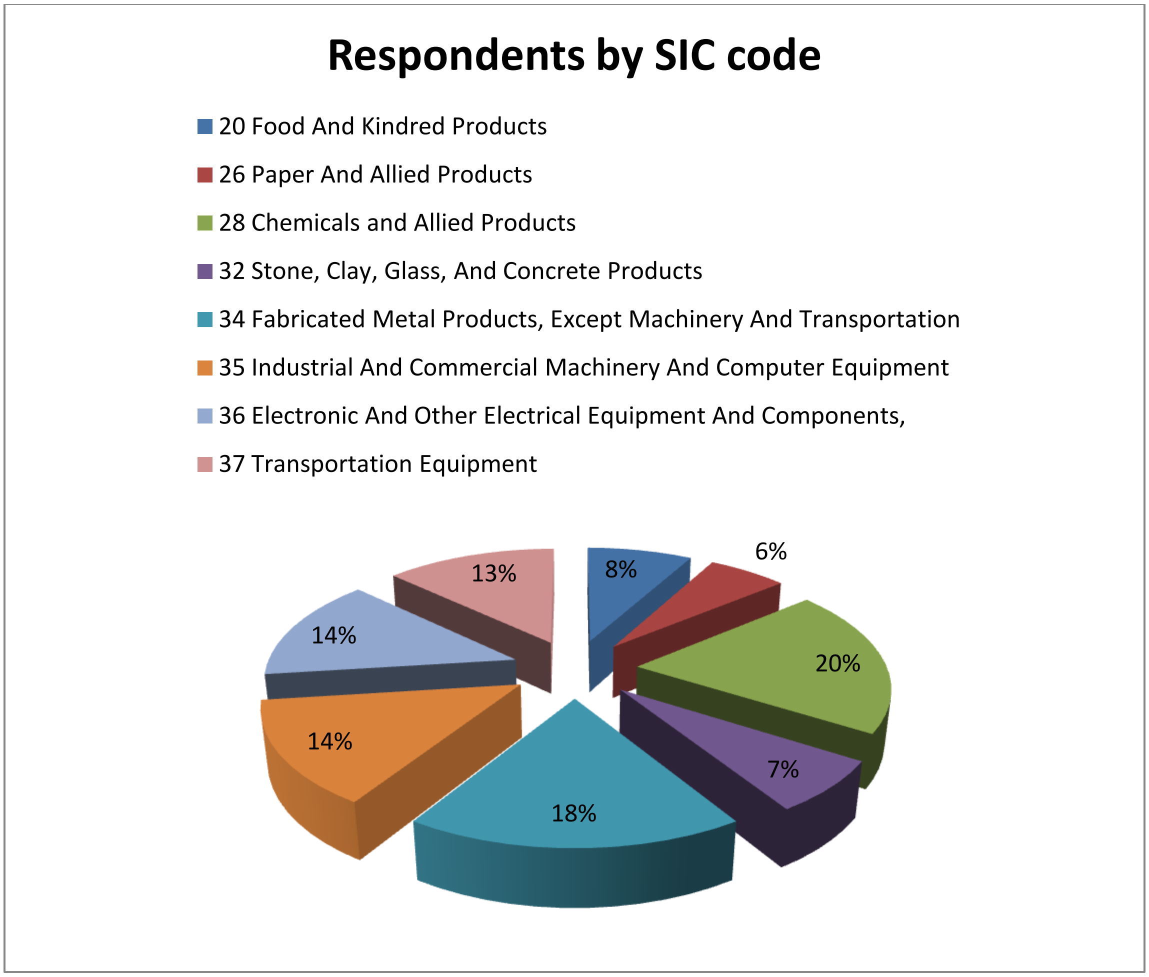


Figure 4.4. Respondents by SIC code

4.2. Research Methods

In this session, the assessment used to evaluate reliability and validity of the measurement model is discussed. Reliability is to measure the consistency of survey instruments. It is concerned with the accuracy and precision of the actual measuring instrument. Validity is defined as the degree to which a study accurately assesses the specific concept that the researcher attempts to measure. It is to know whether the study successfully measure what the researcher intends to measure (Bagozzi and Phillip, 1982). To ensure that the instruments are reliable and valid, 205 responses were analyzed with the following objectives in mind: purification, unidimensionality, reliability, content validity, and constructs validity (convergent and discriminant validity). The methods that were used are: corrected-item to total correlation (for purification), exploratory factor analysis (for unidimensionality), Cronbach's alpha (for reliability), Literature review (for content validity), and correlation analysis and confirmative factor analysis (for convergent and discriminant analysis).

Content validity: Content validity is defined as the extent to which all the items in a particular construct represent it accurately. Content validity was measured through a comprehensive literature review and validated by academicians and practitioners. Items that did not represent the construct have been reworded or removed. Content validity was completed in chapter 3.

Purification and reliability: The purification process is needed to identify and remove the items that do not fit in a particular construct. For the purification, corrected-item total correlation (CITC) was used. CITC indicates whether the variable actually belongs to the construct or not. Items were deleted if their CITC scores were below 0.5. Even though the scores were lower than 0.5, items were kept if there was a clear reason or theoretical justification. The reliability of the remaining items comprising each sub-construct was examined using Cronbach‗s alpha. In general, a higher than 0.7 level for alpha was regarded as evidence of a reliable scale (Nunnally, 1978).

Construct validity: Construct validity refers to the extent to which an item measures up to its claims. It is to examine how well the operationalized items of a variable actually reflect the true theoretical meaning of a concept. To measure construct validity, unidimensionality, convergent validity and discriminant validity are used. Unidimensionality refers to the examination of the existence of a single construct underlying a set of measures (O'Leary-Kelly and Vokurka, 1998; Gerbing and Anderson, 1988). Convergent validity is to measure whether items converge in a particular construct or not. Convergent and discriminant validity were assessed through correlation analysis and confirmative factor analysis. For a scale to have convergent validity, inner-scale item-to-item correlations should be statistically significant. Discriminant validity was assessed at the item-level using a single-method, multiple-trait approach (Campbell and Fiske, 1959). If the number of –violations" (i.e., correlation of item to outer-scale-items being higher than the minimum inner-scale item-to-item correlation) is less than half of all comparisons, it was taken as evidence of discriminant validity.

Exploratory Factor Analysis (EFA) was used to carry out the initial examination of factor structure. Items that have significantly low factor loadings (below 0.60) or that were not factorially pure (having cross-loadings at 0.40 or above yet being below 0.60 on all factor loadings) were considered as candidates for elimination. When items loaded onto certain factors above 0.60 yet have cross-loading on other factors on or above 0.40, a careful examination of each item was carried out to determine whether to keep or delete that item. Although EFA is useful at identifying underlying factor structure and providing initial unidimensionality, convergent validity, and discriminant validity, the initial assumption of EFA is that the measurement errors of the items are uncorrelated. In fact, EFA cannot detect some degree of error correlations among items (Raghunathan et al., 1999). EFA does not provide an explicit test of unidimensionality (Gerbing and Anderson, 1988). In practice, each factor from exploratory analysis is described as a weighted sum of all observed variable in the analysis. Therefore, factors in EFA do not correspond directly to the constructs represented by each set of indicators.

Thus, confirmatory factor analysis has been used for establishing unidimensionality due to its robustness and flexibility.

In this research, AMOS was used for the confirmatory factor analysis to test and modify the measurement model. Model-data fit was evaluated based on multiple fit indexes. The Chi-square, in general, is used to evaluate the goodness of fit of the model. It is measured by calculating the difference between the sample covariance and the fitted covariance. However, the Chi-square index must be interpreted with caution because it is sensitive to sample size. Usually, when sample size increases, the chance of the Chi-square test supporting a fit of the data decreases (Miller et al., 2007). Some of the other measures of overall model fit are goodness of fit index (GFI), comparative fit index (CFI), non-normed-fit index (NFI), incremental fit index (IFI), standardized root mean square residual (SRMR), and Root mean square error of approximation (RMSEA). GFI indicates the relative amount of variance and covariance jointly explained by the model. NNFI is a fit measure that compares the existing model with the independence model. CFI avoids the underestimation of fit often noted in small samples for NNFI. IFI is relatively insensitive to sample size. It can be computed as the ratio of the difference between the Chi-square of the independence model and the chi-square of the target model to the difference between the Chi-square of the target model and the degree of freedom (df) for the target model. Values that exceed .90 are regarded as acceptable, although this index can exceed 1. Many researchers interpret these index scores (GFI, CFI, NFI) in the range of .80-.89 as representing reasonable fit; scores of .90 or higher are considered as evidence of a good fit. The SRMR is used to report a summary statistic based upon residuals between the elements of the implied and observed covariance matrices. Researchers generally use the SRMR to assess model fit because of its sensitivity to simple model misspecification (Hu and Bentler, 1999).

SRMR values should be less than 0.08 in order to indicate adequate model fit. The RMSEA is used to assess lack of fit based upon model misspecification and to provide a measure of this discrepancy per degree of freedom (Browne and Cudeck, 1993). RMSEA values below 0.05 signify good fit and values ranging from 0.05 to 0.08 are acceptable (Byrne, 2009).

Another important aspect of instrument assessment is the validation of the second-order construct. Each sub-construct is measured by several indicators. However, the overall model measures the fit using a second-order latent variable. EFA cannot form high order constructs since it does not clearly reveal second-order constructs. Thus, EFA cannot provide statistical evidence of a second-order construct (Doll et al, 1995). For example, external environment is measured by technological change, level of competition, rapid market change, and supplier uncertainty. However, the question is ‗Do technological change, level of competition, rapid market change, and supplier uncertainty form a high order construct (external environment)?' Therefore, a T coefficient can be used to test for the existence of the single second-order construct that accounts for the variations in all its sub-constructs. A T coefficient is calculated as the ratio of Chi-square of first-order correlation confirmatory factor analysis to the chi-square of second-order factor analysis. The fit index of the second order model is always a little ‗worse" than that of the first order correlation model since more constraints have been added in the latter (Doll et al, 1995). A T coefficient higher than 0.8 may indicate the existence of a second-order construct since most variation shared by the first-order factors is explained by the single second-order factor.

4.3. Large scale measurement results

This section presents the large scale measurement result for eight constructs: External environment (EE), Internal Environment (IE), ERP Implementation (ERPI), Supplier Capabilities (SCAP), Organizational Capabilities (OCAP), Supplier Performance (SPERF), Organizational Performance (OPERF), and Customer Value (CVALUE). For each construct, the assessment methodology described in the previous section has been applied to the 205 responses received through a large-scale survey.

4.3.1. External environment instrument

The analysis began with purification using the corrected-item total correlation (CITC) analysis. The CITCs for each item are shown in Table 4.3.1.1.

Two items (D11TC2 and D11TC4) from ―Technological change" sub-construct had a lower than 0.50 CITC. Examination of the wording revealed that the phrases ―….obsolete" and ―….keeping up with changes in technology…" might not have been a familiar phrase to the respondents. The items were thus deleted from further analysis.

Also one item (D12LC1) from the ―Level of competition" sub-construct had a lower than 0.50 CITC. Examination of the wording showed that the phrase ―…. to offer products with lower prices than ours" might have been too broad or generic to be included in measuring the sub-construct. Therefore, the item was excluded from further analysis.

Overall, the CITC level was high, after the purification; three items in the ―External Environment" construct (D11TC2, D11TC4, and D12LC1) had a CITC lower than 0.50. As a result, the level of Cronbach‘s alpha was also high, ranging from 0.73 to 0.80.

Table 4.3.1.1. Purification for External Environment (Large Scale)

Coding	Items	CITC-1	CITC-2
	Technological Change: **alpha = .68 (initial), .73(final)**		
D11TC1	In our industry, technology changes rapidly.	.57	.57
D11TC2	**In our industry, technology quickly becomes obsolete.**	**.46**	**-**
D11TC3	In our industry, technological change transforms business practices.	.51	.57
D11TC4	**In our industry, keeping up with changes in technology is difficult.**	**.35**	**-**
	Level of Competition: **alpha = .69 (initial); .80 (final)**		
D12LC1	Our major competitors attempt to offer products with lower prices than ours.	.17	-
D12LC2	**Our major competitors attempt to offer products with higher quality than ours.**	**.59**	**.66**
D12LC3	**Our major competitors attempt to offer products with more features than ours.**	**.63**	**.67**
D12LC4	**Our major competitors attempt to offer better customer service than we offer.**	**.57**	**.60**
	Rapid Market Change: **alpha = .80**		
D13RM1	**Our customers' order items are frequently changed.**	**.65**	**-**
D13RM2	**Our customers' order quantity is frequently changed.**	**.62**	**-**
D13RM3	**Our customers' expectations for the product price are frequently changed.**	**.57**	**-**
D13RM4	**Our customers' expectations for the product quality are frequently changed.**	**.64**	**-**
	Supplier uncertainty: **alpha = .80**		
D14UC1	**Our supplier' product quality is unpredictable.**	**.51**	**-**
D14UC2	**Our supplier' delivery times differ from our expectations.**	**.76**	**-**
D14UC3	**Our supplier' delivery quantities differ from our expectations.**	**.69**	**-**

Note: Items in bold were retained for further analysis.

An exploratory factor analysis was then conducted using principal components as the means of extraction and a direct oblimin as the method of rotation. Without specifying the number of factors, there were four factors with eigenvalues greater than 1. The exploratory factor analysis of the items is shown in Table 4.3.1.2. For simplicity, only factor loadings on or above 0.40 are shown in the table. The cumulative variance extracted by the four factors was 69%. AMOS was used to further purify the items and test the unidimensionality of each sub-construct of the external environment. Except for the rapid market change sub-construct, all the other three factors had only two or three items respectively. A model run with either one of these factors would not have yielded model fit statistics. To address this problem the four factors were tested simultaneously as a four-factor model. The model had good model fit and no modification could be done. All indices of goodness-of-fit for the confirmatory factor analysis were presented in Table 4.3.1.4 (Refer the indices of the first order model). Reliability was reexamined for ―Technological change," ―Level of competition," ―Rapid market change", and ―Supplier uncertainty." Cronbach‘s alphas for these four sub-constructs were calculated as 0.73, 0.80, 0.80 and 0.80, respectively.

Next, a correlation matrix (Table 4.3.1.3) of the 12 items retained for further assessment was examined for evidence of convergent and discriminant validity. The smallest within sub-construct (factor) correlations were: technological change = 0.574, level of competition = 0.545, rapid market change = 0.43, and supplier uncertainty = 0.438. All of them were significantly different from zero at $p<0.01$, indicating convergent validity. An examination of the correlation matrix to assess discriminant validity was carried out by counting the number of items to outer-scale item correlations greater than the minimum inner-scale item-to-item correlation. There was a total of one violation out of 106 total comparisons, indicating a high level of discriminant validity.

Finally, a T coefficient was used to validate the high-order construct (EE). The fit indices of both first-order and second-order models for the external environment (EE) and the resulting

T coefficient are listed in Table 4.3.1.4. It is shown that all indices of goodness-of-fit for the second-order model are a little worse than those of the first-order model, but the difference is not significant. GFI= 0.94, NNFI=0.94, IFI=0.94, CFI=0.95, SRMR = 0.0508, and RMSEA= 0.064 for the first–order model and GFI= 0.94, NNFI=0.94, IFI=0.96, CFI=0.96, SRMR = 0.0518, and RMSEA= 0.062 for the second order model respectively. The T coefficient is 99.45%, which indicated the existence of a higher order EE construct, since about ninety nine percent of the variation in the four first–order factors is explained by the EE construct.

Overall, a total of 12 items for four scales were proposed for the external environment (Appendix F).

Table 4.3.1.2. Exploratory factor analysis for retained External Environment items

ITEM	F1-Tehcnological change	F2-Level of competition	F3-Rapid market change	F4-Supplier uncertainty	Alpha (α)
D11TC1	.87				α = .73
D11TC3	.74				
D12LC2		.86			α = .80
D12LC3		.88			
D12LC4		.81			
D13RM1			.71		α = .80
D13RM2			.80		
D13RM3			.78		
D13RM4			.75		
D14UC1				.78	α = .80
D14UC2				.89	
D14UC3				.86	
Eigenvalue	3.85	2.23	1.80	1.07	
% of Variance	29.58	17.12	13.84	8.24	
Cumulative % of Variance	29.58	46.70	60.54	68.78	

Table 4.3.1.3. Item correlation matrix, descriptive statistics, and discriminant validity tests for External Environment (large scale)

	D11TC1	D11TC3	D12LC2	D12LC3	D12LC4	D13RM1	D13RM2	D13RM3	D13RM4	D14UC1	D14UC2	D14UC3
D11TC1	1.000											
D11TC3	0.574	1.000										
D12LC2	0.109	0.069	1.000									
D12LC3	0.146	0.020	0.621	1.000								
D12LC4	0.159	0.087	0.545	0.550	1.000							
D13RM1	0.425	0.451	0.113	0.015	0.058	1.000						
D13RM2	0.297	0.276	0.090	-0.010	-0.007	0.600	1.000					
D13RM3	0.313	0.349	0.170	0.061	0.082	0.430	0.447	1.000				
D13RM4	0.328	0.374	0.277	0.126	0.105	0.551	0.464	0.556	1.000			
D14UC1	0.120	-0.019	0.038	0.019	0.018	0.100	0.164	0.155	0.205	1.000		
D14UC2	0.184	0.215	0.030	-0.017	0.021	0.175	0.296	0.097	0.246	0.523	1.000	
D14UC3	0.087	0.124	0.032	-0.016	-0.009	0.134	0.331	0.118	0.212	0.438	0.753	1.000
	D11TC1	D11TC3	D12LC2	D12LC3	D12LC4	D13RM1	D13RM2	D13RM3	D13RM4	D14UC1	D14UC2	D14UC3
Mean	3.29	3.51	3.00	2.82	2.97	3.32	3.56	3.40	3.37	2.74	2.83	2.58
S.D.	1.15	1.14	1.07	1.04	.97	1.23	1.13	1.08	1.09	1.00	1.11	1.08
# of Violations	0	0	0	0	0	1	0	0	0	0	0	0

Note: None of the count of violations for each item exceeds half of the potential comparisons.
Total # of violations = 1

Table 4.3.1.4. Goodness of Fit Indexes for First and Second Order Model

Construct	Model	Chi-Square	Chi-Square /df	SRMR	GFI	IFI	NNFI	CFI	RMSEA	T coefficient
EE	First-order	88.17 (48)	1.84	0.0508	0.94	0.95	0.94	0.95	0.064	99.45%
	Second-order	88.66 (50)	1.77	0.0518	0.94	0.96	0.94	0.96	0.062	
IE	First-order	261.36 (178)	1.47	0.0429	0.89	0.97	0.96	0.97	0.048	86.67%
	Second-order	301.56 (183)	1.65	0.0715	0.88	0.96	0.95	0.96	0.056	
ERPI	First-order	161.97 (82)	1.98	0.0691	0.91	0.96	0.95	0.96	0.069	92.61%
	Second-order	174.90 (84)	2.08	0.0768	0.90	0.96	0.95	0.96	0.073	
SCAP	First-order	78.80 (41)	1.92	0.0359	0.94	0.98	0.97	0.98	0.067	100.00%
	Second-order	78.80 (41)	1.92	0.0359	0.94	0.98	0.97	0.98	0.067	
OCAP	First-order	356.12 (193)	1.85	0.0587	0.87	0.95	0.94	0.95	0.064	90.47%
	Second-order	393.64 (203)	1.94	0.0719	0.85	0.94	0.93	0.94	0.068	
SPERF	First-order	244.96 (124)	1.98	0.0545	0.88	0.97	0.96	0.97	0.069	96.27%
	Second-order	254.45 (129)	1.97	0.0583	0.88	0.97	0.96	0.97	0.069	
OPERF	First-order	270.49 (125)	2.16	0.0356	0.88	0.97	0.96	0.97	0.076	95.43%
	Second-order	283.44 (130)	2.18	0.0440	0.87	0.96	0.96	0.96	0.076	
CVALUE	First-order	84.86 (59)	1.44	0.0277	0.94	0.99	0.99	0.99	0.046	96.06%
	Second-order	88.34 (61)	1.45	0.0308	0.94	0.99	0.99	0.99	0.047	

4.3.2. Internal environment instrument

The analysis began with a purification using the corrected-item total correlation (CITC) analysis. The CITCs for each item are shown in Table 4.3.2.1.

In assessing the CITC, the ―Organizational structure" sub-construct was especially troublesome, for if all items with a CITC lower than 0.50 were to be deleted, no item would remain for this sub-construct. Careful examination of the items and data revealed that they are not related to each other, even though each item represents the characteristics of organic organizations. Thus, the items were eliminated from further analysis.

Overall, four items were removed through the purification process. Apart from the “Organizational structure,” all other sub-constructs resulted in higher than 0.80 alphas, indicating a high level of reliability. The number of items entering the exploratory factor analysis was 21.

Exploratory factor analysis was conducted using principal components as the means of extraction and a direct oblimin as a method of rotation. Without specifying the number of factors, there were five factors with eigenvalues greater than 1. The exploratory factor analysis of items for the remaining five sub-constructs and 21 items is shown in Table 4.3.2.2. AMOS was used to further purify the items and test the unidimensionality of each sub-construct of the internal environment variable. All the factors had only three or four items respectively. The five factors were tested simultaneously as a five-factor model. The model had good model fit and no modification could be done. All indices of goodness-of-fit for the confirmatory factor analysis were presented in Table 4.3.1.4 (Refer to the indices of the first order model). Reliability was reexamined for “Top management support,” “Organizational culture”, “Communication”, “Business process reengineering”, and “IT readiness”. Cronbach‘s alphas for these five sub-constructs were calculated as 0 .90, 0.89, 0.85, 0.80, and 0.93, respectively.

