ENHANCING BUSINESS PERFORMANCE IN AN ELECTRONIC COMMERCE SETTING: AN EMPIRICAL STUDY

by

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GRADUATE COLLEGE
UNIVERSITY OF NEBRASKA

ENHANCING BUSINESS PERFORMANCE

IN AN ELECTRONIC COMMERCE SETTING:

AN EMPIRICAL STUDY

Qing Cao, Ph.D.

University of Nebraska, 2001

Advisor: Marc J. Schniederjans

Electronic commerce is creating opportunities to rethink business models, processes and relationships along the entire length of the supply chain in pursuit of unprecedented levels of productivity, improved customer propositions and new streams of businesses. Most corporate executives are convinced that the scale and pervasiveness of today's electronic commerce require a fundamental review of business strategy. Operations management researchers also call for substantiating operations strategy research to an electronic commerce environment. However, no empirical research has been found to explore electronic commerce strategic issues using the operations strategy theory.

Drawing on both operations strategy and information systems strategy literature, this research proposed a conceptual framework integrating both operations strategy and information systems strategy models, and then applied the proposed framework to an electronic commerce setting. This research not only provides a conceptual framework to systematically explore electronic commerce strategic issues, but also provides empirical evidence on the relationships between various constructs.

There were several major findings in this research. The first major finding was that operations strategy researchers should build into virtually all research design explicit considerations regarding environment factors. The business environment appeared to have a tangible impact on strategic choices in operations. It also appeared that a link between the business environment and operations strategy helped determine business performance. The second major finding of this research was that the information systems strategic orientation should be considered in conducting operations strategy research in an electronic commerce environment. An information systems strategic orientation appeared to have a direct support in implementing various operations strategy dimensions. It also appeared that an alignment between the information systems strategic orientation and operations strategy influenced business performance. The third major finding suggested that both the business environment and information systems strategic orientation appeared to have direct impact on operations strategy simultaneously. It also appeared that an alignment among the business environment, the information systems strategic orientation, and operations strategy helped determine business performance.

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CHAPTER 1

INTRODUCTION

Electronic commerce is emerging as one of the driving forces in today's economy. According to Forrester Research Institute (2000), business-to-business electronic commerce will hit $2.7 trillion in 2004. While Internet trade between individual partners will continue to flourish, the electronic marketplace will fuel most of the growth – reaching 53% of all online business trade in five years. Business activities for information gathering, shopping, trading, brokerage, banking, accounting, auditing, financing, negotiating, collaborating, marketing, supplying, partnering, training, meeting, scheduling, manufacturing, distributing, servicing, and retailing will be changed thanks to the capabilities of the new information technology (Shaw *et al.*, 1997). In other words, Internet technology has had a profound impact on individual companies and economic sectors. This can be seen not merely in the incredible market capitalization of companies whose business models are rooted in the Internet (e.g., Amazon, eBay, and Yahoo!), but also of companies in the traditional industries (e.g., retailing, banking, and logistics) in the electronic commerce era (Venkatraman, 2000).

Most corporate executives are by now convinced that the scale and pervasiveness of information-driven technological change requires a fundamental review of business strategy (Feeny, 2001). Web-based technology is creating opportunities to rethink business models, processes and relationships along the entire length of the supply chain in the electronic commerce era. Successful electronic commerce strategies translate established strategic concepts into contexts in which they previously were not economically viable.

Although most managers are cognizant of impending changes, the business landscape is fuzzy and fast-changing. There is no definitive understanding of electronic commerce strategy among managers. Some trumpet how they use the Internet to enhance customer service, whereas others point to their success in integrating the physical and digital infrastructures to provide seamless service. Some mention the functionality of the Internet, while others highlight their choice of IT platform (Venkatraman, 2000). As such, a systematic approach to electronic commerce strategy would greatly benefit those in this situation (Riggins and Rhee, 1998). Feeny (2001) suggests a comprehensive map of electronic commerce that incorporates its three domains (operations, marketing, and customer services), and argues that the comprehensive map of electronic commerce can become a platform for exploring the new strategic landscape. According to Feeny (2001), electronic commerce operation opportunities are uses of Internet technology that are directed at strategic change in the way a business manages itself and its supply chain, culminating in the production of its product or service. Operations management literature also suggests that there is a need to investigate the important role operations management (OM) plays in electronic commerce (Geoffrion and Krishnan, 2001; De Figueiredo, 2000; Keeney, 1999; Shaw *et al.*, 1997). To date there exist few conceptual studies addressing electronic commerce strategy from the OM perspective (Han and Noh, 2000; Min and Galle, 1999; Strader and Shaw, 1997). Shaw *et al.* (1997) state that electronic commerce research is multidisciplinary in nature and calls for the integration of operation management and management information system research.

Operations strategy issues have been recently ranked as the most important by managers (St. John *et al.*, 2001; Kathuria, 2000; Ward and Duray, 2000). Technological advances, particularly in information technology (i.e., Internet technology) coupled with globalization are driving changes in manufacturing and service industries in today's electronic commerce environment. Conceptual models and theories that address industrial dynamics, competitive advantage, and inter/intra-organizational processes will likely find more direct application in electronic commerce strategy research as these trends become more pronounced (St. John *et al.*, 2001).

The link between operations strategy and business performance has long been asserted in conceptual work in operation strategy research (Skinner, 1969; Hayes and Wheelwright, 1984). Empirical studies also support this link (Vickery *et al.*, 1993; Ward *et al.*, 1994). More recently, empirical evidence on the nature of the link between environment factors, operations strategy, and performance has emerged (Ward *et al.*, 1995; Williams *et al.*, 1995; Ward and Duray, 2000; Badri *et al.*, 2000). However, the studies mentioned above did not include information systems strategy in their research framework. Moreover, most of these empirical studies were conducted without taking consideration of the electronic commerce environment. Sabherwal and Chan (2001) and Chan *et al.* (1997) studied the fit between operations strategy and information system strategy and its impact on business performance. However, they did not include environment factors in their research framework and these two studies did not consider the electronic commerce environment.

Alignment between business environment, operations strategy, and information strategic orientation is a cornerstone of the success of an electronic commerce company (Venkatraman, 2000). This encompassing study explores electronic commerce research model by focusing on compatibility issues of operations strategies used in the electronic commerce environment, thus linking management information system research with operations management research.

1.1 Purpose of The Study

This study builds on the findings of Ward *et al.* (1995) and Badri *et al.* (2000), and extends their work by incorporating information systems strategy into the research model. Specifically, this study presents a more fully integrated investigation of the link between the business environment, operations strategy, information systems strategic orientation, and business performance in an electronic commerce environment.

This research differs from the work of Ward *et al.* (1995) and Badri *et al.* (2000) in several ways. First, this study explores operations strategy in an electronic commerce setting (i.e. a service setting), while their studies focused on operations strategy in a manufacturing setting. Second, a new conceptual framework is proposed to include information systems strategy orientation as a new construct. Third, the firms surveyed consist of exclusively electronic commerce firms in the U.S. Finally, in addition to standard statistical procedures, this study uniquely provides covariance structure modeling to estimate the resulting path model.

This study not only provides a conceptual model based on the operations strategy literature to uncover a systematic electronic commerce strategic framework, but also provides empirical evidence on the link between the business environment, operations strategy, information systems strategic orientation, and business performance. This research examines the fit between business environment and operations strategy, the fit between information systems strategic orientation and operations strategy, and the impact of both on business performance. The purpose of this study is twofold. First, based on contemporary operations strategy literature, a research model is proposed to illustrate the relationship between environment, operations strategy, information systems strategic orientation, and business performance of electronic commerce firms. Second, empirical evidence is provided to verify the research model, and as such, a systematic electronic commerce strategy is explored.

This research is based on a survey of managers having electronic commerce experience. Data and information gathered from the survey are used to examine the relationship between the business environment, operations strategy, information strategic orientation, and the business performance of electronic commerce firms.

1.2 Definition of Electronic Commerce

Electronic commerce is an emerging concept that describes the process of buying and selling or exchanging products, services, and information via computer networks, such as the Internet (Turban *et al.*, 2000). Electronic commerce can be defined from two perspectives. A narrow view of electronic commerce focuses on the business process of electronic commerce, while a broad view describes the strategic orientation of electronic commerce (Riggins and Rhee,1998).

Laudon and Laudon (2000, p. 25) defined electronic commerce as "the process of buying and selling goods and services electronically involving transactions using the Internet, networks, and other digital technologies." Chase *et al.* (2001, p. 317) provided a similar definition for the term electronic commerce as "the use of computer applications communicating over networks to allow buyers and sellers to complete a transaction or part of a transaction." Applegate *et al.* (1996) considered electronic commerce as "a wide variety of information technology (IT) enabled business transactions" (p. 155). They also argued that electronic commerce is an evaluation process; much is to be learned by exploring early developments in the design and implementation of IT systems that enable communication and sharing information across organizational boundaries.

Turban *et al.* (2001) divided electronic commerce into three categories: (a) business to consumer electronic commerce, (b) business to business electronic commerce, and (c) intra-business electronic commerce. In business to consumer electronic commerce, companies sell directly to consumers over the Internet. The major benefits of business to consumer electronic commerce are increased revenues, the creation of new sources of revenues, and the elimination of costly intermediaries. Business to business electronic commerce means that two businesses make transactions electronically. In business to business electronic commerce, the major benefits include reduced cost, reduced cycle time, increased customer base and sales, and improved customer service. From an intra-business electronic commerce perspective, transactions take place within an organization, in an attempt to increase productivity, speed, quality, and to cut cost.

However, Riggins and Rhee (1998) called for broadening the relatively narrow definition of electronic commerce currently employed by many practitioners and researchers alike. They argued that while the popular literature touted the potential to gain competitive advantage from the use of EDI, the Internet, and intranets, there was little evidence concerning the long-term benefits of those approaches. Hence, a broad view of electronic commerce was needed.

Zwass (1996) provided a more comprehensive view of electronic commerce. He claimed that electronic commerce included not only buying and selling goods, but also various processes within individual organizations that supported that goal. Applegate *et al.* (1999) also considered electronic commerce as more than simply buying and selling goods electronically. They pointed out that electronic commerce involved using network communication technology to engage in a wide range of activities up and down the value-added value chain, both within and outside of the organization. Shaw *et al.* (1997) echoed this broad view of electronic commerce by providing the scope of electronic commerce, which included enterprise management, global electronic commerce infrastructure, interface with consumers, linking with suppliers, and linking with distributors/retailers. A member of predominant management information system practitioners also perceived electronic commerce in a comprehensive way. According to Lou Gerstner, IBM's CEO: "Electronic commerce is all about cycle time, speed, globalization, enhanced productivity, reaching new customers and sharing knowledge across institutions for competitive advantage (Turban *et al.*, 2000, p. 5)."

The comprehensive view of electronic commerce has become the more prevalent definition in management information system research (Riggins and Rhee, 1998), and it serves as the de facto definition of electronic commerce in this study. For the purposes of this study, electronic commerce will be defined as involving not only buying and selling over the Internet, but also servicing customers, collaborating with business partners, and conducting electronic transactions within an organization.

1.3 Research Methodology

Although electronic commerce is not a new phenomenon, the prominent presence of electronic commerce, fueled primarily by the advancement of information technology, has spawned much research interest from academia and business alike. Drawing from operations strategy and information systems strategy literature, this study aims at identifying a systematic electronic strategy framework, and empirically testing the model proposed; thus adding value to the research in practice of electronic commerce.

The research discussed in this dissertation consists of two phases: (1) research framework, and (2) an empirical survey. Phase one provides a conceptual framework of electronic commerce strategy research. The research framework is prepared through the analysis of previous research and studies of relevant areas such as generic operations strategy, information systems strategy, and various electronic commerce aspects. Research questions, the theoretical foundation, and hypotheses are developed in this phase.

The empirical survey includes three phases: (1) item generation, (2) pilot study, and (3) data analysis. The questionnaires were sent out to 800 executives in six industries (business consulting, commercial banking, computer software, IT hardware, retailing, and logistics) based on www.referenceusa.com and SIC codes. Out of 202 responses received in a single mailing, 166 were usable resulting in a response rate of 21%. Following Gerbing and Anderson's (1988) paradigm on testing models, the construct model is tested first, followed by testing of the structural model – path analysis. The construct model is examined using exploratory as well as confirmatory techniques.

1.4 Organization of the Dissertation

This dissertation consists of six chapters: (1) introduction; (2) literature review; (3) theoretical foundation, and hypotheses; (4) research methodology; and (5) results and discussion; and (6) conclusions and managerial implications.

Chapter 2 reviews operations management literature on electronic commerce, operations strategy literature, and information systems strategy literature. While relevant electronic commerce research provides the necessary guidelines for this study, the operations strategy model and information systems strategy framework are combined to serve as the theoretical foundation of this dissertation in Chapter 3. Chapter 3 also presents hypotheses based on the literature review.

Chapter 4 discusses research methodology. This chapter presents the instrument development process including: (1) item generation, (2) pilot study, and (3) data analysis. The data analysis section of this chapter includes data preparation and instrument validation.

Chapter 5 presents the results of the data analyses, as well as descriptive statistics regarding sample information. The hypotheses are tested through statistical methods including structural equation modeling and other techniques.

Finally, Chapter 6 provides a summary of the research and discusses the managerial implications, contributions of this research, and limitations, and concludes the study by suggesting future research directions.

CHAPTER 2

LITERATURE REVIEW

This study explores electronic commerce from an operations management perspective, specifically from the operations strategy research arena. In this section, operation management literature on electronic commerce and other relevant electronic commerce literature are reviewed. The findings of previous studies are briefly discussed as a foundation of the current study. Operations strategy and IS literature is then surveyed to establish linkages between business environment, operations strategy, information systems strategy, and business performance.

2.1 Operations Management Literature on Electronic Commerce

Due to the dominance of electronic commerce in today's economy, electronic commerce research has increased drastically in the past few years. According to Geoffrion and Krishnan (2001), operations management (OM) plays an important role in electronic commerce research. Feeny (2001) presents a comprehensive map of OM research opportunities in the electronic commerce era. The OM research opportunities include supply chain management, procurement, business process reengineering, product and process design, and operations strategy.

The review of OM literature on electronic commerce proceeds as follows. It starts with supply chain management research on electronic commerce. Then, it presents electronic commerce procurement literature (e.g., E-purchasing, Internet-based EDI, etc.)

Next, product and process design literature on electronic commerce is surveyed. Finally, operations strategy research on electronic commerce is presented.

2.1.1 Supply Chain Management and Electronic Commerce

The use of Internet technologies to manage information is a substantial improvement over traditional information systems and conventional uses of the Web (Turban *et al.*, 2001; Venkatraman, 2000; Applegate *et al.*, 1996). Information and communication technologies are forcing managers to rethink and reshape their business strategies, their use of technology, and their relations with suppliers and customers. Information systems in this electronic commerce era allow transactions to be conducted in an integrated and enlarged information space by removing constraints imposed by diverse computing platforms, networks, and applications (Isakowitz *et al.*, 1998; Lederer and Sethi, 1998), thereby transforming supply chain management (Cross, 2000).

Clark and Stoddard (1996) explored supply chain management coordination issues in electronic commerce. They argued that electronic commerce linkages were being created between independent organizations in multiple industries, including manufacturing, financial services, transportation, and retailing. Findings of their research suggested that participating firms could gain dramatic benefits from establishing an electronic linkage only when the system was used to increase interdependence and to expand coordination between firms involved in the new inter-organizational relationship. Drawing on the theoretical and empirical research on electronic communications and inter-firm designs, they developed and empirically tested a model explaining the relationship[s] among performance, interdependence, and coordination of firms involved in inter-organizational relations within the U.S. grocery channel. Both qualitative and quantitative findings indicated that channel performance, interdependence, and coordination were closely related for firms in inter-organizational relationships.

Recognizing the importance of information systems infrastructure in electronic commerce, Yang and Papazoglou (2000) examined supply chain management from an architectural framework standpoint. They claimed that today the boundaries of organizations are more fluid than previously, and that supply chain management forced companies to streamline the ways they manufactured, distributed, and sold products, which ultimately would improve the way organizations conducted business. They argued that an architectural framework that permitted flexibility, interoperability, and openness was needed for electronic commerce applications. They described the critical elements of interoperability in the context of electronic commerce and integrated value chains. They further discussed current development trends and expectations for electronic commerce research employing supply chain management.

Cheng *et al.* (2001) proposed a model for an electronic commerce infrastructure that could be used to support supply chain activities in construction. In their study, a virtual network structure that acted as a value-added component of an electronic commerce infrastructure was used to improve communication and coordination, and also to encourage the mutual sharing of inter-organizational resources and competencies. The electronic commerce infrastructure used to support the proposed network structure, as well as the human, organizational and cultural barriers that might be encountered were presented and discussed. They argued that the proposed electronic commerce model would not only benefit those organizations operating in the construction supply chain, but also might fit other types of business-to-business electronic commerce in situations where cooperation between business partners was necessary for improving organizational performance and gaining a competitive advantage.

According to Graham and Hardaker (2000), good supply chain management is essential for a successful company. Supply chain management can reach beyond the boundaries of a single company to involve sharing that information between suppliers, manufacturers, distributors, and retailers. This is where the Internet plays a central role. Shifts towards the development of a virtual supply-chain architecture dramatically emphasize the importance of knowledge and intellect in creating value. Adoption of an integrated approach throughout the supply chain requires trade-offs in a unique balance of autonomy and control, a balance that must be developed and maintained for each supply partner relationship. Electronic commerce communities can target new markets, by offering low entry costs, relatively minimal complexity with more flexibility, and a convenient way of transacting business. The trend toward outsourcing and strategic alliances in most industries provides an added impetus to support the sharing of supplier, customer, and corporate information that was once proprietary, with competitors and other cross-industry players (Bhatt and Stump, 2001).

2.1.2 Procurement and Electronic Commerce

The increased popularity of electronic commerce in procurement is due to a multitude of operational benefits it can bring to purchasing practices. Examples of these benefits are cost savings resulting from reduced paper transactions, shorter order cycle time and the subsequent inventory reduction resulting from speedy transmission of purchase order related information, and enhanced opportunities for the supplier/buyer partnership through the establishment of a web of business-to-business communication networks.

Through empirical survey research, Min and Galle (1999) investigated factors that influenced purchasing professionals' willingness to adopt or utilize an electronic commerce purchasing system, while determining the most suitable electronic commerce purchasing strategy for a particular organizational setting. In so doing, their research fostered a practical electronic commerce purchasing strategy as it related to a particular organizational setting, while addressing concerns of security and legality. Their findings suggested that the buying firm with large purchase volumes was a heavy user of electronic commerce, and was likely to force its suppliers into the electronic commerce network. Their study also pinpointed the fact that such a firm wanting its suppliers to join the electronic commerce network would not necessarily provide appropriate support for its non-electronic commerce capable suppliers. Finally, they claimed that while the level of a buyer's EC knowledge was factored into its electronic commerce usage, the buyer was really concerned about the potential security risk involved in electronic commerce usage. Nevertheless, they argued that such a security risk alone did not seem to be viewed as an insurmountable obstacle for EC applications.

One of the electronic commerce categories is business to consumer electronic commerce (Turban *et al.*, 2001). Consumer purchasing behavior plays a crucial role in this type of electronic commerce. By comparing purchasing behavior between potential electronic commerce buyers and non-electronic commerce buyers, Phau and Poon (2000) investigated business to consumer electronic commerce in Singapore. It was found that the classification of different types of products and services would significantly influence the consumer choice between a retail store and an Internet shopping mall. The types of products and services that were suitable for selling through the Internet were also identified. Their findings showed that generally products and services that had a low financial outlay were frequently purchased at a brick-and-mortar store, while products and services that had intangible value and relatively high differentiation were more likely to be purchased via the Internet. Their findings also concurred with Simeon's (1999) results, which indicated that electronic commerce shoppers exhibit demographic and psychographic differences.

Before electronic commerce became synonymous with Internet-based commerce, electronic commerce meant electronic data interchange. EDI, a technology that enables corporations to exchange data electronically with their suppliers, has been in use for more than 20 years, and major manufacturers, retailers, and others have spent tens of millions of dollars each year in an ongoing campaign to establish it as the de facto standard for communication. Reality, however, has seen this objective fall significantly short of success. As a new generation of Internet-based technologies emerges, promising to improve the supply chain, many observers leap to the conclusion that EDI is on its way out (Sawabini, 2001). Attention has shifted from electronic data exchange-integration with third parties toward two other areas: (1) stronger integration between heterogeneous systems of a particular company, and (2) applications for electronic commerce, leveraging the Internet (Wortmann, 2000). Esichaikul and Chatiya (1999) presented a research framework for the selection of an electronic data interchange (EDI) third-party network. They also proposed a possible communication means to implement EDI, major factors in selecting EDI communication means, and the criteria for EDI third-party network selection.

Segev *et al.* (1997) argued that the Internet appeared to be a cheap, efficient, and ubiquitous channel for transmitting electronic data interchange (EDI) transactions. Their research contrasted two strategies for implementing Internet-EDI systems. The first strategy was popularized by McKesson, which treated its Internet-EDI system as a traditional information systems development project. The second strategy was used by Bank of America, which built its Internet-EDI system using a prototyping approach. The conditions in which either approach might be appropriate in terms of project goals, time constraints, environmental uncertainty, and organizational structures employed were discussed in the research (Segev *et al.*, 1997). Moreover, they suggested that emerging Internet-EDI applications could transform trading partners' relationships by reducing the import of EDI-capability as a competitive asset.

2.1.3 Process and Production Design and Electronic Commerce

Internet technology is changing the way companies carry out process and product design (Chase *et al.*, 2001). Wells (2000) examined factors affecting the implementation of business process re-engineering (BPR) projects using Internet technology. He argued that each information technology (IT) used during BPR implementation might affect managerial factors differently, and that by determining factors that affected BPR implementation using a specific IT, these factors could be managed to increase the chance of a successful BPR implementation. The factors examined in the research were: egalitarian culture, resource management, resistance management, and change management. The findings of the study suggested that the BPR project team should take control of the reengineering effort and that BPR projects using Internet technology could dramatically change how an organization functioned. The findings also showed that regardless of how successful the implementation of the reengineered system using Internet technology was, there was no great need for additional resources. Moreover, the results indicated that adoption and use of Internet technology might prevent employee's resistance by allowing them to easily acquire the skills necessary to work with the BPR projects.

Electronic commerce technologies provide effective and efficient ways in which corporate buyers can gather information rapidly about available products and services, evaluate and negotiate with suppliers, implement order fulfillment over communications links, and access post-sales services. From the supplier side, marketing, sales, and service information is also readily gathered from customers. Building and maintaining customer relationships is the key to success in e-commerce, and unless service is maintained, customer loss may result, more than offsetting any cost efficiencies gained by introducing electronic commerce technology. Since the core of electronic commerce is information and communications, support for managing customer relationships is available to those who know how to use it. Archer and Yuan (2000) examined how technology could be used to encourage and facilitate customer-business relationships. The findings of their study demonstrated through a customer relationship life cycle model, how the management of related procurement functions in customer companies could be adjusted to take advantage of these relationships.

Park (1999) proposed an intelligent design system environment through agent-based collaborative support via the Internet. This proposed system exchanged process-related features, capabilities and constraints among design and manufacturing agents. The system, which could enhance manufacturing product development, emphasized the consideration of elements related to process planning and manufacturing concurrent with product design, to materialize the design for manufacturability. In doing so, the Internet based system supported the concurrent engineering concept of product and process design.

Accelerating the process by which new products are introduced to the marketplace has become a strategic imperative in many markets. An emerging precondition for new-product development success is the integration of information technology with innovative management practices. Howe *et al.* (2000) explored how the integration of Internet and Intranet applications with the stage-gate process could support and accelerate new product development. This research provided insight into the key role Internet technology could play in facilitating information dissemination, process improvements, reductions in time and costs, and improved project management.

During the past two decades both business managers and academic researchers have shown considerable interest in information system (IS) networks including the Internet, and their effect on business processes and performance. Bhatt and Stump (2001) built on this interest to examine the nature of IS networks and business process improvement initiatives (BPII), and to delineate the process by which IS networks influenced BPII. A model was developed to elaborate on the interrelationships between these two constructs along with two key contextual antecedents (management support and information intensity). The findings of the study indicated that while network connectivity and flexibility were found to be significantly related to process improvement initiatives, network flexibility had no significant effect on customer focus. Information intensity was also found to be significantly related to BPII and partially mediated by network flexibility with regard to process improvement initiatives.

Internet technology has been increasingly used to support various aspects of the product development process. Huang (1999) demonstrated design for manufacture and assembly (DFMA) techniques on the Internet. In his research, an experiment was conducted to show how a well-known design for assembly technique could be converted into a web-based version that was functionally equivalent to its version on a standalone workstation. The web-based client-server architecture was found to be attractive for collaborative DFMA. The findings of the research suggested that the client-side web scripting could be exploited to develop generic frameworks for developing and applying different designs for X (DFX) techniques. In addition, web-based DFX techniques provided more opportunities for integration with other decision support systems such as computer-aided design.