A correlation matrix (Table 4.3.2.3) of the 21 items was examined for evidence of convergent and discriminant validity. The smallest within sub-construct correlations were: Top management support = 0.555, organizational culture = 0.620, Communication = 0.428, Business process reengineering = 0.387, and IT readiness = .709. All of them were significantly different from zero at $p<0.01$. An examination of the correlation matrix to assess discriminant validity resulted in fourteen violations out of 352 total comparisons, indicating a high level of discriminant validity.

Finally, a T coefficient was used to validate the high-order construct (IE). The fit indices of both first-order and second-order models for the internal environment (IE) and the resulting T coefficient are listed in Table 4.3.1.4. It is shown that all indices of goodness-of-fit for the second-order model are a little worse than those of the first-order model, but the difference is not significant. GFI= 0.89, IFI=0.97, NNFI=0.96, CFI=0.97, SRMR = 0.0429, and RMSEA= 0.048 for the first–order model and GFI= 0.88, IFI=0.96, NNFI=0.95, CFI=0.96, SRMR = 0.0715, and RMSEA= 0.056 for the second order model respectively. The T coefficient is 86.67%, which indicated the existence of a higher order IE construct, since about eighty seven percent of the variation in the five first–order factors is explained by the IE construct.

Overall, 21 items and five scales were proposed for the internal environment construct (Appendix F).

Table 4.3.2.1. Purification for Internal Environment (large scale)

Coding	Items	CITC
	Top Management Support: **alpha = .90**	
D21TM1	**Top management understands how the implementation of new technology will benefit the enterprise.**	**.75**
D21TM2	**Top management recognizes the need for long-term support for the implementation of new technology.**	**.72**
D21TM3	**Top management identifies the implementation of new technology as a top priority.**	**.78**
D21TM4	**Top management reinforces the commitment of all the employees to the implementation of new technology.**	**.73**
D21TM5	**Top management willingly assigns resources to facilitate the implementation of new technology as they are needed.**	**.76**
	Organizational Culture**: alpha = .89**	
D22OC1	**We believe that investments in information technology increase creativity among our workers.**	**.81**
D22OC2	**We believe that investments in information technology support product innovation efforts among our workers.**	**.76**
D22OC3	**We believe that investments in information technology support process improvement efforts among our workers.**	**.77**
D22OC4	**We believe that investments in information technology increase intellectual work among our workers.**	**.73**
	Communication: **alpha = .85**	
D23CM1	**Expected outcomes of the project are communicated to managers.**	**.53**
D23CM2	**Expected outcomes of the project are communicated by upper management in advance.**	**.70**
D23CM3	**Expected outcomes of the project are shared among workers within departments.**	**.81**
D23CM4	**Expected outcomes of the project are shared among workers across departments.**	**.72**
	Organizational Structure: **alpha = .68**	
D24OS1	Our workers are supported by middle managers in making their own decision.	.42
D24OS2	Our workers are assigned to work in cross-functional teams.	.47
D24OS3	Our workers have minimal rules and little direct supervision.	.46
D24OS4	Our workers encounter few hierarchical layers when attempting to reach the top management.	.49

Coding	Items	CITC
	Business Process Reengineering: **alpha = .80**	
D25BP1	**We design and document important business processes.**	**.51**
D25BP2	**We appoint the best managers to be process managers.**	**.67**
D25BP3	**We measure our performance based on business process goals rather than functional goals.**	**.63**
D25BP4	**Functional managers support business processes.**	**.65**
	IT Readiness: **alpha = .93**	
D26IT1	**IT staff is able to configure information systems.**	**.82**
D26IT2	**IT staff is able to efficiently implement system upgrades.**	**.87**
D26IT3	**IT staff is able to conduct a formal validation of all system changes.**	**.84**
D26IT4	**IT staff has high degree of technical expertise.**	**.81**

Note: Items in bold were retained for further analysis.

Table 4.3.2.2. Exploratory factor analysis for retained Internal Environment Items (large scale)

ITEM	F1-Top Management Support	F2-Organizational Culture	F3-Communication	F4-Business Process Reengineering	F5-IT Readiness	Alpha (α)
D21TM1	.86					α = .90
D21TM2	.85					
D21TM3	.82					
D21TM4	.81					
D21TM5	.73					
D22OC1		.86				α = .89
D22OC2		.86				
D22OC3		.82				
D22OC4		.84				
D23CM1			.67			**α = .85**
D23CM2			.72			
D23CM3			.91			
D23CM4			.79			
D25BP1				.70		**α = .80**
D25BP2				.86		
D25BP3				.79		
D25BP4				.70		
D26IT1					.88	**α = .93**
D26IT2					.88	
D26IT3					.87	
D26IT4					.90	
Eigenvalue	8.11	3.04	1.67	1.32	1.16	
% of Variance	38.61	14.45	7.96	6.28	5.54	
Cumulative % of Variance	38.61	53.06	61.02	67.30	72.84	

Table 4.3.2.3. Item correlation matrix, descriptive statistics, and discriminant validity tests for Internal Environment (large scale)

	D21TM1	D21TM2	D21TM3	D21TM4	D21TM5	D22OC1	D22OC2	D22OC3	D22OC4	D23CM1	D23CM2	D23CM3	D23CM4	D25BP1	D25BP2	D25BP3	D25BP4	D26IT1	D26IT2	D26IT3	D26IT4
D21TM1	1.000																				
D21TM2	0.723	1.000																			
D21TM3	0.650	0.613	1.000																		
D21TM4	0.604	0.555	0.656	1.000																	
D21TM5	0.594	0.580	0.722	0.690	1.000																
D22OC1	0.460	0.364	0.472	0.373	0.510	1.000															
D22OC2	0.376	0.307	0.425	0.277	0.438	0.782	1.000														
D22OC3	0.444	0.416	0.424	0.381	0.425	0.714	0.639	1.000													
D22OC4	0.332	0.331	0.345	0.330	0.396	0.634	0.620	0.708	1.000												
D23CM1	0.259	0.196	0.159	0.305	0.200	0.113	0.130	0.167	0.144	1.000											
D23CM2	0.361	0.338	0.393	0.355	0.427	0.324	0.355	0.327	0.319	0.468	1.000										
D23CM3	0.331	0.319	0.299	0.366	0.353	0.255	0.253	0.257	0.187	0.532	0.688	1.000									
D23CM4	0.343	0.343	0.356	0.324	0.399	0.341	0.311	0.345	0.309	0.428	0.619	0.760	1.000								
D25BP1	0.222	0.214	0.194	0.253	0.225	0.243	0.250	0.242	0.307	0.297	0.219	0.183	0.250	1.000							
D25BP2	0.279	0.315	0.358	0.261	0.364	0.272	0.372	0.306	0.315	0.223	0.348	0.288	0.331	0.491	1.000						
D25BP3	0.255	0.313	0.298	0.335	0.352	0.300	0.298	0.279	0.273	0.258	0.392	0.416	0.418	0.387	0.565	1.000					
D25BP4	0.305	0.339	0.398	0.340	0.447	0.297	0.329	0.353	0.300	0.319	0.390	0.329	0.387	0.418	0.570	0.591	1.000				
D26IT1	0.148	0.159	0.101	0.129	0.236	0.114	0.160	0.146	0.219	0.314	0.390	0.354	0.378	0.376	0.361	0.372	0.440	1.000			
D26IT2	0.186	0.213	0.185	0.257	0.294	0.148	0.204	0.177	0.279	0.378	0.446	0.417	0.424	0.415	0.376	0.404	0.467	0.837	1.000		
D26IT3	0.186	0.166	0.110	0.161	0.222	0.181	0.188	0.151	0.233	0.345	0.402	0.442	0.404	0.345	0.336	0.371	0.427	0.735	0.784	1.000	
D26IT4	0.162	0.202	0.185	0.182	0.279	0.157	0.209	0.158	0.223	0.300	0.374	0.378	0.338	0.305	0.372	0.325	0.387	0.709	0.753	0.787	1.000
	D21TM1	D21TM2	D21TM3	D21TM4	D21TM5	D22OC1	D22OC2	D22OC3	D22OC4	D23CM1	D23CM2	D23CM3	D23CM4	D25BP1	D25BP2	D25BP3	D25BP4	D26IT1	D26IT2	D26IT3	D26IT4
Mean	4.09	4.01	3.58	4.01	3.65	3.69	3.55	3.78	3.66	4.35	3.39	3.64	3.56	3.96	3.58	3.48	3.40	3.77	3.76	3.62	3.50
S.D.	0.91	.99	1.10	0.97	1.03	0.98	1.06	1.01	0.96	0.84	1.12	0.96	1.00	0.96	0.94	0.98	0.87	0.98	0.87	0.98	0.96
# of Violations	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	4	7	0	0	0	0

Note: None of the count of violations for each item exceeds half of the potential comparisons.
Total # of violations = 14

4.3.3. ERP implementation instrument

The assessment of this instrument with five sub-constructs and 18 items begins with purification. The CITC level was generally high; the lowest CITC was 0.53 for D31IN5. Cronbach‘s alpha ranged from 0.86 to 0.92. The CITCs for each item are shown in Table 4.3.3.1.

Exploratory factor analysis was conducted using principal components as the means of extraction and a direct oblimin as a method of rotation. Without specifying the number of factors, there were three factors with eigenvalues greater than 1. However, since the research expected four subconstructs, the forced method to get four subconstructs was used. For simplicity, only factor loadings on or above 0.40 are shown in the table. The cumulative variance extracted by the six factors was 73%. In the process of eliminating items that are not factorially pure, 3 items were deleted. First, one item from the ―Integration" sub-construct (D31IN1) had low factor loadings (below 0.59). Close examination of the wording of these items showed that the wording was less specific than the other items in describing the integration with other modules and transactions. This item was thus deleted from further analysis.

Second, two items from the ―Configuration" sub-construct (D32CF1 and 2) had low factor loadings (below 0.51) as well as significant cross-loadings (as high as 0.41). Examining the wordings of these two items revealed that certain phrases in these items (e.g., ―…. meets all the needs of organizational processes" or ―…. accommodates the changes") caused them to be interpreted quite close to the ―Integration" sub-construct. The two items were thus eliminated in the subsequent analysis. The exploratory factor analysis of items for the remaining four sub-constructs and 15 items is shown in Table 4.3.3.2. AMOS was used to further purify the items and test the unidimensionality of each sub-construct of the ERP Implementation variable. All the factors had only three or four items respectively. A model run with either one of these factors would not have yielded model fit statistics. To address this problem the four factors were tested simultaneously as a four-factor model. The model had good model fit and no modification could be done. All indices of goodness-of-fit for the confirmatory factor analysis were presented in Table 4.3.1.4 (Refer to the indices of the first order model). Reliability was reexamined for ―Integration,” ―Configuration,” ―Adaptation”, and ―User training”. Cronbach‘s alphas for these four sub-constructs were calculated as 0.87, 0.86, 0.92 and 0.91, respectively.

A correlation matrix (Table 4.3.3.3) of the 15 items was examined for evidence of convergent and discriminant validity. The smallest within sub-construct correlations were: Integration = .578, configuration = 0.470, adaptation = 0.641, and user training = 0.640. All of them were significantly different from zero at $p<0.01$. An examination of the correlation matrix to assess discriminant validity resulted in only 6 violations out of 168 total comparisons, indicating a high level of discriminant validity.

Finally, a T coefficient was used to validate the high-order construct (ERPI). The fit indices of both first-order and second-order models for ERP Implementation (ERPI) and the resulting T coefficient are listed in Table 4.3.1.4. It is shown that all indices of goodness-of-fit for the second-order model are a little worse than those of the first-order model, but the difference is not significant. GFI= 0.91, IFI=0.96, NNFI=0.95, CFI=0.96, SRMR = 0.0691, and RMSEA= 0.069 for the first–order model and GFI= 0.90, IFI=0.96, NNFI=0.95, CFI=0.96, SRMR = 0.0768, and RMSEA= 0.073 for the second order model respectively. The T coefficient is 92.61%, which indicated the existence of a higher order ERPI construct, since about ninety three percent of the variation in the four first–order factors is explained by the ERPI construct.

Overall, 15 items and four scales were proposed for the ERP implementation construct (Appendix F).

Table 4.3.3.1. Purification for ERP Implementation (large scale)

Coding	Items	CITC
	Integration: **alpha = .87**	
D31IN1	**We seamlessly integrate the modules in the ERP system.**	**.76**
D31IN2	**We seamlessly integrate all transactions in the ERP system.**	**.79**
D31IN3	**We seamlessly integrate the ERP system with supply chain management (customer or supplier relationship) system, using communication protocols and standards.**	**.67**
D31IN4	**We seamlessly integrate the ERP system with manufacturing management system, using communication protocols and standards.**	**.77**
D31IN5	**We seamlessly integrate the ERP system with legacy systems.**	**.53**
	Configuration: **alpha = .86**	
D32CF1	**The ERP system meets all the needs of organizational processes.**	**.71**
D32CF2	**The ERP system accommodates the changes required by the organization's processes.**	**.69**
D32CF3	**The ERP system supports the business practices of our company. (Data fit)**	**.66**
D32CF4	**The ERP system data items' names and meanings correspond to those used in our company (i.e. a sales order sheet, sales report).**	**.63**
D32CF5	**The ERP system user interface is well suited to the business needs of our company.**	**.69**
	Adaptation: **alpha = .92**	
D33AD1	**To align with changing organizational needs, we easily alter/append ERP data items.**	**.80**
D33AD2	**To align with changing organizational needs, we easily alter/append ERP processes.**	**.79**
D33AD3	**To align with changing organizational needs, we easily alter ERP input/output screens.**	**.84**
D33AD4	**To align with changing organizational needs, we easily alter ERP reports.**	**.81**
	User Training: **alpha = .91**	
D34UT1	**ERP system users are provided with customized training materials for each specific job.**	**.81**

Coding	Items	CITC
D34UT2	**ERP system users are provided training materials that demonstrate an overview of the system, not just help with the ERP screens and reports.**	**.80**
D34UT3	**ERP system users attend a formal training program that meets their requirements.**	**.81**
D34UT4	**ERP system users are assessed to ensure that they have received the appropriate training.**	**.75**

Note: Items in bold were retained for further analysis.

Table 4.3.3.2. Exploratory factor analysis for retained ERP Implementation (large scale)

ITEM	F1-Integration	F2-Configuration	F3-Adaptation	F4-User Training	Alpha (α)
D31IN1	.78				α = .87
D31IN2	.84				
D31IN3	.89				
D31IN4	.83				
D32CF3		.60			α = .86
D32CF4		.97			
D32CF5		.81			
D33AD1			.77		α = .92
D33AD2			.80		
D33AD3			.91		
D33AD4			.97		
D34UT1				.87	α = .91
D34UT2				.84	
D34UT3				.92	
D34UT4				.87	
Eigenvalue	8.43	2.16	1.67	0.96	
% of Variance	46.82	11.98	9.29	5.33	
Cumulative % of Variance	46.82	58.80	68.10	73.43	

Table 4.3.3.3. Item correlation matrix, descriptive statistics, and discriminant validity tests for ERP Implementation (large scale)

	D31IN1	D31IN2	D31IN3	D31IN4	D32CF3	D32CF4	D32CF5	D33AD1	D33AD2	D33AD3	D33AD4	D34UT1	D34UT2	D34UT3	D34UT4
D31IN1	1.000														
D31IN2	0.809	1.000													
D31IN3	0.578	0.632	1.000												
D31IN4	0.670	0.677	0.659	1.000											
D32CF3	0.445	0.473	0.326	0.515	1.000										
D32CF4	0.392	0.305	0.246	0.382	0.470	1.000									
D32CF5	0.496	0.438	0.330	0.447	0.481	0.718	1.000								
D33AD1	0.476	0.460	0.304	0.469	0.454	0.485	0.541	1.000							
D33AD2	0.412	0.417	0.314	0.411	0.416	0.400	0.445	0.823	1.000						
D33AD3	0.421	0.397	0.234	0.387	0.374	0.422	0.538	0.686	0.693	1.000					
D33AD4	0.357	0.374	0.212	0.338	0.330	0.352	0.451	0.681	0.641	0.874	1.000				
D34UT1	0.350	0.389	0.297	0.280	0.254	0.223	0.290	0.399	0.447	0.434	0.424	1.000			
D34UT2	0.382	0.397	0.296	0.313	0.263	0.207	0.322	0.431	0.455	0.453	0.419	0.814	1.000		
D34UT3	0.385	0.433	0.329	0.283	0.313	0.184	0.296	0.334	0.401	0.358	0.319	0.710	0.706	1.000	
D34UT4	0.326	0.383	0.292	0.245	0.253	0.122	0.238	0.370	0.402	0.331	0.328	0.653	0.640	0.756	1.000
	D31IN1	D31IN2	D31IN3	D31IN4	D32CF3	D32CF4	D32CF5	D33AD1	D33AD2	D33AD3	D33AD4	D34UT1	D34UT2	D34UT3	D34UT4
Mean	3.91	3.82	3.41	3.65	3.66	3.77	3.63	3.42	3.20	3.26	3.18	3.26	3.10	2.99	2.68
S.D.	1.00	.97	1.04	1.01	0.95	1.04	1.03	1.16	1.17	1.26	1.21	1.09	1.07	1.12	1.12
# of Violations	0	0	0	0	2	1	3	0	0	0	0	0	0	0	0

Note: None of the count of violations for each item exceeds half of the potential comparisons. Total # of violations = 6

4.3.4. Supplier capabilities instrument

The assessment of this instrument with five sub-constructs and 12 items begins with purification. The CITC level was generally high; the lowest CITC was 0.65 for D41IC1. Cronbach‘s alpha ranged from 0.87 to 0.94. The CITCs for each item are shown in Table 4.3.4.1.

Exploratory factor analysis was conducted using principal components as the means of extraction and a direct oblimin as a method of rotation. Without specifying the number of factors, there were two factors with eigenvalues greater than 1. However, since the research expected three subconstructs, the forced method was used to get three subconstructs.

One item from the ―Process improvement” sub-construct (D42PI1) had low factor loadings (below 0.48) as well as significant cross-loadings (as high as 0.42). Examining the wording of the item revealed that certain phrases in this item (e.g., ―… new product development cycle times") caused them to be interpreted quite close to the ―Product innovation" sub-construct. The item was thus eliminated in the subsequent analysis. The exploratory factor analysis of items for the remaining five sub-constructs and 12 items is shown in Table 4.3.4.2. AMOS was used to further purify the items and test the unidimensionality of each sub-construct of the supplier capabilities variable. All the factors had only three or four items respectively. A model run with either one of these factors would not have yielded model fit statistics. To address this problem the three factors were tested simultaneously as a three-factor model. The model had good model fit and no modification could be done. All indices of goodness-of-fit for the confirmatory factor analysis were presented in Table 4.3.1.4 (Refer to the indices of the first order model). Reliability was reexamined for ―Information access", ―Process improvement", and ―Product innovation". Cronbach‘s alphas for these three sub-constructs were calculated as 0.87, 0.88, and 0.94, respectively.

A correlation matrix (Table 4.3.4.3) of the 12 items was examined for evidence of convergent and discriminant validity. The smallest within sub-construct correlations were: Information access = .519, process improvement = 0.506, and product innovation = 0.746. All of them were significantly different from zero at $p<0.01$. An examination of the correlation matrix to assess discriminant validity resulted in only three violations out of 80 total comparisons, indicating a high level of discriminant validity.

Finally, a T coefficient was used to validate the high-order construct (SCAP). The fit indices of both first-order and second-order models for the supplier capabilities (SCAP) and the resulting T coefficient are listed in Table 4.3.1.4. It is shown that all indices of goodness-of-fit for the second-order model are a little worse than those of the first-order model, but the difference is not significant. It can be seen that both first and second modes have identical indexes (GFI= 0.94, IFI=0.98, NNFI=0.97, CFI=0.98, SRMR = 0.0359, and RMSEA= 0.067), indicating satisfactory model fits. The T coefficient is 100.00%, which indicated the existence of a higher order SCAP construct, since about one hundred percent of the variation in the three first–order factors is explained by the SCAP construct.

Overall, 11 items and three scales were proposed for the supplier capabilities construct (Appendix F).

Table 4.3.4.1. Purification for Supplier Capabilities (large scale)

Coding	Items	CITC
	Information Access: **alpha = .87**	
D41IC1	**Our suppliers are able to retrieve information on their suppliers, customers and competitors.**	**.65**
D41IC2	**Our suppliers are able to access in-house databases on products they need.**	**.68**
D41IC3	**Our suppliers are able to gather and process data for our product preferences quickly.**	**.80**
D41IC4	**Our suppliers are able to gather and process data for fundamental shifts in the purchasing environment quickly.**	**.77**
	Process Improvement: **alpha = .88**	
D42PI1	**Our suppliers are able to reduce new product development cycle times.**	**.69**
D42PI2	**Our suppliers are able to reduce delays in the distribution process.**	**.79**
D42PI3	**Our suppliers are able to reduce paperwork.**	**.69**
D42PI4	**Our suppliers are able to reduce wasted time and costs in all internal processes.**	**.81**
	Product Innovation: **alpha = .94**	
D43PN1	**Our suppliers are able to develop products with unique features.**	**.81**
D43PN2	**Our suppliers are able to improve product quality.**	**.87**
D43PN3	**Our suppliers are able to develop products with better performance.**	**.91**
D43PN4	**Our suppliers are able to develop new products and features.**	**.89**

Note: Items in bold were retained for further analysis.

Table 4.3.4.2. Exploratory factor analysis for retained Supplier Capabilities items (large scale)

ITEM	F1-Information Access	F2-Process Improvement	F3-Product Innovation	Alpha (α)
D41IC1	.72			α = .87
D41IC2	.94			
D41IC3	.82			
D41IC4	.82			
D42PI2		-.70		α = .88
D42PI3		-.93		
D42PI4		-.82		
D43PN1			.87	α = .94
D43PN2			.88	
D43PN3			.90	
D43PN4			.96	
Eigenvalue	7.00	1.59	.87	
% of Variance	58.32	13.24	7.27	
Cumulative % of Variance	58.32	71.56	78.84	

Table 4.3.4.3. Item correlation matrix, descriptive statistics, and discriminant validity tests for Supplier Capabilities (large scale)

	D41IC1	D41IC2	D41IC3	D41IC4	D42PI2	D42PI3	D42PI4	D43PN1	D43PN2	D43PN3	D43PN4
D41IC1	1.000										
D41IC2	0.519	1.000									
D41IC3	0.631	0.629	1.000								
D41IC4	0.570	0.619	0.785	1.000							
D42PI2	0.450	0.452	0.571	0.556	1.000						
D42PI3	0.367	0.365	0.460	0.510	0.622	1.000					
D42PI4	0.436	0.331	0.486	0.451	0.739	0.681	1.000				
D43PN1	0.423	0.319	0.471	0.393	0.555	0.393	0.565	1.000			
D43PN2	0.396	0.385	0.475	0.402	0.599	0.450	0.636	0.746	1.000		
D43PN3	0.366	0.346	0.483	0.434	0.604	0.511	0.605	0.763	0.864	1.000	
D43PN4	0.374	0.271	0.435	0.336	0.583	0.433	0.557	0.770	0.820	0.874	1.000
	D41IC1	D41IC2	D41IC3	D41IC4	D42PI2	D42PI3	D42PI4	D43PN1	D43PN2	D43PN3	D43PN4
Mean	3.07	3.38	3.16	3.29	3..29	3.35	3.32	2.99	3.18	3.09	2.97
S.D.	1.03	1.12	1.07	1.03	1.09	1.09	1.00	0.97	.96	0.97	0.98
# of Violations	0	0	1	1	0	0	1	0	0	0	0

Note: None of the count of violations for each item exceeds half of the potential comparisons. Total # of violations = 3

4.3.5. Organizational capabilities instrument

The assessment of this instrument with five sub-constructs and 26 items begins with purification. The CITC level was generally high; the lowest CITC was 0.63 for D52IC1. Cronbach's alpha ranged from 0.86 to 0.96. The CITCs for each item are shown in Table 4.3.5.1.

Exploratory factor analysis was conducted using principal components as the means of extraction and a direct oblimin as a method of rotation. Without specifying the number of factors, there were five factors with eigenvalues greater than 1. However, since the research expected six subconstructs, the forced method was used to get six subconstructs. In the process of eliminating items that are not factorially pure, 4 items were deleted.

First, one item from the ―Process improvement" sub-construct (D53PI1) had low factor loading (below 0.40) as well as multiple cross-loading (0.56) on the ―Product innovation" factor. Close examination of the wording of this item, along with the pattern of cross-loading, revealed that the item was not clearly distinguished from the ―Product innovation" sub-construct. Thus the item was eliminated from the subsequent analysis. Second, one item from ―Flexibility" sub-construct (D55FL1) had had low factor loading (below 0.40) as well as multiple cross-loading (0.55) on the ―Product innovation" factor. Close examination of the wording of this item, along with the pattern of cross-loading, revealed that the item was not clearly distinguished from the ―Product Innovation" sub-construct. Thus the item was eliminated from subsequent analysis. Third, one item from the ―Flexibility" sub-construct (D55FL3) had low factor loading (0.56). Looking into the wording of this item showed that the wording was less specific than the other items in describing flexibility. The item was thus deleted from further analysis.

Finally, one item from the ―Agility” sub-construct (D56AG1) had low factor loading (0.58). Looking into the wording of this item showed that the wording was less specific than the other items in describing agility. The item was thus deleted from further analysis. The exploratory factor analysis of items for the remaining six sub-constructs and 26 items is shown in Table 4.3.5.2. AMOS was used to further purify the items and test the unidimensionality of each sub-construct of the organizational capabilities variable. All the factors had only three or four items respectively. A model run with either one of these factors would not have yielded model fit statistics. To address this problem the six factors were tested simultaneously as a six-factor model. The model had good model fit and no modification could be done. All indices of goodness-of-fit for the confirmatory factor analysis were presented in Table 4.3.1.4 (Refer to the indices of the first order model). Reliability was reexamined for ―Cross-functional coordination,” ―Information access”, ―Process improvement”, “Product innovation”, ―Flexibility”, and ―Agility”. Cronbach‘s alphas for these six sub-constructs were calculated as 0.86, 0.86, 0.86, 0.96, 0.89, and 0.84, respectively.

A correlation matrix (Table 4.3.5.3) of the 26 items was examined for evidence of convergent and discriminant validity. The smallest within sub-construct correlations were: cross-functional coordination= .587, Information access = 0.525, process improvement = 0.588, product innovation = 0.828, flexibility = 0.567, and agility = 0.591. All of them were significantly different from zero at $p<0.01$. An examination of the correlation matrix to assess discriminant validity resulted in five violations out of 402 total comparisons, indicating a high level of discriminant validity.

Finally, a T coefficient was used to validate the high-order construct (OCAP). The fit indices of both first-order and second-order models for the organizational capabilities (OCAP) and the resulting T coefficient are listed in Table 4.3.1.4. It is shown that all indices of goodness-of-fit for the second-order model are a little worse than those of the first-order model, but the difference is not significant. GFI= 0.87, IFI=0.95, NNFI=0.94, CFI=0.95, SRMR = 0.0587, and RMSEA= 0.064 for the first –order model and GFI= 0.85, IFI=0.94, NNFI=0.93, CFI=0.94, SRMR = 0.0719, and RMSEA= 0.068 for the second order model respectively. The T coefficient is 90.47%, which indicated the existence of a higher order OCAP construct, since about ninety percent of the variation in the six first–order factors is explained by the OCAP construct.

Overall, 22 items and six scales were proposed for the organizational capabilities construct (Appendix F).

Table 4.3.5.1. Purification for Organizational Capabilities (large scale)

Coding	Items	CITC
	Cross-functional Coordination: **alpha = .86**	
D51CF1	**We are able to work together across functions in our organizations.**	**.70**
D51CF2	**We are able to share resources, ideas, and information between functions in our organizations.**	**.72**
D51CF3	**We are able to informally work together as a team within our organizations.**	**.72**
D51CF4	**We are able to achieve goals collectively within our organizations.**	**.72**
	Information Access: **alpha = .86**	
D52IC1	**We are able to retrieve information on suppliers, customers and competitors.**	**.63**
D52IC2	**We are able to access in-house databases on product/ we need.**	**.69**
D52IC3	**We are able to gather and process data for customers' product preferences quickly.**	**.74**
D52IC4	**We are able to gather and process data for fundamental shifts in the purchasing environment quickly.**	**.75**
	Process Improvement: **alpha = .88**	
D53PI1	**We are able to reduce new product development cycle times.**	**.66**
D53PI2	**We are able to reduce delays in the distribution process.**	**.77**
D53PI3	**We are able to reduce paperwork.**	**.68**
D53PI4	**We are able to reduce wasted time and costs in all internal processes.**	**.83**
	Product Innovation: **alpha = .96**	
D54PN1	**We are able to develop products with unique features.**	**.88**
D54PN2	**We are able to improve product quality.**	**.89**
D54PN3	**We are able to develop products with better performance.**	**.91**
D54PN4	**We are able to develop new products and features.**	**.90**
	Flexibility: **alpha = .90**	
D55FL1	**We are able to make product changes in design to meet market needs.**	**.67**
D55FL2	**We are able to make product mix changes to meet market needs.**	**.80**
D55FL3	**We are able to make product volume changes to meet market needs.**	**.68**
D55FL4	**We are able to make product changes in design without excessive costs.**	**.73**
D55FL5	**We are able to make product mix changes without excessive costs.**	**.78**
D55FL6	**We are able to make product volume changes without excessive costs.**	**.74**
	Agility: **alpha = .87**	
D56AG1	**We are able to rapidly respond to emerging environmental opportunities (e.g., new regulations, globalization).**	**.70**
D56AG2	**We are able to rapidly respond to natural threats (e.g., natural disaster).**	**.66**

Coding	Items	CITC
D56AG3	**We are able to rapidly respond to competitive threats (e.g., competitor's price change and new market campaign).**	**.77**
D56AG4	**We are able to rapidly respond to operational threats (e.g., supply chain disruption).**	**.78**

Note: Items in bold were retained for further analysis.

Table 4.3.5.2. Exploratory factor analysis for retained Organizational Capabilities (large scale)

ITEM	F1-Cross-functional Coordination	F2-Information Access	F3-Process Improvement	F4-Product Innovation	F5-Flexibility	F6-Agility	Alpha (α)
D51CF1	.81						α = .86
D51CF2	.70						
D51CF3	.90						
D51CF4	.68						
D52IC1		.77					α = .86
D52IC2		.86					
D52IC3		.70					
D52IC4		.71					
D53PI2			-.74				α = .86
D53PI3			-.86				
D53PI4			-.84				
D54PN1				.83			α = .96
D54PN2				.81			
D54PN3				.90			
D54PN4				.92			
D55FL2					-.60		α = .89
D55FL4					-.73		
D55FL5					-.92		
D55FL6					-.91		
D56AG2						-.76	α = .84
D56AG3						-.76	
D56AG4						-.75	
Eigenvalue	9.72	2.41	1.55	1.39	1.21	.92	
% of Variance	44.17	10.96	7.03	6.33	5.50	4.18	
Cumulative % of Variance	44.17	55.13	62.16	68.49	73.98	78.16	

Table 4.3.5.3. Item correlation matrix, descriptive statistics, and discriminant validity tests for Organizational Capabilities (large scale)

	D51CF1	D51CF2	D51CF3	D51CF4	D52IC1	D52IC2	D52IC3	D52IC4	D53PI2	D53PI3	D53PI4	D54PN1	D54PN2	D54PN3	D54PN4	D55FL2	D55FL4	D55FL5	D55FL6	D56AG2	D56AG3	D56AG4
D51CF1	1.000																					
D51CF2	0.596	1.000																				
D51CF3	0.608	0.623	1.000																			
D51CF4	0.587	0.641	0.627	1.000																		
D52IC1	0.356	0.389	0.300	0.415	1.000																	
D52IC2	0.361	0.416	0.210	0.339	0.567	1.000																
D52IC3	0.401	0.538	0.402	0.468	0.525	0.619	1.000															
D52IC4	0.445	0.524	0.391	0.489	0.560	0.601	0.749	1.000														
D53PI2	0.458	0.466	0.333	0.493	0.349	0.447	0.541	0.562	1.000													
D53PI3	0.387	0.351	0.398	0.398	0.302	0.382	0.461	0.413	0.588	1.000												
D53PI4	0.465	0.438	0.408	0.492	0.343	0.392	0.448	0.471	0.772	0.693	1.000											
D54PN1	0.381	0.481	0.444	0.448	0.392	0.349	0.441	0.474	0.555	0.429	0.569	1.000										
D54PN2	0.366	0.434	0.434	0.451	0.378	0.351	0.414	0.441	0.545	0.411	0.559	0.828	1.000									
D54PN3	0.311	0.431	0.390	0.398	0.315	0.323	0.401	0.432	0.493	0.328	0.496	0.833	0.876	1.000								
D54PN4	0.348	0.406	0.431	0.383	0.289	0.293	0.363	0.405	0.487	0.352	0.504	0.861	0.835	0.860	1.000							
D55FL2	0.336	0.273	0.344	0.351	0.143	0.156	0.328	0.283	0.377	0.295	0.322	0.527	0.575	0.580	0.560	1.000						
D55FL4	0.117	0.291	0.180	0.290	0.218	0.180	0.332	0.287	0.326	0.128	0.288	0.382	0.473	0.500	0.409	0.567	1.000					
D55FL5	0.200	0.246	0.238	0.334	0.155	0.177	0.354	0.346	0.409	0.267	0.373	0.353	0.451	0.405	0.358	0.622	0.712	1.000				
D55FL6	0.188	0.234	0.201	0.326	0.152	0.158	0.335	0.340	0.388	0.214	0.323	0.354	0.445	0.427	0.365	0.591	0.656	0.856	1.000			
D56AG2	0.301	0.382	0.378	0.424	0.308	0.114	0.290	0.261	0.343	0.170	0.329	0.492	0.451	0.500	0.464	0.426	0.491	0.322	0.295	1.000		
D56AG3	0.373	0.475	0.447	0.472	0.433	0.262	0.438	0.461	0.409	0.282	0.420	0.528	0.537	0.489	0.531	0.303	0.397	0.321	0.320	0.591	1.000	
D56AG4	0.349	0.449	0.350	0.529	0.321	0.263	0.468	0.463	0.447	0.316	0.420	0.552	0.513	0.503	0.483	0.422	0.471	0.447	0.416	0.607	0.718	1.000
	D51CF	D51CF	D51CF	D51CF	D52IC	D52IC	D52IC	D52IC	D53PI	D53PI	D53PI	D54PN	D54PN	D54PN	D54PN	D55FL	D55FL	D55FL	D55FL	D56AG	D56AG	D56AG
Mean	3.74	3.41	3.35	3.46	2.85	3.53	3.22	3.19	3.36	3.55	3.40	2.87	3.19	3.07	2.94	3.15	2.61	2.78	2.89	2.66	3.04	2.98
S.D.	0.85	1.05	1.06	1.01	1.17	1.00	1.02	0.98	1.04	1.05	1.02	1.04	1.06	1.03	1.04	1.08	1.02	1.07	1.12	1.06	1.06	1.08
# of	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0

Note: None of the count of violations for each item exceeds half of the potential comparisons.
Total # of violations = 5

4.3.6. Supplier performance instrument

The assessment of this instrument with five sub-constructs and 19 items begins with purification. The CITC level was generally high; the lowest CITC was 0.675 for D64CP4. Cronbach‘s alpha ranged from 0.89 to 0.95. The CITCs for each item are shown in Table 4.3.6.1.

Exploratory factor analysis was conducted using principal components as the means of extraction and a direct oblimin as a method of rotation. Without specifying the number of factors, there were four factors with eigenvalues greater than 1. However, since the research expected five subconstructs, the forced method was used to get five subconstructs. In the process of eliminating items that are not factorially pure, 1 item was deleted. One item from the “Cost performance” sub-construct (D64CP4) had low factor loading (0.58). Looking into the wording of this item showed that the wording was less related than the other items to cost performance. The item was thus deleted from further analysis. The exploratory factor analysis of items for the remaining five sub-constructs and 18 items is shown in Table 4.3.6.2. AMOS was used to further purify the items and test the unidimensionality of each sub-construct of the supplier performance variable. All the factors had only three or four items respectively. A model run with either of these factors would not have yielded model fit statistics. To address this problem the five factors were tested simultaneously as a five-factor model. The model had good model fit and no modification could be done. All indices of goodness-of-fit for the confirmatory factor analysis were presented in Table 4.3.1.4 (Refer to the indices of the first order model). Reliability was reexamined for “Short lead time”, “Product variety”, “Delivery reliability”, “Cost performance”, and “Quality”. Cronbach‘s alphas for these five sub-constructs were calculated as 0.93, 0.94, 0.94, 0.89, and 0.95 respectively.

A correlation matrix (Table 4.3.6.3) of the 18 items was examined for evidence of convergent and discriminant validity. The smallest within sub-construct correlations were: short lead time= .713, product variety = 0.806, delivery reliability = 0.735, cost performance = 0.690, and quality = 756. All of them were significantly different from zero at p<0.01. An examination of the correlation matrix to assess discriminant validity resulted in only one violation out of 258 total comparisons, indicating a high level of discriminant validity.

Finally, a T coefficient was used to validate the high-order construct (SPERF). The fit indices of both first-order and second-order models for the supplier performance (SPERF) and the resulting T coefficient are listed in Table 4.3.1.4. It is shown that all indices of goodness-of-fit for the second-order model are a little worse than those of the first-order model, but the difference is not significant. GFI= 0.88, IFI=0.97, NNFI=0.96, CFI=0.97, SRMR = 0.0545, and RMSEA= 0.069 for the first –order model and GFI= 0.88, IFI=0.97, NNFI=0.96, CFI=0.97, SRMR = 0.0583, and RMSEA= 0.069 for the second order model respectively. The T coefficient is 96.27%, which indicated the existence of a higher order SPERF construct, since about ninety six percent of the variation in the five first–order factors is explained by the SPERF construct. Overall, 18 items and five scales were proposed for the supplier performance construct (Appendix F).

Table 4.3.6.1. Purification for Supplier Performance (large scale)

Coding	Items	CITC
	Short Lead Time: **alpha = .93**	
D61SL1	**Our suppliers deliver products within a shorter time.**	**.79**
D61SL2	**Our suppliers improve the speed of service through eliminating waste and non-value added activities.**	**.85**
D61SL3	**Our suppliers have shorter throughput time.**	**.83**
D61SL4	**Our suppliers minimize the time from order placement to the delivery of procured items.**	**.86**
	Product Variety: **alpha = .94**	
D62PV1	**Our suppliers provide new products with additional features anytime.**	**.91**
D62PV2	**Our suppliers provide new products with improved performance anytime.**	**.91**
D62PV3	**Our suppliers have a wide products offering.**	**.82**
	Delivery Reliability: **alpha = .94**	
D63DR1	**Our suppliers fulfill our orders on time.**	**.81**
D63DR2	**Our suppliers provide dependable delivery.**	**.85**
D63DR3	**Our suppliers fulfill our order quantity.**	**.87**
D63DR4	**Our suppliers fulfill our orders accurately.**	**.88**
	Cost Performance: **alpha = .89**	
D64CP1	**After introducing an ERP system, our suppliers have lower production unit costs.**	**.787**
D64CP2	**After introducing an ERP system, our suppliers have lower material costs.**	**.794**
D64CP3	**After introducing an ERP system, our suppliers have lower overhead cost.**	**.788**
D64CP4	**After introducing an ERP system, our suppliers have lower inventory level.**	**.675**
	Quality: **alpha = .95**	
D65QL1	**Our suppliers offer products that consistently conform to our specifications.**	**.83**
D65QL2	**Our suppliers offer products that are highly dependable.**	**.91**
D65QL3	**Our suppliers offer products that are durable.**	**.88**
D65QL4	**Our suppliers offer products that have lower defective rates.**	**.88**

Note: Items in bold were retained for further analysis.

Table 4.3.6.2. Exploratory factor analysis for retained Supplier Performance items (large scale)

ITEM	F1-Short Lead Time	F2-Product Variety	F3-Delivery Reliability	F4-Cost Performance	F5-Quality	Alpha (α)
D61SL1	.76					α = .93
D61SL2	.84					
D61SL3	.92					
D61SL4	.86					
D62PV1		.92				α = .94
D62PV2		.95				
D62PV3		.89				
D63DR1			.72			α = .94
D63DR2			.81			
D63DR3			.94			
D63DR4			.90			
D64CP1				.93		α = .89
D64CP2				.95		
D64CP3				.76		
D65QL1					.77	α = .95
D65QL2					.88	
D65QL3					.97	
D65QL4					.89	
Eigenvalue	11.45	1.48	1.24	1.20	0.80	
% of Variance	60.27	7.78	6.54	6.32	4.23	
Cumulative % of Variance	60.27	68.05	74.59	80.91	85.13	

Table 4.3.6.3. Item correlation matrix, descriptive statistics, and discriminant validity tests for Supplier Performance (large scale)

	D61SL1	D61SL2	D61SL3	D61SL4	D62PV1	D62PV2	D62PV3	D63DR1	D63DR2	D63DR3	D63DR4	D64CP1	D64CP2	D64CP3	D65QL1	D65QL2	D65QL3	D65QL4
D61SL1	1.000																	
D61SL2	0.748	1.000																
D61SL3	0.713	0.758	1.000															
D61SL4	0.718	0.809	0.806	1.000														
D62PV1	0.599	0.584	0.539	0.523	1.000													
D62PV2	0.581	0.547	0.503	0.487	0.923	1.000												
D62PV3	0.526	0.540	0.471	0.520	0.806	0.809	1.000											
D63DR1	0.649	0.666	0.636	0.724	0.575	0.537	0.497	1.000										
D63DR2	0.618	0.609	0.565	0.641	0.607	0.572	0.543	0.804	1.000									
D63DR3	0.553	0.592	0.548	0.605	0.531	0.478	0.477	0.735	0.775	1.000								
D63DR4	0.559	0.612	0.579	0.633	0.556	0.495	0.457	0.741	0.778	0.899	1.000							
D64CP1	0.507	0.547	0.497	0.512	0.530	0.506	0.487	0.535	0.480	0.473	0.502	1.000						
D64CP2	0.442	0.481	0.412	0.431	0.543	0.533	0.508	0.503	0.462	0.466	0.498	0.852	1.000					
D64CP3	0.513	0.551	0.529	0.567	0.505	0.503	0.484	0.535	0.540	0.463	0.501	0.695	0.690	1.000				
D65QL1	0.541	0.543	0.513	0.533	0.562	0.565	0.521	0.546	0.572	0.607	0.644	0.507	0.501	0.544	1.000			
D65QL2	0.514	0.541	0.473	0.529	0.563	0.558	0.537	0.512	0.570	0.596	0.612	0.546	0.542	0.529	0.838	1.000		
D65QL3	0.456	0.514	0.462	0.487	0.523	0.529	0.520	0.429	0.528	0.546	0.545	0.476	0.495	0.454	0.756	0.854	1.000	
D65QL4	0.477	0.555	0.484	0.519	0.524	0.562	0.533	0.496	0.515	0.565	0.584	0.540	0.560	0.479	0.761	0.831	0.868	1.000
	D61SL1	D61SL2	D61SL3	D61SL4	D62PV1	D62PV2	D62PV3	D63DR1	D63DR2	D63DR3	D63DR4	D64CP1	D64CP2	D64CP3	D65QL1	D65QL2	D65QL3	D65QL4
Mean	3.44	3.46	3.46	3.50	2.91	2.96	3.00	3.39	3.40	3.47	3.36	3.07	3.05	3.16	3.20	3.23	3.18	3.26
S.D.	1.05	1.04	1.04	1.03	0.91	0.94	0.96	1.00	0.94	0.98	1.01	0.90	0.91	0.96	0.83	0.85	0.85	0.85
# of	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: None of the count of violations for each item exceeds half of the potential comparisons. Total # of violations = 1

4.3.7. Organizational performance instrument

The assessment of this instrument with five sub-constructs and 19 items begins with purification. The CITC level was generally high; the lowest CITC was 0.71 for D71CP4. Cronbach‘s alpha ranged from 0.91 to 0.96. The CITCs for each item are shown in Table 4.3.7.1.