2.1.4 Quality Management and Electronic Commerce

As quality management has become increasingly important, linking quality management efforts to customer wants and needs has also expanded. For consumer product manufacturers this has resulted in a need to develop more direct links to the customer. Anecdotal reports indicate that firms are beginning to tap into Internet discussions as a source for this type of information (Shaw *et al.*, 1997). Finch (1999)

suggested a set of fundamental objectives to describe the bottom line consequences of concern to EC. According to Keeney (1999), the fundamental objectives included the overall objective (maximizing customer satisfaction), maximizing product quality, minimizing cost, minimizing time to receive product, maximizing convenience, minimizing time spent, maximizing privacy, maximizing shopping enjoyment, maximizing safety, and minimizing environment impact. The contribution of the study is that it provides an instrument for measuring operations strategy in an electronic commerce setting. Although anecdotal evidence supported Keeney's conceptual framework, empirical study is needed to test the framework proposed.

Bauer and Colgan's (2001) study focused on Internet strategy and its place in the corporate competitive strategy. The purpose of their study was to explore the relationship between the generic and Internet strategies of retail institutions in the financial services industry and thus determine whether there existed an alignment between them. The corporate competitive strategy was conceptualized through Michael Porter's generic strategies: differentiation, cost leadership and focus. Three Internet strategies were proposed: (1) proprietary strategy – implement their own Internet applications and data interfaces; (2) open strategy – the user interface (through Quicken or Money) is identical, regardless of which financial institution the consumer is banking with; and (3) denial strategy – choose not to offer online transactional services over the Internet, but will most likely still operate a small website with some information for advertising and public relation purposes. However, the results of the study indicated that there was no connection between corporate strategy and Internet strategy in the proposed model.

2.1.6 Other Related Electronic Commerce Literature

This section presents the literature on critical success factors in electronic commerce from other perspectives, i.e., marketing aspects (De Figueiredo, 2000), microeconomic theory (Grover and Ramanlal, 1999), strategic aspects (Evans and Wurster,1999; Raghunathan and Madey,1999), and critical failure factors (Han and Noh, 2000). Finally, the electronic commerce literature is summarized and the motivation of this study is presented.

Marketing Aspects

De Figueiredo (2000) studied critical success factors (CFCs) of electronic commerce (EC) companies (web retailers) from a marketing research standpoint. He argued that, to sustain a competitive advantage, Web retailers must align their strategies with product characteristics and buying practices of customers in their market segment. He proposed a conceptual framework that divided the EC retail market into four segments on the basis of the types of goods sold and the strategies needed to succeed in each segment examined. However, his research did not provide empirical evidence to support the research framework proposed in his study.

Microeconomic Theory

Grover and Ramanlal (1999) studied the electronic commerce environment using microeconomic theory. They pinpointed the fact that electronic commerce was driven by customized mass production. The study was framed in terms of six myths and counter-myths of information technology and effective markets. On one hand, the study provided a conventional view of how increased customization and outsourcing, open architectures, a larger customer base, and low price guarantees in the electronic commerce environment would benefit the buyer. On the other hand, the study pointed out that the counter-myths illustrated the means that suppliers in electronic commerce may employ to extract consumer surplus. The contribution of their study was to link the electronic commerce environment with information system strategy and performance conceptually. However, without providing empirical evidence to support the proposed theories, their study has a limited managerial implication.

Strategic Aspects

Evans and Wurster (1999) pointed out that a second generation of electronic commerce was emerging. They argued that the key players, i.e., branded goods suppliers, physical retailers, electronic retailers, and pure navigators in the second generation of EC would shift their attention from claiming territory to defending or capturing it. In other words, the second generation of electronic commerce would be shaped more by strategy than by experimentation or implementation of information technology.

Raghunathan and Madey (1999) examined the fact that many firms failed to properly plan their electronic commerce information system infrastructure before embarking on electronic commerce. They argued that poor planning was often attributed to the lack of a framework. They proposed a firm-level framework that integrated several themes and recent concepts from the discipline of information systems. The proposed framework included six components -- organizational EC strategy, business processes transformation, information technology management, information management, customer management, and organizational knowledge management. The framework emphasized the significance of framework components and their interrelationships to planning an electronic commerce information system infrastructure. However, their study only proposed a conceptual framework and did not provide empirical evidence to support its claims.

Critical Failure Factors

Han and Noh (2000) analyzed the factors that discouraged the growth of EC even when rapid growth could be expected due to increased Internet use. The goal of their research was to identify the critical failure factors (CFFs) that counteracted the growth of EC and to suggest possible strategies to overcome them. The paper investigated why EC sometimes failed to appeal to customers despite promising plans by investigating inverted critical success factors – critical failure factors. The authors examined possible obstacle factors of EC discussed in the literature and conducted an empirical examination. Several hypotheses were developed to determine which factors were the critical failure factors that discouraged EC growth. Alternative strategies to encourage growth in electronic commerce were also suggested in their studies. Nevertheless, their study did not present empirical evidence for the alternative strategies proposed.

2.1.7 Literature Summary and Motivation of This Study

This literature review has examined previous studies on electronic commerce from different operations management aspects and related areas. The majority of the literature is conceptual-based or exploratory in nature, especially operations strategy literature on electronic commerce, and thus the managerial implications of these studies are limited. Most of the previous studies did not provide a systematic framework to guide business practices in electronic commerce, and such frameworks are greatly needed in the real business world (Afuah and Tucci, 2001). Moreover, most of the studies lack theoretical foundation and empirical evidence (Venkatraman, 2001; Yang and Papazoglou, 2000; Shaw *et al.*, 1997).

This study takes a more comprehensive view of electronic commerce, that is, electronic commerce should be used to support the total delivery of products and services to the customer rather than just function as another marketing tool. Drawing upon both operations strategy and information systems strategy literature, this study proposes a systematic research framework to explore electronic commerce from a strategic alignment standpoint. This study further provides empirical evidence to support the research framework proposed using an empirical survey. As a result, this study will expand operation management literature on electronic commerce, and electronic commerce research as a whole.

2.2 Operations Strategy Literature

Operations strategy research plays an important role in the operations management field, especially at the dawn of the new millennium, when tremendous changes have impacted the global economy (St. John *et al.*, 2001). Many of these changes are driven by technology, particularly Internet technologies; and in most cases today's firms are already grappling with their effects. Thus, there is a great need to explore electronic commerce from an operations strategy perspective (Geoffrion and Krishnan, 2001). This section reviews relevant operations strategy literature.

There are many studies on the content of operation strategies (Badri *et al.*, 2000; Ward and Duray, 2000; Kathuria, 2000; Youndt *et al.*, 1996; Ward *et al.*, 1995; Miller and Roth, 1994; Adam and Swamidass, 1989; Wheelwright, 1984; Skinner, 1969). Miller and Roth (1994) identified three strategic groups of manufacturers with similar manufacturing tasks, which they labeled caretakers, marketers, and innovators. For each manufacturing group, the relationships between the competitive capabilities, the business context, manufacturing activities, and manufacturing performance measures were explored and compared. They argued that although there was an industry effect, all three manufacturing strategy types were observed in various industries. The two main dimensions along which the manufacturing strategy groups differ, were the ability of the firms in them to differentiate themselves from competition with their products and services, and the scope of their product lines and markets.

Youndt *et al.* (1996) examined the moderating effect of different operation strategies on the human resource systems-performance relationship by cluster-analyzing 97 manufacturing companies across four operation strategies orientations (quality, delivery flexibility, scope flexibility, and cost). Their analysis yielded five groups of manufacturers, which they labeled by the emphasis on corresponding operation strategies. However, they did not find these strategy clusters to have any direct impact on operation performance as captured by self-reported measures of product quality, employee productivity, on-time delivery, and equipment utilization.

More recently, to avoid the limitations of previous operations strategy research that focused on specific relationships among a few constructs, Kathuria (2000) developed a taxonomy based on the content of operations strategy (i.e., competitive priorities). Findings of his study suggested that different groups of manufacturers emphasized different sets of competitive priorities, and that different groups of manufacturers appeared to perform better on certain performance measures that were consistent with their focus. However, Kathuria (2000) ignored environmental factors in his research.

There are a few studies on the alignment between environmental factors and operations strategy. Swamidass and Newell (1987) established the importance of the business environment as a significant causal element in the operations strategy – business performance nexus. They concluded that flexibility was a function of environmental uncertainty and the higher the flexibility, the better the performance. They argued that an organization might find help in coping with uncertainties by increasing manufacturing flexibility and by maintaining the role of manufacturing managers in strategic decision-making. Bourgeois (1985) considered that the fit between environment and organizational capabilities and resources is a central tenet of major strategic management paradigms. Examination was made of the relationship between top management perceptions of uncertainty, corporate goal structures, and industry volatility in explaining economic performance in 20 firms. The findings indicated that attempts to avoid true environmental uncertainty, and to seek high levels of goal congruence might be dysfunctional. However, in an exploratory study, Pagell and Krause (1999) found, contrary to most of the literature, that environmental uncertainty was not always a driver of flexibility. Moreover, they found that matching flexibility to the level of environmental uncertainty did not lead to a performance advantage.

In their review of the operations strategy literature, Anderson *et al.* (1989) proposed the hypothesis that a company would perform better if it linked its operations strategy to its business strategy. Tracey *et al.* (1999) examined the effect of the fit between advanced manufacturing technology and operations strategy on performance. The results indicated that firms with a high level of manufacturing technology, and a high level of manufacturing manager's participation in strategy formulation, had high levels of competitive capabilities and improved performance. Smith and Reece (1999) defined and measured the concept of fit as it applied to operations strategy. They further investigated the interrelationships between business strategy, operations strategy, productivity, and performance. The findings of their study suggested that the fit between operations strategy and business strategy was of greater importance than the particular choice of strategy, and that the fit had a significant positive and direct effect on business performance. Using survey responses from 160 U.S. manufacturing firms, Kotha and Swamidass (2000) investigated the relationship between operations strategy, advanced manufacturing technology (AMT) use, and business performance. The findings of their study suggested that a fit between certain business strategies and AMT dimensions was associated with superior performance.

Ward and Duray (2000) examined the relationship between environment, competitive strategy, manufacturing strategy, and business performance. Their study demonstrated that the strategic linkages in manufacturing businesses were clearer among good performers than poor performers. The findings of their study also suggested that competitive strategy acted as a mediator between an organization's environment and its manufacturing strategy, and that the relationship between competitive strategy and performance is mediated by manufacturing strategy.

Ward *et al.* (1995) investigated the relationship between environmental factors, operations strategy, and business performance by surveying 1000 firms in Singapore. Their research suggested that environmental concerns appeared to have a substantial impact on operations strategy, and that good performers adopted different operations strategies in response to environmental stimuli than did poor performers. Their study verified the notion by Bourgeois - that the fit between environment and organizational capabilities was a central tenet of each of the major strategic management streams (Bourgeois, 1985). Badri *et al.* (2000) extended the study of Ward *et al.* (1995) to a different environment, the United Arab Emirates, and expanded the environment dimension to include other variables, such as government regulations and political effects. Their study concurred with the findings of Ward *et al.* (1995), and suggested that proper environmental considerations should be a part of any operations strategy framework.

One of the caveats of operations strategy research lies in neglecting the impact of information system strategy in the conceptual framework. Moreover, it appears that there has been no empirical research to date that applies operations strategy to the context of electronic commerce.

2.3 Information Systems Strategy Literature

Information systems strategy is integral to business strategy, and the focus of information systems strategy is on alignment with business strategy (Levy and Powell, 2000). Blili and Raymond (1993) showed that information systems strategy in companies became more critical as technology became more central to companies' products and processes, and that the information systems strategy needed to be integrated with the business strategy. Without an alignment between information systems strategy and business strategy, it is likely that information systems will be developed in a piecemeal manner, neither contributing to strategic vision nor enhancing organizational flexibility to respond to market changes (Avison *et al.*, 1998). Earl (1996) also argued that information systems strategy needed to change in respond to the business environment. According to Levy *et al.* (1998), firms adopting information systems without considering business strategy are unlikely to gain business benefits. King and Teo (1997) attempted to establish and test relevant benchmark variables that could assist in identifying and predicting the stage of business strategy and information systems strategy integration. The results of their study supported the stages of growth model of business strategy. Information systems strategy integration and benchmark variables were found to be successful in predicting the stage of integration.

A string of information systems strategy research also addressed the fit between operations strategy and information systems strategic orientation, and the impact of that fit on business performance (King, 1987; Wiseman, 1988; Reich and Benbasat, 1996; Chan *et al.*, 1997; Chan *et al.*, 1998; Reich and Benbasat, 2000; Sabherwal and Chan, 2001).

Chan *et al.* (1997) proposed a conceptual model that illustrated links between operations strategy, information systems strategic orientation, and business performance. Their study presented survey instruments developed to operationalize these constructs, and described the results of empirical tests of the measurement and structural models. Findings of their research suggested that companies with high IS strategic alignment were better performing companies. Although the findings implied that there were "several ways to win," alignment between operations strategy and information systems strategic orientations was linked to business performance.

Chan *et al.* (1998) examined the realized information systems strategy (the existing uses of information technology in organizations), operations strategy, and performance. The objective of their study was to develop valid and reliable means of quantifying how information technology was actually used by organizations to provide support for business operations. Their research suggested that the fit between realized information systems and operations strategy had a positive impact on business performance. However, the information systems research in this area did not include environmental factors.

Reich and Benbasat (2000) investigated factors that influenced the social dimension of alignment (the social dimension of alignment refers to the state in which business and IT executives understand and are committed to the business and IT mission, objectives, and plans) between business and information technology objectives. They argued that the establishment of strong alignment between information technology (IT) and organizational objectives was one of the key concerns of information systems managers. This paper presented findings from a study which investigated the influence of several factors on the social dimension of alignment within 70 business units in the Canadian life insurance industry.

Sabherwal and Chan (2001) studied the alignment between business strategy and information systems strategy, which was widely believed to improve business performance. They examined the impact of alignment on perceived business performance using Miles and Snow's popular classifications of the Defender, Analyzer, and Prospector business strategies. A priori theoretical profiles for these business strategies were developed using Venkatraman's (1989) measure of business strategy. Theoretical profiles for IS strategies were developed in terms of four types of systems – operational support systems, market information systems, strategic decision support systems, and inter-organizational systems. Empirical data from two multi-respondent surveys of 164 and 62 companies were analyzed. Results indicated that alignment affected perceived business performance, but only in some organizations. Alignment appeared to influence overall business success in Prospectors and Analyzers but not in Defenders.

In this study, a comprehensive conceptual framework is proposed based on both information systems research and operations strategy research. The framework explores the relationship between environmental factors, information strategic orientation, operations strategy, and business performance in an electronic commerce setting.

CHAPTER 3

THEORETICAL FOUNDATION, RESEARCH MODEL, AND HYPOTHESES

As mentioned in the previous chapter, most electronic commerce research is conceptual-based and lacking in empirical evidence (Venkatraman, 2001; Yang and Papazoglou, 2000; Shaw *et al.*, 1997). Moreover, most of the previous electronic commerce research is fragmented in nature, and hence there is a great need to develop a systematic approach to electronic commerce research (Afuah and Tucci, 2001). Although operations strategy research is based on a solid theoretical foundation, none of the previous studies in operations strategy research address the effects of information systems strategy on operations strategy and business performance. More importantly, there is no empirical operations strategy research on electronic commerce.

In contrast to previous research, this research applies operations strategy theory while incorporating one of the elements of the information systems strategy model – information systems strategic orientation to an electronic commerce environment. In this research, the linkages among business environment, operations strategy, information systems strategic orientation, and business performance are considered simultaneously using empirical evidence.

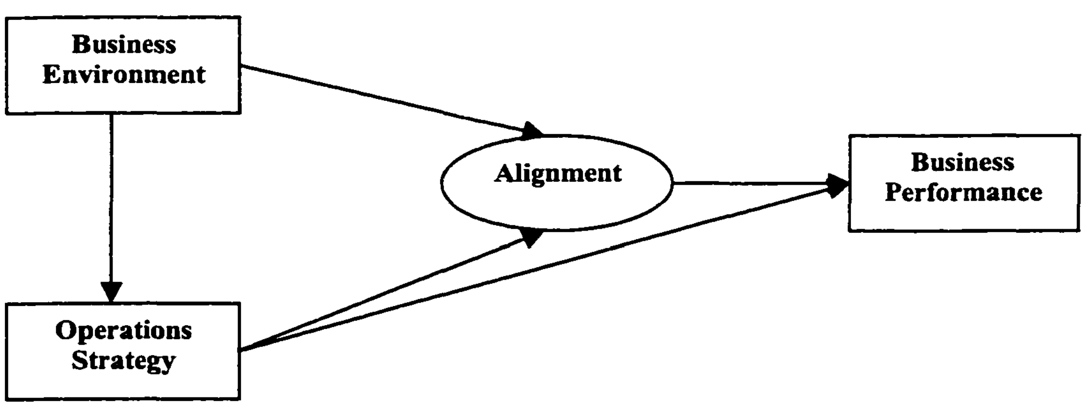
This chapter elaborates the theoretical foundation of this research, presents a research framework for electronic commerce research, and proposes a set of the hypotheses of this research.

3.1 Operations Strategy Theory

The operations strategy theory initially developed by Skinner (1969) is the predominant conceptual framework in operations strategy research (Ward and Duray, 2000; Badri *et al.*, 2000; Ward *et al.*, 1995; Cleveland *et al.*, 1989). It is the theoretical foundation for studies that examine the impact of operations strategy on performance. As a result, the operations strategy model serves as the theoretical foundation of this study. Figure 3.1 depicts the operations strategy model. The initial operations strategy model proposed by Skinner (1969) has three constructs including business environment, operations strategy, and business performance. The model prescribes links among the business environment, operations strategy, and business performance. According to Skinner (1969), environment factors influence managers' selection of the operations strategy, and the alignment (fit) between environment factors and operations strategy has a positive impact on the business performance.

Ward *et al.* (1995) and Badri *et al.* (2000) empirically tested the operations strategy model in two different countries, and results of both studies verified the conceptual framework proposed by Skinner (1969).

Figure 3.1: Operations Strategy Model



3.1.1 Business Environment

The business environment has been studied extensively in the operations management field. There are various concepts and measurements of the business environment proposed by different authors (Pagell and Krause, 1999). For instance, Kotha and Orne (1989) looked at what they described as organization's scope, which included a firm's geographic scope, market and customers. Wernerfelt and Karani (1987) defined environmental uncertainty as having four dimensions: demand, supply, competitive, and external. Swamidass and Newell (1987) used perceptual measures to address a company's ability to predict elements of their environment such as competitors, customers, and suppliers. Aldrich (1979, p. 132) developed a conceptual framework of environmental dimensions that are consistent with both resource-based and population ecology views of organizations. Dess and Beard (1984) used empirical methods and archival data, based primarily on transactions between firms and their environments, to reduce five of Aldrich's original six dimensions to three orthogonal environmental factors: munificence, dynamism, and complexity. The most comprehensive business environment measurement was proposed by Ward *et al.* (1995). They argued that the business environment was multidimensional, and included business cost, labor availability, competitive hostility, and dynamism. Environment dynamism refers to the degree of turbulence in products, technologies, and the demand for products in a market (Dess and Beard, 1984). Table 3.1 provides a set of scale items to measure the business environment construct proposed by Ward *et al.* (1995). This set of items addresses perceptions of the environment. It is noted that perceptions of the environment are more important than the actual environment (Swamidass and Newell, 1987).

Table 3.1: Business Environment Measurement (Ward *et al.*, 1995)

Items used to assess the business environment
Business costs
Rising labor cost
Rising material cost
Rising transport cost
Rising telecommunication cost
Rising utilities cost
Rising rental cost
Rising health care cost
Strong Singapore dollar
Labor availability
Shortage of managerial and administrative staff
Shortage of technicians
Shortage of clerical and related workers
Shortage of skilled workers
Shortage of production workers
Inability to operate a third shift
Competitive hostility
Keen competition in local markets
Keen competition in foreign markets
Low profit margins
Declining demand in local markets
Declining demand in foreign markets
Producing to the required quality standards
Unreliable vendor quality
Scored on a five-point Likert scale: 1 = unimportant; 5 = important
Dynamism (rate of change)
Rate at which products and services become outdated
Rate of innovation of new products and services
Rate of innovation of new operation processes
Rate of change in taste and preferences of customers
Scored on a five-point Likert scale: 1 = slow; 5 = rapid

In addition, Bluedorn (1993) argued that perceptual measures of the business environment had dominated tests of structural contingency theory. Badri *et al.* (2000) included government regulations in the environment factors, and claimed that government regulations interacted with operations strategy. They also included political factors in the environment factors, in that their study was done in a third world country in which political factors were predominant in business dealings.

3.1.2 Operations Strategy

The most commonly stated operations strategy taxonomy identifies cost, quality, delivery, and flexibility as important dimensions of operations strategy or competitive priorities (Kathuria, 2000; Ward and Duray, 2000; Badri *et al.*, 2000; Ward *et al.*, 1995; Hill, 1994; Swamidass and Newell, 1989). Ward *et al.* (1995) pointed out that the four competitive priorities were each multidimensional; capturing the various dimensions required multiple items on a survey for each competitive priority.

Cost strategy

Stonebraker and Leong (1994, pp. 45) defined cost strategy as "the production and distribution of a product with a minimum of expenses or wasted resources such that you have a cost advantage in the market." If a company has chosen the cost strategy approach, it is indicated by the emphasis placed on reducing unit costs, material and overhead costs, or inventory reduction (Ward *et al.*, 1995). In other words, cost strategy needs to be measured by multi-items associated with lowing the costs.

Quality Strategy

Stonebraker and Leong (1994, pp. 45) define quality strategy as "the manufacture of products/services in conformance with specifications, or meeting customer needs." Quality strategy is multi-dimensional. Table 3.2 shows the eight dimensions of quality proposed by Garvin (1987). Flynn *et al.* (1994) developed a set of 14 perceptual scales to measure product quality based on the seven dimensions of quality management identified in their paper. The proposed scales were then tested and found reliable and valid, and were widely adopted by operations management researchers for hypothesis testing, and also by practitioners for assessing quality management practices (Kathuria, 2000).

Table 3.2: Eight Dimensions of Quality

	Dimensions of Quality	Functions
Performance	A product's primary operating characteristics	Design
Features	Secondary characteristics	Design
Conformance	The probability of a product malfunctioning within a given period	Manufacturing
Durability	A measure of a product's life in terms of both its technical and economic dimensions	Design
Serviceability	The ease of servicing (planned or breakdown) to include the speed and provision of after-sales services	Design and after-sales
Aesthetics	How the final product looks	Design
Perceived Quality	How a customer views the product	Marketing and Design
Source: Garvin, D.A. "Competing on the Eight Dimensions of Quality," *Harvard Business Review*, Nov-Dec, 1987, pp. 101-119.		

Delivery Strategy

Delivery strategy consists of two components – delivery reliability and delivery speed (Chase *et al.*, 2001; Lee and Schniederjans, 1994; Hill, 1994). According to Hill (1994), delivery reliability or on-time delivery might constitute an order-losing sensitive qualifier, while delivery speed might win orders for company through its ability to deliver more quickly than competitors. This is extremely true in the electronic commerce era (Feeny, 2001). Stonebraker and Leong (1994, pp. 46) give a formal definition of delivery strategy as "the dependability in meeting requested and promised delivery schedules, or speed in responding to customer orders". Instrument of delivery strategy was provided by several authors (Ward and Duray, 2000; Badri *et al.*, 2000; Ward *et al.*, 1995).

Flexibility Strategy

Flexibility strategy has been a widely researched operations management topic in recent years (D'Souza and Williams, 2000; Vokurka and O'Leary-Kelly, 2000; Koste and Malhotra, 1999; Berry and Cooper, 1999; Collins *et al.*, 1998). As defined by Stonebraker and Leong (1994, pp. 46), flexibility strategy is "the ability to respond to rapid changes of the product, service, or process, often identified as mix or volume." D'Souza and Williams (2000) proposed a theoretically grounded operationalization of the flexibility strategy construct by providing a taxonomy of flexibility dimensions. Four flexibility dimensions were identified in their study: volume flexibility, variety flexibility, process flexibility, and materials handling flexibility. Table 3.3 shows the taxonomy of flexibility dimensions proposed by D'Souza and Williams (2000).

3.1.3 Business Performance

The measures used to evaluate a company's business performance have historically been financial ones, such as the monetary values of sales and profits or percentage return on monetary investments (White, 1996). Many authors agree on the need to use more non-financial measures of business performance (Swamidass and Newell, 1987; Nemetz, 1990; Cleveland *et al.*, 1989; Venkatraman, 1990; Ward *et al.*, 1995; Badri *et al.*, 2000; Vastag, 2000; Samson and Terziovski, 1999).

Table 3.3: The Four Dimensions of Flexibility Strategy

Category 1: Externally-driven flexibility dimensions	
1. Volume flexibility	This dimension of flexibility represents the ability to change the level of output of a manufacturing process.
2. Variety flexibility	This dimension represents the ability of the manufacturing system to produce a number of different products and to introduce new products.
Category 2: Internally-driven flexibility dimensions	
1. Process flexibility	This dimension represents the ability of the system to adjust to and accommodate changes/disruptions in the manufacturing process.
2. Handling flexibility	This dimension represents the ability of the materials handling process to effectively deliver materials to the appropriate stages of the manufacturing process.
Source: D'Souza, D.E. and Williams, F.P. "Toward a taxonomy of manufacturing flexibility dimensions", *Journal of Operations Management*, (18:5), 2000, pp. 577-593.	