Exploratory factor analysis was conducted using principal components as the means of extraction and a direct oblimin as a method of rotation. Without specifying the number of factors, there were three factors with eigenvalues greater than 1. However, since the research expected five subconstructs, the forced method was used to get five subconstructs. The exploratory factor analysis of items for the remaining five sub-constructs and 19 items is shown in Table 4.3.7.2. AMOS was used to further purify the items and test the unidimensionality of each sub-construct of organizational performance variable. All the factors had only three or four items respectively. A model run with either one of these factors would not have yielded model fit statistics. To address this problem the five factors were tested simultaneously as a five-factor model. The model had good model fit and no modification could be done. All indices of goodness-of-fit for the confirmatory factor analysis were presented in Table 4.3.1.4 (Refer to the indices of the first order model). Reliability was reexamined for ―Cost performance”, ―Product variety”, ―Delivery reliability”, ―Time-to-market”, and ―Quality”. Cronbach‘s alphas for these five sub-constructs were calculated as 0.91, 0.95, 0.95, 0.94, and 0.96, respectively.

A correlation matrix (Table 4.3.7.3) of the 19 items was examined for evidence of convergent and discriminant validity. The smallest within sub-construct correlations were: cost performance = 0.604, product variety = 0.836, delivery reliability = 0.808, time-to-market = .756, and quality = .814. All of them were significantly different from zero at $p<0.01$. An examination of the correlation matrix to assess discriminant validity resulted in ten violations out of 288 total comparisons, indicating a high level of discriminant validity.

Finally, a T coefficient was used to validate the high-order construct (OPERF). The fit indices of both first-order and second-order models for the organizational performance (OPERF) and the resulting T coefficient are listed in Table 4.3.1.4. It is shown that all indices of goodness-of-fit for the second-order model are a little worse than those of the first-order model, but the difference is not significant. GFI= 0.88, IFI=0.97, NNFI=0.96, CFI=0.97, SRMR = 0.0356, and RMSEA= 0.076 for the first –order model and GFI= 0.87, IFI=0.96, NNFI=0.96, CFI=0.96, SRMR = 0.044, and RMSEA= 0.076 for the second order model respectively. The T coefficient is 95.43%, which indicated the existence of a higher order OPERF construct, since about ninety nine percent of the variation in the five first –order factors is explained by the OPERF construct.

Overall, 19 items and five scales were proposed for the organizational performance construct (Appendix F).

Table 4.3.7.1. Purification for Organizational Performance (large scale)

Coding	Items	CITC
	Cost Performance: **alpha = .91**	
D71CP1	**After introducing an ERP system, we have lower production unit costs.**	**.80**
D71CP2	**After introducing an ERP system, we have lower material costs.**	**.84**
D71CP3	**After introducing an ERP system, we have lower overhead cost.**	**.80**
D71CP4	**After introducing an ERP system, we have lower inventory level.**	**.71**
	Product Variety: **alpha = .95**	
D72PV1	**We provide new products with additional features in the market anytime.**	**.92**
D72PV2	**We provide new products with improved performance anytime.**	**.91**
D72PV3	**We have a wide products offering.**	**.86**
	Delivery Reliability: **alpha = .95**	
D73DR1	**We fulfill customers' orders on time.**	**.89**
D73DR2	**We provide dependable delivery.**	**.86**
D73DR3	**We fulfill customers' order quantity.**	**.90**
D73DR4	**We fulfill customers' orders accurately.**	**.90**
	Time-to-market: **alpha = .94**	
D74TM1	**We are quick in delivering our product to market.**	**.83**
D74TM2	**We are usually first in the market to introduce new products.**	**.87**
D74TM3	**We are usually first in the market to make improvements to existing products.**	**.87**
D74TM4	**We have time-to-market that is lower than our industry average.**	**.85**
	Quality: **alpha = .96**	
D75QL1	**We offer products that consistently conform to our specifications.**	**.88**
D75QL2	**We offer products that are highly dependable.**	**.90**
D75QL3	**We offer products that are durable.**	**.90**
D75QL4	**We offer products that have lower defective rates.**	**.89**

Note: Items in bold were retained for further analysis.

Table 4.3.7.2. Exploratory factor analysis for retained Organizational Performance items (large scale)

ITEM	F1-Short Lead Time	F2-Product Variety	F3-Delivery Reliability	F4-Cost Performance	F5-Quality	Alpha (α)
D71CP1	.82					α = .91
D71CP2	.90					
D71CP3	.79					
D71CP4	.66					
D72PV1		-.83				α = .95
D72PV2		-.89				
D72PV3		-.77				
D73DR1			.80			α = .95
D73DR2			.73			
D73DR3			.92			
D73DR4			.87			
D74TM1				.60		α = .94
D74TM2				.77		
D74TM3				.83		
D74TM4				.79		
D75QL1					.75	α = .96
D75QL2					.70	
D75QL3					.82	
D75QL4					.79	
Eigenvalue	12.80	1.38	1.03	0.66	0.60	
% of Variance	67.37	7.26	5.40	3.47	3.17	
Cumulative % of Variance	67.37	74.63	80.03	83.50	86.67	

Table 4.3.7.3. Item correlation matrix, descriptive statistics, and discriminant validity tests for Organizational Performance (large scale)

	D71CP1	D71CP2	D71CP3	D71CP4	D72PV1	D72PV2	D72PV3	D73DR1	D73DR2	D73DR3	D73DR4	D74TM1	D74TM2	D74TM3	D74TM4	D75QL1	D75QL2	D75QL3	D75QL4
D71CP1	1.000																		
D71CP2	0.823	1.000																	
D71CP3	0.718	0.738	1.000																
D71CP4	0.604	0.670	0.690	1.000															
D72PV1	0.599	0.594	0.546	0.520	1.000														
D72PV2	0.565	0.589	0.557	0.510	0.921	1.000													
D72PV3	0.611	0.611	0.562	0.541	0.840	0.836	1.000												
D73DR1	0.636	0.594	0.639	0.677	0.530	0.554	0.577	1.000											
D73DR2	0.587	0.570	0.602	0.634	0.545	0.562	0.570	0.834	1.000										
D73DR3	0.549	0.473	0.540	0.611	0.476	0.519	0.550	0.840	0.808	1.000									
D73DR4	0.530	0.506	0.579	0.694	0.505	0.520	0.543	0.841	0.813	0.890	1.000								
D74TM1	0.574	0.635	0.568	0.567	0.696	0.674	0.677	0.679	0.614	0.593	0.647	1.000							
D74TM2	0.564	0.598	0.535	0.579	0.725	0.717	0.702	0.558	0.573	0.553	0.566	0.795	1.000						
D74TM3	0.526	0.551	0.548	0.590	0.732	0.735	0.669	0.565	0.563	0.537	0.584	0.756	0.830	1.000					
D74TM4	0.577	0.588	0.524	0.592	0.677	0.661	0.638	0.599	0.562	0.563	0.622	0.766	0.783	0.825	1.000				
D75QL1	0.604	0.528	0.502	0.522	0.729	0.666	0.684	0.591	0.598	0.578	0.604	0.739	0.683	0.644	0.689	1.000			
D75QL2	0.603	0.593	0.562	0.577	0.724	0.712	0.703	0.618	0.652	0.588	0.619	0.744	0.710	0.656	0.663	0.863	1.000		
D75QL3	0.576	0.550	0.498	0.527	0.729	0.689	0.729	0.511	0.587	0.533	0.555	0.697	0.675	0.689	0.681	0.819	0.842	1.000	
D75QL4	0.585	0.590	0.543	0.578	0.694	0.668	0.693	0.587	0.612	0.601	0.606	0.706	0.656	0.647	0.660	0.814	0.834	0.868	1.000
	D71CP1	D71CP2	D71CP3	D71CP4	D72PV1	D72PV2	D72PV3	D73DR1	D73DR2	D73DR3	D73DR4	D74TM1	D74TM2	D74TM3	D74TM4	D75QL1	D75QL2	D75QL3	D75QL4
Mean	3.14	3.06	3.16	3.55	2.93	2.99	3.01	3.64	3.57	3.67	3.69	3.25	3.04	3.08	3.14	3.28	3.26	3.25	3.26
S.D.	0.95	0.99	0.96	1.01	0.86	0.93	0.97	0.95	0.94	0.94	0.97	0.93	0.92	0.90	0.97	0.90	0.88	0.88	0.92
# of Violations	3	2	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: None of the count of violations for each item exceeds half of the potential comparisons. Total # of violations = 10

4.3.8. Customer value instrument

The assessment of this instrument with four sub-constructs and 14 items begins with purification. The CITC level was generally high; the lowest CITC was 0.73 for D81VM3 and D82CN3. Cronbach‘s alpha ranged from 0.87 to 0.96. The CITCs for each item are shown in Table 4.3.8.1.

Exploratory factor analysis was conducted using principal components as the means of extraction and a direct oblimin as a method of rotation. Without specifying the number of factors, there were three factors with eigenvalues greater than 1. However, since the research expected four subconstructs, the forced method was used to get four subconstructs. In the process of eliminating items that are not factorially pure, one item was deleted. One item from the “Convenience” sub-construct (D82CN3) had low factor loadings (0.44) as well as cross-loadings (0.45) on the “Timely response” sub-construct. Close examination of the wording of these items, along with the pattern of cross-loading, revealed that the items were not clearly distinguished from the “Timely response” sub-construct. Thus the item was eliminated from subsequent analysis. The exploratory factor analysis of items for the remaining four sub-constructs and 13 items is shown in Table 4.3.8.2. AMOS was used to further purify the items and test the unidimensionality of each sub-construct of customer value variable. All the factors had only two, three or four items respectively. A model run with either one of these factors would not have yielded model fit statistics. To address this problem the four factors were tested simultaneously as a four-factor model. The model had good model fit and no modification could be done. All indices of goodness-of-fit for the confirmatory factor analysis were presented in Table 4.3.1.4 (Refer to the indices of the first order model). Reliability was reexamined for “Value for money”, “Convenience”, “Timely response”, and “Reputation for quality”. Cronbach‘s alphas for these four sub-constructs were calculated as 0.87, 0.88, 0.93, and 0.96, respectively. A correlation matrix (Table 4.3.8.3) of the 13 items was examined for evidence of convergent and discriminant validity. The smallest within sub-construct correlations were: Value for money = 0.66, Convenience = 0.801, Timely response = 0.725, and Reputation for quality = .842. All of them were significantly different from zero at $p<0.01$. An examination of the correlation matrix to assess discriminant validity resulted in no violation out of 124 total comparisons, indicating a high level of discriminant validity.

Finally, a T coefficient was used to validate the high-order construct (CVALUE). The fit indices of both first-order and second-order models for the customer value (CVALUE) and the resulting T coefficient are listed in Table 4.3.1.4. It is shown that all indices of goodness-of-fit for the second-order model are a little worse than those of the first-order model, but the difference is not significant. GFI= 0.94, IFI=0.99, NNFI=0.99, CFI=0.99, SRMR = 0.0277, and RMSEA= 0.046 for the first–order model and GFI= 0.94, IFI=0.99, NNFI=0.99, CFI=0.99, SRMR = 0.0308, and RMSEA= 0.047 for the second order model respectively. The T coefficient is 96.06%, which indicated the existence of a higher order CVALUE construct, since about ninety six percent of the variation in the four first –order factors is explained by the CVALUE construct.

Overall, 13 items and four scales were proposed for the customer value construct (Appendix F).

Table 4.3.8.1. Purification for Customer Value (large scale)

Coding	Items	CITC
	Value for Money: **alpha = .87**	
D81VM1	**Our customers perceive that our products offer high value at a low price.**	**.76**
D81VM2	**Our customers perceive that our products prices are reasonable.**	**.75**
D81VM3	**Our customers perceive that our company reduces prices while providing high-value products.**	**.73**
	Convenience: **alpha = .89**	
D82CN1	**Our customers perceive that they easily receive information on the products they need.**	**.80**
D82CN2	**Our customers perceive that they easily purchase the products they need.**	**.82**
D82CN3	**Our customers perceive that our order fulfillment system is convenient.**	**.73**
	Timely Response: **alpha = .93**	
D83TR1	**Our customers perceive that they experience quick customer services such as order fulfillment and delivery.**	**.86**
D83TR2	**Our customers perceive that they receive the products they need in time.**	**.85**
D83TR3	**Our customers perceive that they receive the information they need when they need it.**	**.83**
D83TR4	**Our customers perceive that their complaints are rapidly handled.**	**.81**
	Reputation for Quality: **alpha = .96**	
D84RP1	**We have a reputation for better product quality than our competitors.**	**.89**
D84RP2	**We have a reputation for better product performance than our competitors.**	**.91**
D84RP3	**We have a reputation for products that durable than our competitors.**	**.92**
D84RP4	**We have a reputation for products with lower defect rates than our competitors.**	**.95**

Table 4.3.8.2. Exploratory factor analysis for retained Customer Value items (large scale)

ITEM	F1-Value for Money	F2-Convenience	F3-Timely Response	F5-Reputation for Quality	Alpha (α)
D81VM1	.87				α = .87
D81VM2	.91				
D81VM3	.74				
D82CN1		-.88			α = .88
D82CN2		-.92			
D83TR1			.89		α = .93
D83TR2			.96		
D83TR3			.75		
D83TR4			.82		
D84RP1				-.93	α = .96
D84RP2				-.94	
D84RP3				-.94	
D84RP4				-.91	
Eigenvalue	8.22	1.28	1.01	0.57	
% of Variance	63.19	9.87	7.78	4.35	
Cumulative % of Variance	63.19	73.06	80.84	85.19	

Table 4.3.8.3. Item correlation matrix, descriptive statistics, and discriminant validity tests for Customer Value (large scale)

	D81VM1	D81VM2	D81VM3	D82CN1	D82CN2	D83TR1	D83TR2	D83TR3	D83TR4	D84RP1	D84RP2	D84RP3	D84RP4
D81VM1	1.000												
D81VM2	0.710	1.000											
D81VM3	0.680	0.660	1.000										
D82CN1	0.592	0.570	0.602	1.000									
D82CN2	0.542	0.543	0.554	0.801	1.000								
D83TR1	0.552	0.462	0.532	0.621	0.668	1.000							
D83TR2	0.509	0.464	0.505	0.616	0.643	0.832	1.000						
D83TR3	0.555	0.545	0.541	0.684	0.645	0.765	0.777	1.000					
D83TR4	0.581	0.519	0.523	0.623	0.630	0.756	0.725	0.758	1.000				
D84RP1	0.493	0.443	0.557	0.555	0.550	0.577	0.524	0.611	0.561	1.000			
D84RP2	0.491	0.457	0.570	0.579	0.571	0.583	0.539	0.620	0.570	0.871	1.000		
D84RP3	0.473	0.464	0.549	0.547	0.574	0.587	0.532	0.633	0.590	0.842	0.887	1.000	
D84RP4	0.497	0.446	0.551	0.543	0.534	0.595	0.557	0.634	0.623	0.848	0.849	0.879	1.000
	D81VM1	D81VM2	D81VM3	D82CN1	D82CN2	D83TR1	D83TR2	D83TR3	D83TR4	D84RP1	D84RP2	D84RP3	D84RP4
Mean	3.35	3.40	3.44	3.36	3.41	3.49	3.52	3.46	3.42	3.65	3.61	3.57	3.59
S.D.	0.85	0.79	0.89	0.87	0.88	0.92	0.89	0.85	0.90	0.88	0.86	0.88	0.91
# of Violations	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: None of the count of violations for each item exceeds half of the potential comparisons. Total # of violations = 0

4.4. Summary of measurement analysis

Figure 4.4.1 illustrates a revised research framework as a result of having “Organizational structure” deleted as a sub-construct from the internal environment construct.

Table 4.4.1 contains the summary of measurement analysis carried out in this chapter. The final Cronbach‘s alpha value and the eigenvalue (rotation sums of squared loadings) for each of the scales are displayed. All scales have demonstrated a sufficient level of reliability (Cronbach‘s alphas on or above 0.73), and convergent / discriminant validity.

The items are worded in manufacturing specific terms, making it easy for operations/ IT managers to answer to each item. Each scale had three to six measurement items, except for the “technological change” and “Convenience” sub-constructs, which ended up as two items measure. Measurement items for each sub-construct are listed in Appendix F.

Figure 4.4.1. Revised research framework

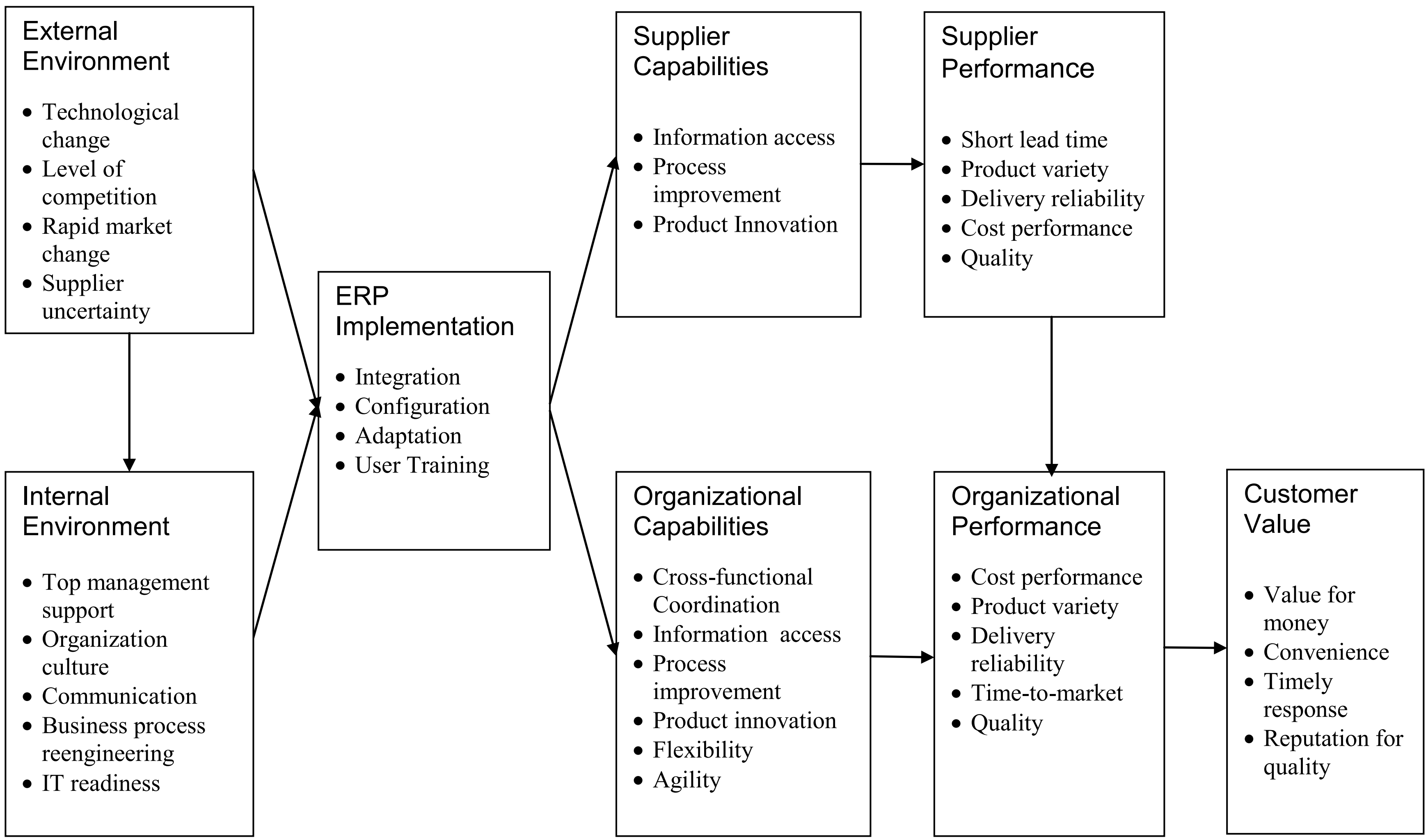


Table 4.4.1. Summary of measurement analysis

Constructs	Sub-Constructs	# of Items	Alpha
External Environment (EE)	Rapid Market Change (D13RM)	4	0.80
	Level of Competition (D12LC)	3	0.80
	Supplier Uncertainty (D14UC)	3	0.80
	Technological Change (D11TC)	2	0.73
Internal Environment (IE)	Top Management Support (D21TM)	5	0.90
	IT Readiness (D26IT)	4	0.93
	Organizational Culture (D22OC)	4	0.89
	Communication (D23CM)	4	0.85
	Business Process Reengineering (D25BP)	4	0.80
ERP Implementation (ERPI)	Integration (D31IN)	4	0.87
	User Training (D34UT)	4	0.91
	Adaptation (D33AD)	4	0.92
	Configuration (D32CF)	3	0.86
Supplier Capabilities (SCAP)	Product Innovation (D43PN)	4	0.94
	Information Access (D41IC)	4	0.87
	Process Improvement (D42PI)	3	0.88
Organizational Capabilities (OCAP)	Product Innovation (D54PN)	4	0.96
	Information Access (D52IC)	4	0.86
	Flexibility (D55FL)	4	0.89
	Agility (D56AG)	3	0.84
	Process Improvement (D53PI)	3	0.86
	Cross-functional Coordination (D51CF)	4	0.86
Supplier Performance (SPERF)	Short Lead Time (D61SL)	4	0.93
	Quality (D65QL)	4	0.95
	Cost Performance (D64CP)	3	0.89
	Product Variety (D62PV)	3	0.94
	Delivery Reliability (D63DR)	4	0.94
Organizational Performance (OPERF)	Quality (D75QL)	4	0.96
	Delivery Reliability (D73DR)	4	0.95
	Cost Performance (D71CP)	4	0.91

Constructs	Sub-Constructs	# of Items	Alpha
	Time to Market (D74TM)	4	0.94
	Product Variety (D72PV)	3	0.95
Customer Value (CVALUE)	Timely Response (D83TR)	4	0.93
	Reputation for Quality (D84RP)	4	0.96
	Value for Money (D81VM)	3	0.87
	Convenience (D82CN)	2	0.88

4.5. Construct-level correlation analysis

The preliminary statistical validity of the 9 hypotheses presented in chapter 2 was checked, using the Pearson correlation. For each construct, a composite score was computed by taking the average scores of all items. The results are presented in Table 4.5.1. All correlations are statistically significant at the .05 level, except the correlations between external environment and ERP implementation (H2). The correlation coefficient are 0.179 (External environment and Internal environment), 0.572 (Internal environment and ERP Implementation), 0.642 (ERP implementation and Supplier capabilities), 0.615 (ERP implementation and Organizational capabilities), 0.699 (Supplier capabilities and Supplier performance), 0.764 (Organizational capabilities and Organizational performance), 0.823 (Supplier performance and Organizational performance), and 0.733 (Organizational performance and Customer value). It is presumed that there are high correlations between the constructs except the relationship between External environment and ERP implementation. Causal relationships between the constructs will be examined using structural equation modeling in the following chapter.

Table 4.5.1. Construct-level correlation analysis results

Hypotheses	Independent Variable	Dependent Variable	Pearson Correlation
H1	External Environment (EE)	Internal Environment (IE)	0.179*
H2	External Environment (EE)	ERP Implementation (ERPI)	0.018
H3	Internal Environment (IE)	ERP Implementation (ERPI)	0.572**
H4	ERP Implementation (ERPI)	Supplier Capabilities (SCAP)	0.642**
H5	ERP Implementation (ERPI)	Organizational Capabilities (OCAP)	0.615**
H6	Supplier Capabilities (SCAP)	Supplier Performance (SPERF)	0.699**
H7	Organizational Capabilities (OCAP)	Organizational Performance (OPERF)	0.764**
H8	Supplier Performance (SPERF)	Organizational Performance (OPERF)	0.823**
H9	Organizational Performance (OPERF)	Customer Value(CVALUE)	0.733**

* Significant at 0.05 level, ** significant at 0.01 level (two tail test)

CHAPTER 5: CAUSAL MODEL AND HYPOTHESES TESTING

In this chapter, the nine proposed hypotheses from chapter 3 are tested with valid and reliable scales that measure some critical dimensions of external environment (EE), internal environment (IE), ERP implementation (ERPI), supplier capabilities (SCAP), organizational capabilities (OCAP), supplier performance (SPERF), organizational performance (OPERF), and customer value (CVALUE). A structural equation modeling (SEM) framework is used to explore the relationship among the constructs and to test the hypotheses.

5.1. The causal model

A structural equation model (SEM) is used to test and estimate the causal relationships amongst various constructs (Bollen, 1993). In general, the SEM is composed of two elements: (1) the measurement model and (2) the structural model. The measurement model in SEM is used to measure and assess the reliability and validity of latent variables, whereas the structural model is applied to investigate the complex interrelations among latent variables (Joreskog and Sorbom, 1989). Since the reliability and validity of each constructs were checked through rigorous analysis in chapter 4, the SEM analysis focuses on the structural model. To explore the relationships between external environment, internal environment, ERP implementation, supplier capabilities, organizational capabilities, supplier performance, organizational performance, and customer value, the SMART Partial Least Square (PLS) software was used. In SEM, it is better to use several indicators of a construct than a single indicator (Hair et al., 1995). In this research, composite measures were calculated to use as indicators for each construct. Composite measures are created by dividing the sum of individual scores of items in each sub-construct by the number of items. These composite measures are used as observable indicators of the exogenous latent construct (EE) and endogenous latent constructs (IE, ERPI, SCAP, OCAP, SPERF, OPERF, and CVALUE). Figure 5.1.1 illustrates the causal model with composite measures of the exogenous and endogenous latent variables.

5.2. Results of testing the causal model

Partial Least Squares Regression (PLS) provides a vigorous method for testing causal models with both observable and latent variables. It is capable of simultaneously evaluating both the measurement and causal components of complex models (Chin et al., 2003). In PLS analysis, T-value, beta coefficient, and R^2 of the causal relationships between exogenous and endogenous constructs are used as the SEM evaluation indicators to test the hypotheses stated in Chapter 2.

T-value indicates the significant level of a relationship in the proposed hypothesis (Rosnow, 2000; Chin et al., 2003). To generate t-statistics, a bootstrapping procedure is used. A T-value less than 1.6 indicates that the relationship between variables is not significant and that the significance level is below ninety five percent. At this level of T-value, the hypothesis cannot be supported. For a T value between 1.6 and 2.00, the relationship in the hypothesis is considered significant at ninety-five percent level. For a T –value more than 2.00, the hypothesis is significant at ninety-nine percent level (Chin et al., 2003).

Beta coefficient indicates the strength of the relationship and assesses the interaction of the path coefficient between two constructs (Chin, 1998). The cut-off value for the standardized beta coefficient is 0.20. The coefficient that is higher than this value is considered as indicating a meaningful relationship (Chin, 1998) between the constructs. Finally, R^2 examines the impact of independent variables on dependent variables (Chin, 1998). PLS algorithm procedure using path weighting scheme technique is used to calculate both the standardized coefficient (Beta coefficient) and R^2.

All 205 responses were utilized in carrying out the PLS analysis. The —Supplier uncertainty" sub-construct from the external environment was eliminated because it has a negative coefficient, compared to other sub-constructs. The standardized coefficients and t-values of the indicators are shown in Table 5.2.1. They are all above the minimum acceptable t-value of 1.6 (at $\alpha = 0.05$ for two-tailed t-test) except the relationship between external environment and ERP implementation.

Figure 5.2.1 and Table 5.2.2 display a summary of the data generated by PLS related to the testing of the relationships between constructs. Among the nine hypotheses proposed in Chapter 2, hypothesis 2 was not supported by the data. The result indicates that there are no direct causal relationships from external environment to ERP implementation. The nature of this relationship appears to be indirect; the relationship between external environment and ERP implementation is mediated through the internal environment (top management support, organizational culture, communication, business process reengineering, and IT readiness).

To further assess the various relationships between constructs, coefficients of direct, indirect and total effects were examined through PLS. The coefficient of indirect effect is computed by multiplying the coefficients of direct paths lying along the indirect path. If multiple indirect paths exist between two constructs, the sum of all possible coefficients of indirect path calculated represents the indirect effect between two constructs (Nahm, 2000). Total effects are calculated by adding coefficients of both direct and indirect effects. The results are presented in Table 5.2.3. All relationships turned out to be significant in total effects in five percent significant level, including the relationship between external environment and ERP implementation that has not been significant when only direct effects were considered. A detailed discussion of each testing result is shown in following sections.

5.2.1. Discussion of structural modeling and results of hypotheses

Hypothesis 1: A firm which operates in a highly uncertain, competitive, and rapidly changing environment will have a high level of adjustment and improvement in internal environments.

The hypothesis which shows that external environment has a positive relationship with internal environment was evidenced through a highly significant coefficient at =0.41, t=3.51. This result indicates that there is a strong direct relationship between external environment and internal environment. This finding is consistent with the findings of Gordon (1991) and Nahm et al. (2003) that organizations, in general, are affected by their environments. For example, decision makers' perception of the external environment impacts an organization's characteristics (Lawrence and Lorsch, 1967; Duncan, 1972). Also, departments facing a changing environment have more communication than those in stable environments. Further, a firm's attempts to be ready for accommodating unpredictable technological change optimize its organizational effectiveness. Thus, the empirical results of this survey demonstrate that a firm's external environment has positive impact on an organization's internal readiness for information technology adoption and implementation.

Hypothesis 2: The more a firm operates in a highly uncertain, competitive and rapidly changing environment, the higher the level of ERP implementation.

This relationship was found to be non-significant (Beta coefficient =0.05, t=0.51), which indicates that there is no direct positive relationship between external environment and ERP implementation. This contradicts the results of other researchers which show that environmental uncertainty has impacts on adoption of information technology (Grover and Goslar, 1993). This non-significant relationship may be explained by the following.

First, organizations may have implemented ERP systems, not because of the pressure from external environment but because of internal motivation to improve organizational performance. In their research, Premkumar and Ramamurthy (1995) state that a firm initiates to adopt an information system based on internal and external needs (Li, 2002).

Second, implementing an ERP system has become common practice for organizations apart from their environmental surroundings. That is, having an ERP system is not unique in today‘s business environment. There is also a possibility that the external environment measures may not be appropriate for information technology implementation.

To further examine the relationship between external environment and ERP implementation, the coefficients of both total and indirect effects are calculated. The coefficient of total effect between external environment and ERP Implementation is calculated by adding the coefficient of both direct and indirect paths between them. The coefficient of the direct path between external environment and ERP implementation is 0.041. The coefficient of indirect effect is calculated by multiplying the coefficient of direct effect between external environment and internal environment (0.405) to that between internal environment and ERP implementation (0.58), resulting in 0.23 (Table 5.2.3). Thus, the coefficient of the total effect is 0.27. This indicates that even though there may be no direct relationships between external environment and ERP implementation, there is a positive and significant indirect relationship between them, resulting in significant total effect in their relationship.

Hypothesis 3: The more a firm is internally ready for change in the turbulent external environment, the higher the level of ERP implementation.

The hypothesis which indicate that internal environment has a positive relationship with ERP implementation was evidenced through a highly significant coefficient at =0.58, t=9.18. This result indicates that there is a strong direct relationship between internal environment and ERP implementation. This finding is consistent with the findings of the research which indicate that internal environment leads to successful ERP implementation (Motwani et al., 2002; Zhang et al., 2002; Kwahk and Lee, 2008). Organizational readiness and proper change management in the uncertain external environment enable firms to successfully implement an ERP system. In this study, all of the sub-constructs, except organizational structure, were proved as critical factors for ERP implementation. The empirical results of this survey demonstrate that a firm‘s internal environment has positive impact on ERP implementation success.

Hypothesis 4: The higher the level of ERP implementation, the higher the level of supplier capabilities.

The hypothesis which shows that ERP implementation has a positive relationship with supplier capabilities was evidenced through a highly significant coefficient at =0.66, t=13.13. This result indicates that there is a strong direct relationship between ERP implementation and supplier capabilities. This finding is consistent with the findings of the research which show that successful ERP implementation of a buying firm enhances supplier‘s capabilities through improving information integration between buyers and suppliers. Sharing operational, tactical, and strategic information enables suppliers to improve forecasts, synchronize production and delivery, coordinate inventory-related decisions, and develop a shared understanding of performance bottlenecks (Lee and Whang, 2000; Simchi-Levi et al. 2000). Formal and informal information sharing enhance visibility and reduce uncertainty (Brennan and Turnbull, 1999; Handfield and Bechtel, 2002). Fast and real-time information enable suppliers to improve coordination of allocated resources, identify market opportunities, proactively develop more cost-effective products and services, accommodate consistently the buying firm‘s requests, and increase their response to an unpredictable and changing business environment. Thus, the empirical results of this survey demonstrate that fast and real-time information sharing through ERP implementation increase suppliers‘ capabilities.

Hypothesis 5: The higher the level of ERP Implementation, the higher the level of organizational capabilities.

The hypothesis which points out that ERP Implementation has a positive relationship with organizational capabilities was evidenced through a highly significant coefficient at =0.63, t=13.58. This result indicates that there is a strong direct relationship between ERP Implementation and organizational capabilities. This finding is consistent with the findings of the research which show that successful ERP implementation enhances integration and coordination between business units and increase productivity (Davenport, 2000; Hedman and Borell, 2002; Howcroft and Truex, 2002). The successfully implemented ERP system enables a firm to enhance the cross-functional coordination, to assemble flexibly requisite assets, knowledge, and business relationships, to sense opportunities for new competitive action in its marketplaces, to detect and respond environmental changes rapidly and flexibly, to have fast access to information for decision making and managerial control, and to improve the management and execution of the entire new product innovation process (Goldman et al., 1995; Sambamurthy et al., 2003; Duncan 1995). The empirical results of this survey demonstrate that successful ERP implementation enhances organizational capabilities including cross-functional coordination, information access, process improvement, product innovation, agility, and flexibility.

Hypothesis 6: The higher the level of supplier capabilities, the higher the level of supplier performance.

The hypothesis indicates that supplier capabilities have a positive relationship with supplier performance, which was evidenced through a highly significant coefficient at =0.71, t=16.88. This result indicates that there is a strong direct relationship between supplier capabilities and supplier performance.

This finding is consistent with the resource-based view of firm theory of Barney (1991) and Wernerfelt (1984), a view that indicates that a firm‘s unique resources and capabilities enhance organizational performance. A firm‘s increased capabilities enhance its performance. The capabilities developed through sharing fast and precise information with buyers which implement the ERP system enhance suppliers‘ performance (Thatte et al., 2008). Accordingly, information access, process improvement and product innovation capabilities contribute to suppliers‘ competitiveness and market success.

Hypothesis 7: The higher the level of organizational capabilities, the higher the level of organizational performance.

The hypothesis which shows that organizational capabilities have a positive relationship with organizational performance was evidenced through a highly significant coefficient at =0.33, t=3.52. This result indicates that there is a strong direct relationship between organizational capabilities and organizational performance. This finding is consistent with the resource-based view of firm theory of Barney (1991) and Wernerfelt (1984), a view that indicates that a firm‘s unique resources and capabilities enhance organizational performance. The developed capabilities contribute to performance outcomes because they typify dynamic routines to drive product and service differences (Teece et al., 1997; Sinkovics and Roath, 2004). Increased capabilities (cross-functional coordination, information access, process improvement, product innovation, agility, and flexibility) through higher levels of information sharing can lead a firm's competitiveness and market success (Thatte et al., 2008)

Hypothesis 8: The higher the level of supplier performance, the higher the level of organizational performance.

The hypothesis which indicates that supplier performance has a positive relationship with organizational performance was evidenced through a highly significant coefficient at =0.58, t=6.45. This result indicates that there is a strong direct relationship between supplier performance and organizational performance. This finding is consistent with the findings of Shin et al. (2000), Thatte et al. (2008), and Li at al. (2007) that supplier performance is considered one of the determining factors for the company‘s operational success. It was proven that better supplier performance in lead time, quality, delivery and cost performance improves a company‘s overall quality, reduced costs, delivery, and product variety.

Hypothesis 9: The higher the level of organizational performance, the higher the level of the customer value.

The hypothesis which shows that organizational performance has a positive relationship with customer value was evidenced through a highly significant coefficient at =0.73, t=16.37. This result indicates that there is a strong direct relationship between organizational performance and customer value. Improved operational performance affects positively a customer‘s perception on a firm‘s products and services such as cost reduction, convenience and timely response. It also enhances customer‘s reputation on products and services. Thus, the empirical results of this survey demonstrate that enhanced operational performance has a positive impact on value to customer.

Figure 5.1.1. Primary causal model

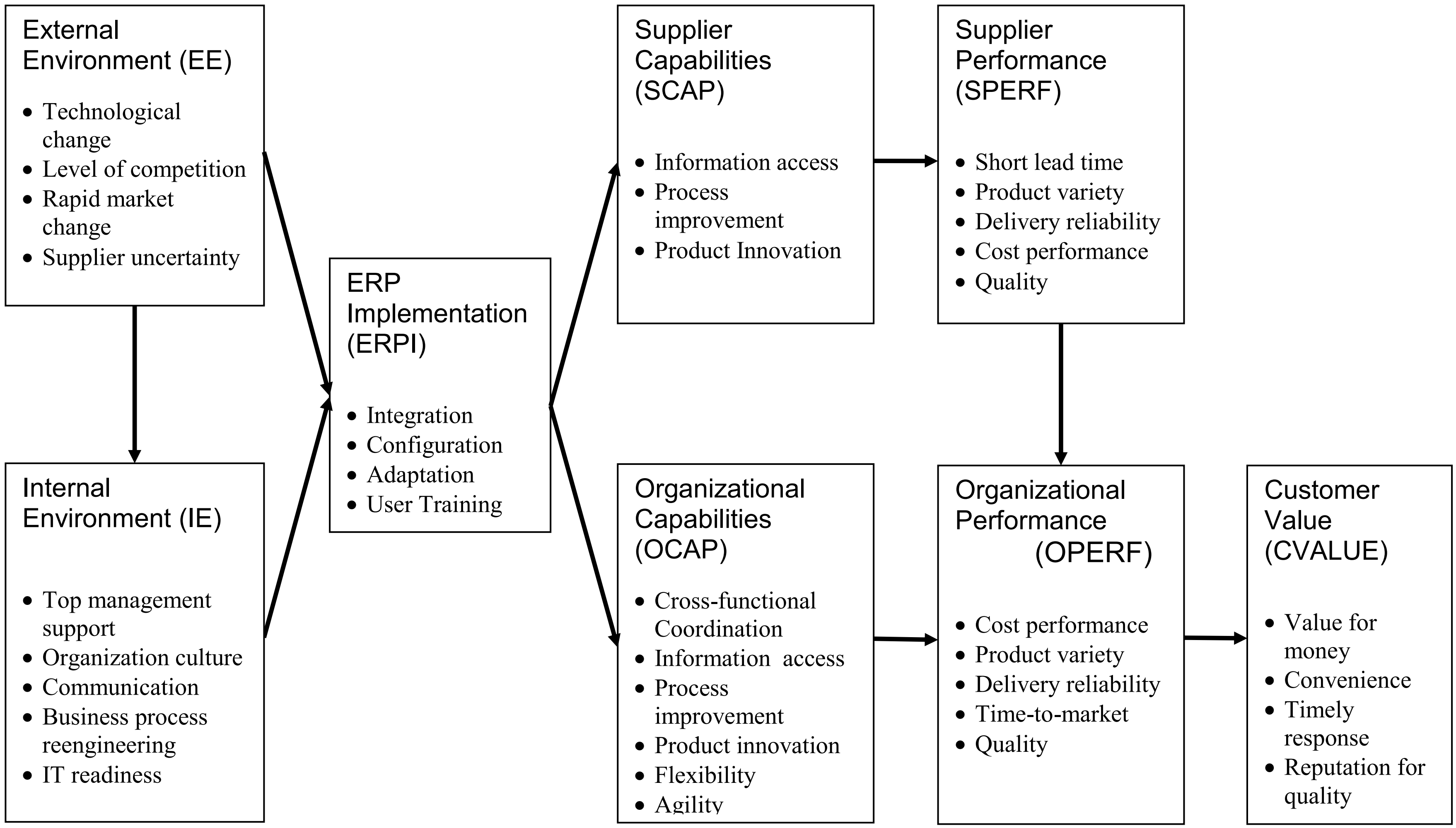


Table 5.2.1. Summary of PLS Generated Data for Indicators

Exogenous Construct Indicators	Standardized Coefficients	t-values	Endogenous Construct Indicators	Standardized Coefficients	t-values
D11TC	0.865	15.872**	D21TM	0.722	17.926**
D12LC	0.405	2.597**	D22OC	0.704	14.352**
D13RM	0.802	9.955**	D23CM	0.751	19.984**
			D25BP	0.797	24.868**
			D26IT	0.681	13.549**
			D31IN	0.833	36.625**
			D32CF	0.865	44.372**
			D33AD	0.772	22.814**
			D34UT	0.725	19.950**
			D41IC	0.793	23.513**
			D42PI	0.909	67.830**
			D43PN	0.858	40.869**
			D51CF	0.794	30.799**
			D52IC	0.736	17.010**
			D53PI	0.778	25.148**
			D54PN	0.802	22.357**
			D55FL	0.688	13.940**
			D56AG	0.806	25.910**
			D61SL	0.847	38.055**
			D62PV	0.790	24.419*
			D63DR	0.852	32.385**
			D64CP	0.833	33.715**
			D65QL	0.828	33.711**
			D71CP	0.842	32.473**
			D72PV	0.862	42.668**
			D73DR	0.828	26.834**
			D74TM	0.881	46.038**
			D75QL	0.883	47.014**
			D81VM	0.840	33.722**
			D82CN	0.902	60.463**
			D83TR	0.896	47.780**
			D84RP	0.830	22.868**

Note: * Significant at $\alpha < 0.05$, ** $\alpha < 0.01$ (Two-tailed t-test)