Nemetz (1990, p.66) found in her research that "because of the virtual nonexistence of accurate, standard, and objective performance data, and the practical difficulties associated with attempting to gather it, it was necessary to rely on perceptual performance measures for the operations management research." Venkatraman (1990) agreed with Nemetz's notion on using perceptual business performance measures in operations management research, and stated that perceived performance measures are viable choices when objective performance measures are hard to obtain.

The appropriateness of the performance measure to use may depend on circumstances unique to the study (Ferdows and De Meyer, 1990). For instance, Badri *et al.* (2000) used the company's self-reported profit for the last three years as the classification mechanism to differentiate the "high performer" and "low performer". Ward *et al.* (1995) partitioned the companies into high and low performers with respect to self-reported change in profitability. In this research, perceptual business performance measures are used for the reasons stated by Nemetz (1990), while objective performance measures are also gathered for comparing with the result of perceived performance measures. Business performance measures are adopted and revised based on both operations strategy and information systems strategy literature.

3.1.4 Relationships

Operations strategy literature (Venkatraman, 1989; Gerwin, 1993; Vickery *et al.*, 1993; Berry and Cooper, 1999; Smith and Reece, 1999; Kathuria, 2000) suggested relationships among the constructs of the operations strategy model. For example, Venkatraman (1989) argued that the business environment affected managers' choices of operations strategy. Gerwin (1993) studied the relationship between business environment and operations strategy. Their findings suggested that the business environment led to the operations strategy. Vickery *et al.* (1993) identified a fit relationship between environment factors and operations strategy, and its impact on business performance. Ward *et al.* (1995) found that with respect to the substance of operations strategy, the business environment appeared to have a tangible impact on strategic choices in operations. They further argued that ignoring environmental effects in the operations strategy model was likely to result in a specification error, which could lead to erroneous findings.

Operations strategy literature also suggested that operations strategy had a positive impact on performance (Berry and Cooper, 1999; Smith and Reece, 1999; Kathuria, 2000). Kathuria (2000) developed a taxonomy of small manufacturers based on their emphasis on several competitive priorities. The results of his study suggested the positive impact of operations strategy on business performance. Research works examining individual dimensions of operations strategy on business performance have shown a positive impact of individual dimensions of operations strategy on business performance. For example, Flynn *et al.* (1994) suggested that quality management positively influenced business performance. Samson and Terziovski (1999) studied the relationship between total quality management (TQM) practices and business performance. The findings of their study indicated that the relationship between TQM practices and business performance was significant. Numerous researchers found that flexibility – one of the four dimensions of operations strategy, positively affected business performance (D'Souza and Williams, 2000; Vokurka and O'Leary-Kelly, 2000; Koste and Malhotra, 1999; Berry and Cooper, 1999; Collins *et al.*, 1998).

A comprehensive review by Anderson *et al.* (1989) revealed that the operations strategy model holds true. Moreover, they argued that the fit between the business environment and the operations strategy positively affected business performance. More recently, Ward *et al.* (1995) empirically tested the operations model using a sample of manufacturers in three industries in the United States. Their research supported the concept of relationships among the constructs of the manufacturing strategy model. They claimed that the fit between the business environment and the operations strategy was a central tenet of major strategic management paradigms. However, their study focused only on the overall manufacturing strategy model (the relationships among the constructs) without detailing the operations strategy construct. Moreover, their study only investigated the financial aspects of performance and omitted the operational dimensions of the performance measure. Badri *et al.* (2000) expanded the study of Ward *et al.* (1995) by including more factors in the environment factors construct. Their research rendered similar results, but also had limitations similar to those of Ward's *et al.* (1995) study.

Although there is an obvious relationship between the business environment and business performance as more often cited in economics research, it is out of the scope of operations strategy research (Badri *et al.*, 2000).

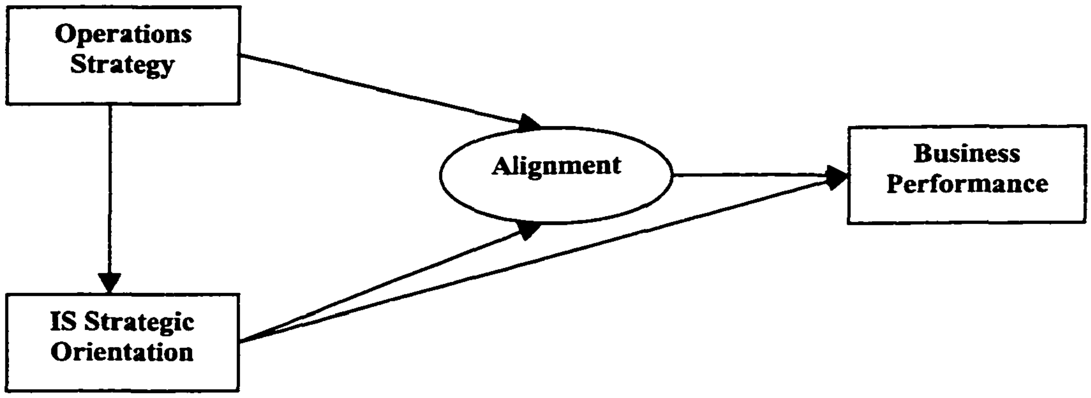
In conclusion, operations strategy theory is a well-established research agenda in operations management, and thus it is well suited as the theoretical foundation for electronic commerce research. This research applied the theoretically grounded operations strategy theory to an electronic commerce environment, while modifying it by adding an information systems strategy construct. In this research, instruments are first adopted from the previous operations strategy studies and then modified based on the electronic commerce environment.

3.2 Information Systems Strategic Model

The relationship between information systems and operations strategy has been the focus of much discussion during the past decade. Despite the fact that there have been numerous calls for research in this area (i.e., Sabherwal and Chan, 2001; Reich and Benbasat, 2000; Chan *et al.*, 1998; Chan *et al.*, 1997; Wiseman, 1988), few empirical studies have been carried out to determine the extent to which information systems complements operations strategy (Sabherwal and Chan, 2001; Chan *et al.*, 1997). Chan *et al.* (1997) proposed a conceptual framework to establish links between the business strategy orientation, the information systems strategy orientation, and business performance. Figure 3.2 shows the conceptual model proposed by Chan *et al.* (1997).

It indicates that information systems strategic orientation directly influences business performance, that business strategy influences information systems strategic orientation, and that the alignment of information systems strategic orientation with operations strategy has a positive impact on business performance.

Figure 3.2: Information Strategy Model



3.2.1 Business Strategy Orientation

The business strategy orientation instrument was a refined version of Venkatraman's strategic orientation of business enterprises (STROBE) instrument (Venkatraman, 1985). Venkatraman (1985) viewed organizations as having characteristic orientations evident with respect to their marketplace behavior, and claimed that STROBE was multidimensional, including the following dimensions; company aggressiveness, company analysis, company internal defensiveness, company external defensiveness, company futurity, company pro-activeness, company risk aversion, and company innovativeness.

3.2.2 Information System Strategic Orientation

Chan *et al.* (1997) defined the strategic orientation of the existing portfolio of information systems (IS) applications (STROEPIS) based on a business strategic orientation. This orientation included IS support for aggressiveness, IS support for external defensiveness, IS support futurity, IS support for pro-activeness, IS support for risk aversion, and IS support for innovativeness. In this research, STROEPIS is modified based on four dimensions of operations strategy.

3.2.3 Business Performance

As for business performance, Chan *et al.* (1997) proposed four dimensions: market growth, profitability, product/service innovation, and company reputation. These dimensions were supported by other business strategies and performance literature (e.g., Venkatraman and Ramanujam, 1986; Sabherwal and Chan, 2001). Performance measures in information systems strategy research were based on respondents' perceptions and statements. In other words, performance measures were perceptual in natural.

3.2.4 Relationships

Information systems strategy (ISS) literature suggested a positive impact of information systems strategic orientation on business performance (Sabherwal and Chan, 2001; Reich and Benbasat, 2000; Sambamurthy, 1999; Segars and Grover, 1998; Chan *et al.*, 1998; Chan *et al.*, 1997; King and Teo, 1997). ISS literature also suggested that operations strategy positively influenced the information systems strategic orientation. For example, Sambamurthy (1999) argued that the operations strategy affected firms' information systems strategic orientation. Segars and Grover (1998) also found that the operations strategy influences managers' choices of the information systems strategy.

Furthermore, Chan *et al.* (1997) found that companies with high information systems strategic alignment were better performing companies. Chan *et al.* (1998)

conducted a similar empirical survey study, and examined the realized information systems strategy (the existing uses of information technology in organizations), operations strategy, and performance. Their focus was on the types and capabilities of information systems (IS)/information technologies (IT) and the IS/IT support provided for business strategy. Findings of their research rendered similar results to those by Chan *et al.* (1997); that is, the fit between IS/IT and business strategy influenced business performance, and IS/IT had a direct positive impact on business performance. Most recently, Sabherwal and Chan (2001) studied the alignment between business strategy and information systems strategy, which was widely believed to improve business performance. They examined the impact of alignment on perceived business performance using Miles and Snow's popular classification of the Defender, Analyzer, and Prospector business strategies. Results indicated that alignment positively affected perceived business performance.

3.3 Electronic Commerce Research Model

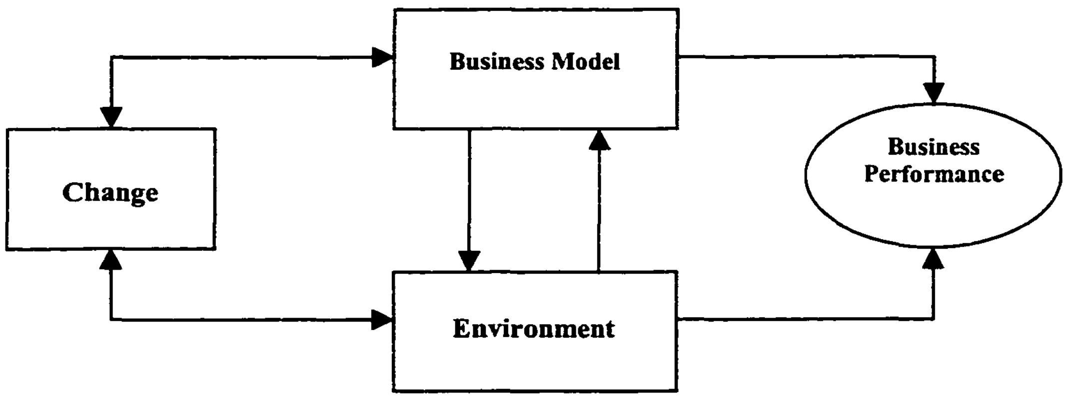
Electronic commerce research is in its infancy and there exists little electronic commerce strategy research, let alone empirical studies (Bauer and Colgan, 2001). Electronic commerce strategy research is primarily conceptual-based, using either a generic strategy framework (Porter, 1980) or value chain model (Porter, 1985). Evans and Wurster (1999) called for a systematic approach to electronic commerce strategy research.

Afuah and Tucci (2001. p.2) provided a research framework conceptualizing future electronic commerce strategy research. Figure 3.3 shows the conceptual framework for electronic commerce strategy research proposed by Afuah and Tucci (2001). There are three major determinants of business performance: business models, the environment in which businesses operate, and change.

3.3.1 Business Models

According to Afuah and Tucci (2001, p. 3-4), a business model is "the method by which a firm builds and uses its resources to offer its customers better value than its competitors and to make money doing so; the model is what enables a firm to have a sustainable competitive advantage, to perform better than its rivals in the long term." For instance, in the 1990s Dell Computer was often cited as a firm that was good at reinventing its business model from "make to stock" to "make to order" in an electronic commerce environment (Chase *et al.*, 2001).

Figure 3.3: Electronic Commerce Strategy Model



Source: Afuah, A. and Tucci, C.L. Internet Business Models and Strategies: Text and Cases. Irwin/McGraw Hill, IL, 2001, pp. 3-4.

3.3.2 Environment

Afuah and Tucci (2001, p. 4-5) suggested two types of environments – the competitive environment and the macro environment. The competitive environment means that firms do not formulate and execute their business models in a vacuum, rather they compete with their competitors. Beyond the competitive environment lies the macro environment of government policies, the natural environment, national boundaries, deregulations/regulation, and technological change.

3.3.3 Change

The last determinant of firm performance is change. Its role is more indirect than direct. Change impacts business models or their environments, which can translate into higher or lower profitability. Change can come from competitors, suppliers, customers, demographics, and the macro environment.

The electronic commerce research framework proposed by Afuah and Tucci (2001) provides a roadmap for electronic commerce research in general. However, the construct is not well defined and lacks theoretical grounding. Moreover, Afuah and Tucci (2001) did not provide a measuring instrument for future research.

Contrasted with previous research, this study proposes a comprehensive research model, which integrates both operations strategy theory and the information systems strategy model. Further, the integrated model proposed is applied and empirically tested in an electronic commerce setting.

3.4 Research Purpose, Model, and Hypothesis

This section describes the research purpose, the process of developing the research model, and the hypotheses.

3.4.1 Research Purpose

Based on the detailed literature review of electronic commerce research from operations management and other related areas, it is noted that operations management research can contribute to electronic commerce literature by providing a systematic research framework along with empirical evidence. Literature review of operations strategy reveals that there are numerous studies of the relationships between the business environment, operations strategy, and business performance, but there is no operations strategy research incorporating information systems strategy. The information systems research literature review also shows that there are numerous studies on the relationships between information systems strategy, operations strategy, and business performance, but there is no information systems research incorporating the business environment. Moreover, there is no empirical literature found in applying operations strategy and information systems strategy research to the electronic commerce environment. The purpose of this study is to synthesize an operations strategy research and information systems research framework, and apply the proposed framework in an electronic commerce environment.

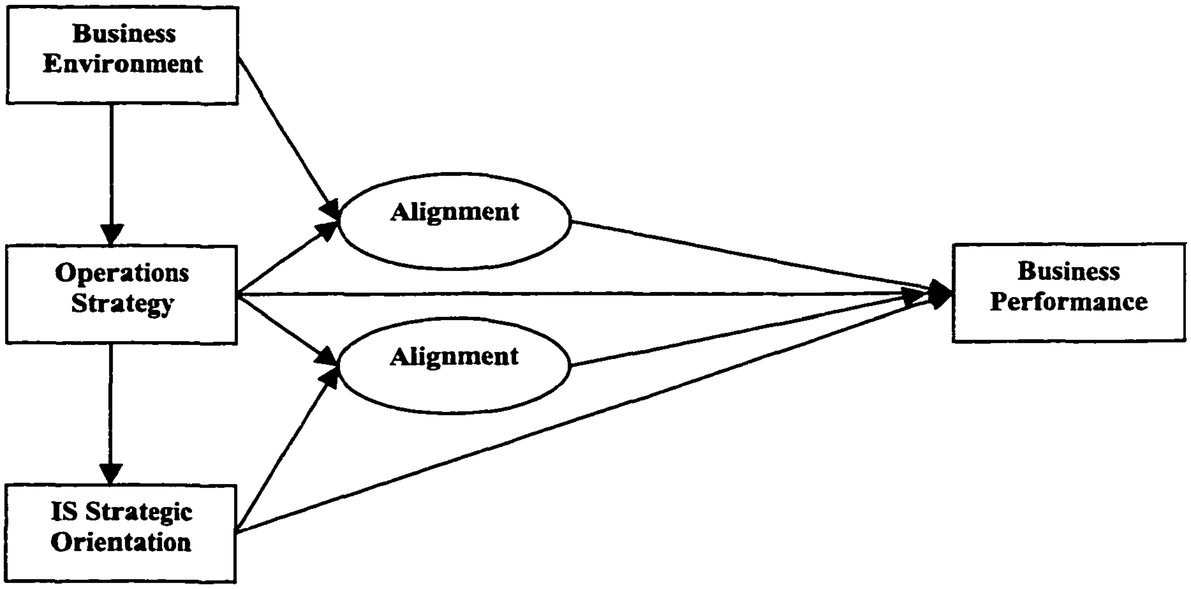
The purpose of this study is fourfold: (1) to propose a comprehensive operations/information systems strategy model in an electronic commerce setting; (2) to identify the alignment between business environment and operations strategy, and the alignment between information systems strategy and operations strategy; (3) to identify the impact of information systems strategy alignment, environment alignment, and information systems strategy on business performance; and (4) to model the constructs using both holistic (systems) and dimension-specific (bi-variate) approaches.

3.4.2 Research Model

This study extends the de facto operations strategy model (Badri *et al.*, 2000; Ward *et al.*, 1995; Skinner, 1969) by incorporating an information systems strategic orientation (Chan *et al.*, 1997; Chan *et al.*, 1998; Reich and Benbasat, 2000; Sabherwal and Chan, 2001). Moreover, this study applies the proposed conceptual framework in an electronic commerce setting. Figure 3.4 shows the holistic (systems) electronic commerce manufacturing strategy model.

Figure 3.4 indicates that the business environment directly influences operations strategy, that the alignment between business environment and operations strategy influences business performance, that operations strategy has a direct impact on information systems strategic orientation, that the fit between information systems strategic orientation and operations strategy influences business performance, and that information systems strategic orientation directly influences business performance. The conceptual model can also be tested to verify the structural contingency theory.

Figure 3.4: Electronic Commerce Operations strategy Model – A Holistic Model



While Figure 3.4 presents a holistic (systems) view of the relationships among the constructs, Figure 3.5 presents a dimension-specific (bivariate) view (Drazin and Van de Ven, 1985). The holistic view suggests that relationships between constructs are meaningful, whereas the dimension-specific view suggests that the dimensions of these constructs can be disaggregated and that relationships among these dimensions can be meaningfully tested (Chan *et al.*, 1997). In this study, both models will be tested.

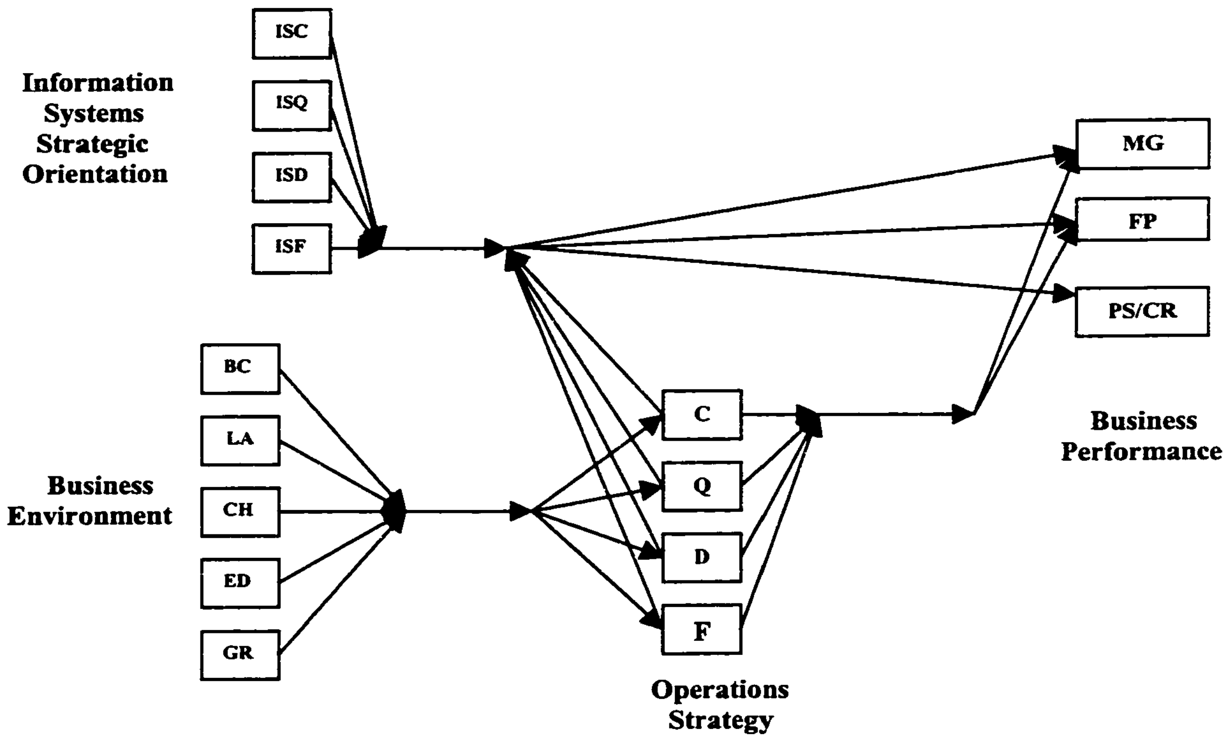
Dimensions of business environment are adapted from Ward *et al.* (1995), and one additional dimension – government regulations, is added because government regulations have great influence on electronic commerce (i.e., taxation, freedom of speech, etc.). Four of the most commonly stated operations strategy dimensions are included (Stonebraker and Leong, 1994; Ward *et al.*, 1995; Kathuria, 2000). The dimensions of information systems strategy is a revised version of Chan *et al.*'s

STROEPIS instrument (Chan *et al.*, 1997), based on the notion that information systems strategy complements operations strategy.

The business performance instrument is adapted from Chan *et al.* (1997), and includes market growth, profitability, product/service innovation, and company reputation. The classification of "high performer" and "low performer" is based on the performance measures developed by Hambrick (1984). Subjective performance measures are used in this study due to difficulty in obtaining accurate performance data and controlling for industry variations. The subjective nature of the data gathered is a limitation of the current research, although subjective data have frequently been used in this type of research and considered acceptable (Chan *et al.*, 1997; Venkatraman and Ramanujam, 1987).

The relationships between individual dimensions of different constructs are examined and tested to provide more managerial insights.

Figure 3.5: Electronic Commerce Operations Strategy Model – A Bi-variate View



Legend

BC – Business Cost
LA – Labor Availability
CH – Competitive Hostility
ED – Environment Dynamism
GR – Government Regulations
C – Cost
Q – Quality
D – Delivery
F – Flexibility

ISC – IS Support for Cost Reduction
ISQ – IS Support for Quality Improvement
ISD – IS Support for Delivery
ISF – IS Support for Flexibility
MG – Marketing Growth
FP – Financial Performance
PS – Product/Service Innovation
CR – Company Reputation

3.4.3 Research Hypotheses

Based on the framework presented in Figure 3.4 and Figure 3.5, several hypotheses are developed and stated as follows:

H1: Business environment positively influences operations strategy choice.

Hypothesis 1 tests whether there is a direct relationship between business environment and operations strategy. The literature provides some empirical evidence on a positive relationship between these two constructs. In chapter 2, it is noted that several such studies (Ward and Duray, 2000; Badri *et al.*, 2000; Youndt *et al.*, 1996; Miller and Roth, 1994; Adam and Swamidass, 1989; Wheelwright, 1984; Skinner, 1969) reported that business environment influenced managers' selection of operations strategy. Similar findings are expected in this study. The evidence of the support of this hypothesis is assessed by using the entire sample (166 subjects). If there is more than one significant path between a business environment dimension and an operations strategy dimension, hypothesis 1 will be supported.

Operations strategy literature also suggests, that from a bi-variate model standpoint, there are significant differences between paths for high and low performing electronic commerce organizations. Hypothesis 1a describes such relationship between high and low performing EC companies.

$H1_a$: High performing EC organizations utilize different operations strategy to deal with business environment from those used by low performing organizations.

The empirical support of this hypothesis is assessed by comparing the path analyses of operations strategy and business environment for both high and low performing groups.

H2: The fit between business environment and operations strategy positively influences business performance.

This hypothesis is tested to identify a positive relationship between the alignment of business environment, operations strategy, and business performance in an electronic commerce setting. Previous studies provide empirical evidence on the predicted direct link between the fit between environment factors and operations strategy and business performance. According to Badri *et al.* (2000) and Ward *et al.* (1995), high performers responded more to environmental stimuli by adopting different operation strategies than did low performers. The empirical support of this hypothesis is assessed by comparing the fit indices of both high and low performing groups.

H3: Operations strategy positively influences information systems strategic orientation.

This hypothesis tests the impact of operations strategy on information systems strategy. Literature provides some empirical evidence on this relationship. Sabherwal and Chan (2001), Reich and Benbasat (2000), Sambamurthy (1999), Segars and Grover (1998), Das *et al.* (1993), and Henderson and Venkatraman (1992) all suggested that operations strategy influenced information systems strategic orientation. This relationship was also supported by other previous studies (Turban *et al.*, 2000; Shaw *et* *al.*, 1997). As a result, it is expected that operations strategy will positively influence information systems strategic orientation. The evidence of the support of this hypothesis is assessed by using the whole sample (166 subjects). If there is more than one significant path between an operations strategy dimension and a dimension of information systems strategic orientation, hypothesis 3 will be supported.

Information strategic orientation literature also suggests, that from a bi-variate model standpoint, there are significant differences between paths for high and low performing electronic commerce organizations. Hypothesis 3a describes such relationship between high and low performing EC companies.

$H3_a$: High performing EC organizations implement different information strategic orientation to support operations strategy from those implemented by low performing organizations.

The empirical support of hypothesis 3a is assessed by comparing the path analyses of the relationship between operations strategy and information systems strategic orientation from both high and low performing groups.

H4: The fit between information systems strategic orientation and operations strategy positively influences business performance.

Hypothesis 4 tests whether the alignment between information systems strategic orientation and operation strategy has a positive influence on the business performance. The literature contains evidence of a positive impact of the fit between information systems strategic orientation and operations strategy on business performance (Chan *et al.*, 1997; Chan *et al.*, 1998). Hence, it is expected that the fit between information systems strategic orientation and operations strategy will have a positive impact on the performance. The empirical support of this hypothesis is assessed by comparing the fit indices of the relationship between information systems strategic orientation and operations strategy from both high and low performing groups.

H5: Information systems strategic orientation positively influences business performance.

This hypothesis tests the direct impact of between information systems strategic orientation on business performance. Weill (1990) and Earl (1996) provided empirical evidence that information system strategy was directly linked with business performance. The findings of Chan *et al.* (1997) and Chan *et al.* (1998) rendered similar results. It is expected that between information systems strategic orientation directly influences business performance. The evidence of the support of this hypothesis is assessed by using the whole sample (166 subjects). If there is more than one significant path between a dimension of information systems strategic orientation and one of the three dimensions of business performance, hypothesis 5 will be supported.

Strategy literature suggests, that from a bi-variate model standpoint, information systems strategic orientation of high performing EC firms has different impact on the business performance as compared with low performing EC firms.

Hypothesis 5a describes such relationship between high and low performing EC companies.

H5$_a$: Information systems strategic orientation implemented by high performing EC organizations has significant impact on the business performance than by the low performing EC companies.

The empirical support of hypothesis 5a is assessed by comparing the path analyses of the relationship between information systems strategic orientation and business performance from both high and low performing groups.

H6: High performing organizations conform to the conceptual model to a greater extent than low performing organizations.

Because of broad support in the literature, it is expected that the model will fit companies that exhibit relatively high business performance. Relatively high and low performers are distinguished in this study because the literature suggests that low performers are less likely to adhere to the model (Badri *et al.*, 2000; Chan *et al.*, 1998; Chan *et al.*, 1997; Ward *et al.*, 1995). It is expected to find statistical support that high performers have a good fit for a path model directly linking environment factors, operations strategy, electronic business, and business performance. However, the absence of significant linkages or good model fit for high performers would indicate that the data do not support this conceptual model. The empirical support of hypothesis 6 is assessed by comparing the fit indices of the overall conceptual model from both high and low performing groups.

In summary, this research explores the relationships among all the constructs from both holistic and bi-variate levels.

CHAPTER 4

RESEARCH METHODOLOGY

Chapter 4 presents the research methodology of this research. It provides details of the research instrument (questionnaire) development, sample information, and data collection procedures. This chapter also discusses data analysis for construct validation of the research model proposed. The data analysis contains explanations of data preparation, instrument reliability test, and instrument validity test. Application of the structural equation modeling is also briefly discussed.

4.1 Questionnaire Construction

The preliminary questionnaire was developed through literature review and interviews with managers of several electronic commerce companies. A set of questionnaire items was developed to corresponding constructs of the business environment, operations strategy, information systems strategic orientation, and business performance (see Appendix A). Each set is designed to measure the specific content of each of the corresponding items. Reponses are measured on a five-point Likert Scale. The questions used in the development of the instrument were adapted from several previous studies with modifications to fit the electronic commerce setting.

4.1.1 Business Environment

The business environment construct is multi-dimensional, and a multiple items list is often used to measure each dimension of the construct. For example, Table 4.1

shows the business environment construct assessed by Ward *et al.* (1995). This set of scale items addresses perceptions of the environment.

Table 4.1: Items to measure the business environment construct

Items used to assess the business environment
Business costs (α = 0.79)
Rising labor cost
Rising material cost
Rising transport cost
Rising telecommunication cost
Rising utilities cost
Rising rental cost
Rising health care cost
Strong Singapore dollar
Labor availability (α = 0.69)
Shortage of managerial and administrative staff
Shortage of technicians
Shortage of clerical and related workers
Shortage of skilled workers
Shortage of production workers
Inability to operate third shift
Competitive hostility (α = 0.73)
Keen competition in local markets
Keen competition in foreign markets
Low profit margins
Declining demand in local market
Declining demand in foreign markets
Producing to the required quality standards
Unreliable vendor quality
Scored on a five-point Likert scale: 1 = unimportant; 5 = important
Dynamism (rate of change) (α = 0.82)
Rate at which products and services become outdated
Rate of innovation of new products and services
Rate of innovation of new operation processes
Rate of change in taste and preferences of customers
Scored on a five-point Likert scale: 1 = slow; 5 = rapid

These measures have been implemented in many operations strategy research efforts, and have been shown to have good reliability [the Cronbach's alphas are shown for the data collected by Ward *et al.* (1995)], and were validated as well by (Pagell and Krause, 1999; Ward *et al.*, 2000; Badri *et al.*, 2000). In this study, the business environment instrument contains five dimensions including business costs, labor availability, competitive hostility, environment dynamism, and government regulations. The scale items for the first four dimensions of the business environment construct are adapted from Ward *et al.* (1995), while the set of scale items measuring government regulations is adapted from Badri *et al.* (2000) with a reported Cronbach's alpha of 0.917.

4.1.2 Operations Strategy

A common approach to measuring operations strategy involves using a multiple item list and asks respondents to rate the relative importance of each operations strategy dimension. For example, Table 4.2 illustrates the four dimensions of operations strategy explored by Ward *et al.* (1995), who used items originally developed for the Boston University Manufacturing Futures Survey (Miller and Vollmann, 1984). These measures have been employed in numerous studies and have been shown to have good reliability [the Cronbach's alphas are shown for the data collected by Ward *et al.* (1995), and been deemed valid as well] (Ward *et al.*, 2000; Badri *et al.*, 2000).

Similar measures have been employed by Badri *et al.*, (2000), Ward *et al.*, (1998), and Dean and Snell (1996). Badri *et al.* (2000) employed 17 scale items similar to those used by Ward *et al.* (1995) to measure four dimensions of operations strategy. Ward *et al.* (1998) employed 21 items that asked respondents to rate the relative importance of various dimensions of operations strategy. These items were then combined with an overall rating regarding the business performance on these dimensions.

Table 4.2: Items to measure operations strategy construct

Items used to assess the operations strategy construct
Cost strategy ($\alpha = 0.77$)
Reduce unit cost
Reduce materials costs
Reduce overhead costs
Reduce inventory level
Quality strategy ($\alpha = 0.78$)
Reduce defective rates
Improve product performance and reliability
Improve vendor's quality
Implement quality control circles
Obtaining ISO 9000 certification
Flexibility strategy ($\alpha = 0.83$)
Reduce manufacturing lead-time
Reduce procurement lead-time
Reduce new product develop cycle
Reducing setup/changeover time
Delivery strategy ($\alpha = 0.83$)
Increase delivery reliability
Increase delivery speed
Improve pre-sales service and technical support
Improve after sales service
Scored on a five-point Likert scale: 1 = unimportant; 5 = important

The measures employed in the three studies cited are representative of the ways operations strategy is generally assessed in survey-based research. These measures share several positive characteristics. The measures are generalizeable to a variety of industries and businesses (Boyer and Pagell, 2000).

In this study, the operations strategy instrument is a refined version of Ward *et al.* (1995), incorporating specific operations strategy instrument items in an electronic commerce setting developed by Keeney (1999).

4.1.3 Information Systems Strategic Orientation

Information systems strategic orientation is generally measured by multiple scale items. Table 4.3 shows the information systems strategic orientation construct assessed by Chan *et al.* (1997). These measures initially developed by Venkatraman (1985) were used in other studies (Sabherwal and Chan, 2001; Chan *et al.*, 1998). Scores for the information systems strategic orientation construct exhibited relatively high Cronbach's alpha values in these cited studies, thus indicating that the instrument is reliable.

Table 4.3: Items to measure information systems strategic orientation

Items used to assess information systems strategic orientation
Information systems strategic orientation ($\alpha = 0.87$)
IS Support for Aggressiveness
IS Support for Analysis
IS support for Internal Defensiveness
IS support for External Defensiveness
IS support for Futurity
IS support for Proactiveness
IS support for Risk Aversion
IS support for Innovativeness
Scored on a five-point Likert scale: 1 = unimportant; 5 = important

In this study, information systems strategic orientation instrument is a revised version of Chan *et al.*'s instrument (Chan *et al.*, 1997), which was based on the notion that information systems strategy complements operations strategy.

4.1.4 Business Performance

The business performance construct is a complex, multi-faceted concept (Chan *et al.*, 1997). In the business strategy literature, it has often been suggested that multiple measures be used when trying to assess business performance (Venkatraman and Ramanuja, 1986; Chan *et al.*, 1997; Chan *et al.*, 1998; Sabherwal and Chan, 2001). However, most of the operations strategy research only employed one dimensional measure – profitability, in assessing the business performance (Badri *et al.*, 2000; Ward *et al.*, 2000; Ward *et al.*, 1995).

Attempting to overcome the pitfalls of the business performance measure commonly utilized by the operations strategy research, this research employed multiple measures to assess the business performance using the refined business performance instrument (Chan *et al.*, 1997), initially developed by Venkatraman and Ramanuja (1986). Table 4.4 shows a set of the scale items measuring business performance used by (Chan *et al.*, 1997).

Table 4.4: Items to measure business performance

Items used to assess
Market Growth (α = .901)
Financial performance (α = .921)
Product-service Innovation (α = .876)
Company reputation (α = .817)
Scored on a five-point Likert scale: 1 = low; 5 = high

The business performance instrument used in this research includes hour dimensions: market growth, profitability, product-service innovation, and company reputation. These measures have been used in other information systems strategy research and have been found reliable (Chan *et al.*, 1998; Sabherwal and Chan, 2001). In this research, the business performance measures are adapted from Chan *et al.* (1997) with a small modification. This research combines last two dimensions of Chan *et al.*' (1997) business performance instrument (i.e., product-service innovation, and company reputation) into one dimension named operational performance.

In conclusion, the research instrument employed in this research is adapted from various previous studies and the reliability of each construct variable examined in the context of the studies from which the measuring instrument was adapted was found to be reliable. In this research, the measures adapted from the cited studies are representative of the constructs of the research model. Moreover, they possess psychometric properties that have all been successfully employed in prior research and shown to exhibit good reliability and construct validity. Table 4.5 shows the measuring instrument employed in this research.

Table 4.5: Measuring Instrument

Construct: <u>Business Environment</u>

Dimension [BC] Business costs:

Item [BC1] rising labor cost

Item [BC2] rising transport cost

Item [BC3] rising telecommunication cost

Item [BC4] rising utilities cost

Item [BC5] rising rental cost

Item [BC6] rising health care cost

Dimension [LA] Labor availability:

Item [LA1] shortage of managerial and administrative staff

Item [LA2] shortage of IS technicians

Item [LA3] shortage of clerical and related workers

Item [LA4] shortage of service workers

Item [LA5] inability to operate 24 hours a day

Dimension [CH] Competitive hostility:

Item [CH1] keen competition

Item [CH2] low profit margins

Item [CH3] declining demand

Item [CH4] providing services to the required quality standards

Item [CH5] unreliable vendor quality

Dimension [GR] Government regulations:

Item [GR1] complexity of government regulations

Item [GR2] potential Taxation on electronic commerce

Item [GR3] limitations on electronic commerce

Item [GR4] protecting conventional firms

Dimension [ED] Environmental dynamism:

Item [ED1] the rate at which your services become outdated

Item [ED2] the rate of innovation of your new services

Item [ED3] the rate of innovation of your new operating processes

Item [ED4] the tastes and preferences of customers in your industry

Construct: <u>Operations Strategy</u>

Dimension [FS] Flexibility strategy:

Item [FS1] maximize purchasing convenience

Item [FS2] maximize time flexibility in purchasing

Item [FS3] provide purchasing convenience

Item [FS4] minimize effort of shopping

Item [FS5] maximize ease of finding product/service

Item [FS6] increase variety of products/services

Dimension [QS] Quality strategy:

Item [QS1] maximize product value

Item [QS2] ensure quality of product

Item [QS3] minimize fraud

Item [QS4] assure system security

Item [QS5] maximize access to information

Item [QS6] minimize misuse of credit card

Item [QS7] minimize misuse of personal information

Dimension [DS] Delivery strategy:

Item [DS1] provide reliable delivery

Item [DS2] assure arrival of purchase

Item [DS3] minimize delivery time

Item [DS4] minimize shipping time

Dimension [CS] Cost strategy:

Item [CS1] minimize product/service cost

Item [CS2] minimize tax cost

Item [CS3] minimize shipping cost

Item [CS4] reduce inventory

Item [CS5] increase capacity utilization

Construct: Information Systems Strategic Orientation

Item [ISC] IS strategy support for cost strategy

Item [ISQ] IS strategy support for quality strategy

Item [ISD] IS strategy support for delivery strategy

Item [ISF] IS strategy support for flexibility strategy

Construct: Business Performance

Dimension [MG] Market growth:

Item [MG1] market share gains

Item [MG2] sales growth

Item [MG3] revenue growth

Dimension [FP] Financial performance:

Item [FP1] return on investment

Item [FP2] return on sales

Item [FP3] liquidity

Item [FP4] cash flow

Item [FP5] profitability

Dimension [I] Operational performance:

Item [I1] developments in business operations

Item [I2] development in products and services

Item [CR] reputation among major customer segments

4.2 Data Collection

4.2.1 Sample

Based on the electronic commerce industry classification (Storey *et al.*, 2000), 800 potential electronic commerce companies [i.e., business consulting (SIC code 8741), commercial banking (SIC code 6021 & 6022), computer software (SIC code 7371), IT hardware (SIC code 3571), retailing (SIC code 5399), and logistics (SIC code 4731)] were selected using Standard Industrial Classification (SIC) codes from Dun and Bradstreet directories. Detailed company information was gathered using the ReferenceUSA database. ReferenceUSA is an Internet-based reference service from the library division of *info*USA, and it contains detailed information on nearly 12 million U.S. businesses. To ensure that the respondents are all from electronic commerce firms, the survey questionnaire contains a scanning question based on the electronic commerce criteria proposed by (Bauer and Colgan, 2001): (1) proprietary strategy – implement their own Internet applications and data interfaces; (2) open strategy – the user interface is identical, regardless of which company the consumer is doing business with; and (3) denial strategy – choose not to offer online transactional services over the Internet, but will most likely still operate a small website with some information for advertising and public relation purposes. Subjects of this research who meet the first two criteria of electronic commerce are asked to respond to the survey.

The surveys were sent to top executives in the selected firms; informants' titles were generally chief executive officer (CEO), chief financial officer (CFO), chief information officer (CIO), chief operations officer (COO), and plant managers. The surveys were mailed to such managers in 800 firms representing various electronic commerce industries categorized by (Storey *et al.*, 2000). Out of 202 responses received in a single mailing, 166 were usable resulting in a response rate of 21%. Table 4.6 shows the summary of data collection. Detail profiles of the respondents and their companies are discussed in chapter 5.

Table 4.6: Summary of data collection

Number of questionnaires distributed	800
Number of questionnaires returned	202
Number of questionnaires unusable	36
Number of questionnaires used for analyses	166
Response rate	25.25%
Usable response rate	21%

4.2.2 Procedures

A pilot test was conducted by distributing the preliminary questionnaire to the managers of several electronic commerce companies in the mid-west region. They were asked to examine the degree to which the preliminary questionnaire would capture the measured constructs and how easy/difficult the preliminary questionnaire was to complete.

800 survey questionnaires were mailed to upper level managers of the companies across six electronic commerce industries. To increase the response rate, follow-up letters reminding the subjects of this research were sent ten days after initial survey distribution.

4.3 Data Analysis

The data analysis of this research includes: (1) data preparation to conduct a normality test, and (2) instrument validation (reliability and validity) to test the research framework.

Several tests were conducted during the instrument validation, including descriptive statistics analysis, tests of scale reliability, criterion-related (horizontal) validity, unidimensionality, construct validity, and tests of convergence and discriminant in measurements and constructs. Generally speaking, these tests and analyses have been widely used in instrument developments in operations management research (Flynn *et al.*, 1990; Dixon, 1992; Gupta and Somers, 1992; Ward *et al.*, 1995; Pagell and Krause, 1999; Badri, *et al.*, 2000; Shin *et al.*, 2000; Koufteros *et al.*, 2001). Figure 4.1 shows the summary of the data analysis procedures of this research.

Figure 4.1: Data Analysis Procedures

Data Preparation

- Normality test (skewness and kurtosis)

↓

Scale Reliability

- Cronbach's Alpha
- Item-to-Total Score Correlation
- Split-half

↓

Instrument Validity

- Content Validity
  - Literature
- Criterion-Related (horizontal) Validity
  - Expected Cross Validity Index (ECVI)
- Construct Validity
  - Test of Dimensionality
    - Exploratory Factor Analysis
    - Confirmatory Factor Analysis (individual construct)
  - Test of Convergence in Measurements
    - Confirmatory Factor Analysis (Three-concept model)
  - Test of Discriminant in Measurements

4.3.1 Data Preparation

The objective of data preparation is to test normality of the scores of each dimension of the four constructs of the model proposed in this research. Kline (1998, p.81) stated that the estimation procedures that are widely used in structural equation modeling typically assume normal distributions for continuous variables. Skewness and kurtosis are two ways that a distribution can be non-normal. Unlike normal distributions, which are symmetrical about their means, those that are skewed are asystemtrical because they have most of the cases either below the mean or above it. Kurtosis means a relative excess of cases in the tails of a distribution relative to a normal skew. West *et al.* (1995) suggested an approach to significance tests of normality by interpreting the absolute values of the skewness and kurtosis indices. They considered scores to be moderately non-normal if they demonstrated skewness index values ranging from 2.0 to 3.0 and kurtosis values from 7.0 to 21.0; extreme non-normality is defined by skewness index values greater than 3.0 and kurtosis values great than 21.0. Kline (1998, p.83) noted that scale item scores with absolute values of the skewness index greater than 3.0 are described as "extremely" non-normal. Absolute values of kurtosis greater than 10.0 may indicate a problem and values great than 20.0 may suggest an even more serious one.

4.3.2 Instrument Validation

Field based empirical research is becoming one of the dominant research methodologies in the operations management arena (O'Leary-Kelly and Vokurka, 1998). However, Flynn *et al.* (1990) noted that a substantial portion of the empirical research in operations management was lacking a strong conceptual and methodological base. In particular, they argue that the methodological issue of instrument validity was generally ignored. This research employs various statistical methods to assess instrument validity. Schwab (1980, p.5) defined instrument validity as "representing the correspondence between a construct (conceptual definition of a variable) and the operational procedure to measure or manipulate that construct". There are two major criteria for evaluating the instrument validity: scale reliability and construct validity.

4.3.2.1 Scale Reliability

Scale reliability pertains to the consistency or stability of a measure and is inversely related to the degree to which a measure is contaminated by random error (Rosnow and Rosenthal, 1998; Bollen, 1989). Random error is always present to a certain degree, and in some cases can constitute a major problem that can jeopardize the validity of research findings. Therefore, it is incumbent upon researchers to assess and report the reliability of their measures (Flynn *et al.*, 1990). However, this basic step of instrument validity has been found to be ignored in many of the operations management researches (e.g., Schroeder *et al.*, 1986; De Meyer *et al.*, 1989; Das *et al.*, 1993; Upton, 1995). According to Cooper and Schindler (1998), scale reliability contains three types: (1) test-retest reliability to assess the consistency of a measure from one time to another, (2) parallel-forms reliability assesses the consistency of the results of two tests constructed in the same way from the same content domain, (3) internal consistency reliability assess the consistency of results across items within a test. Based on relevance, this research only addresses the internal consistency reliability based on classical test theory. Churchill (1979) recommended the use of Cronbach's alpha as the measure of internal consistency, followed by item-to-total correlation to eliminate the items that performed poorly in capturing the construct. A split-halves coefficient is used to measure the homogeneity (Pedhazur and Schmelkin, 1991).

Cronbach's alpha

The Cronbach's alpha coefficient is one of the most popular methods for assessing the reliability, and measures the internal consistency of items in a scale (Rosnow and Rosenthal, 1998; Kendall *et al.*, 1990). The alpha coefficient can range from 0 to 1 (the higher the alpha the higher the reliability) and represents the estimated systematic variance of a measure (O'Leary-Kelly and Vokurka, 1998). The alpha coefficient is based on the correlations among the indicators that comprise a measure, with higher correlations among the indicators associated with high alpha coefficients (Pedhazur and Schmelkin, 1991). Davis (1995) noted that the Cronbach's alpha is the most widely used method of reliability assessment in operations management research. However, there is no complete agreement among business researchers on what is an acceptable threshold for the alpha coefficient. For instance, Kline (1998, p. 194) suggested that an alpha coefficient around 0.90 could be considered as "excellent," that a coefficient value of 0.80 could be viewed as "very good", and that value around 0.70 is "adequate". Nunnally (1978) noted that reliabilities below 0.70 were not acceptable. Davis (1995) suggested an alpha coefficient value of 0.80 for an instrument development study. It is clear that higher levels of alpha create greater confidence in the measure. However, there are several pitfalls associated with the Cronbach alpha method. First, it is problematic when used for studies involving congeneric measures because it tends to underestimate reliability for these studies (Bollen, 1989). Second, if/when reliability estimates of single-item measures cannot be made using the Cronbach's alpha method, then multiple indicator measures must be used (Nunnally, 1978).

Item-to-total correlation

Item-to-total correlation measures how closely the items within a scale relate to the scale as a whole. When analyzing the correlation between each scale item score and its corresponding construct total score, the scale item score is subtracted from its corresponding construct's total score to avoid a spurious part-whole correlation (Cohen and Cohen, 1975). Too high a correlation, and it appears that literally the same item is being offered over and again; too low or negative, and it appears that respondents do not see this item as associated with the construct, or that they see it associated with a different construct.

As a rule of thumb, an item-to-total correlation value above 0.3 is deemed to be adequate for a good internal consistency. Spector (1992) recommended a similar approach to assess the internal consistency of the reliability.

Split-halves coefficient

Split-halves coefficient is another approach to assess reliability by measuring homogeneity. In a split-half reliability, all items that purport to measure the same construct are randomly divided into two sets (Pedhazur and Schmelkin, 1991). Nunnally (1978) noted that a split-haves coefficient value of 0.80 could be considered as adequate for a reliability test. Badri *et al.* (2000) employed the split-halves coefficient in an operations strategy research.

4.3.3 Instrument Validity

Construct validity is a multifaceted process that consists of three primary characteristics: content validity, criterion-related and horizontal validity (Cooper and Schindler, 1998). Over the years, as research in operations management has become increasingly rigorous, there have been various comments about the inadequacies of construct validation in the theory building process within the discipline (Swink and Way, 1995; Flynn *et al.*, 1990; Anderson *et al.*, 1989; Swamidass and Newell, 1987). This research explores all three characteristics of construct validity.

4.3.3.1 Content Validity

Content validity refers to the construction or "make up" of an instrument and whether the items adequately capture the construct domain or essence of the domain (Churchill, 1979). In other words, content validity requires the identification of a group of measurement items which are thought to measure the construct. The determination of content validity is rather subjective (Hensley, 1999). Literature reviews and pre-tests normally serve as the means of justification for content validity, which will be used in this study.

4.3.3.2 Criterion-Related Validity

Criterion-related validity is a measure of the relationship between the scale and surrogate measures of the construct (Cooper and Schindler, 1998). A scale exhibiting a strong relationship between the scale and the measures may be used as an accurate measure of the construct in the real world to predict future performance (Spector, 1992). Some of the operations management studied used a form of measure for criterion-related validity by comparing the scale to the selected measures (e.g., Flynn *et al.*, 1994; Sakakibara *et al.*, 1993; Saraph *et al.*, 1989).

In this research, the expected cross validity index (ECVI) is used as the measure of criterion-related validity as suggested by Kline (1998). In general, ECVI validation indices of less than 1 signify a high probability of correspondence between sample and population model fit (Browne and Cudeck, 1993).

4.3.3.3 Construct Validity

Construct validity attempts to identify the underlying construct (s) being measured and determine how well the test represents them (Cooper and Schindler, 1998). Construct validity is comprised of a test of unidimensionality, a test of convergence in measurements, and a Test of Discriminant in Measurements.

<u>Test of unidimensionality</u>

Unidimensionality is defined by Gerbing and Anderson (1988, p. 186) as "the existence of a single trait or construct underlying a set of measurement". There are two common methods for assessing the unidimensionality of a measure: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) (Kline, 1998). The major difference between EFA and CFA is that under EFA, the association between the scale items and latent variables are not pre-specified, while in CFA the associations are specified (Kim and Mueller, 1978). This research employs both EFA and CFA to test the unidimensionality of the constructs.

Exploratory Factor Analysis

Exploratory factor analysis (EFA) is an analytic method used to condense a group of scale items into a smaller set of composite factors with a minimum loss of information (Kline, 1998). EFA is a commonly used method to explore data in search of unidimensional latent variables. EFA is the popular choice among operations management researchers for assessing unidimensionality in their studies, even though it has certain serious shortcomings (Hensley, 1999). The primary purpose of EFA is to establish that a set of scale items is unidimensional with regard to a predefined latent variable (Schwab, 1980). For example, in the study by Ward *et al.* (1995), empirical indicators were theoretically related to each of the different latent variables and unidimensionality was assessed via EFA. In this research, scale items were shown to theoretically correspond with constructs (business environment, operations strategy, information systems strategy, and business performance) and EFA (principle components) was employed to detect underlying patterns for each construct – which set of scale items loaded onto which criteria.