Figure 5.2.1. Result of PLS analysis

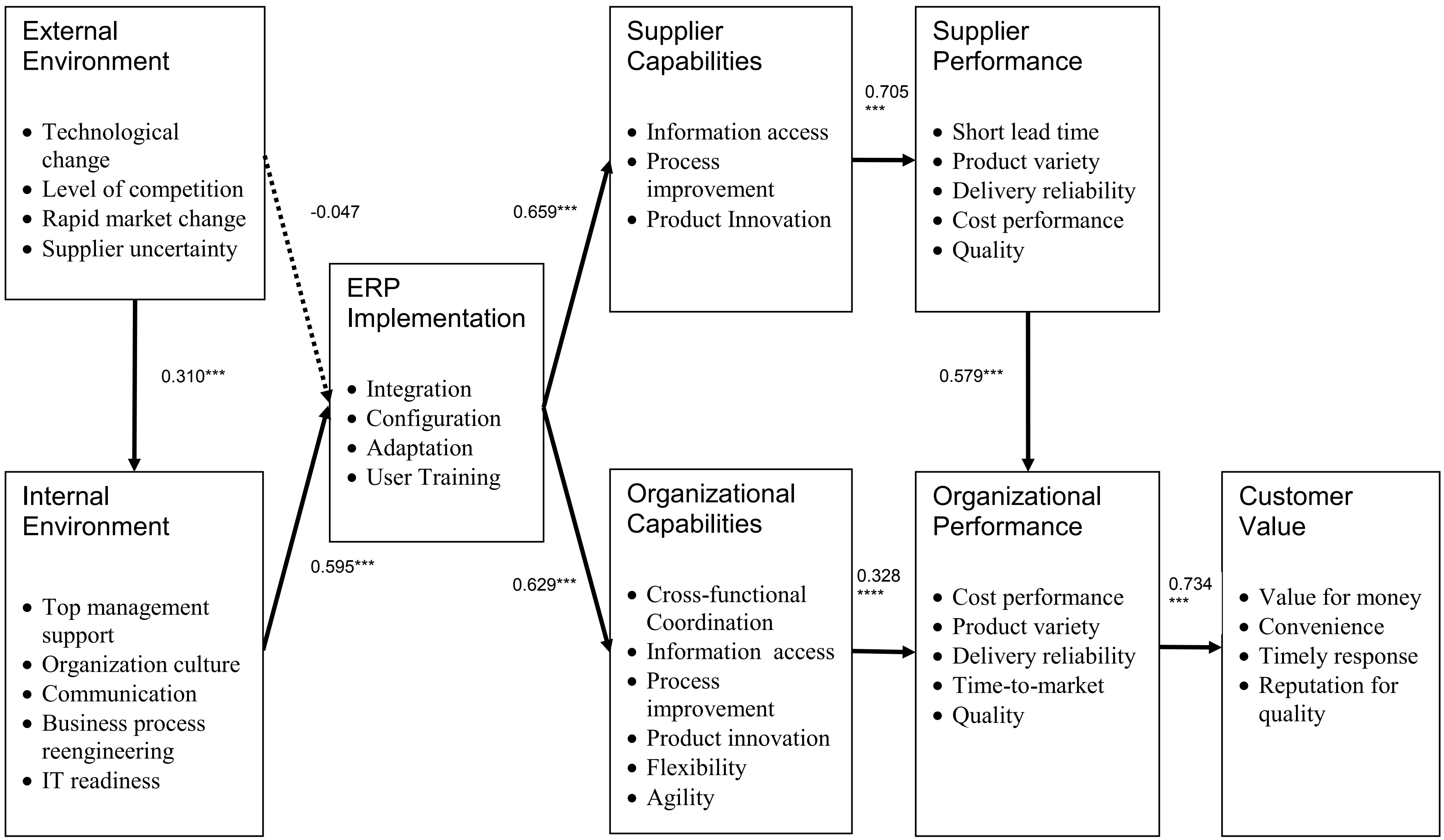
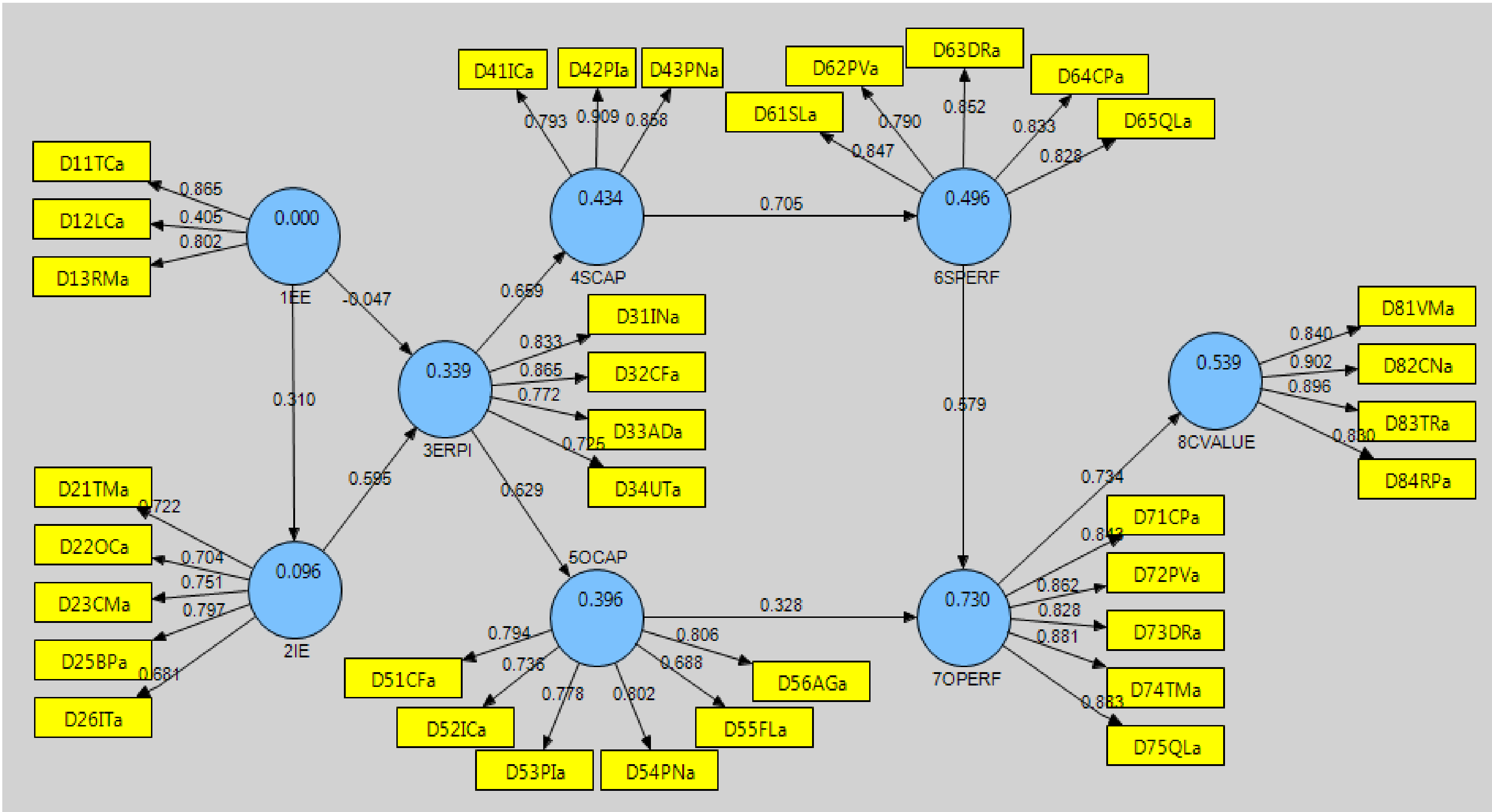
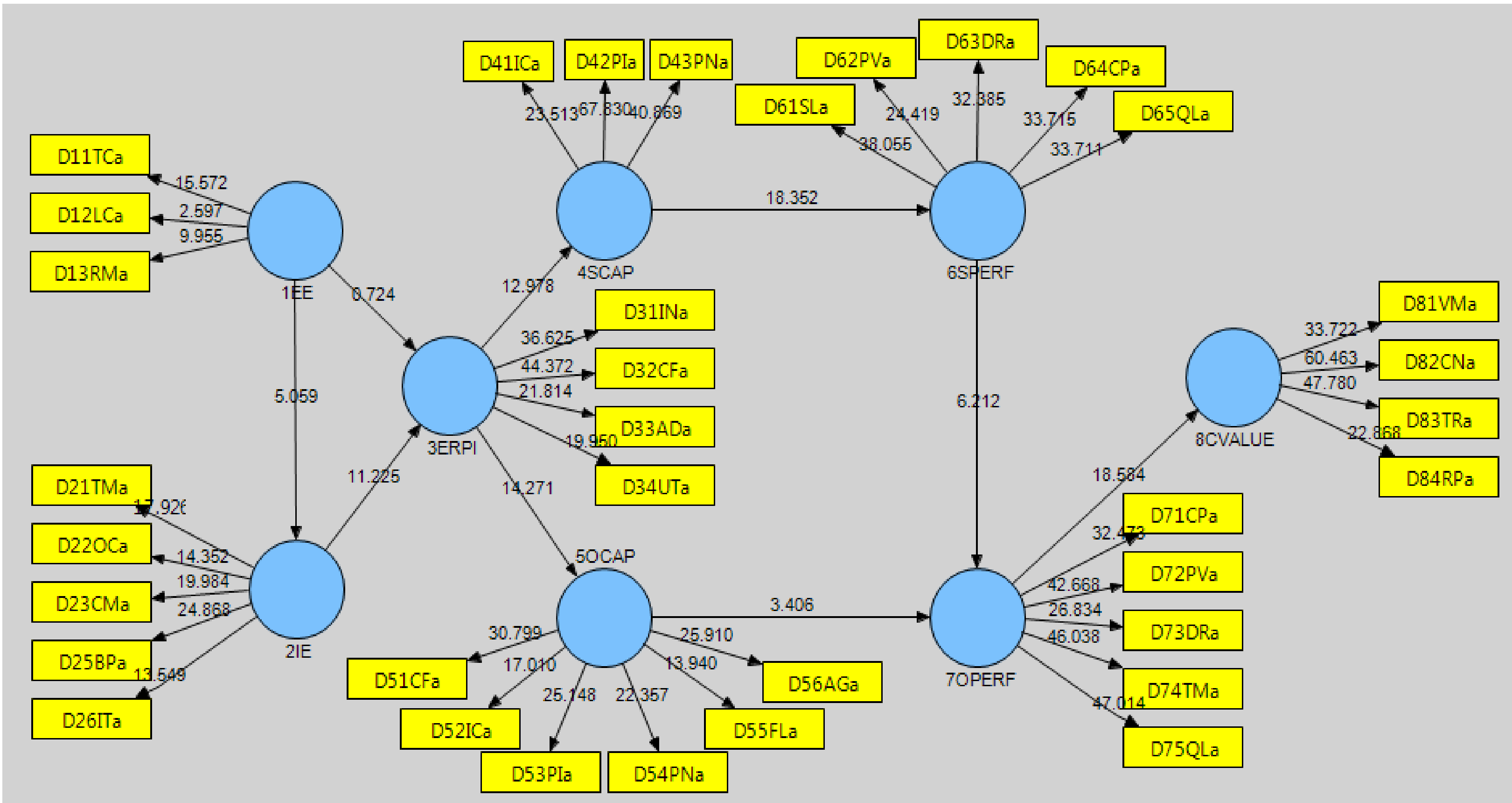


Figure 5.2.2. Result of PLS analysis (Beta coefficients)



1EE: External Environment, 2IE: Internal Environment, 3ERPI: ERP Implementation, 4SCAP: Supplier Capabilities, 5OCAP: Organizational Capabilities, 6SPERF: Supplier Performance, 7OPERF: Organizational Performance, 8CVALUE: Customer Value

Figure 5.2.3. Result of PLS analysis (T-values)



1EE: External Environment, 2IE: Internal Environment, 3ERPI: ERP Implementation, 4SCAP: Supplier Capabilities, 5OCAP: Organizational Capabilities, 6SPERF: Supplier Performance, 7OPERF: Organizational Performance, 8CVALUE: Customer Value

Table 5.2.2. Summary of PLS generated data for hypotheses testing

Relationship	Standardized Coefficient	t-value	Significant?	Hypotheses Testing
EE → IE	0.310	5.059**	Yes ($\alpha < 0.01$)	H1: Supported
EE → ERPI	-0.047	0.724	No	H2: Not Supported
IE→ ERPI	0.595	11.225**	Yes ($\alpha < 0.01$)	H3: supported
ERPI → SCAP	0.659	12.978**	Yes ($\alpha < 0.01$)	H4: supported
ERPI→ OCAP	0.629	14.271**	Yes ($\alpha < 0.01$)	H5: Supported
SCAP→ SPERF	0.705	18.352**	Yes ($\alpha < 0.01$)	H6: Supported
OCARP→OPERF	0.328	3.406**	Yes ($\alpha < 0.01$)	H7: Supported
SPERF→ OPERF	0.579	6.212**	Yes ($\alpha < 0.01$)	H8: Supported
OPERF→CVALUE	0.734	18.584**	Yes ($\alpha < 0.01$)	H9: Supported

Note: * Significant at $\alpha < 0.05$, ** Significant at $\alpha < 0.01$ (one-tailed t-test)

Table 5.2.3. Decomposition of effects (Standardized coefficients and t-values)

Relationship	Total Effects	Direct Effect	Indirect Effects
EE → IE	0.310 (5.059)**	0.310 (5.059)**	-
EE → ERPI	0.138 (2.14)**	-0.047 (0.724)	0.18 (4.596)**
IE→ ERPI	0.595 (11.225)**	0.595 (11.225)**	-
ERPI → SCAP	0.659 (12.978)**	0.659 (12.978)**	-
ERPI→ OCAP	0.629 (14.271)**	0.629 (14.271)**	-
SCAP→ SPERF	0.705 (18.352)**	0.705 (18.352)**	-
OCARP→OPERF	0.328 (3.406)**	0.328 (3.406)**	-
SPERF→ OPERF	0.579 (6.212)**	0.579 (6.212)**	-
OPERF→CVALUE	0.734 (18.584)**	0.734 (18.584)**	-

Note: * Significant at $\alpha < 0.05$, ** Significant at $\alpha < 0.01$ (one-tailed t-test)

CHAPTER 6: SUMMARY, DISCUSSION, AND RECOMMENDATIONS FOR FUTURE RESEARCH

This chapter provides (1) a summary of research findings and major contributions, (2) discussion of the implications for practitioners and academics, (3) limitations of this research, and (4) recommendations for future research.

6.1. Summary of the research findings and major contributions

An organization's business environment is changing and becoming turbulent at an accelerated speed throughout the world, creating significant challenges for firms in maintaining a competitive advantage. To sustain competitiveness, firms should be able to embrace global challenges as well as manage their environment effectively. This research presented a model to explain the impact of ERP implementation on supplier/organizational capabilities, supplier/organizational performance, and customer value, drawing on contingency theory, the resource-based view of the firm theory, and the dynamic capabilities theory. Successful ERP implementation driven by the external and internal environments can increase supplier capabilities and organizational capabilities, which in turn enhances supplier performance and organizational performance. Improved supplier performance leads to better organizational performance. Finally, successful ERP implementation enhances customer value mediated by organizational capabilities and performance.

At the same time, implementing ERP systems should take into consideration the external and internal environments. In addition, it is necessary to consider the mediating role of organizational capabilities between ERP implementation and organizational performance, since ERP implementation must be viewed and undertaken from the perspective of the entire organization and its environment, not just as a software installation. The research contributions that address these issues are discussed below.

The findings of this research provide evidence of the need to have ―a good fit” between ERP characteristics and organizational environments. While the findings from this research indicate that firms can indirectly embrace external environments, the results also indicate that achieving goodness of fit between a firm‘s environments and the characteristics of an ERP system has a great impact on its performance. Therefore, better fit of ERP with organizational environments is critical for ERP implementation success and organizational performance.

The research findings also indicate that understanding the mediating role of organizational capabilities is critical to find the impact of ERP implementation on organizations. Even though an ERP system has impact on the entire organization and its environments, many researchers focus on its financial performance, such as ROI (Return on Investment) and ROE (Return on Equity). However, this research finds that ERP implementation increases organizational capabilities and eventually improves organizational performance and customer value. The study also pays attention to the impact of ERP implementation on both suppliers and organizational capabilities. That is, ERP implementation has a good impact on not only an organization but also its suppliers.

This research is one of the first large scale empirical studies that considers the impact of ERP implementation on organizational capabilities and performance. The fundamental contribution of this paper is to extend prior research by developing a theoretical framework that integrates the relationships between an external environment, internal environment, ERP implementation, supplier capabilities organizational capabilities, supplier performance, organizational performance, and customer value. This research seeks to fill the gaps in the existing literature that has focused on studying the critical success factors of ERP implementation and how ERP has directly impacted on organizational performance.

6.2. Implications for academics and practitioners

6.2.1. Implications for academics

This study makes several contributions to academic literature. First of all, it offers a theoretical framework on understanding the impact of successful ERP implementation on organizations that incorporate contingency theory, a resource-based view of a firm theory, and dynamic capabilities theory. These theories are widely discussed in operations and information systems management literature but have received little attention in studies on the ERP systems. Incorporating these theories, this study developed the theoretical framework to examine critical factors related to ERP implementation. These factors are external and internal environment of a firm, success factors in ERP implementation, the impact of successful ERP implementation on supplier/organizational capabilities and performance, and customer value. Second, the research directs attention toward classifying success factors as internal and external factors. Previous researchers have focused on studying key success factors of ERP implementation as a whole without discussing them separately. There are a few researchers who separate environmental factors from ERP implementation factors (Markus and Tanis, 2000; Tarafdar and Roy, 2003), but none separate internal factors from external factors. In this paper, however, internal and external factors of successful ERP implementation are separated. These will be helpful to researchers in understanding the key success factors in ERP implementation endogenously and exogenously.

Third, this study highlights the relationship between ERP implementation and organizational capabilities. Previous researchers have focused on the key success factors of ERP implementation (Al-Mashari et al., 2003; Nah et al., 2001; Finney and Corbett, 2007; Soja, 2006) and the impact of information technology on firm performance (Wu et al., 2006). However, without examining the impact of ERP implementation on organizational capabilities, the relationship between ERP implementation and firm performance may be inaccurate because the enhancement of operational performance by ERP systems may be squandered before it affects a firm's overall performance (Banker et al., 2006; Ray et al, 2004; Jean et al, 2008). ERP may have a significant indirect effect on firm performance, mediated by organizational capabilities. This paper theorized that successful ERP implementation may improve organizational capabilities such as agility, flexibility, cross-functional coordination, product innovation, process improvement, and information access. Therefore, this conceptualization may have significant implications for how researchers should think about the impact of ERP implementation on organizational capabilities and regard organizational capability as complementary resources for organizational performance.

Fourth, this study highlights the relationship between ERP implementation and organizational capabilities Not many researchers study the relationship between information technology investment on an organization and supplier capabilities (Shin et al., 2000; Seidmann and Sundarajan, 1997). However, operational information sharing can leverage economies of scale and expertise across organizations. Information sharing allows suppliers to improve forecasts, synchronize production and delivery, coordinate inventory-related decisions, and develop a shared understanding of performance bottlenecks (Lee and Whang 2000; Simchi-Levi et al. 2000). It allows firms to access data across their supply chains, enabling them to collaborate in activities such as sales, production, and logistics. Thus, ERP implementation in the buyer firm motivates supplier firms to enhance their capabilities as well. This paper seeks to show that successful ERP implementation may improve supplier capabilities, such as information access, process improvement, and product innovation. Therefore, this conceptualization may have significant implications for how researchers should think about the value of ERP implementation and supplier capabilities.

Fifth, this conceptual paper emphasizes a dynamic capability perspective on studying ERP implementation. Many researchers have attempted to examine the impact of ERP implementation on organizations, based on a theory of the resource-based view of the firm (Wu et al., 2006). However, in a turbulent business environment, firms must continually reconfigure internal and external resources and competencies to adapt to business conditions. (Banker et al, 2006). The firm's ability to leverage the ERP systems creates agile and flexible competences which lead to an improvement of customer value (Sambamurthy et al., 2003). Dynamic capabilities theory provides an adequate approach to finding important elements to implement ERP systems successfully in the turbulent and rapidly changing business environment. Therefore, in this paper, the four important constructs for successful ERP implementation were theorized and identified: integration, configuration, adaptation, and user training. For effective ERP implementation, researchers need to consider these four elements.

Sixth, this paper highlights the key factors of how ERP implementation affects organizational capabilities. Until recently, there has been little research on this. The benefits of

ERP system implementation can be transferred to organizational capabilities (Shang and Seddon, 2002). Based on a resource-based view of a firm theory, many researchers have mentioned the impact of IT on organizational capabilities, but they have not dealt with the real issues of what kind of capabilities can be generated in the organizations. Instead, manufacturing capabilities and organizational learning capabilities are the main issues in their research. In this paper, six different kinds of organizational capabilities are identified and presented. They are cross-functional coordination, information access, process improvement, product innovation, flexibility, and agility. These capabilities are derived from the concept of dynamic capabilities. They are also derived from five different kinds of benefits of ERP implementation on firms. The five benefits are managerial, strategic, operational, information infrastructure and organizational benefits (Shang and Seddon, 2002; Spathis and Constantinides, 2003). These elements of organizational capabilities help researchers to approach ERP implementation with a broader view of ERP systems.

A final contribution of this research is that it highlights the relationship between organizational capabilities and customer value. The theoretical model presented in this research suggests that the increased organizational capabilities created through successful ERP implementation have an impact on organizational performance and customer value. The more organizational capabilities grow, the more the ways there are to meet customer needs. As customers become more demanding, firms should increase their capabilities to enhance their organizational performance and eventually satisfy customer needs. The increase in capabilities resulting from ERP implementation in an organization will be beneficial to the customer. Through effective logistics such as improving delivery times, increasing stock turnover, and reducing errors in logistics, firms can save time for customers and provide quality products with low prices. The effective internal communication and improved coordination between departments provided by ERP implementation can help firms to respond quickly to customer needs. Efficient data processing and information systems can help firms to give more information to customers directly. Through the mediating effects of organizational capabilities, the customized implementation of ERP systems can positively affect customer value.