Carmines and Zeller (1979) suggested the following criteria for establishing the unidimensionality of sales using principle components: (1) the first factor loading should explain a large proportion of the variance in the items (i.e. > 0.40); (2) subsequent components should explain fair proportions of the remaining variance, in a gradually decreasing fashion; (3) all or most of the items should have sizable loadings on the first factor (i.e., > 0.30); and (4) all or most of the items should have higher loadings on the first factor than on subsequent factors. Other researchers noted that a minimum factor loading of 0.30 was the rule of thumb of the EFA method (e.g., Hair *et al.*, 1992; Kerlinger, 1986). This research utilizes the more stringent EFA thresholds proposed by (Carmines and Zeller, 1979).

As mentioned earlier, there are some drawbacks of the EFA method. For instance, when analyzing a heterogeneous set of scale items using EFA, the researcher is faced with the decision of letting either all or none of the latent variables be free to correlate. A dilemma regarding with regard to which decision to choose to assess the unidimensionality is created in studies where some latent variables are correlated while others are not (Suarez *et al.*, 1996). In addition, sample size is a concern of using EFA to assess the unidimensionality. As a rule of thumb, the larger the sample size the more stable the results (Kline, 1998). Generally speaking, EPA should be conducted on samples with greater than 50 observations (Hair, 1992).

Confirmatory Factor Analysis (CFA)

Unlike the EFA method, confirmatory factor analysis (CFA) contains inferential statistics that allow for hypothesis testing regarding the unidimensionality of a set of scale items (Kline, 1998). This leads to a more stringent and objective interpretation of unidimensionality than does EFA (Gerbing and Anderson, 1988). Unlike EFA, the use of

CFA requires the researcher to specify the CFA-model prior to analyzing the data; that is, the latent variables and their associated scale items have to be specified a priori (Kline, 1998). In doing so, CFA provides enhanced control for assessing unidimensionality and is more in line with the overall process of construct validation. Moreover, CFA addresses the problems associated with EFA. For example, unlike the subjective criteria for EFA, in CFA the significance of the factor loading can be tested using a t-test. In addition, CFA gives researchers the advantage of being able to evaluate the overall acceptability of the measurement model in terms of the model's fit to the data, using a chi square (χ^2) test. CFA also provides the capability to simultaneously test the unidimensionality for a set of scale items that are comprised of both correlated and uncorrelated latent variables. In addition, CFA provides a means for directly assessing whether latent variables are correlated as stipulated in the model. This is accomplished by examining both the overall model as well as the significance of each of the correlations.

In conclusion, CFA is a better technique for assessing unidimensionality than EFA. However, according to O'Leary-Kelly and Vojurka (1998), CFA use is a rarity in operations management research. This research uses CFA to assess the unidimensionality of the constructs and test the hypotheses proposed. CFA was executed on all scale items hypothesized to measure the same construct. In this research, there were four measurement models (four latent variables or constructs), and thus four CFA analyses were conducted separately for the four constructs.

Various fit indices in CFA are employed to determine whether each individual construct model provides an adequate explanation for the covariances among the observed measuring items. Marsh *et al.* (1988) divided goodness-of-fit into two categories: stand-alone indexes and incremental indexes.

Stand-alone indexes are based on the maximum likelihood fitting function, which performs much better than those indexes derived from the generalized least squares approach (Hu and Bentler, 1998). Stand-alone indexes include standardized root-mean-square residual (SRMR), root-mean-square-error of approximation (RMSEA), goodness-of-fit index (GFI), adjusted GFI (AGFI), competitive fit index (CFI), χ^2/df, and Critical N (Marsh *et al.*, 1988). Hu and Bentler (1998) recommended a maximum value close to 0.08 for SRMR; and a maximum cutoff value close to 0.06 for RMSEA. Bollen (1989) suggested a minimum cutoff value close to 0.9 for competitive fit index (CFI). The minimum cutoff value close to 0.9 for goodness-of-fit index (GFI) and adjusted GFI (AGFI) was recommended by Jöreskog and Sörbom (1993). Kline (1998) suggested a maximum cutoff of χ^2/df ratio of 3.0. Critical N allows research to assess the fit of a model relative to identical hypothetical models estimated with different sample sizes (Hoelter, 1983). Critical N is computed based on the Chi square (χ^2) and its degrees of freedom. Thus, a Critical N that is lower than the actual sample size in CFA shows that CFA has sufficient power to detect some trivial problems causing a poor fit (Jöreskog and Sörbom, 1993).

Incremental fit indices include the Bentler-Bonne normed fit index (BBI), the non-normed fit index (BBNI), and the Tucker-Lewis (TLI) approach. Bentler and Bonett (1980) proposed BBI & BBNI, and noted that value information could be obtained by comparing the ability of nested models to fit the same data. In particular, for CFA it is useful to compare the fit of the proposed target model with the fit of a null model in which all the p variables are assumed to be uncorrelated. Bollen (1989) suggested a minimum cutoff value close to 0.9 for both BBI and BBNI. Marsh *et al.* (1988) cautioned that an absolute TLI value of 0.9 usually meant that the model could be improved substantially.

Test of Convergent validity

Convergent validity is shown when different measures of the same construct have high correlations (Spector, 1992; Churchill, 1987). The use of measures that lack convergent validity can lead to numerous problems in the interpretation of the results of a study. For instance, Fiske (1982) argued that the finding of a significant relationship between variables that lacked convergent validity might be attributable to the method (s) used to measure the latent variables and not to any "true" relationship between them.

According to Hensley (1999), two of most commonly used methods for assessing convergent validity are the multitrait-multimethod matrix method (MTMM), and the confirmatory factor analysis (CFA) of structural equation model. The CFA method has an edge over the MTMM matrix method in that the CFA provides a direct means for assessing the degree to which convergence is achieved (Bagozzi *et al.*, 1991), with an additional advantage that the CFA technique does not require the strict assumption of equal method factor influence across all variables. Good fit when using the CFA method provides support for the convergence in measurements by taking into account random error (Bagozzi and Phillips, 1982). In this research, convergence in measurements was evaluated using CFA for the "four-construct" model. The four-construct model (overall model) is the model that combines the business environment construct, information systems strategic orientation construct, operations strategy construct, and business performance construct into one measurement model.

Test of Discriminant in Measurements

Discriminant validity is the degree to which measures of different latent variables are unique (Hensley, 1999). That is, in order for a measure to be valid, the variance in the measure should reflect only the variance attributable to its intended latent variable and not to other latent variables. Two approaches have been used to demonstrate discriminant validity (Widaman, 1985). One approach compares two CFA-models: one in which the correlation of a pair of latent variables is constrained to equal 1.0, and another in which the correlation is free to vary (Venkatraman, 1989). A significantly lower Chi square (χ^2) value for the unconstrained model, as compared to the constrained model, provides support for discriminant validity. This approach requires separate comparisons for each pair of latent variables. The second approach simply involves testing that correlations between the latent variables are statistically different from 1.0 (Bagozzi *et al.*, 1991). In this research, the first approach was employed because it is more stringent in discriminant validity testing.

4.4 Path Analysis

Path analysis allows researchers to specify and test structural models that reflect a priori assumptions about spurious associations, and direct or indirect causal effects among observed variables (Kline, 1998). Path analysis is a viable methodology for capturing relationships between variables because it is concerned with estimating the magnitude of the linkages between variables, and uses those estimates to provide information about underlying causal process (Asher, 1983). In this study, covariance structure models are employed to estimate path coefficients by solving the system of equations simultaneously and accounting for covariance among variables within the model.

Three exploratory models tested in this research were a priori based on the literature review to address the impact of the business environment on operations strategy, the impact of information systems strategic orientation on operations strategy, and the impact of information systems strategic orientation on business performance.

CHAPTER 5

RESULTS AND DISCUSSIONS

In this chapter, the respondents' profiles are first presented. Next, following the data analysis procedures discussed in the previous chapter, this chapter provides analytical results including: (1) results of data preparation; (2) results of scale reliability; (3) results of instrument validity; and (4) results of hypotheses testing using path analysis. Finally, these results are discussed.

5.1 Respondents' Profiles

This section presents the results of the sample profiles including participating organizations' profiles, respondents' profiles, and an electronic commerce technology profile.

5.1.1 Participating Organization Profile

A total of 800 questionnaires were distributed. Out of 202 responses received in a single mailing, 166 were usable resulting in a response rate of 21%. Among the 36 unusable responses, 10 of them do not meet the electronic commerce (EC) criteria and the other 26 do not contain sufficient data for further analyzing. Such a response rate is not unusual when the unit of analysis is the firm and involves an extensive organizational level survey (Griffin, 1997).

The six categories of industries used in this research were business consulting, commercial banking, computer software, IT hardware, retailing, and shipping. Table 5.1

shows a breakdown of the number of each type of industry participating in this research. The EC retailing industry provides the most responses (45) while the EC shipping industry produces the least responses (9).

Table 5.1: Profile of Participating Companies

Type of Industry	**Number of Respondents**	**Percent (%)**
Retailing	45	27
IT related Manufacturing	36	22
Business Consulting	31	19
Computer Software	24	14
Commercial Banking	21	13
Shipping	9	5
E-commence Strategy		
Open strategy	104	63
Proprietary strategy	62	37
Number of Employees		
Less than 200	8	5
> 200-400	55	33
> 400-700	49	30
> 700-1000	38	23
More than 1000	16	10
Annual Sales (millions)		
Less than 20	20	12
> 20-100	27	16
> 100-300	45	27
> 300-500	42	25
> 500-1 billion	22	13
More than 1 billion	10	6

Table 5.1 also indicates that the majority of the electronic commerce firms surveyed (104) employ the open strategy, that is, the user interface is identical, regardless of which company the consumer is doing business with. The various organizations can be divided into five groups based on the number of employees. The five groups can be broken into categories of less than 200 employees, between 200 to 400 employees, between 400-700 employees, between 700 to 1000 employees, and more than 1000 employees. The category of less than 200 employees has the lowest respond rate (5%), while the category of between 200 to 400 employees has the highest respond rate (55%). The participating companies can also be divided into six groups based on annual sales. The six groups can be broken into categories of less than $20 million of annual sales, between 20 to 100 million, between 300 to 500 million, between 500 million to 1 billion, and more than 1 billion. The category of between 100 to 300 million of annual sales has the highest respond rate (45%), while the category of more than 1 billion of annual sales has the lowest respond rate (10%).

5.1.2 Respondent Profile

Table 5.2 indicates that respondents are top managers of participating companies from different functional areas including IT/IS, accounting/finance, operations, marketing, and other areas such as purchasing and engineering. IT/IS managers comprise of the greatest responses (57), while managers from areas other than IT/IS, accounting/finance, operations, and marketing provide the least response (7). On average, respondents have stayed in their current position for 9.5 years. An average of 3.4 years of experience in electronic commerce were also reported.

Table 5.2: Respondent Profile

Position (VP or Manager)	**Number of** Respondents
IT/IS	57
Accounting & Finance	41
Operations	35
Marketing	25
Other	7
	Average
Number of years in current position	9.5
Number of years of EC experience	3.4

5.1.3 EC Technology and Operations Strategy Information

Table 5.3 reports the five most used electronic commerce (EC) technologies, the five most important reasons of EC technologies, and the importance of competition, core competence, and information systems strategy. The five EC technologies most employed in practice, according to this research, are Intranets (146 #1 votes), followed by groupware, the Internet, traditional EDI, and extranets. It is interesting to note that although Internet-based EDI is more advantageous than traditional EDI (Segev *et al.*, 1997), traditional EDI is still more frequently used in businesses than Internet-based EDI. As for the important reasons for using EC technologies, creating an easy access network is ranked number one followed by flexibility in time of delivery, exchange of information, increasing productivity, and reducing costs. The results are supported by Keeney (1999). The respondents rated flexibility as the most important operations strategy dimension in an electronic commerce environment with 121 #1 votes followed by delivery and quality. Cost is the least important operations strategy dimension among the four. On average, respondents view both competition and information systems strategy as very important with respective average scores of 4.3 and 4.6 on a five-point Likert scale (1 being unimportant; 5 being important).

Table 5.3: EC Technology and Operations Strategy Information

EC Technologies	**Rank**	**#1 choice votes**
Intranet	1	146
Groupware Technology	2	126
Internet	3	117
Traditional EDI	4	43
Extranet	5	26
Important Reasons of EC Technologies	**Rank**	**#1 choice votes**
Create an easy access network	1	142
Flexibility in time of delivery	2	131
Exchange information	3	102
Increase productivity	4	91
Reduce costs	5	82
Importance of operations strategy	**Rank**	**#1 choice votes**
Flexibility	1	121
Delivery	2	101
Quality	3	96
Cost	4	40
	Average	
Importance of competition	4.3	
Importance of information systems strategy	4.6	

5.2 Data Analysis Results

5.2.1 Results of the Normality Test

As discussed in Chapter 4, the normality test is employed to ensure that each scale items is normally distributed. Table 5.4 shows skewness and kurtosis values for all 61 scale items collected from 166 respondents in this research. The absolute values of skewness of the scale items in this study are all below 1.33, and thus meet the rule of thumb (that the absolute value of skewness should be less than 3.0) for the normality test of skewness. As for the kurtosis test, none of the scale item has an absolute value of kurtosis value greater than 2.0 – the rule of thumb for the normality test of kurtosis. As a result, it is clear that all 61 scale items in this research are normally distributed, and hence are acceptable for further analysis using structural equation modeling techniques such as CFA and path analysis.

Table 5.4: Normality Test (Skewness & Kurtosis)

Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
BC1	166	1	5	3.133	.871	.129	-.700
BC2	166	1	5	3.181	.916	-.176	-.590
BC3	166	1	5	3.428	.862	-.319	-.212
BC4	166	1	5	3.470	.711	-.251	.323
BC5	166	1	5	3.928	.878	-.892	.878
BC6	166	1	5	2.711	.895	.553	-.023
LA1	166	1	5	2.880	.879	.725	-.011
LA2	166	2	5	4.283	.873	-1.140	.599
LA3	166	1	5	3.133	.783	.146	-.188
LA4	166	1	5	3.000	.817	.338	.027
LA5	166	1	5	2.578	1.113	.494	-.330
CH1	166	2	5	3.361	1.004	.096	-1.076
CH2	166	1	5	3.470	.945	-.327	-.367
CH3	166	1	5	3.506	1.072	-.076	-1.127
CH4	166	1	5	3.277	.871	-.071	-.658
CH5	166	1	5	2.976	.991	-.141	-.684
GR1	166	2	5	3.428	.903	-.056	-.797
GR2	166	1	5	3.289	.997	-.126	-.704
GR3	166	1	5	3.133	1.024	.176	-.808
GR4	166	1	5	2.910	.9134	-.158	-.299

Table 5.4: Normality Test (Skewness & Kurtosis) – Continued

Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
ED1	166	1	5	3.271	1.178	-.182	-.938
ED2	166	1	5	3.410	1.181	-.351	-.781
ED3	166	1	5	3.205	1.204	-.170	-1.052
ED4	166	1	5	3.235	1.170	-.124	-.928
FS1	166	2	5	3.548	.864	-.179	-.602
FS2	166	1	5	3.783	.888	-.452	.055
FS3	166	1	5	3.578	.910	-.236	-.498
FS4	166	2	5	3.548	.850	-.302	-.528
FS5	166	1	5	3.621	.931	-.129	-.631
FS6	166	1	5	3.434	.883	.044	-.452
QS1	166	2	5	3.934	.895	-.330	-.833
QS2	166	2	5	3.922	.755	-.383	-.050
QS3	166	2	5	3.639	.825	-.223	-.428
QS4	166	1	5	3.723	.878	-.296	-.306
QS5	166	2	5	3.627	.870	-.144	-.627
QS6	166	2	5	3.608	.886	-.149	-.674
DS1	166	2	5	3.988	.824	-.438	-.408
DS2	166	2	5	3.711	.839	-.159	-.556
DS3	166	1	5	3.717	.859	-.464	-.037
DS4	166	1	5	3.693	1.001	-.561	-.294
CS1	166	1	5	3.578	.896	-.136	-.477
CS2	166	1	5	3.410	.954	-.141	-.635
CS4	166	1	5	3.440	1.070	.038	-.897
CS5	166	1	5	3.494	1.205	-.249	-1.052
CS6	166	1	5	3.139	1.269	-.084	-1.162
ISC	166	2	5	3.560	1.092	.042	-1.317
ISQ	166	2	5	3.747	.702	.079	-.456
ISF	166	2	5	3.783	.928	-.152	-.954
ISD	166	2	5	3.669	.975	-.166	-.964
MG1	166	1	5	2.705	.833	-.099	-.279
MG2	166	1	5	2.735	.840	.162	-.038
MG3	166	1	5	2.687	.823	.375	.007
FP1	166	1	5	2.825	.908	.305	-.741
FP2	166	1	5	2.759	.840	.232	.111
FP3	166	1	5	2.615	.865	.153	-.499
FP4	166	1	5	2.789	.965	.066	-.823
FP5	166	1	5	3.072	1.346	-.133	-1.415
I1	166	2	5	3.343	.945	.090	-.919
I2	166	2	5	3.506	1.025	.052	-1.122
CR	166	1	5	3.753	1.047	-.419	-.740

5.3 Scale Reliability

This presents results of scale reliability tests including Cronbach's alpha, the corrected item-to-total correlation, and the split-half test. Table 5.5 exhibits the results of these reliability tests.

5.3.1 Results of Cronbach's Alpha

Cronbach's alpha is the most commonly used method for assessing scale reliability in empirical studies (Rosnow and Rosenthal, 1998). In this research, Cronbach's alpha was calculated for each dimension of the relevant construct of the research model, as suggested for empirical research in operations management by many researchers (Flynn *et al.*, 1995; Vickery *et al.*, 1993; Vickery, 1991; Swamidass and Newell, 1987). The Cronbach's alpha values for each dimension ranged from 0.774 to 0.892 for the business environment construct. More specifically the following coefficients resulted: business cost (0.774), labor availability (0.817), competitive hostility (0.842), government regulations (0.802), and environment dynamism (0.892). For the operations strategy dimensions, the following alpha values resulted: flexibility strategy (0.840), quality strategy (0.843), delivery strategy (0.805), and cost strategy (0.845). The dimensions of information systems'strategic orientation are measured by single scale items, thus there is no alpha value for each dimension. However, the alpha for this construct is 0.773. The Cronbach's alpha values for each dimension ranged from 0.717 to 0.858 for business performance. More specifically the following coefficients resulted: market growth (0.717), financial performance (0.858), and Innovation/reputation (0.830).

These Cronbach's alpha values exceed the rule of thumb alpha value of 0.70 – generally considered as "adequate" for assessing reliability in empirical research (Kline 1998; Nunnally, 1978). Thus, it is assumed that the scale items used in this research can be considered reliable.

Table 5.5: Scale Reliability: Cronbach's coefficient alpha (α), Item-to-total correlation (r), and Split-half

Construct	Dimensions	Items	α if deleted	r
Business Environment Split-half α = 0.841	Business Costs α = 0.774	BC1	0.746	0.498
		BC2	0.741	0.519
		BC3	0.703	0.653
		BC4	0.727	0.653
		BC5	0.749	0.492
		BC6	0.770	0.616
	Labor Availability α = 0.817	LA1	0.771	0.652
		LA2	0.756	0.689
		LA3	0.790	0.578
		LA4	0.784	0.602
		LA5	0.805	0.536
	Competitive Hostility α = 0.842	CH1	0.781	0.746
		CH2	0.806	0.659
		CH3	0.815	0.630
		CH4	0.807	0.661
		CH5	0.835	0.661
	Government Regulations α = 0.802	GR1	0.762	0.595
		GR2	0.698	0.718
		GR3	0.743	0.634
		GR4	0.795	0.521
	Environment Dynamism α = 0.892	ED1	0.858	0.771
		ED2	0.858	0.771
		ED3	0.860	0.765
		ED4	0.869	0.741
Operation Strategy Split-half α = 0.8753	Flexibility Strategy α = 0.840	FS1	0.790	0.739
		FS2	0.805	0.658
		FS3	0.805	0.661
		FS4	0.816	0.661
		FS5	0.842	0.605
		FS6	0.822	0.477
	Quality Strategy α = 0.843	QS1	0.835	0.477
		QS2	0.846	0.458
		QS3	0.807	0.681
		QS4	0.791	0.753
		QS5	0.787	0.776
		QS6	0.833	0.548
	Delivery Strategy α = 0.805	DS1	0.773	0.584
		DS2	0.772	0.586
		DS3	0.729	0.676
		DS4	0.747	0.676
	Cost Strategy α = 0.845	CS1	0.833	0.574
		CS2	0.814	0.653
		CS3	0.799	0.702
		CS4	0.802	0.694
		CS5	0.812	0.665

Table 5.5: Scale Reliability: Cronbach's coefficient alpha (α), Item-to-total correlation (r), and Split-half (Continued)

Construct	Dimensions	Items	α if deleted	r
Split-half (ISSO) α = 0.7539	IS Strategic Orientation α = 0.773	ISC	0.883	0.420
		ISQ	0.614	0.748
		ISF	0.582	0.794
		ISD	0.615	0.746
Business Performance Split-half α = 0.923	Market Growth α = 0.717	MG1	0.668	0.503
		MG2	0.575	0.579
		MG3	0.638	0.529
	Financial Performance α = 0.858	FP1	0.828	0.695
		FP2	0.838	0.434
		FP3	0.828	0.643
		FP4	0.836	0.437
		FP5	0.802	0.785
	Innovation/Reputation α = 0.830	I1	0.756	0.607
		I2	0.753	0.375
		CR	0.787	0.607

5.3.2 Results of the Item-to-total Correlation

Corrected item-total correlations (CITC) were used for purification purposes because 'garbage' items may confound the interpretation of the factor analysis (Koufteros *et al.*, 2001). Table 5.5 shows that the item-to-total score correlations of all scale items ranged from 0.375 to 0.794 and thus were above the 0.30 rule of thumb of this reliability test. The lower bound of this range is in line with those in other operations management and information systems studies (Koufteros *et al.*, 2001; Doll and Torkzadeh, 1998; Ives *et al.*, 1983). With this CITC range, it is believed that all scale items in this study cover various dimensions and are adequate measures of their corresponding constructs.

5.3.3 Results of the Split-half Test

In addition to Cronbach's alpha and the corrected item-to-total correlation test, the split-half test was employed in this study to assess the homogeneity aspect of the scale reliability. The split-half alpha values reported in Table 5.5 ranged from 0.754 to 0.923. More specifically the following coefficients resulted: business environment (0.841), operations strategy (0.875), information systems' strategic orientation (0.754), and business performance (0.923). These values are generally considered adequate for empirical research (Nunnally, 1978).

In conclusion, all 61 scale items used in this research tested as reliable based on the results of the Cronbach's alpha approach, the corrected item-to-total correlation test, and the split-half test. The unidimensionality of these 61 scales items is further examined in the next section.

5.4 Instrument Validity

This section presents the results of instrument validity, which is comprised of results of content validity, criterion-related validity, and construct validity.

5.4.1 Content Validity

The content validity of a measuring instrument is the extent to which it provides adequate coverage of the topic under study (Rosnow and Rosenthal, 1998). Cooper and Schindler (1998) suggested two ways of determining content validity: (1) through a careful definition of the topic of concern, the items to be scaled, and the scales to be used; and (2) using a panel of experts to judge how well the instrument meets the standard. In this study, the measuring instrument (a questionnaire) is employed based on the operations strategy theory and the information systems strategy research literature which covers all major aspects of the content areas. Moreover, the items to be scaled and the scales to be used in this research are adapted from previous operations strategy and information systems strategy empirical studies. A preliminary questionnaire was sent to and carefully examined by a panel of experts in both the operations and IS/IT fields. The final questionnaire was modified to meet the standards based on the input of the panel of experts.

5.4.2 Criterion-related Validity

Criterion-related validity is the degree to which the instrument (questionnaire) correlates with one or more criteria. While correlation between the scale and the measurement is commonly used in criterion-related validity (Cooper and Schindler, 1998), the expected cross validity index (ECVI) is preferred as a measure for criterion-related validity in the structural equation model scenario (Kline, 1998). Table 5.6 reports the ECVI values of all four constructs in this research ranging from 0.13 to 0.77. More specifically the following ECVI values resulted: business environment (0.65), operations strategy (0.13), information systems strategic orientation (0.77), and business performance (0.65). These ECVI values are well below 1 – the rule of thumb for "adequate" in a criterion-related validity test. As a result, it is assumed that all scale items have high probability of correspondence between sample and population model fit.

Table 5.6: Criterion-Related (horizontal) Validity

	Business Environment	Operation Strategy	IS Strategic Orientation	Performance
ECVI	0.65	0.13	0.77	0.65

5.4.3 Construct Validity

This section describes three dimensions in which construct validity is assessed: (1) a test of unidimensionality; (2) a test of convergence validity; and (3) a test of discriminant validity.

5.4.3.1 The Unidimensionality Test

The unidimensionality test provides evidence of a single latent construct (Flynn et al., 1990). In this research, both exploratory factor analysis and confirmatory factor analysis are employed to assess the unidimensionality.