6.2.2. Implications for practitioners

The results of this study have several important implications for practitioners. To this date, there is no empirical research evidence that associates the impact of ERP on organizational capabilities. This research may help practitioners and executives to identify critical drivers of ERP implementation in an organization‘s environment and its impact on organizational capabilities, performance, and customer value. These findings are helpful for practitioners to use as a supporting document, when they make critical decisions. Firms that are uncertain about applying their resources to specific activities can use the research model presented here to inform their decisions. This study indicates that successful ERP implementation in uncertain business environments leads to better organizational performance and customer satisfaction. Explanations of the managerial implications of this research will be examined next.

First, perceived changes in external environments are not stimulated directly by practitioners who adopt ERP systems in organizations. Instead, organizational readiness and proper change management in an uncertain external environment enable firms to implement an ERP system successfully. A firm that is internally ready for turbulent business environments can implement information systems more successfully. Therefore, managers should assess the nature of their internal environment to adapt new technology successfully in their business environment.

Second, managers should periodically reexamine the impact of ERP implementation on their organization. In general, it is easy to measure the impact of an ERP system based on business performance, but managers need to consider its impact on both supplier and organizational capabilities in their evaluation of ERP systems. Therefore, this study provides practitioners insights regarding the impact of ERP systems on organizations.

Third, the research, based on dynamic capabilities theory, identifies the key dimensions that practitioners should consider in the course of implementing ERP systems. They are integration, configuration, adaptation, and user training. Not only technical issues but also people issues should be considered during the implementation period. Even though organizations have realized the importance of implementing ERP systems, they often do not know exactly what to emphasize for successful implementation. The findings demonstrate to practitioners that in the stage of implementing ERP systems, integration, configuration, adaptation, and user training should receive most focus.

Fourth, this research provides practitioners a lens to measure the impact of ERP implementation on organizational capabilities and further organizational performance. Although there is research to measure the impact of ERP systems, they usually focus on specific capabilities such as innovation capabilities and organizational learning capabilities. However, this research provides practitioners a way to measure the impact ERP has on organizations. This is cross-functional coordination, information access, process improvement, product innovation, flexibility, and agility for measuring organization capabilities. It also measures cost performance, product variety, delivery reliability, time-to-market, and quality. This is an important measure of organizational performance.

Fifth, this study offers practitioners new perspectives to measure customer value driven by ERP implementation. Generally, many practitioners measure customer value from marketing or finance perspectives, but this research measures customer‘s perceived value from an information system and manufacturing perspective.

6.3. Limitations of the research

Although this research seeks to make several significant contributions from both theoretical and practical standpoint, there are some limitations that need to be addressed.

First, there is an issue of measurement inaccuracy. In this research, only a single respondent for each organization in the survey was asked to respond to complex issues such as ERP implementation, supplier capabilities and performance, organizational capabilities and performance, and customer value. But no one in an organization can thoroughly measure both the level of ERP implementation and that of organizational capabilities and performance. For example, an operations manager alone cannot measure the level of supplier capabilities or that of ERP implementation because he/she may not have enough knowledge of suppliers or information technology. Individual perception and opinion may not represent the collective organizational perception. The survey could be more accurate if more than one person in a firm responded to the survey.

Second, even though the survey was conducted on manufacturing firms with ERP systems, some of the organizations responding to the survey had less than five years of ERP system use. Even organizations which have implemented ERP systems are still adding more modules or updating the systems consistently so that it was not easy to measure the impact of ERP implementation on organizations accurately. It might be more accurate if this study involved only organizations who implemented ERP systems more than 3-5 years ago.

Third, there is a time limitation issue in this survey. Initially, this research developed items for 6 sub-constructs of supplier capabilities. Considering the response rate and time limitation, three sub-constructs and their items were eliminated from the survey questionnaires. Advanced information technology implementation enables suppliers to work tightly with the buyers and to coordinate and optimize their supply activities. Advances in IT make it possible for firms to exchange with suppliers information on a variety of parameters, such as demand and inventory related information, process quality information, and feedback from customers so that suppliers can respond to their buyers flexibly and proactively (Kulp et al., 2004).

Fourth, all the respondents are located in Korea. Initially the survey items were prepared for a United States audience. Because of a low response rate from the US audience, this research was analyzed using 205 Korean companies' data only.

Fifth, the non-response bias was not checked. Because the operations managers in operations or IT departments were personally contacted via telephone and time is limited, there is no way to check non-response bias.

6.4. Recommendations for future research

This section presents some interesting issues for future research based on the limitations discussed above and research potentials. They can be generally categorized into two: (1) measurement issues and (2) structural issues.

6.4.1. Recommendations and discussion of measurement Issues

First, for the ―organizational structure" sub-construct in the internal environment construct, it will be better if different construct definition and measurement items could be developed. All items in the sub-construct were eliminated because of a low CITC value. Future research should attempt to verify this understanding by developing better a definition and multi-item measurement scales for organizational structure.

Second, future research should conduct factorial invariance tests. Generalizability of measurement scales can further be supported by factorial invariance tests. Using the instruments developed in this research, one may test for factorial invariance across different industries (through respondents from industries other than SIC 20, 26, 28, 32, 34, 35, 36, or 37), across different size firms and across firms with different product complexity.

Third, future research needs to use multiple methods in the course of obtaining data. The use of single respondents may generate some imprecision more than the usual amount of random error (Koufteros, 1995; Nahm, 2000). In this study, respondents were asked to respond to complex questionnaires dealing with organizational-level variables. It is suggested that multiple methods should be used to derive estimates of measures. Future research should seek to utilize multiple respondents from each participating organizations as an effort to enhance reliability of research findings. Once a construct is measured with multiple methods, random error and method variance may be assessed using multitrait-multimethod approach.

6.4.2. Recommendations and discussion of structural Issues

First, future research should investigate alternative models to develop more hypotheses and examine structural relationships among variables. This research used composite measures of items for each sub-construct as indicators for latent variables and tested the relationships between latent variables only. However, there are many ways to examine the relationship among sub-constructs across variables. Numerous alternative models of structural relationships may be developed through assessing the relationships among sub-constructs.

Second, future research should include contextual variables in the structural model. To uncover potentially useful roles of contextual variables, this research has included 8 contextual variables. The contextual variables such as firm size and manufacturing type may have important bearings on the internal environment construct and its relationship with ERP implementation and organizational capabilities. The number of years to use ERP systems in the firm may be useful to measure the level of integration and configuration in ERP implementation. Degrees of product complexity may have an effect on the level of ERP implementation and its relationship with other variables. Future research may incorporate such contextual variables as antecedents and moderators for ERP implementation.

Third, future research should test hypothesized structural relationships with a different referent population. Respondents from industries other than SIC 20, 26, 28, 32, 34, 35, 36, or 37 should be utilized to test the generalizability of structural relationships. The relationships should also be tested in both manufacturing and service firms as well.

Fourth, future research should examine more thoroughly how different dimensions of the external environment affect various dimensions of the internal environment, ERP implementation, supplier capabilities, organizational capabilities, supplier performance, organizational performance, and customer value by performing multiple analysis of variance.

Fifth, future research should incorporate the hypothesized structural relationship across industries. Structural analysis may be conducted industry by industry, presuming a sufficient sample size in each industry. Measuring Industry-specific relationship or invariance of structural relationship across industry may be useful to measure the impact of ERP on each industry.

Sixth, the hypothesized structural relationship across countries may be examined in future research. In this research, only Korean data was used to examine the relationship between the latent variables. Using data from other countries such as the USA, India, China, and Japan would be useful. It would allow the comparison of ERP impact in different countries, identifying country-specific ERP implementation issues and it could generalize common ERP success factors as well as their impact on organizational capabilities.

Seventh, future research should incorporate the inhibiting factors of ERP implementation. The inhibiting factors such as organizational reluctance, amounts of time to implement an ERP systems, and complexity of ERP systems may have a negative impact on ERP implementation. The research on the impacts of such inhibiting factors may be useful to reduce such negative impact on ERP implementation and to improve overall organizational performance and customer value.

Finally, future research can further develop the current research framework by adding new constructs from other research fields. For example, it can measure the impact of ERP implementation on supply chain capabilities by incorporating the new constructs representing supply chain capabilities into this model. This may be interesting for the supply chain management research field.

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APPENDIX A: MEASUREMENT ITEMS ENTERING Q-SORT

EXTERNAL ENVIRONMENT

Technological change
In our industry, technology changes rapidly.
In our industry, technology quickly becomes obsolete.
In our industry, technological change transforms business practices.
In our industry, keeping up with changes in technology is difficult.
In our industry, our competitors introduce new technology quite often.

Level of competition
Our major competitors attempt to offer products with lower prices than us.
Our major competitors attempt to offer products with higher quality than us.
Our major competitors attempt to offer faster delivery of products than us.
Our major competitors attempt to offer products with additional features than us.
Our major competitors attempt to offer better customer service than us.

Rapid market change
Our customers‘ requirements change rapidly.
Our customers‘ expectations change rapidly.
Our demand fluctuates drastically from week to week.
Our supply requirements vary from week to week.
In our industry, the product life cycle is shorter.

Supplier uncertainty
Our customers‘ requirements regarding product features are difficult to forecast.
Our customers‘ demand in volume is difficult to predict.
Our customers‘ demand in product mix is difficult to predict.
Our supplier‘s product quality is unpredictable.
Our supplier‘s delivery time differ from our expectations.
Our supplier‘s delivery quantities differ from our expectations.
Our competitors‘ often introduce new product(s) unexpectedly.

APPENDIX A: MEASUREMENT ITEMS ENTERING Q-SORT (continued)

INTERNAL ENVIRONMENT

Top management support

Top management understands how the implementation of new technology will benefit the enterprise.
Top management recognizes the need for long-term support for the implementation of new technology.
Top management identifies the implementation of new technology as top priority.
Top management reinforces the commitment of all the employees for the implementation of new technology.
Top management willingly assigns resources to the implementation of new technology as they are needed.

Organizational culture

We believe that managers should focus on providing value to customers.
We believe that investments in facilities and equipment support process improvement efforts among our workers.
We believe that employees should work together as a team.
We believe that decisions should be based on overall company objectives.
We believe that workers should simply follow the directions given by their managers. (Reverse coded)
We believe that the best suppliers are the ones who enable us to provide value to customers.

Communication

Expected outcomes of the project are communicated to managers.
Expected outcomes of the project are communicated to workers.
Expected outcomes of the project are communicated by upper management in advance.
Expected outcomes of the project are shared by workers.
Expected outcomes of the project are shared among workers across department.

Organizational structure

Our workers are supported in making their own decision by middle managers.
Our workers are encouraged to be creative in dealing with problems at work.
Our workers are assigned to work in cross-functional teams.
Our workers are trained to work in cross-functional teams.
Our workers are informed of written rules and procedures that describe how they can make changes on their job.
Our workers have few hierarchical layers to reach the top management.

IT readiness

IT staff is able to configure information systems.
IT staff is able to understand custom ERP software programs.
IT staff is able to efficiently implement system upgrades.
IT staff is able to conduct a formal validation of all system changes.
IT staff is able to analyze the technical impact of proposed system changes.
IT staff has high degree of technical expertise.
IT staff is always available to help.

APPENDIX A: MEASUREMENT ITEMS ENTERING Q-SORT (continued)

ERP IMPLEMENTATION

Integration
We integrate seamlessly the modules in the ERP system.
We integrate seamlessly all transactions in the ERP system.
We integrate seamlessly the ERP system with other business software, such as customer relationship management system and supply chain management system.
We integrate seamlessly the ERP system with legacy system.
We integrate seamlessly the ERP system with our suppliers using communication protocols and standards.

Configuration
The ERP system meets all the needs of organizational processes.
The ERP system accommodates the changes required by the organization‘s processes.
The ERP system supports the business practices of our company. (Data fit)
The ERP system data items‘ name and meaning correspond to those used in our company (i.e. a sales order sheet, sales report).
The ERP system user interface is well suited to the business needs of our company.

Adaption
To align with changing organizational needs, we easily alter ERP data items.
To align with changing organizational needs, we easily append new ERP data items.
To align with changing organizational needs, we easily alter ERP processes.
To align with changing organizational needs, we easily append new ERP processes.
To align with changing organizational needs, we easily alter ERP input/output screens.
To align with changing organizational needs, we easily alter ERP reports.

User training
ERP system users are provided with customized training materials for each specific job.
ERP system users are provided training materials that demonstrate an overview of the system, not just help with the ERP screens and reports.
ERP system users attend a formal training program that meets their requirements.
ERP system users are assessed to ensure that they have received the appropriate training.
ERP system users have been trained in basic skills.

APPENDIX A: MEASUREMENT ITEMS ENTERING Q-SORT (continued)

ORGANIZATIONAL CAPABILITIES

Cross-functional coordination
We are able to work together across functions in our firm.
We are able to share resources, ideas, and information between functions in our organization.
We are able to informally work together as a team within our organization.
We are able to achieve goals collectively within our organization.

Information access
We are able to find out what products or services we need in the future.
We are able to retrieve information on suppliers, customers and competitors.
We are able to do a lot of in-house research on product and services we need.
We are able to detect changes fast in our product and service preferences.
We are able to detect fundamental shifts fast in the purchasing environment.

Process improvement
We are able to reduce order-processing cycle time.
We are able to reduce new product or service development cycle times.
We are able to reduce overall product or service delivery cycle times.
We are able to reduce paper work.
We are able to find wasted time and costs in all internal processes.

Product innovation
We are able to develop customized products.
We are able to develop products with unique features.
We are able to develop better quality products.
We are able to develop products with better performance.
We are able to develop new products and features.

Flexibility
We are able to make rapid changes in design.
We are able to introduce new products quickly.
We are able to make rapid volume change.
We are able to make rapid product mix changes.
We are able to offer broad product line.

Agility
We are able to rapidly respond to emerging opportunities in markets.
We are able to rapidly respond to emerging environmental opportunities (e.g., new regulations, globalization).
We are able to rapidly respond to natural threats (e.g., natural disaster).
We are able to rapidly respond to competitive threats (e.g., competitor's price change and new market campaign).
We are able to rapidly respond to operational threats (e.g., supply chain disruption).
We are able to rapidly respond to adopt best practices used by others.

APPENDIX A: MEASUREMENT ITEMS ENTERING Q-SORT (continued)

ORGANIZATIONAL PERFORMANCE

Cost performance
We reduce production unit costs.
We reduce material costs.
We reduce overhead cost.
We reduce inventory level.

Product variety
We introduce new products with additional features in the market.
We introduce new products with improved performance.
We introduce new products with different price structures.

Delivery reliability
We fulfill customers' orders on time.
We meet promised delivery dates.
We provide dependable delivery.
We provide the correct number of products to our customers.
We provide the products that meet customers' specifications.

Time-to-market
We are quick in delivering our product to market.
We are usually first in the market to introduce new products.
We are usually first in the market to make improvements to existing products.
We have time-to-market that is lower than our industry average.

Quality
We offer products that conform to customers' specifications.
We offer products that are highly reliable products.
We offer products that are durable.
We offer products that have additional features.
We offer products that have lower defective rates.

APPENDIX A: MEASUREMENT ITEMS ENTERING Q-SORT (continued)

CUSTOMER VALUE

Value for money
Our customers perceive that our products offer high-value at a low price.
Our customers perceive that our products prices are considered reasonable.
Our customers perceive that our company offers high value products.

Convenience
Our customers perceive that they easily receive the information of the products they need.
Our customers perceive that they easily purchase the products they need.
Our customers perceive that our order fulfillment system is considered convenient.

Timely response
Our customers perceive that they experience quick customer services such as order fulfillment and delivery.
Our customers perceive that they receive the products they need in time.
Our customers perceive that they receive up-to-date information.
Our customers perceive that their complaints are rapidly handled

Reputation for quality
Our customers perceive that we consistently deliver products/ services of the highest quality
Our customers perceive that our products are very reliable.
Our customers perceive that our staff treat them with great respect.
Our customers perceive that our products

APPENDIX B: COHEN'S KAPPA AND MOORE AND BENBASAT COEFFICIENT

In the Q-sort methodology, the degree of agreement between judges is the basis of assessing construct validity and improving the reliability of the constructs. There are two steps in the method (Nahm, 2000). In the first step, two judges are requested to sort the questionnaire items according to different constructs, based on which the inter-judge agreement is measured. In the second step, questionnaire items that were identified as being too ambiguous, as a result of the first stage, are reworded or deleted. In the course of doing those, the agreement between the judges can be improved. The procedure is conducted repeatedly until the level of agreement is acceptable. Below is an example describing the theoretical basis for the Q-sort method and the two central evaluation indices to measure inter-judge agreement level: Cohen‗s Kappa (Cohen, 1960) and Moore and Benbasat‗s ―Hit Ratio" (Moore and Benbasat, 1991).

(1) Cohen's Kappa

The first measure of both the reliability of the classification scheme and the validity of the items was developed by Cohen (1960). In the example below, two judges independently classified a set of N components as either acceptable or rejectable. After the work was finished the following table was constructed:

		Judge 1		
Judge 2		Acceptable	Rejectable	Total
	Acceptable	X_{11}	X_{12}	X_{1+}
	Rejectable	X_{21}	X_{22}	X_{2+}
	Total	X_{+1}	X_{+2}	N

X_{ii} = the number of components in the i^{th} row and i^{th} column, for i = 1,2.
X_{i+} = the total number of components in the i^{th} row
X_{+i} = the total number of components in the i^{th} column

The above table can also be transformed using percentages by dividing each numerical entry by the total number, N. For the population of components, the table will look like:

		Judge 1		
Judge 2		Acceptable	Rejectable	Total
	Acceptable	P_{11}	P_{12}	P_{1+}
	Rejectable	P_{21}	P_{22}	P_{2+}
	Total	P_{+1}	P_{+2}	100

Pii = the percentage of components in the i^{th} row and i^{th} column.
P_{i+} = the percentage of components in the i^{th} row
P_{+i} = the percentage of components in the i^{th} column

The table of percentages above can be used to compute the Cohen's Kappa coefficient of agreement. The simplest measure of agreement is the proportion of components that were classified the same by both judges ($\Sigma_i P_{ii} = P_{11} + P_{22}$). However, Cohen suggested comparing the actual agreement ($\Sigma_i P_{ii}$) with the chance of agreement that would occur if the row and columns are independent ($\Sigma_i P_{i+}P_{+i}$). The difference between the actual and chance agreements ($\Sigma_i P_{ii} - \Sigma_i P_{i+}P_{+i}$) is the percent agreement above which is due to chance. This difference can be standardized by dividing it by its maximum possible value ($100- \Sigma_i P_{i+}P_{+i}$). The ratio of these is denoted by the Greek letter Kappa and is referred to as Cohen's Kappa. The formula to calculate Cohen's Kappa is shown below.

In general, Cohen's Kappa can be interpreted as the proportion of joint judgment excluding chance agreement. The three basic assumptions for this agreement coefficient are following: (1) The units are independent, (2) The categories of the nominal scale are independent and mutually exclusive, and (3) the judges operate independently. There is no general agreement regarding to required scores to accept or reject. However, several researchers consider acceptable scores which are greater than 0.65 (Vessey, 1984; Jarvenpaa 1989; Solis-Galvan, 1998). Landis and Koch (1977) have provided a more detailed guideline to interpret Kappa coefficient. Below is the guideline they suggested.

Value of Kappa	Degree of Agreement
0.76 - 1.00	Excellent
0.40 - 0.75	Fair to Good (Moderate)
Less than 0.39	Poor

(2) Moore and Benbasat's 'hit ratio'

Moore and Benbasat (1991) developed the method to measure both the reliability of the classification scheme and the validity of the items. The method measures how many items were placed within the target construct by the panel of judges for each round. In other words, it measures the overall frequency of items that judges placed within the intended theoretical construct. The higher the percentage of items placed in the target construct, the higher the degree of inter-judge agreement across the panel happened. The high degree of correct placement of items within them can be regarded to have a high degree of construct validity and reliability. Even though there are no established guidelines for determining good levels of placement, the matrix can be used to highlight any potential problem areas. The following example shows how to measure inter-judge agreement ratio (Hit ratio). In the example below, there are four theoretical constructs with ten items developed for each construct. A panel of three judges could make total of 30 placements within each construct theoretically. Therefore, a theoretical versus actual matrix of item placements could be constructed (refer the table below).

		ACTUAL				Total	% Hits
		A	B	C	D		
THEORETICAL	A	26	2	1	1	30	87
	B	8	18	4	0	30	60
	C	0	0	30	0	30	100
	D	0	1	1	28	30	93

Item Placements: 120 Hits: 102 Overall “Hit Ratio”: 85%

The item placement ratio, called “Hit Ratio”, is an indicator of how many items were placed in the intended construct by the judges. 102 items (Actual placement) out of 120items (theoretical placements) are placed in right categories. Therefore, an overall “hit ratio” is 85%. The amounts of off-diagonal entries show how ambiguous any construct might be. If there are a high number of entries in the off-diagonal, the construct might be considered vague. Therefore, the items should be reexamined and modified for the further study.