Results of Exploratory Factor Analysis (EFA)

EFA is a commonly used method to assess unidimensionality in operations management research (Hensley, 1999). EFA was conducted by using the principal components method as the extraction technique and the varimax approach as a method of rotation. A rule of thumb for EFA that indicates unidimensionality is that all or most of the items should have sizable loadings on the first factor with a factor value larger than 0.3 (Doll and Torkzadeh, 1988). In this research, a more rigorous measure of EFA

(Carmines and Zeller, 1979) was employed. To achieve unidimensionality, scale items must meet the following criteria:

1. First factor loading should explain a large proportion of the variance in the items (i.e. > 0.40)
2. All or most of the items should have sizable loadings on the first factor (i.e., > 0.30)
3. All or most of the items should have higher loadings on the first factor than on subsequent factors.

Table 5.7 presents the EFA results of this research. The resulting overall exploratory solution indicated a thirteen factor solution. The thirteen factors had eigenvalues greater than one and accounted for 71.25% of the total explained variance. The total explained variance (71.25%) is greater than the 0.40 threshold and thus the first criteria of unidimensionality test was met. All scale items loaded on their intended factors. For instance, six scale items measuring the business cost dimension of the business environment construct loaded on a single factor labeled business cost. Overall, scales items loaded strongly on their intended factors, as the lowest factor loading stood at 0.402. As a result, all scale items had sizable loadings on the first factor greater than 0.30, and hence met the second criteria of the unidimensionality test. Some scale items have cross-loadings. More specifically the following cross-loadings resulted: Item BC1 (0.308), Item BC2 (0.346), Item BC4 (0.450), Item FS4 (0.327), Item QS5 (0.424), Item QS5 (0.447), Item CS1 (0.374), and Item IS1 (0.333). Cross-loading were low and not alarming. More importantly, all scale items had higher loadings on the first factor than on subsequent factors. Thus, the third criteria of the unidimensionality test was met.

In conclusion, each of the scales in this research met all three criteria of the unidimensionality test proposed by Carmines and Zeller (1979). Hence, it is assumed that the scale items used in this research were unidimensional based on a more stringent

EFA test. However, as mentioned in chapter 4, EFA has some drawbacks in assessing the unidimensionality of scale items (Suarez *et al.*, 1996). As such, CFA was also employed to assess the unidimensionality of scale items in this research.

Table 5.7: Exploratory Factor Analysis (EFA)

	Component												
	1	2	3	4	5	6	7	8	9	10	11	12	13
BC1	.629						.308						
BC2	.602					.346							
BC3	.742												
BC4	.519									.450			
BC5	.555												
BC6	.459												
LA1		.557											
LA2		.459											
LA3		.585											
LA4		.547											
LA5		.576											
CH1			.797										
CH2			.703										
CH3			.744										
CH4			.671										
CH5			.595										
GR1				.776									
GR2				.761									
GR3				.686									
GR4				.517									
ED1					.790								
ED2					.806								
ED3					.797								
ED4					.758								
FS1						.784							
FS2						.676							
FS3						.664							
FS4					.327	.589							
FS5						.615							
FS6						.583							
QS1							.670						
QS2							.580						
QS3							.579						
QS4							.506						
QS5					.424		.495						
QS6				.447			.481						

Table 5.7: Exploratory Factor Analysis (EFA) – Continued

	Component												
	1	2	3	4	5	6	7	8	9	10	11	12	13
DS1								.639					
DS2								.616					
DS3								.640					
DS4								.634					
CS1							.374		.560				
CS2									.576				
CS3									.667				
CS5									.723				
CS4									.761				
CS6									.732				
IS1								.333		.507			
IS2										.726			
IS3										.699			
IS4										.691			
MG1											.504		
MG2											.540		
MG3											.657		
FP1												.722	
FP2												.575	
FP3												.589	
FP4												.610	
FP5												.507	
I1													.420
I2													.402
CR													.603
Eigenvalue	12.22	10.49	9.82	9.01	8.45	7.99	7.31	6.45	4.39	3.17	2.81	2.02	1.76
Variance (%)	71.25%												

Results of Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) is a more stringent and objective approach to assess the unidimensionality of the instrument (Kline, 1998). Unlike EFA, the use of CFA requires the researcher to specify the conceptual model prior to analyzing the data. In this research, four individual concept models (constructs) were specified as a priori based on the theoretical foundation drawing from both operations strategy and information systems strategy literature. CFA results for each individual-concept model are summarized in Table 5.8. All CFAs were computed by using the maximum likelihood fitting function as an estimation method, and were based on the validation sample of 166 respondents.

Table 5.8: Summary of CFA Fit Indices of Individual Construct Models

	Individual Construct Model			
	Business Environment	**IS Strategic Orientation**	**Operation Strategy**	**Performance**
SRMR	0.069	0.094	0.067	0.035
CFI	0.89	0.99	0.89	0.98
RMSE	0.078	0.084	0.072	0.049
χ^2	496.93 (df=247)	4.90 (df=2)	344.63 (185)	57.22 (41)
χ^2/df	2.01	2.45	1.86	1.40
Critical N	108.13	123.61	107.88	176.48
Power	0.879	0.516	.921	0.850

Business Environment Construct

Fit indices of CFA for the individual-concept model of the business environment construct were presented in Table 5.8. Overall, the CFA fit indices of the business environment construct were in the acceptable range, and thus indicated that the model had a "good fit". SRMR (0.069) was lower than the 0.08 rule of thumb for a "good fit". An RMSE value of 0.078 also met the 0.08 rule of thumb for the CFA fit index. A χ^2/df of 2.01 was below the 3.0 rule of thumb. The CFI value of 0.89 met the rule of thumb for the CFA competitive fit index – a minimum cutoff close to 0.90 (Jöreskog and Sörbom, 1993). Critical N (108.13) was lower than the sample size of 166 indicating a good fit. Finally, the power value of 0.879 showed that scale items exhibited high power.

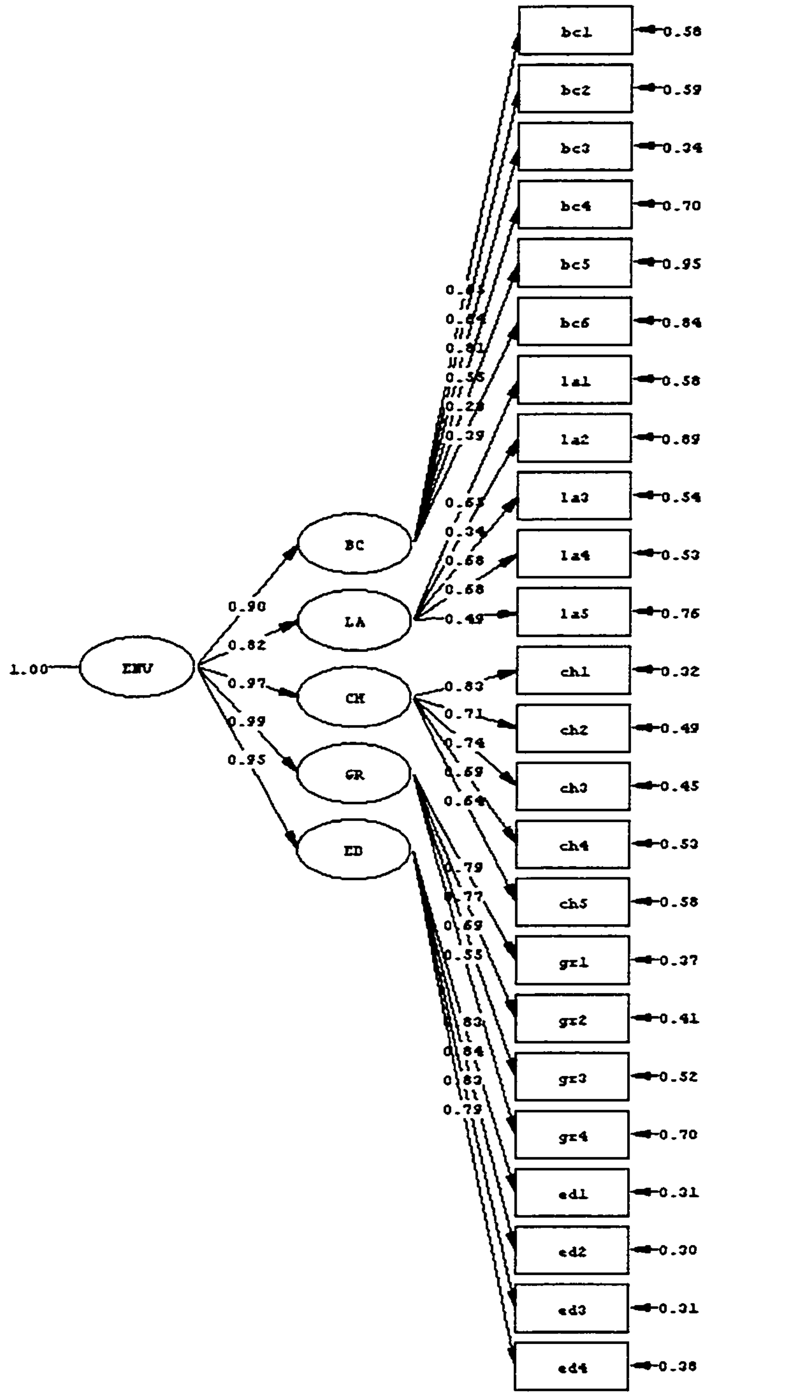
Table 5.9 reports the results of CFA measures of the business environment construct including standardized loadings, t-values, and variance explained (R^2). All scale items loaded on their intended dimensions. Standardized loadings for scale items ranged from 0.23 to 0.84. These CFA loading results were in the moderate-to-high level. Moreover, t-values for scale items ranged from 3.79 to 13.01 and thus exceeded the 2.0 rule of thumb. As a result, all loadings for scale items were significant at the $p = 0.05$ level. All five dimensions then loaded on the business environment construct. Overall, dimensions loaded strongly on the business environment construct with the lowest standardized loading at 0.82. All t-values for various dimensions were much higher than the 2.0 rule of thumb, hence all loadings for dimensions were significant at the $p = 0.05$ level. All of the loadings of various dimensions had explained variances higher than the 0.50 rule of thumb suggested by researchers (e.g., Bagozzi and Yi, 1998). More specifically the following standardized loading for five dimensions of the construct resulted: business cost (0.90), labor availability (0.82), competitive hostility (0.97), government regulations (0.99), and environment dynamism (0.95).

Figure 5.1 shows the LISREL output for the business environment construct model. In conclusion, it is believed that the business environment concept model was a good fit, and all scale items were unidimensional.

Table 5.9: CFA Measures of Business Environment Construct

Construct	Dimension	Loading	T-value	R^2	Item	Loading	T-value	R^2
Business Environment	Business Cost	.90	8.23	.82	BC1	.65	6.87	.42
					BC2	.64	7.01	.41
					BC3	.81	8.43	.66
					BC4	.55	6.14	.30
					BC5	.23	2.75	.05
					BC6	.39	4.58	.16
	Labor Availability	.82	7.54	.68	LA1	.65	6.59	.42
					LA2	.34	3.79	.11
					LA3	.68	6.99	.46
					LA4	.68	7.03	.46
					LA5	.49	5.35	.24
	Competitive Hostility	.97	12.23	.94	CH1	.83	12.34	.68
					CH2	.71	10.16	.51
					CH3	.74	10.69	.51
					CH4	.69	9.74	.47
					CH5	.64	8.94	.42
	Government Regulations	.99	11.77	.97	GR1	.79	11.23	.63
					GR2	.77	10.75	.59
					GR3	.69	9.52	.48
					GR4	.55	7.20	.30
	Environment Dynamism	.95	12.06	.90	ED1	.83	10.19	.69
					ED2	.84	13.01	.70
					ED3	.83	12.77	.69
					ED4	.79	11.83	.62

Figure 5.1: LISREL Output of Business Environment Construct Model



Chi-Square=496.93, df=247, P-value=0.00000, RMSEA=0.078

Operation Strategy Construct

CFA fit indices for the individual-concept model of operations strategy are reported in Table 5.8. Overall, the CFA fit indices for the operations strategy construct were in the acceptable range and thus indicated that the model had a "good fit". SRMR (0.067) was lower than the 0.08 rule of thumb as "good fit". The RMSE value of 0.072 also met the 0.08 rule of thumb for the CFA fit index. The χ^2/df value of 1.86 was below the 3.0 rule of thumb. A CFI value of 0.89 met the rule of thumb for the CFA competitive fit index – a minimum cutoff close to 0.90 is suggested (Jöreskog and Sörbom, 1993). Critical N (107.88) was lower than the sample size of 166 indicating a good fit. Finally, a power value of 0.921 indicated that the scale items had a very high statistical power.

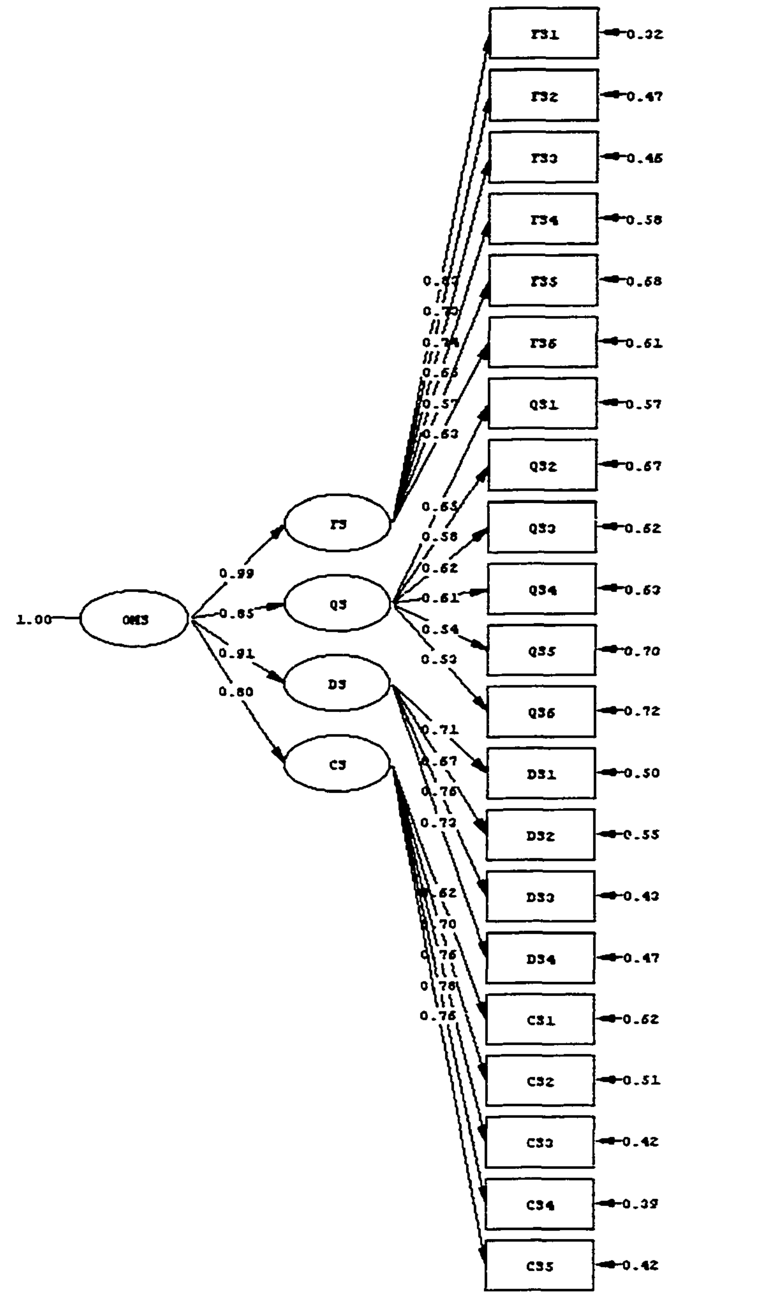
Table 5.10 reports results of CFA measures of the construct including standardized loadings, t-values, and variance explained (R^2). All scale items loaded on their respective dimensions. Standardized loadings for scale items ranged from 0.53 to 0.83. These loading results of CFA were in the moderate-to-high level. Moreover, t-values for scale items ranged from 5.82 to 12.11 exceeding the 2.0 rule of thumb. Thus, all loadings for scale items were significant at the $p = 0.05$ level. All four dimensions then loaded on the operations strategy construct. Dimensions loaded strongly on the business environment construct with the lowest standardized loading at 0.80. All t-values for various dimensions were much higher than the 2.0 rule of thumb, hence all loadings for dimensions were significant at the $p = 0.05$ level. All of the loadings of various dimensions had explained variance higher than the 0.50 rule of thumb. More specifically the following standardized loading for five dimensions of the construct resulted:

flexibility strategy (0.99), quality strategy (0.85), delivery strategy (0.91), and cost strategy (0.80). The LISREL operations strategy construct model output is shown in Figure 5.2. It is believed that the operations strategy concept model had a good fit, and that all scale items measuring the construct were unidimensional.

Table 5.10: CFA Measures of Operation Strategy Construct

Construct	Dimension	Loading	T-value	R^2	Item	Loading	T-value	R^2
Operation Strategy	Flexibility Strategy	.99	12.17	.99	FS1	.83	12.11	.68
					FS2	.73	10.43	.53
					FS3	.74	10.53	.54
					FS4	.65	8.96	.42
					FS5	.57	7.59	.32
					FS6	.63	8.57	.39
	Quality Strategy	.85	7.79	.73	QS1	.65	8.67	.43
					QS2	.58	6.26	.33
					QS3	.62	6.65	.38
					QS4	.61	6.54	.37
					QS5	.54	5.96	.30
					QS6	.53	5.82	.28
	Delivery Strategy	.91	9.12	.83	DS1	.71	8.45	.50
					DS2	.67	7.94	.45
					DS3	.76	8.88	.57
					DS4	.73	8.53	.53
	Cost Strategy	.80	7.23	.63	CS1	.62	6.79	.38
					CS2	.70	7.25	.49
					CS3	.76	7.73	.58
					CS4	.78	7.85	.61
					CS5	.76	7.73	.58

Figure 5.2: LISREL Output of Operations Strategy Construct Model



Chi-Square=344.63, df=185, P-value=0.00000, RMSEA=0.072

Information Systems Strategic Orientation Construct

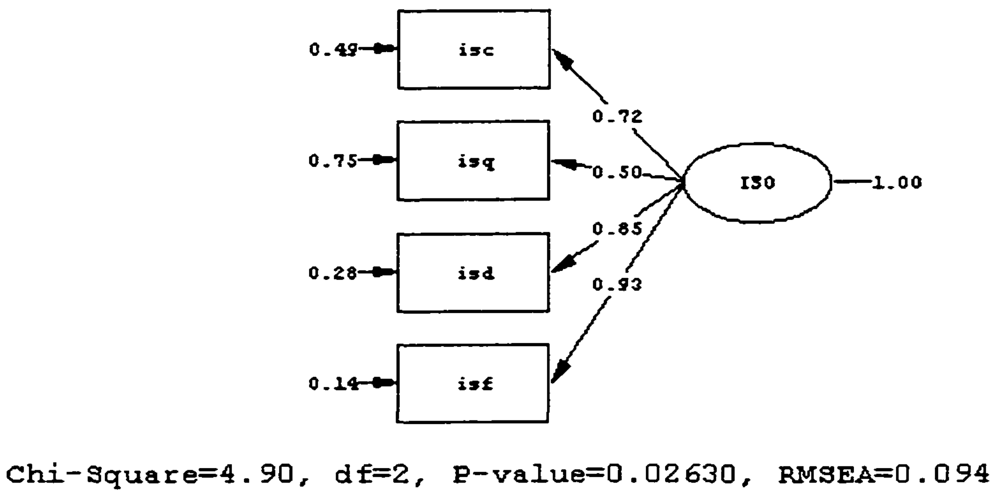
CFA fit indices for the individual-concept model of information systems strategic orientation are reported in Table 5.8. The CFA fit indices of the information systems strategic orientation construct suggested that the model had a "good fit" because most of the fit indices were in the acceptable range. The χ^2/df value of 2.45 was below the 3.0 rule of thumb as a "good fit". The RMSE value of 0.084 was very close to the minimum cutoff value of 0.08 of the CFA fit index. However, SRMR (0.094) was slightly more than the minimum cutoff value of 0.08. The CFI value of 0.99 exceeded the rule of thumb for the CFA competitive fit index – a minimum cutoff close to 0.90. Critical N (123.61) was lower than the sample size of 166 indicating a good fit. Finally, power value of 0.516 exhibited moderate power of scale items.

Table 5.11 shows the results of the CFA measures of the information systems strategic orientation construct including standardized loadings, t-values, and variance explained (R^2). All scale items loaded directly on the construct. Standardized loadings for scale items ranged from 0.50 to 0.93. These CFA loading results were in the moderate-to-high level. Moreover, t-values for scale items ranged from 6.51 to 14.56 and thus exceeded the 2.0 rule of thumb. Loadings for scale items were significant at the p = 0.05 level. All of the loadings except item [ISQ] had explained variance higher than the 0.50 rule of thumb. Figure 5.3 shows the LISREL output of the business environment construct model. In conclusion, it is believed that the business environment concept model a good fit and all scale items were unidimensional.

Table 5:11 CFA Measures of Information Systems Strategic Orientation Construct

Construct	Item	Loading	T-value	R^2
IS Strategic Orientation	ISC	.72	10.21	.51
	ISQ	.50	6.51	.25
	ISF	.85	12.75	.72
	ISD	.93	14.56	.86

Figure 5.3: LISREL Output of IS Strategic Orientation Construct Model



Business Performance Construct

Fit indices for the business performance construct are shown in Table 5.8. The CFA fit indices of business performance construct are in the acceptable range and thus indicate that the model has a "good fit". Both SRMR (0.035) and RMSE (0.049) were lower than the 0.08 rule of thumb indicating a "good fit". The χ^2/df of 1.40 was below the 3.0 rule of thumb. The CFI value of 0.98 exceeded a minimum cutoff requirement of 0.90. However, Critical N (176.48) was slightly higher than the sample size of 166. Lastly, a power value of 0.850 indicated that it had a high statistical power.

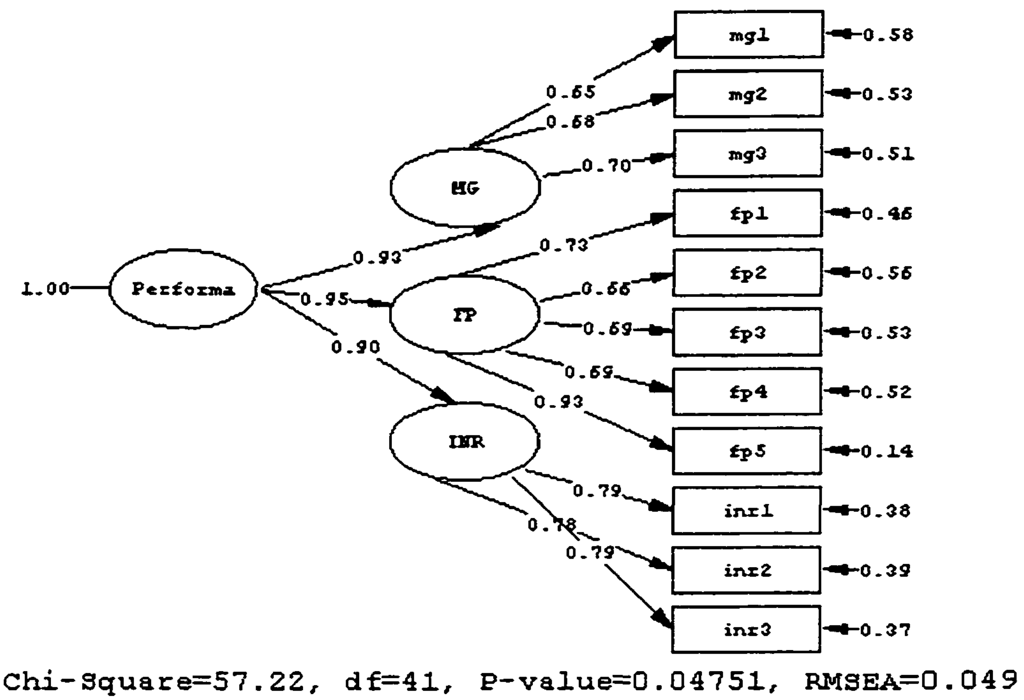
Table 5.12 shows the results of CFA measures of the business performance construct including standardized loadings, t-values, and variance explained (R^2). All scale items loaded on their intended dimensions. Standardized loadings for scale items ranged from 0.65 to 0.93. These CFA loading results were in a moderate-to-high level. Moreover, t-values for scale items ranged from 7.20 to 12.14 exceeding the 2.0 rule of thumb. Hence, all loadings for scale items were significant at the p = 0.05 level. All three dimensions then loaded on the business performance construct. Dimensions loaded strongly on the business performance construct with the lowest standardized loading at 0.90. All t-values for the various dimensions were much higher than the 2.0 rule of thumb, hence all loadings for dimensions were significant at the p = 0.05 level. All of the loadings of the various dimensions had explained variance higher than the 0.50 rule of thumb. More specifically the following standardized loading for the five dimensions of the construct resulted: market growth (0.93), financial performance (0.95), and Innovation/ Reputation (0.90). Figure 5.4 shows the LISREL output of the business performance construct model.