APPENDIX C: LIST OF CONTEXTUAL AND PERFORMANCE VARIABLES

CONTEXTUAL VARIABLES

Please select the TYPE OF OPERATION that best describes your plant:
☐ High volume, discrete part production
☐ Continuous flow process ☐ Flexible manufacturing
☐ Manufacturing cells ☐ Assembly line
☐ Job shop ☐ Projects ☐ Batch processing

Please indicate which SIC group represents your PRIMARY industry.
☐ Fabricated Metal Products
☐ Industrial Machinery
☐ Electric and Electronic Equipment
☐ Transport Equipment

The NUMBER OF EMPLOYEES working in your plant.
☐ 100 – 249 ☐ 500 – 999 ☐ 2,500 and over
☐ 250 – 499 ☐ 1,000 – 2,499

What is the degree of product complexity in your dominant product line?
☐ Very low ☐ Low☐ Moderate ☐ High ☐ Very high

The AVERAGE ANNUAL SALES $ (in millions) for your plant.
☐ Less than 10 ☐ 50 – 99.9 ☐ 500 – 1 billion
☐ 10 – 49.9 ☐ 100 – 499.9☐ Over 1 billion

What is your present job title?
☐ CEO/President ☐ Director ☐ Other
☐ Vice President ☐ Manager

Please supply us with information on an ERP implementation project that you have been involved with:

Name of the ERP system: ________________________

Please supply us with information on an ERP implementation project that you have been involved with:

ERP implementation accomplished Date: ____________________

APPENDIX D: ACRONYMS USED FOR CODING OF ITEMS IN EACH SUB-CONSTRUCT

EXTERNAL ENVIRONMENT

D11TC	Technological change
D12LC	Level of competition
D13RM	Rapid market change
D14UC	Uncertainty

INTERNAL ENVIRONMENT

D21TM	Top management support
D22OC	Organizational culture
D23CM	Communication
D24OS	Organizational structure
D25BP	Business process reengineering
D26IT	IT readiness

ERP IMPLEMENTATION

D31IN	Integration
D32CF	Configuration
D33AD	Adaption
D34UT	User training

SUPPLIER CAPABILITIES

D41IC	Information access
D42PI	Process improvement
D43PN	Product innovation

ORGANIZATIONAL CAPABILITIES

D51CF	Cross-functional coordination
D52IC	Information access
D53PI	Process improvement
D54PN	Product innovation
D55FL	Flexibility
D56AG	Agility

APPENDIX D: ACRONYMS USED FOR CODING OF ITEMS IN EACH SUB-CONSTRUCT (continued)

SUPPLIER PERFORMANCE

D61SL	Short lead time
D62PV	Product variety
D63DR	Delivery reliability
D64CP	Cost performance
D65QL	Quality

ORGANIZATIONAL PERFORMANCE

D71CP	Cost performance
D72PV	Product variety
D73DR	Delivery reliability
D74TM	Time-to-market
D75QL	Quality

CUSTOMER VALUE

D81VM	Value for money
D82CN	Convenience
D83TR	Timely response
D84RP	Reputation for quality

APPENDIX E: Measurement items before the large study

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

EXTERNAL ENVIRONMENT

Technological change

D11TC1 In our industry, technology changes rapidly.
D11TC2 In our industry, technology quickly becomes obsolete.
D11TC3 In our industry, technological change transforms business practices.
D11TC4 In our industry, keeping up with changes in technology is difficult.

Level of competition

D12LC1 Our major competitors attempt to offer products with lower prices than ours.
D12LC2 Our major competitors attempt to offer products with higher quality than ours.
D12LC3 Our major competitors attempt to offer products with more features than ours.
D12LC4 Our major competitors attempt to offer better customer service than we offer.

Rapid market change

D13RM1 Our customers' order items are frequently changed.
D13RM2 Our customers' order quantity is frequently changed.
D13RM3 Our customers' expectations for the product price are frequently changed.
D13RM4 Our customers' expectations for the product quality are frequently changed.

Supplier uncertainty

D14UC1 Our supplier' product quality is unpredictable.
D14UC2 Our supplier' delivery times differ from our expectations.
D14UC3 Our supplier' delivery quantities differ from our expectations.

APPENDIX E: Measurement items before the large study (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

INTERNAL ENVIRONMENT

Top management support

D21TM1 Top management understands how the implementation of new technology will benefit the enterprise.

D21TM2 Top management recognizes the need for long-term support for the implementation of new technology.

D21TM3 Top management identifies the implementation of new technology as a top priority.

D21TM4 Top management reinforces the commitment of all the employees to the implementation of new technology.

D21TM5 Top management willingly assigns resources to facilitate the implementation of new technology as they are needed.

Organizational culture

D22OC1 We believe that investments in information technology increase creativity among our workers.

D22OC2 We believe that investments in information technology support product innovation efforts among our workers.

D22OC3 We believe that investments in information technology support process improvement efforts among our workers.

D22OC4 We believe that investments in information technology increase intellectual work among our workers.

Communication

D23CM1 Expected outcomes of the project are communicated to managers.

D23CM2 Expected outcomes of the project are communicated by upper management in advance.

D23CM3 Expected outcomes of the project are shared among workers within departments.

D23CM4 Expected outcomes of the project are shared among workers across departments.

APPENDIX E: Measurement items before the large study (continued)

Organizational structure

D24OS1	Our workers are supported by middle managers in making their own decision.
D24OS2	Our workers are assigned to work in cross-functional teams.
D24OS3	Our workers have minimal rules and little direct supervision.
D24OS4	Our workers encounter few hierarchical layers when attempting to reach the top management.

Business process reengineering

D25BP1	We design and document important business processes.
D25BP2	We appoint the best managers to be process managers.
D25BP3	We measure our performance based on business process goals rather than functional goals.
D25BP4	Functional managers support business processes.

IT readiness

D26IT1	IT staff is able to configure information systems.
D26IT2	IT staff is able to efficiently implement system upgrades.
D26IT3	IT staff is able to conduct a formal validation of all system changes.
D26IT4	IT staff has high degree of technical expertise.

APPENDIX E: Measurement items before the large study (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1= Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

ERP IMPLEMENTATION

Integration

D31IN1 We seamlessly integrate the modules in the ERP system.

D31IN2 We seamlessly integrate all transactions in the ERP system.

D31IN3 We seamlessly integrate the ERP system with supply chain management (customer or supplier relationship) system, using communication protocols and standards.

D31IN4 We seamlessly integrate the ERP system with manufacturing management system, using communication protocols and standards.

D31IN5 We seamlessly integrate the ERP system with legacy systems.

Configuration

D32CF1 The ERP system meets all the needs of organizational processes.

D32CF2 The ERP system accommodates the changes required by the organization's processes.

D32CF3 The ERP system supports the business practices of our company. (Data fit)

D32CF4 The ERP system data items' names and meanings correspond to those used in our company (i.e. a sales order sheet, sales report).

D32CF5 The ERP system user interface is well suited to the business needs of our company.

Adaption

D33AD1 To align with changing organizational needs, we easily alter/append ERP data items.

D33AD2 To align with changing organizational needs, we easily alter/append ERP processes.

D33AD3 To align with changing organizational needs, we easily alter ERP input/output screens.

D33AD4 To align with changing organizational needs, we easily alter ERP reports.

User training

D34UT1 ERP system users are provided with customized training materials for each specific job.

D34UT2 ERP system users are provided training materials that demonstrate an overview of the system, not just help with the ERP screens and reports.

D34UT3 ERP system users attend a formal training program that meets their requirements.

D34UT4 ERP system users are assessed to ensure that they have received the appropriate training.

APPENDIX E: Measurement items before the large study (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

SUPPLIER CAPABILITIES

Information access

D41IC1	Our suppliers are able to retrieve information on their suppliers, customers and competitors.
D41IC2	Our suppliers are able to access in-house databases on product they need.
D41IC3	Our suppliers are able to gather and process data for our product preferences quickly.
D41IC4	Our suppliers are able to gather and process data for fundamental shifts in the purchasing environment quickly.

Process improvement

D42PI1	Our suppliers are able to reduce new product development cycle times.
D42PI2	Our suppliers are able to reduce delays in the distribution process.
D42PI3	Our suppliers are able to reduce paperwork.
D42PI4	Our suppliers are able to reduce wasted time and costs in all internal processes.

Product innovation

D43PN1	Our suppliers are able to develop products with unique features.
D43PN2	Our suppliers are able to improve product quality.
D43PN3	Our suppliers are able to develop products with better performance.
D43PN4	Our suppliers are able to develop new products and features.

APPENDIX E: Measurement items before the large study (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

ORGANIZATIONAL CAPABILITIES

Cross-functional coordination

D51CF1	We are able to work together across functions in our organizations.
D51CF2	We are able to share resources, ideas, and information between functions in our organizations.
D51CF3	We are able to informally work together as a team within our organizations.
D51CF4	We are able to achieve goals collectively within our organizations.

Information access

D52IC1	We are able to retrieve information on suppliers, customers and competitors.
D52IC2	We are able to access in-house databases on product we need.
D52IC3	We are able to gather and process data for customers' product preferences quickly.
D52IC4	We are able to gather and process data for fundamental shifts in the purchasing environment quickly.

Process improvement

D53PI1	We are able to reduce new product development cycle times.
D53PI2	We are able to reduce delays in the distribution process.
D53PI3	We are able to reduce paperwork.
D53PI4	We are able to reduce wasted time and costs in all internal processes.

Product innovation

D54PN1	We are able to develop products with unique features.
D54PN2	We are able to improve product quality.
D54PN3	We are able to develop products with better performance.
D54PN4	We are able to develop new products and features.

Flexibility

D55FL1	We are able to make product changes in design to meet market needs.
D55FL2	We are able to make product mix changes to meet market needs.
D55FL3	We are able to make product volume changes to meet market needs.
D55FL4	We are able to make product changes in design without excessive costs.
D55FL5	We are able to make product mix changes without excessive costs.
D55FL6	We are able to make product volume changes without excessive costs.

APPENDIX E: Measurement items before the large study (continued)

Agility

D56AG1	We are able to rapidly respond to emerging environmental opportunities (e.g., new regulations, globalization).
D56AG2	We are able to rapidly respond to natural threats (e.g., natural disaster).
D56AG3	We are able to rapidly respond to competitive threats (e.g., competitor's price change and new market campaign).
D56AG4	We are able to rapidly respond to operational threats (e.g., supply chain disruption).

APPENDIX E: Measurement items before the large study (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

SUPPLIER PERFORMANCE

Short lead time

D61SL1 Our suppliers deliver products within a shorter time.
D61SL2 Our suppliers improve the speed of service through eliminating waste and non-value added activities.
D61SL3 Our suppliers have shorter throughput time.
D61SL4 Our suppliers minimize the time from order placement to the delivery of procured items.

Product variety

D62PV1 Our suppliers provide new products with additional features anytime.
D62PV2 Our suppliers provide new products with improved performance anytime.
D62PV3 Our suppliers have a wide products offering.

Delivery reliability

D63DR1 Our suppliers fulfill our orders on time.
D63DR2 Our suppliers provide dependable delivery.
D63DR3 Our suppliers fulfill our order quantity.
D63DR4 Our suppliers fulfill our orders accurately.

Cost performance

D64CP1 After introducing an ERP system, our suppliers have lower production unit costs.
D64CP2 After introducing an ERP system, our suppliers have lower material costs.
D64CP3 After introducing an ERP system, our suppliers have lower overhead cost.
D64CP4 After introducing an ERP system, our suppliers have lower inventory level.

Quality

D65QL1 Our suppliers offer products that consistently conform to our specifications.
D65QL2 Our suppliers offer products that are highly dependable.
D65QL3 Our suppliers offer products that are durable.
D65QL4 Our suppliers offer products that have lower defective rates.

APPENDIX E: Measurement items before the large study (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

ORGANIZATIONAL PERFORMANCE

Cost performance

D71CP1 After introducing an ERP system, we have lower production unit costs.
D71CP2 After introducing an ERP system, we have lower material costs.
D71CP3 After introducing an ERP system, we have lower overhead cost.
D71CP4 After introducing an ERP system, we have lower inventory level.

Product variety

D72PV1 We provide new products with additional features in the market anytime.
D72PV2 We provide new products with improved performance anytime.
D72PV3 We have a wide products offering.

Delivery reliability

D73DR1 We fulfill customers' orders on time.
D73DR2 We provide dependable delivery.
D73DR3 We fulfill customers' order quantity.
D73DR4 We fulfill customers' orders accurately.

Time-to-market

D74TM1 We are quick in delivering our product to market.
D74TM2 We are usually first in the market to introduce new products.
D74TM3 We are usually first in the market to make improvements to existing products.
D74TM4 We have time-to-market that is lower than our industry average.

Quality

D75QL1 We offer products that consistently conform to our specifications.
D75QL2 We offer products that are highly dependable.
D75QL3 We offer products that are durable.
D75QL4 We offer products that have lower defective rates.

APPENDIX E: Measurement items before the large study (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

CUSTOMER VALUE

Value for money

D81VM1	Our customers perceive that our products offer high value at a low price.
D81VM2	Our customers perceive that our products prices are reasonable.
D81VM3	Our customers perceive that our company reduces prices while providing high-value products.

Convenience

D82CN1	Our customers perceive that they easily receive information on the products they need.
D82CN2	Our customers perceive that they easily purchase the products they need.
D82CN3	Our customers perceive that our order fulfillment system is convenient.

Timely response

D83TR1	Our customers perceive that they experience quick customer services such as order fulfillment and delivery.
D83TR2	Our customers perceive that they receive the products they need in time.
D83TR3	Our customers perceive that they receive the information they need when they need it.
D83TR4	Our customers perceive that their complaints are rapidly handled.

Reputation for quality

D84RP1	We have a reputation for better product quality than our competitors.
D84RP2	We have a reputation for better product performance than our competitors.
D84RP3	We have a reputation for products that durable than our competitors.
D84RP4	We have a reputation for products with lower defect rates than our competitors.

APPENDIX F: MEASUREMENT ITEMS AFTER THE LARGE STUDY

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

EXTERNAL ENVIRONMENT

Technological change

D11TC1 In our industry, technology changes rapidly.

D11TC3 In our industry, technological change transforms business practices.

Level of competition

D12LC2 Our major competitors attempt to offer products with higher quality than ours.

D12LC3 Our major competitors attempt to offer products with more features than ours.

D12LC4 Our major competitors attempt to offer better customer service than we offer.

Rapid market change

D13RM1 Our customers‘ order items are frequently changed.

D13RM2 Our customers‘ order quantity is frequently changed.

D13RM3 Our customers‘ expectations for the product price are frequently changed.

D13RM4 Our customers‘ expectations for the product quality are frequently changed.

Supplier uncertainty

D14UC1 Our supplier‘ product quality is unpredictable.

D14UC2 Our supplier‘ delivery times differ from our expectations.

D14UC3 Our supplier‘ delivery quantities differ from our expectations.

APPENDIX F: MEASUREMENT ITEMS AFTER THE LARGE STUDY (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

INTERNAL ENVIRONMENT

Top management support

D21TM1	Top management understands how the implementation of new technology will benefit the enterprise.
D21TM2	Top management recognizes the need for long-term support for the implementation of new technology.
D21TM3	Top management identifies the implementation of new technology as a top priority.
D21TM4	Top management reinforces the commitment of all the employees to the implementation of new technology.
D21TM5	Top management willingly assigns resources to facilitate the implementation of new technology as they are needed.

Organizational culture

D22OC1	We believe that investments in information technology increase creativity among our workers.
D22OC2	We believe that investments in information technology support product innovation efforts among our workers.
D22OC3	We believe that investments in information technology support process improvement efforts among our workers.
D22OC4	We believe that investments in information technology increase intellectual work among our workers.

Communication

D23CM1	Expected outcomes of the project are communicated to managers.
D23CM2	Expected outcomes of the project are communicated by upper management in advance.
D23CM3	Expected outcomes of the project are shared among workers within departments.
D23CM4	Expected outcomes of the project are shared among workers across departments.

Business process reengineering

D25BP1	We design and document important business processes.
D25BP2	We appoint the best managers to be process managers.
D25BP3	We measure our performance based on business process goals rather than functional goals.
D25BP4	Functional managers support business processes.

IT readiness

D26IT1	IT staff is able to configure information systems.
D26IT2	IT staff is able to efficiently implement system upgrades.
D26IT3	IT staff is able to conduct a formal validation of all system changes.
D26IT4	IT staff has high degree of technical expertise.

APPENDIX F: MEASUREMENT ITEMS AFTER THE LARGE STUDY (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

ERP IMPLEMENTATION

Integration

D31IN1 We seamlessly integrate the modules in the ERP system.

D31IN2 We seamlessly integrate all transactions in the ERP system.

D31IN3 We seamlessly integrate the ERP system with supply chain management (customer or supplier relationship) system, using communication protocols and standards.

D31IN4 We seamlessly integrate the ERP system with manufacturing management system, using communication protocols and standards.

Configuration

D32CF3 The ERP system supports the business practices of our company. (Data fit)

D32CF4 The ERP system data items' names and meanings correspond to those used in our company (i.e. a sales order sheet, sales report).

D32CF5 The ERP system user interface is well suited to the business needs of our company.

Adaption

D33AD1 To align with changing organizational needs, we easily alter/append ERP data items.

D33AD2 To align with changing organizational needs, we easily alter/append ERP processes.

D33AD3 To align with changing organizational needs, we easily alter ERP input/output screens.

D33AD4 To align with changing organizational needs, we easily alter ERP reports.

User training

D34UT1 ERP system users are provided with customized training materials for each specific job.

D34UT2 ERP system users are provided training materials that demonstrate an overview of the system, not just help with the ERP screens and reports.

D34UT3 ERP system users attend a formal training program that meets their requirements.

D34UT4 ERP system users are assessed to ensure that they have received the appropriate training.

APPENDIX F: MEASUREMENT ITEMS AFTER THE LARGE STUDY (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

SUPPLIER CAPABILITIES

Information access

D41IC1 Our suppliers are able to retrieve information on their suppliers, customers and competitors.

D41IC2 Our suppliers are able to access in-house databases on products they need.

D41IC3 Our suppliers are able to gather and process data for our product preferences quickly.

D41IC4 Our suppliers are able to gather and process data for fundamental shifts in the purchasing environment quickly.

Process improvement

D42PI2 Our suppliers are able to reduce delays in the distribution process.

D42PI3 Our suppliers are able to reduce paperwork.

D42PI4 Our suppliers are able to reduce wasted time and costs in all internal processes.

Product innovation

D43PN1 Our suppliers are able to develop products with unique features.

D43PN2 Our suppliers are able to improve product quality.

D43PN3 Our suppliers are able to develop products with better performance.

D43PN4 Our suppliers are able to develop new products and features.

APPENDIX F: MEASUREMENT ITEMS AFTER THE LARGE STUDY (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

ORGANIZATIONAL CAPABILITIES

Cross-functional coordination

D51CF1 We are able to work together across functions in our organizations.

D51CF2 We are able to share resources, ideas, and information between functions in our organizations.

D51CF3 We are able to informally work together as a team within our organizations.

D51CF4 We are able to achieve goals collectively within our organizations.

Information access

D52IC1 We are able to retrieve information on suppliers, customers and competitors.

D52IC2 We are able to access in-house databases on product we need.

D52IC3 We are able to gather and process data for customers' product preferences quickly.

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Process improvement

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Product innovation

D54PN1 We are able to develop products with unique features.

D54PN2 We are able to improve product quality.

D54PN3 We are able to develop products with better performance.

D54PN4 We are able to develop new products and features.

Flexibility

D55FL2 We are able to make product mix changes to meet market needs.

D55FL4 We are able to make product changes in design without excessive costs.

D55FL5 We are able to make product mix changes without excessive costs.

D55FL6 We are able to make product volume changes without excessive costs.

Agility

D56AG2 We are able to rapidly respond to natural threats (e.g., natural disaster).

D56AG3 We are able to rapidly respond to competitive threats (e.g., competitor's price change and new market campaign).

D56AG4 We are able to rapidly respond to operational threats (e.g., supply chain disruption).

APPENDIX F: MEASUREMENT ITEMS AFTER THE LARGE STUDY (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

SUPPLIER PERFORMANCE

Short lead time

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D61SL4 Our suppliers minimize the time from order placement to the delivery of procured items.

Product variety

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D62PV2 Our suppliers provide new products with improved performance anytime.

D62PV3 Our suppliers have a wide products offering.

Delivery reliability

D63DR1 Our suppliers fulfill our orders on time.

D63DR2 Our suppliers provide dependable delivery.

D63DR3 Our suppliers fulfill our order quantity.

D63DR4 Our suppliers fulfill our orders accurately.

Cost performance

D64CP1 After introducing an ERP system, our suppliers have lower production unit costs.

D64CP2 After introducing an ERP system, our suppliers have lower material costs.

D64CP3 After introducing an ERP system, our suppliers have lower overhead cost.

Quality

D65QL1 Our suppliers offer products that consistently conform to our specifications.

D65QL2 Our suppliers offer products that are highly dependable.

D65QL3 Our suppliers offer products that are durable.

D65QL4 Our suppliers offer products that have lower defective rates.

APPENDIX F: MEASUREMENT ITEMS AFTER THE LARGE STUDY (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

ORGANIZATIONAL PERFORMANCE

Cost performance

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Delivery reliability

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Time-to-market

D74TM1 We are quick in delivering our product to market.
D74TM2 We are usually first in the market to introduce new products.
D74TM3 We are usually first in the market to make improvements to existing products.
D74TM4 We have time-to-market that is lower than our industry average.

Quality

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D75QL2 We offer products that are highly dependable.
D75QL3 We offer products that are durable.
D75QL4 We offer products that have lower defective rates.

APPENDIX F: MEASUREMENT ITEMS AFTER THE LARGE STUDY (continued)

Note: Respondents were asked to response to the following questions, using the anchor 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, and 6=Not applicable.

CUSTOMER VALUE

Value for money

D81VM1	Our customers perceive that our products offer high value at a low price.
D81VM2	Our customers perceive that our products prices are reasonable.
D81VM3	Our customers perceive that our company reduces prices while providing high-value products.

Convenience

D82CN1	Our customers perceive that they easily receive information on the products they need.
D82CN2	Our customers perceive that they easily purchase the products they need.

Timely response

D83TR1	Our customers perceive that they experience quick customer services such as order fulfillment and delivery.
D83TR2	Our customers perceive that they receive the products they need in time.
D83TR3	Our customers perceive that they receive the information they need when they need it.
D83TR4	Our customers perceive that their complaints are rapidly handled.

Reputation for quality

D84RP1	We have a reputation for better product quality than our competitors.
D84RP2	We have a reputation for better product performance than our competitors.
D84RP3	We have a reputation for products that durable than our competitors.
D84RP4	We have a reputation for products with lower defect rates than our competitors.