Judging from the results for the CFA measures, it is believed that all scale items in this research were significantly related to their specified constructs, verifying the posited relationships among scale items and constructs. With respect to fit indices, it is believed that all four individual-concept models fitted well and thus represented a reasonably close approximation to the population.

Table 5:12: CFA Measures of the Business Performance Construct

Construct	Dimension	Loading	T-value	R^2	Item	Loading	T-value	R^2
Performance	Market Growth	0.93	8.39	0.86	MG1	0.65	7.20	0.42
					MG2	0.68	7.53	0.47
					MG3	0.70	7.70	0.49
	Financial Performance	0.95	10.84	0.91	FP1	0.73	9.30	0.54
					FP2	0.66	8.48	0.44
					FP3	0.69	8.81	0.47
					FP4	0.69	8.87	0.48
					FP5	0.93	12.14	0.86
	Innovation & Reputation	0.90	10.34	0.81	I1	0.79	10.77	0.62
					I2	0.78	10.64	0.61
					CR	0.79	10.82	0.63

Figure 5.4: LISREL Output Business Performance Construct Model



5.4.3.2 Convergence Validity Test

Convergent validity relates to the degree to which multiple methods of measuring a variable provide the same results (Churchill, 1987). In this research, a CFA approach was employed instead of the less rigorous MTMM. Table 5.13 shows the summary of the CFA measures of the four-concept model. The SRMR (0.063), RMSEA (0.062), and χ^2/df (2.35) measures met the requirements of a "good" fit. CFI (0.93) also exceeded the minimum cutoff value of 0.90. Critical N (112.20) was lower than the sample size (166) in the analysis. The model was also shown to have high statistical power (0.945).

Table 5.13: Summary of CFA Fit Indices of the Four-concept Model

SRMR	CFI	RMSEA	χ^2	χ^2/df	Critical N	Power
0.063	0.93	0.062	120 (51)	2.35	112.20	0.945

Table 5.14 reports CFA measures of the four-concept model including standardized loadings, t-values, and variance explained (R^2). The CFA results measures illustrated that all standardized loadings were high, ranging from 0.30 to 0.86. All t-values were high than 2.0, and hence were significant at the $p = 0.05$ level. Most of the R^2 values were high than 0.30, except scale items [BC6], [LA2], [LA5], and [QS6].

In conclusion, the overall CFA results for the four-concept model in this research suggested that the model had a good fit. Thus, it is believed that the convergence validity of the proposed research model tested as significant.

Table 5.14: CFA Measures of the Four-Concept Model

Construct	Dimension	Loading	T-value	R^2	Item	Loading	T-value	R^2
Business Environment	Business Cost	.82	9.51	.73	BC1	.60	6.15	.38
					BC2	.62	7.01	.32
					BC3	.76	8.11	.46
					BC4	.53	5.94	.41
					BC5	.45	5.75	.35
					BC6	.30	4.28	.15
	Labor Availability	.79	8.54	.61	LA1	.58	5.78	.35
					LA2	.31	3.12	.13
					LA3	.54	6.03	.39
					LA4	.60	6.32	.41
					LA5	.40	4.91	.19
	Competitive Hostility	.91	10.91	.84	CH1	.77	10.46	.61
					CH2	.68	8.96	.48
					CH3	.66	8.69	.47
					CH4	.63	8.31	.44
					CH5	.61	7.92	.39
	Government Regulations	.90	10.34	.77	GR1	.72	9.82	.58
					GR2	.71	9.45	.57
					GR3	.66	8.81	.46
					GR4	.56	7.23	.31
	Environment Dynamism	.87	9.72	.82	ED1	.80	9.99	.66
					ED2	.81	11.01	.69
					ED3	.82	11.37	.68
					ED4	.77	9.63	.61
Operation Strategy	Flexibility Strategy	.93	11.29	.87	FS1	.81	11.31	.68
					FS2	.69	9.43	.53
					FS3	.71	9.59	.51
					FS4	.61	8.12	.41
					FS5	.54	6.99	.30
					FS6	.63	8.57	.39
	Quality Strategy	.85	10.01	.73	QS1	.61	8.21	.41
					QS2	.53	5.26	.34
					QS3	.58	6.65	.35
					QS4	.60	8.54	.43
					QS5	.55	6.23	.30
					QS6	.51	5.64	.25
	Delivery Strategy	.84	9.34	.83	DS1	.70	9.41	.48
					DS2	.65	7.73	.44
					DS3	.74	10.05	.52
					DS4	.71	9.18	.51
	Cost Strategy	.76	6.87	.63	CS1	.57	6.92	.34
					CS2	.67	7.85	.44
					CS3	.73	8.74	.56
					CS4	.75	9.85	.60
					CS5	.72	8.93	.56

Table 5.14: CFA Measures of the Four-Concept Model – Continued

Construct					Item	Loading	T-value	R^2
IS Strategic Orientation					ISC	.61	8.38	.53
					ISQ	.62	7.51	.35
					ISF	.81	11.20	.66
					ISD	.86	13.12	.72
Construct	Dimension	Loading	T-value	R^2	Item	Loading	T-value	R^2
Performance	Market Growth	0.88	10.39	0.85	MG1	0.61	6.70	0.39
					MG2	0.63	7.23	0.47
					MG3	0.65	7.71	0.49
	Financial Performance	0.82	9.32	0.81	FP1	0.72	8.93	0.56
					FP2	0.59	6.44	0.47
					FP3	0.63	8.25	0.44
					FP4	0.64	8.40	0.43
					FP5	0.84	11.98	0.79
	Innovation & Reputation	0.72	8.29	0.75	I1	0.64	8.35	0.58
					I2	0.72	9.64	0.59
					CR	0.81	11.02	0.72

5.4.3.3 Discriminant Validity Test

If a construct has discriminant validity, scale items measuring different constructs should have low correlations (Spector, 1992). CFA was employed in this research to assess the discriminant validity (χ^2 difference test using a significance of $p = 0.01$ level). Table 5.15 presents results of discriminant validity using the χ^2 difference test. For each of these six pairwise comparisons, the χ^2 difference between the unconstrained model and the constrained model was significant at the $p = 0.01$ level. As a result, it is believed that all the four constructs were related but conceptually distinct traits.

In summary, in general, all scale items used in this research met the requirements of normality, scale reliability, and instrument validity tests. Hypotheses testing is described in the next section.

Table 5.15: Results of Discriminant Validity – χ^2 Difference Test

	χ^2 Values		
Between Constructs	Unconstrained Model	Constrained Model	Difference
Business Environment vs.			
Operations strategy	61.34	72.58	11.24 [a]
IS strategic orientation	34.53	41.61	7.08 [a]
Business performance	52.42	66.90	14.48 [a]
Operations Strategy vs.			
IS strategic orientation	81.32	87.48	6.16 [a]
Business performance	45.22	59.16	13.94 [a]
IS strategic Orientation vs.			
Business performance	71.32	87.92	16.6 [a]

a: significant at $p = 0.01$ level

5.5 Results of Hypotheses Testing

As mentioned in chapter 3, H1, H3, and H5 are assessed by using the whole sample data and H1a, H2, H3a, H4, H5a, and H6 are assessed by partitioning the database into two groups – high performing EC organizations and low performing EC firms.

5.5.1 Normality of Partitioned Data

To assess H1a, H2, H3a, H4, H5a, and H6, the database of this research was also partitioned into high and low performers with respect to combined scores of three dimensions of the business performance construct. Hambrick (1984) suggested dividing the sample into separate high and low performance sub-samples in this manner as a practical analytical technique for strategy research. This practical analytical technique has been widely employed in operations strategy research (Badri *et al.*, 2000; Ward *et al.*, 2000; Berry *et al.*, 1999; Ward *et al.*, 1995; Ward *et al.*, 1994). As mentioned in the previous chapter, performance measures are all perceptual scale items. The questions that measure these scale items used a Likert scale ranging from 1 to 5 (Appendix A). First, scale items measuring the three dimensions of business performance were averaged to ensure scale consistency among the three dimensions. Then the average scores for the business performance measures of market growth, financial performance, and innovation/reputation were combined and used to identify 84 high performers and 82 low performers. The averaged scores for the business performance measures of market growth, financial performance, and innovation/reputation were added to create a scale that ranges from a low of 3 to a high of 15. Based on this composite score, companies were separated into two groups: low performers having performance values of nine or less and high performers having performance values of 10 or more. Ward *et al.* (2000) used a similar approach to calculate the composite scores of business performance. A Normality test and an F-test were also conducted to assure that the partitioned data were normally distributed. Table 5.16 reports the results of the normality test of the high performers with absolute skewness values ranging from 0.03 to 2.58 and with absolute kurtosis value ranging from 0.05 to 6.26. These results indicated that the business performance data of high performers were normal. Table 5.16 also shows an F-value of 50.223. Thus, business performance scale items for high performers were significantly normal at p = 0.001 level. By the same token, Table 5.17 indicates that the normality of the data of the low performers were also significant at p = 0.001 level.

Table 5.16: Normality Test (Skewness & Kurtosis) and F-test – High Performers

Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis	F-value	p-value
MG1	84	6.00	15.00	9.68	1.88	0.28	-0.05	50.223	0.000
MG2	84	6.00	15.00	9.82	1.94	1.48	1.58		
MG3	84	6.00	15.00	9.64	2.09	1.03	0.75		
FP1	84	6.00	15.00	10.36	2.20	-0.62	-0.89		
FP2	84	6.00	15.00	9.79	2.14	1.15	0.62		
FP3	84	3.00	15.00	9.46	2.21	-0.76	-0.14		
FP4	84	3.00	15.00	10.18	2.55	-2.58	2.16		
FP5	84	6.00	15.00	12.68	1.70	-2.45	6.26		
I1	84	9.00	15.00	12.04	1.95	-0.03	-1.69		
I2	84	6.00	15.00	12.61	2.41	-2.45	0.69		
CR	84	9.00	15.00	13.68	1.57	-1.51	-3.54		

Table 5.17: Normality Test (Skewness & Kurtosis) and F-test – Low Performers

Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis	F-value	P-value
MG1	82	3.00	9.00	6.51	1.99	-0.61	-2.15	22.551	0.000
MG2	82	3.00	12.00	6.55	1.89	0.42	0.31		
MG3	82	3.00	9.00	6.44	1.64	0.26	0.54		
FP1	82	3.00	12.00	6.55	1.64	1.67	3.46		
FP2	82	3.00	9.00	6.73	1.86	-0.63	-1.65		
FP3	82	3.00	9.00	6.18	1.79	-0.05	-0.31		
FP4	82	3.00	12.00	6.51	1.88	0.53	0.63		
FP5	82	3.00	12.00	5.67	2.26	3.22	5.44		
I1	82	6.00	15.00	7.98	2.01	2.34	1.85		
I2	82	6.00	15.00	8.38	2.04	1.57	0.72		
CR	82	3.00	12.00	8.78	2.30	-0.64	-1.45		

In addition to the perceptual performance measures discussed above, participating firms were also asked for their object performance data on earnings growth. However, fewer than half of the firms in the sample responded to this question because the objective data were more sensitive for managers concerned about revealing confidential data. A correlation between perceptual and objective measures was employed to help validate subjective measures as suggested by Vickery *et al.* (1993). The objective measure of earnings growth correlates strongly (significant at less than 0.001) with the categorical variable constructed on the basis of composite perceptual performance, thus strengthening the perceptual measures.

5.5.2 H1: Business environment positively influences operations strategy choice.

Using the specifications for the bivariate model (Figure 3.5) where there are five variables (dimensions) representing the business environment and four variables (dimensions) representing operations strategy, path coefficients were estimated for all 166 respondents by employing the path analysis method. Table 5.18 shows path coefficients and significance levels for all paths for the whole sample. Eight significant paths between business environment and operations strategy were found for the entire sample. Because there was at least one significant path between a business environment dimension and an operations strategy dimension, hypothesis 1 is thus supported.

Table 5.18: Path coefficients and significance level – Business Environment vs. Operations Strategy (Entire Sample)

Path	Entire sample	
	Path coefficient	t value
Business cost to		
Cost strategy	0.155	0.18
Quality strategy	0.05	0.34
Flexibility strategy	0.15	1.30
Delivery strategy	0.1105	0.81
Labor availability to		
Cost strategy	0.233	2.42 [a]
Quality strategy	0.00935	0.47
Flexibility strategy	0.1635	2.02 [a]
Delivery strategy	-0.0595	0.0086
Competitive hostility to		
Cost strategy	0.195	3.25 [a]
Quality strategy	0.18	0.96
Flexibility strategy	0.255	2.72 [a]
Delivery strategy	0.255	3.40 [a]
Government regulations to		
Cost strategy	-0.1245	-1.06
Quality strategy	0.235	3.46 [a]
Flexibility strategy	0.325	3.17 [a]
Delivery strategy	0.075	-1.18
Dynamism to		
Cost strategy	0.15	1.48
Quality strategy	0.155	-0.52
Flexibility strategy	0.05	0.85
Delivery strategy	0.15	3.50 [a]

[a] Significant path at 0.05 level

5.5.3 H1a: High performing EC organizations utilize different operations strategy to deal with business environment than low performing organizations.

Using the specifications for the bi-variate model (Figure 3.5) where there are five variables (dimensions) representing the business environment and four variables (dimensions) representing operations strategy, path coefficients were estimated for both high and low performers by employing the path analysis method. Table 5.19 depicts path coefficients and significance levels for all paths for both high and low performers. Several significant paths between business environment and operations strategy were evident for both high and low performers. For high performers, the following seven significant paths emerged:

1. Labor availability with flexibility strategy
2. Competitive hostility with flexibility strategy
3. Competitive hostility with delivery strategy
4. Government regulation with quality strategy
5. Government regulation with flexibility strategy
6. Environment dynamism with flexibility strategy
7. Environment dynamism with delivery strategy

For low performers, the following nine significant paths emerged:

1. Business cost with cost strategy
2. Labor availability with cost strategy
3. Competitive hostility with quality strategy
4. Competitive hostility with flexibility strategy
5. Government regulations with flexibility strategy

6. Government regulations with delivery strategy
7. Environment dynamism with cost strategy
8. Environment dynamism with flexibility strategy
9. Environment dynamism with delivery strategy

Acceptance of hypothesis 1a is two-fold. First, it requires the demonstration of at least one significant path between a business environment dimension and an operations strategy dimension for both high and low performing EC firms. Second, it requires that at least one path between a business environment dimension and an operations strategy dimension differ between high and low performers. Results of seven significant paths for high performers and nine significant paths for low performers supported the hypothesis 1a because both high and low performers had at least one significant path between a business environment dimension and an operations strategy dimension, and because the test of path coefficients showed significant differences between paths for high and low performers. Results of the significant paths are also shown in Figure 5.5 for high performers and in Figure 5.6 for low performers. The figures also present the fit indices of both models. However, more detailed fit indices are summarized in Table 5.19.

Table 5.19: Path coefficients and significance level -- Business Environment vs. Operations Strategy (Both High and Low Performers)

Path	High performers		Low performers	
	Path coefficient	t value	Path coefficient	t value
Business cost to				
Cost strategy	0.030	0.20	0.28	2.49 [a]
Quality strategy	0.070	0.53	0.030	-0.25
Flexibility strategy	0.15	1.06	0.15	1.50
Delivery strategy	-0.069	-0.49	0.29	2.66
Labor availability to				
Cost strategy	0.096	0.74	0.37	3.31 [a]
Quality strategy	0.0077	0.83	0.011	0.096
Flexibility strategy	0.38	4.20 [a]	-0.053	-0.59
Delivery strategy	0.0010	0.0086	-0.12	-1.21
Competitive hostility to				
Cost strategy	0.26	2.55	0.13	0.59
Quality strategy	0.14	0.96	0.22	1.72 [a]
Flexibility strategy	0.32	2.72 [a]	0.19	1.89 [a]
Delivery strategy	0.37	3.40 [a]	0.14	1.28
Government regulations to				
Cost strategy	-0.15	-1.06	-0.099	-0.74
Quality strategy	0.30	2.36 [a]	0.17	1.72
Flexibility strategy	0.25	2.27 [a]	0.40	3.79 [a]
Delivery strategy	-0.16	-1.18	0.31	1.81 [a]
Dynamism to				
Cost strategy	0.13	1.48	0.37	2.95 [a]
Quality strategy	-0.069	-0.52	0.25	1.77
Flexibility strategy	0.26	2.85 [a]	0.31	2.70 [a]
Delivery strategy	0.36	3.50 [a]	0.22	2.81 [a]

[a] Significant path at 0.05 level

Figure 5.5: LISREL Output of Path Analysis – Business Environment vs. Operations Strategy (High Performers)

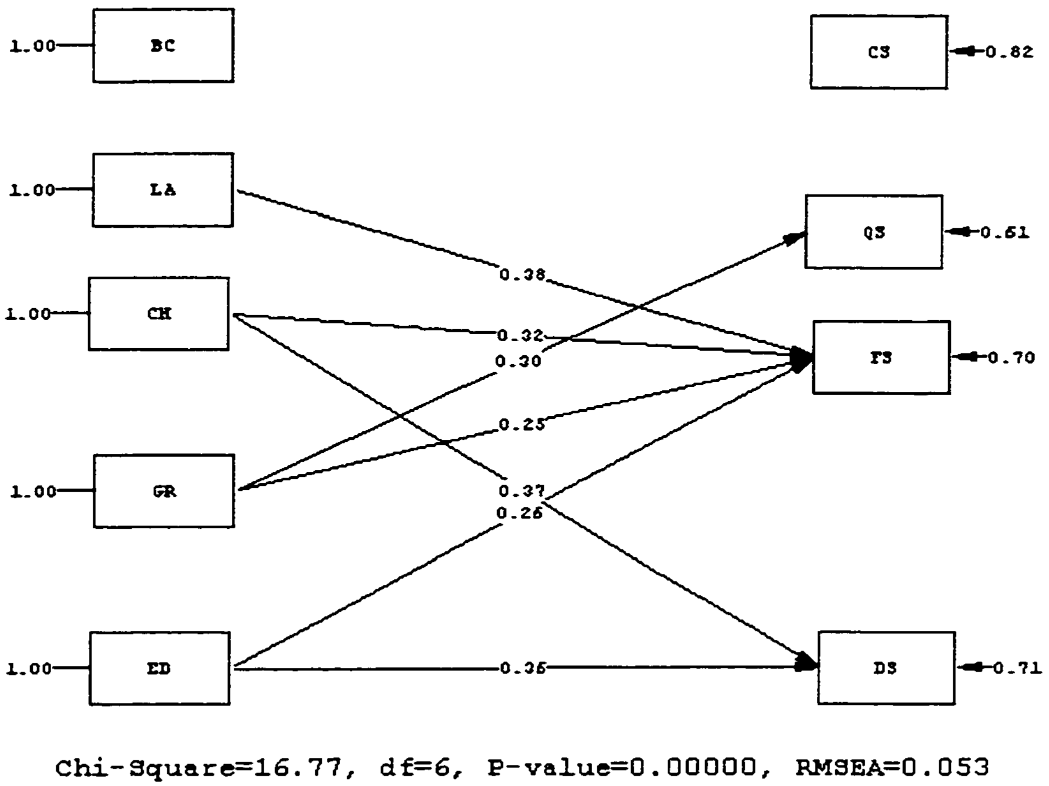
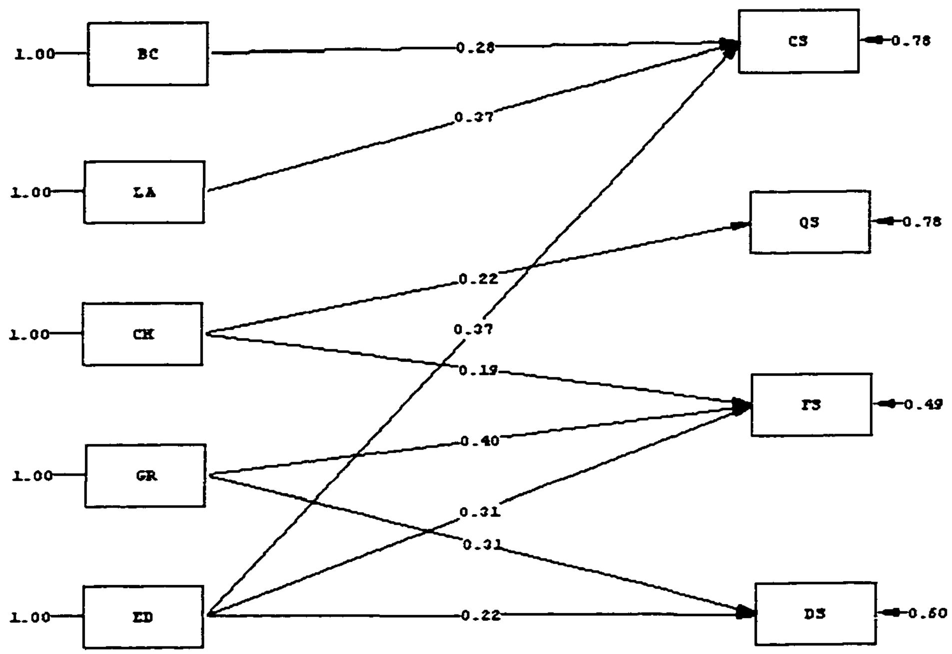


Figure 5.6: LISREL Output of Path Analysis – Business Environment vs. Operations Strategy (Low Performers)



Chi-Square=29.81, df=6, P-value=0.00004, RMSEA=0.229

5.5.4 H2: The fit between business environment and operations strategy positively influences business performance.

Fit indices for the high performer's model of the business environment vs. operations strategy showed that overall, the fit indices of the high performers were in the acceptable range, thus indicating that the model has a "good fit". The SRMR (0.069) was lower than the 0.08 rule of thumb as "good fit". The RMSE value of 0.053 also was below the 0.08 rule of thumb of the fit index. The χ^2/df of 2.795 met the rule of thumb of less than 0.30. A CFI value of 0.89 met the requirement of competitive fit index – a minimum cutoff close to 0.90. Critical N (37) was lower than the sample size of 84 indicating a good fit. Finally, a power value of 0.937 showed that scale items exhibited high power. Relative to the high performer's model, the low performer's model showed non-fit characters with SRMR (0.157), RMSE (0.229), χ^2/df (4.968), CFI (0.66), and Critical N (94.42). A power value of 0.472 also indicates low statistical power of the low performer's model. As a result, it is believed that the high performer's model has a better fit between the business environment and operations strategy than the low performer's model. Thus, the second hypothesis, that the fit between environment factors and operations strategy influences business performance, was supported.

Table 5.20: Fit Indices – Business Environment vs. Operations Strategy (Both High and Low Performers)

	BE vs. OM	
	High Performer	Low Performer
SRMR	0.069	0.157
CFI	0.89	0.66
RMSE	0.053	0.229
χ^2	16.77 (6)	29.81 (6)
χ^2/df	2.795	4.968
Critical N	37	94.42
Power	0.937	0.472

5.5.5 H3: Operations strategy positively influences information systems strategic orientation.

Using the specifications for the bivariate model (Figure 3.5) where there are four dimensions representing the operations strategy and four dimensions representing information systems strategic orientation, path coefficients were estimated for all 166 respondents by employing the path analysis method. Table 5.21 shows path coefficients and significance levels for all paths for the entire sample. Seven significant paths between operations strategy and information systems strategic orientation were found for the entire sample. Because there was at least one significant path between a operations strategy dimension and an information systems strategic orientation dimension, hypothesis 3 is hence supported.

Table 5.21: Path coefficients and significance level – IS Strategic Orientation vs. Operations Strategy (Entire Sample)

Path	Entire Sample	
	Path coefficient	t value
Cost Strategy to		
IS Cost strategy	0.17	0.186
IS Quality strategy	0.16	1.51
IS Flexibility strategy	0.06	0.28
IS Delivery strategy	0.10	1.23
Quality Strategy to		
IS Cost strategy	0.19	2.23 [a]
IS Quality strategy	0.15	1.01
IS Flexibility strategy	0.13	0.76
IS Delivery strategy	0.15	2.48 [a]
Flexibility Strategy to		
IS Cost strategy	0.07	1.89
IS Quality strategy	0.20	2.89 [a]
IS Flexibility strategy	0.67	7.58 [a]
IS Delivery strategy	0.16	2.43 [a]
Delivery Strategy to		
IS Cost strategy	0.16	1.63
IS Quality strategy	0.21	2.32 [a]
IS Flexibility strategy	0.06	0.56
IS Delivery strategy	0.27	3.27 [a]

[a] Significant path at 0.05 level

5.5.6 $H3_a$: High performing EC organizations implement different information strategic orientation to support operations strategy than low performing organizations.

Based on the bivariate model specifications (Figure 3.5) where there were four variables (dimensions) representing information systems strategic orientation and four variables (dimensions) representing operations strategy, path coefficients were estimated for both high and low performers. Table 5.22 reports path coefficients and significance levels for all paths for both high and low performers. Several significant paths between the information systems strategic orientation and operations strategy were derived for both high and low performers. For high performers, the following seven significant paths have emerged:

1. Flexibility strategy with IS quality strategy
2. Flexibility strategy with IS flexibility strategy
3. Flexibility strategy with IS delivery strategy
4. Quality strategy with IS cost strategy
5. Quality strategy with IS delivery strategy
6. Delivery strategy with IS quality strategy
7. Delivery strategy with IS delivery strategy

For low performers, the following six significant paths have emerged:

1. Cost strategy with IS cost strategy
2. Flexibility strategy with IS flexibility strategy
3. Flexibility strategy with IS delivery strategy
4. Quality strategy with IS quality strategy

5. Quality strategy with IS flexibility strategy
6. Delivery strategy with IS delivery strategy

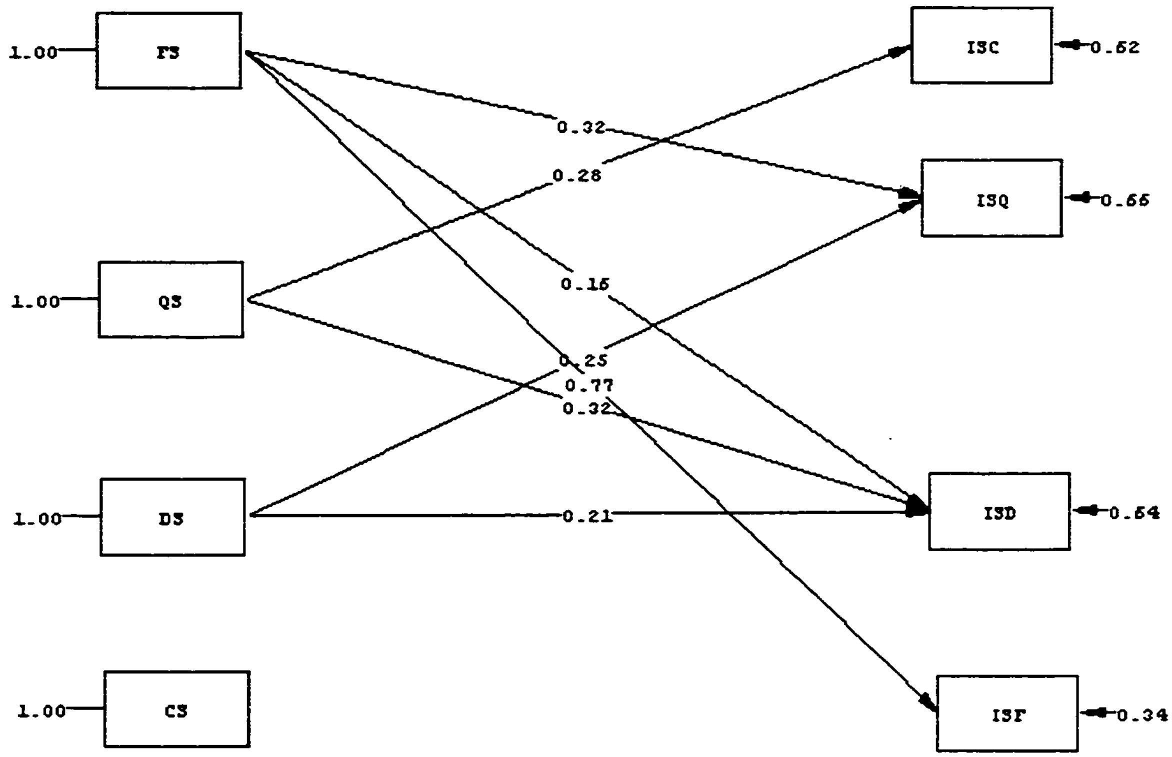
Acceptance of the third hypothesis, that the operations strategy influences information systems strategic orientation, is two-fold. First, it requires the demonstration of at least one significant path between an information systems strategic orientation dimension and an operations strategy dimension. Second, it requires that at least one path between an information systems strategic orientation dimension and an operations strategy dimension differ between high and low performers. Results of seven significant paths for high performers and six significant paths for low performers supported hypothesis 3a because both high and low performers had at least one significant path between an information systems strategic orientation dimension and an operations strategy dimension, and also because the test of path coefficients showed significant differences between paths for high and low performers. Results of the significant paths are also shown in Figure 5.7 for high performers and in Figure 5.8 for low performers. The figures also present the fit indices of both models. However, more detailed fit indices are summarized in Table 5.23.

Table 5.22: Path coefficients and significance level – IS Strategic Orientation vs. Operations Strategy (Both High and Low Performers)

Path	High performers		Low performers	
	Path coefficient	t value	Path coefficient	t value
Cost Strategy to				
IS Cost strategy	0.19	0.1.96	0.22	2.12 [a]
IS Quality strategy	0.25	1.45	0.073	0.61
IS Flexibility strategy	0.021	0.30	0.094	1
IS Delivery strategy	0.11	1.17	0.082	0.73
Quality Strategy to				
IS Cost strategy	0.28	2.40 [a]	0.10	0.94
IS Quality strategy	0.12	1.01	0.17	2.04 [a]
IS Flexibility strategy	0.065	0.76	0.20	2.33 [a]
IS Delivery strategy	0.32	2.68 [a]	-0.016	-0.15
Flexibility Strategy to				
IS Cost strategy	0.17	1.89	-0.026	-0.24
IS Quality strategy	0.32	3.35 [a]	0.081	0.73
IS Flexibility strategy	0.77	11.45 [a]	0.57	6.55 [a]
IS Delivery strategy	0.16	2.77 [a]	0.15	2.01 [a]
Delivery Strategy to				
IS Cost strategy	0.22	1.93	0.10	0.94
IS Quality strategy	0.25	2.15 [a]	0.17	1.58
IS Flexibility strategy	0.056	0.76	0.068	0.74
IS Delivery strategy	0.21	2.87 [a]	0.33	2.96 [a]

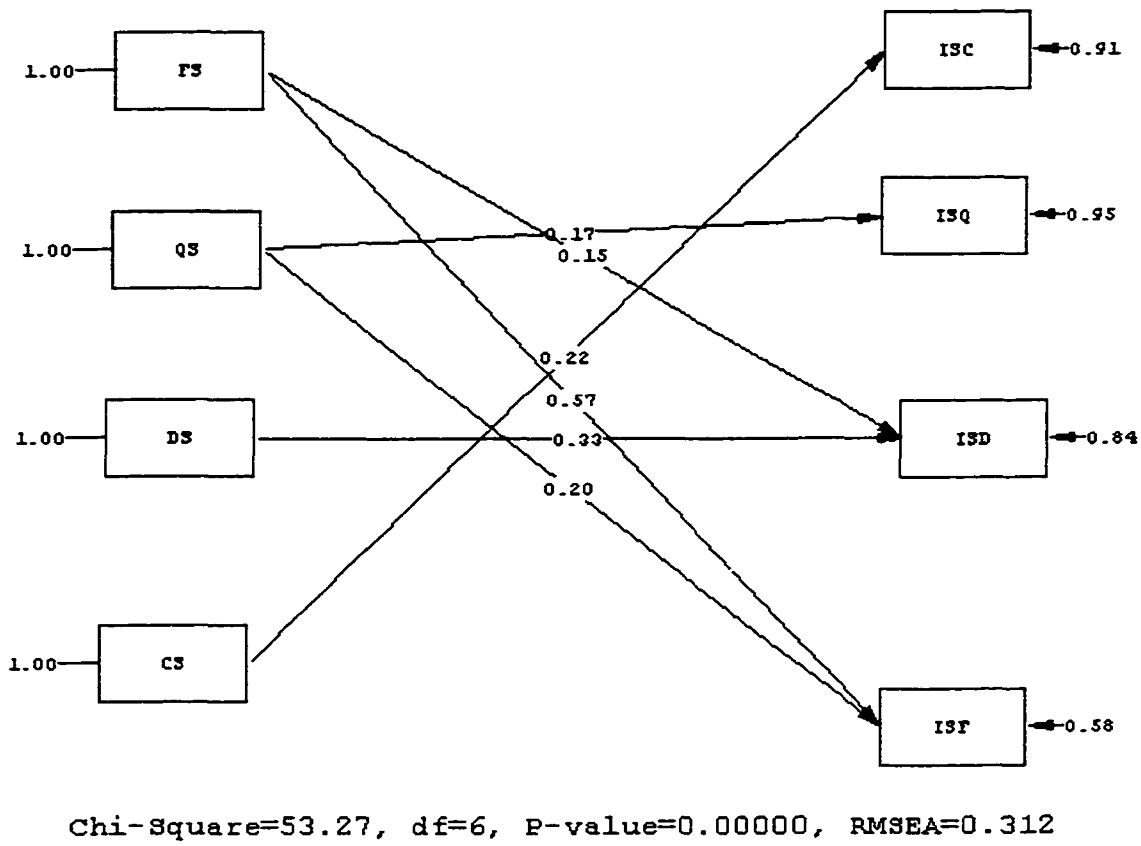
[a] Significant path at 0.05 level

Figure 5.7: LISREL Output of Path Analysis – IS Strategic Orientation vs. Operations Strategy (High Performers)



Chi-Square=17.92, df=6, P-value=0.00644, RMSEA=0.054

Figure 5.8: LISREL Output of Path Analysis – IS Strategic Orientation vs. Operations Strategy (Low Performers)



5.5.7 H4: The fit between information systems strategic orientation and operations strategy positively influences business performance.

Table 23 shows the fit indices between operations strategy and information systems strategic orienation. Fit indices for the high performer's model of the information systems strategic orientation vs. operations strategy indicated that overall, the fit indices of the high performers were in the acceptable range, and thus indicated that the model had a "good fit". SRMR (0.046) was lower than the maximum 0.8 requirement for a "good fit". An RMSE value of 0.054 also was below the 0.08 rule of thumb for the fit index. The χ^2/df of 2.987 just met the rule of thumb of less than 0.30. The CFI value of 0.95 exceeded the requirement of the competitive fit index – a minimum cutoff close to 0.90. Critical N (72.81) was lower than the sample size of 84 indicating a good fit. Finally, the power value of 0.962 indicated that scale items exhibited very high statistical power. Relative to the high performer's model, the low performer's model demonstrated non-fit characters with SRMR (0.12), RMSE (0.32), χ^2/df (8.88), CFI (0.51), and Critical N (118.67). The power value of 0.410 also indicates low statistical power for the low performer's model. As a result, it is believed that the high performer's model has a better fit between the information systems strategic orientation and operations strategy than the low performer's model. In inclusion, the fourth hypothesis, that the fit between the information systems strategic orientation and operations strategy influences business performance was supported.

Table 5.23: Fit Indices – Information Systems Strategic Orientation vs. Operations Strategy (Both High and Low Performers)

	ISO vs. OM	
	High Performer	Low Performer
SRMR	0.046	0.12
CFI	0.95	0.51
RMSE	0.054	0.32
χ^2	17.92 (6)	53.27 (6)
χ^2/df	2.987	8.88
Critical N	72.81	118.67
Power	0.962	0.410

5.5.8 H5: Information systems strategic orientation positively influences business performance.

Using the specifications for the bivariate model (Figure 3.5) where there are four dimensions representing the information systems strategic orientation and three dimensions representing business performance, path coefficients were estimated for all 166 respondents by employing the path analysis method. Table 5.24 shows path coefficients and significance levels for all paths for the entire sample. Four significant paths between operations strategy and information systems strategic orientation were found for the entire sample. Because there was at least one significant path between an operations strategy dimension and an information systems strategic orientation dimension, hypothesis 5 is hence supported.

Table 5.24: Path coefficients and significance level – IS Strategic Orientation vs. Business Performance (Entire Sample)

Path	High performers	
	Path coefficient	T value
IS Cost Strategy to		
Market growth	0.11	2.12 [a]
Financial performance	0.06	0.34
Innovation/reputation	-0.06	-0.82
IS Quality Strategy to		
Market growth	0.17	3.40 [a]
Financial performance	0.10	1.95
Innovation/reputation	0.01	0.076
IS Flexibility Strategy to		
Market growth	-0.01	-1.58
Financial performance	0.11	-0.64
Innovation/reputation	-0.02	-1.29
IS Delivery Strategy to		
Market growth	0.13	1.23
Financial performance	0.24	3.40 [a]
Innovation/reputation	0.21	2.67 [a]

[a] Significant path at 0.05 level

5.5.9 H5$_a$: Information systems strategic orientation implemented by high performing EC organizations has significant impact on the business performance than by the low performing EC companies.

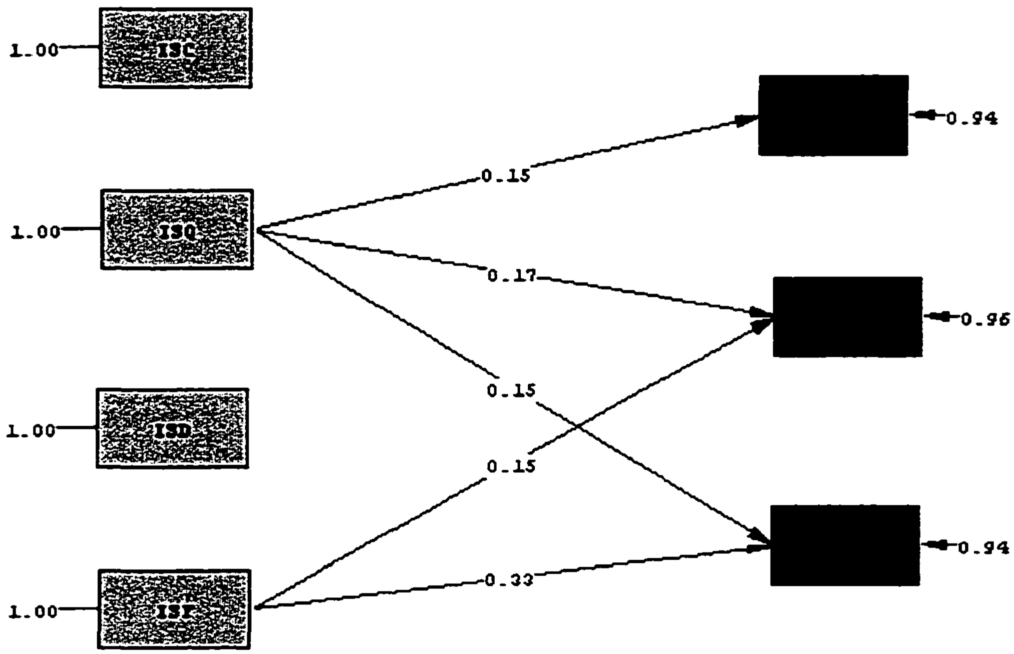
Based on the bivariate model specifications (Figure 3.5) where there were four variables (dimensions) representing the information systems strategic orientation and three variables (dimensions) representing business performance, path coefficients were estimated for both high and low performers. Table 5.25 shows path coefficients and significance levels for all paths for both high and low performers. Acceptance of the third hypothesis, that the information systems strategic orientation influences business performance, is sought at two levels. First, it requires the demonstration of at least one significant path between an information systems strategic orientation dimension and a performance dimension. Second, it requires that at least one path between an information systems strategic orientation dimension and a business performance dimension differ between high and low performers. Since there was more than one significant path between an information systems strategic orientation dimension and a business performance dimension, and since the test of path coefficients showed significant differences between paths for high and low performers, it is believed that these results support hypothesis 5a. Results of the significant paths are also shown in Figure 5.9 for high performers and in Figure 5.10 for low performers. Detailed fit indices are summarized in Table 5.26. Fit indices indicated that both the high performer's and the low performer's models had good fits. In addition, both models exhibited high statistical power.

Table 5.25: Path coefficients and significance level – IS Strategic Orientation vs. Business Performance (Both High and Low Performers)

Path	High performers		Low performers	
	Path coefficient	T value	Path coefficient	T value
IS Cost Strategy to				
Market growth	0.11	2.38	0.11	2.56 [a]
Financial performance	0.040	0.48	0.080	1.02
Innovation/reputation	-0.074	-0.90	-0.043	-0.72
IS Quality Strategy to				
Market growth	0.15	2.80 [a]	0.19	3.10 [a]
Financial performance	0.17	2.05 [a]	0.031	1.22
Innovation/reputation	0.15	2.76 [a]	-0.121	-1.01
IS Flexibility Strategy to				
Market growth	-0.16	-1.58	0.15	2.37 [a]
Financial performance	-0.04	-0.64	0.25	3.61 [a]
Innovation/reputation	-0.13	-1.29	0.10	1.18
IS Delivery Strategy to				
Market growth	0.13	1.23	0.13	2.41 [a]
Financial performance	0.15	2.40 [a]	0.33	4.58 [a]
Innovation/reputation	0.33	3.18 [a]	0.09	1.82

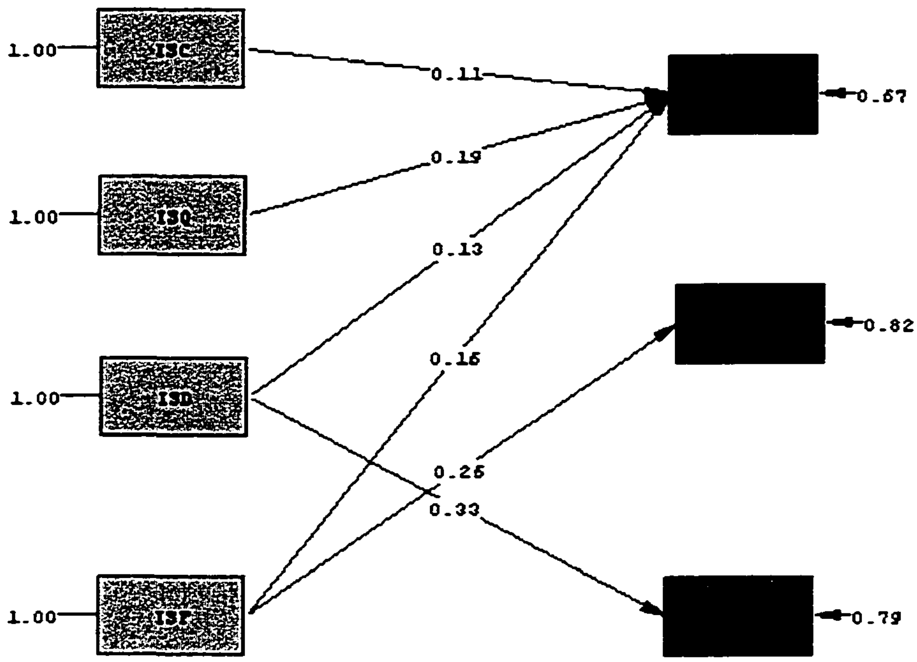
[a] Significant path at 0.05 level

Figure 5.9: LISREL Output of Path Analysis – IS Strategic Orientation vs. Business Performance (High Performers)



Chi-Square=21.59, df=7, P-value=0.00000, RMSEA=0.018

Figure 5.10: LISREL Output of Path Analysis – IS Strategic Orientation vs. Business Performance (Low Performers)



Chi-Square=32.29, df=7, P-value=0.00000, RMSEA=0.057

Table 5.26: Fit Indices – Information Systems Strategic Orientation vs. Business Performance (Both High and Low Performers)

	ISO vs. BP	
	High Performer	Low Performer
SRMR	0.018	0.045
CFI	0.94	0.91
RMSE	0.057	0.082
χ^2	21.59 (7)	32.29 (7)
χ^2/df	3.08	4.61
Critical N	71.23	92
Power	0.971	0.866

[a] Significant path at 0.05 level

5.5.10 H6: High performing organizations conform to the conceptual model to a greater extent than low performing organizations.

Table 5.27 shows fit indices of the three-construct model of both low and high performers. The high performer's model showed an SRMR index of 0.018, a CFI value of 0.94, an RMSE index of 0.057, a χ^2/df value of 3.08, and a Critical N of 71.23. All fit indices indicated a good fit of the model for high performers. This indication of a good fit substantiated the overall model of the relationship of business environment, the information systems strategic orientation, and operations strategy for high performing companies. The high performer's model also suggested high statistical power.

The same four-construct model was specified for low performers with dramatically different results. The fit indices did not suggest a good fit of the model when data from low performers were used. The low performer's model showed an SRMR index of 0.142, a CFI value of 0.55, an RMSE index of 0.310, a χ^2/df value of 11.622, and a Critical N of 120.53. All the fit indices indicate a poor fit of the overall model for low performers. The indication of a good fit for high performer's model and poor fit for the low performer's model supported hypothesis 6, that high performers conform to the conceptual model to a greater extent than low performers.

Table 5.27: Fit Indices – Relationship Among Business Environment, Information Systems Strategic Orientation, and Operations Strategy (Both High and Low Performers)

	BE, ISO, & OM	
	High Performer	Low Performer
SRMR	0.025	0.142
CFI	0.97	0.55
RMSE	0.047	0.310
χ^2	15.71 (6)	69.73 (6)
χ^2/df	2.618	11.622
Critical N	73.51	120.53
Power	0.992	0.368

[a] Significant path at 0.05 level

5.6 Discussion

This section discusses the effect of the business environment on operations strategy, the impact of the information systems strategic orientation on operations strategy, the impact of the information systems strategic orientation on business performance, and the influences of various strategic alignments on business performance.

5.6.1 Effect of the Business Environment on Operations Strategy

The significant paths (Figure 5.6) in the high performer's model imply a well circumscribed set of strategic responses to perceived business environment stimuli for high performing electronic commerce (EC) companies. Higher environment dynamism sparks significantly more operations strategy on flexibility and delivery dimensions. This finding is consistent with several operations strategy studies' conclusion about the relationship between the business environment and flexibility (Ward *et al.*, 2000; Badri *et al.*, 2000, Ward *et al.*, 1995; Swamidass and Newell, 1997). The finding also implies that a set of capabilities which support responsiveness to customers is particularly valued in such a dynamic environment as EC. This finding is also supported by other researchers who suggested that differentiation was an appropriate strategy in a dynamic environment (Badri *et al.*, 2000; Ward *et al.*, 1995; Richardson *et al.*, 1985; Porter, 1980). Conceptual work in operations strategy also supported the notion that flexibility and delivery were appropriate operations strategy responses to environment dynamism (Ward *et al.*, 1998; Anderson *et al.*, 1989; Skinner, 1969). The finding is further supported by EC literature (Evans and Wurster, 1999; Raghunathan and Madey, 1999).

Successful EC companies facing greater perceived competitive hostility respond with a greater emphasis on quality and delivery strategic dimensions, thus indicating an attempt to further differentiate their products/services rather than emphasizing a cost reduction strategy. This strategic response for high performers is consistent with the findings of other researchers (Ward *et al.*, 2000; Badri *et al.*, 2000; Ward *et al.*, 1995). The analysis also illustrated that successful EC companies responded to perceived labor shortages through a strategic focus on flexibility. This finding is consistent with views held by many researchers in operations strategy that shortages of skilled labor were a major reason for pursuing an operations flexibility strategy (Badri *et al.*, 2000; Jaikumar, 1989). The path model also suggests that successful EC companies facing great perceived uncertainty with regard to government regulations respond with a greater emphasis on quality and flexibility rather than emphasizing cost reduction strategies.

The path model suggests that some of the strategic responses of low performers to business environment are in exactly the same direction as high performers: (1) emphasizing flexibility to deal with competitive hostility; (2) emphasizing flexibility to deal with government regulations; (3) emphasizing flexibility to deal with environment dynamism; and (4) emphasizing delivery to deal with environment dynamism. However, low performers also respond to environment dynamism, business costs, and labor shortages by focusing on a cost reduction strategy. In other words, low performing EC companies respond to concerns about environmental munificence (i.e., business costs, labor availability, competitive hostility, government regulations, and environment dynamism) quite differently than do high performers. The difference between high performing EC companies and low performers strategic responses to competitive strategy corroborates the notion suggested by Porter (1990), that the danger of being stuck in the middle, and thus performing poorly, might simultaneously trigger increased emphasis on cost. It is evident that unlike higher performers, low performers show greater response to various business environment dimensions by emphasizing a cost reduction strategy.

5.6.2 Impact of the Operations Strategy on IS Strategic Orientation

The significant paths (Figure 5.8) in the high performer's model imply a fairly well circumscribed set of information systems (IS) strategies in supporting various dimensions of operations strategy for high performing electronic commerce (EC) companies. Operations' flexibility is supported by three dimensions of IS strategic orientation (i.e., ISQ, ISD, and ISF). Operations' quality is supported by two dimensions of IS strategic orientation (i.e., ISC and ISD). Operations' delivery strategy is supported by two dimensions of the IS strategic orientation (i.e., ISQ and ISD). These findings are consistent with several IS strategy studies' conclusions about the relationship between IS strategic orientation and operations strategy (Sabherwal and Chan, 2001; Chan *et al.*, 1998; Chan *et al.*, 1997). The findings also imply that high performing EC companies utilize various IS strategies to enhance operations dimensions where needed the most. The findings are consistent with the results of the previous section, that high performing EC companies respond to the dynamic environment by emphasizing quality, flexibility and delivery strategies instead of focusing on a cost strategy. The findings are further supported by EC literature (Evans and Wurster, 1999; Raghunathan and Madey, 1999).

The path model also suggests that some of the impacts of IS strategic orientations of low performers on operations strategic needs are in exactly the same direction as high performers: (1) supporting operations' flexibility strategy utilizing ISD and ISF; and (2) supporting operations' delivery strategy utilizing ISD.

However, low performers also utilize IS strategic orientations' cost dimension (i.e., ISC) to support a cost reduction strategy. In other words, low performing EC companies utilize IS strategic orientations (i.e., ISC, ISQ, ISF, and ISD) quite differently than do high performers. The difference between high performing EC companies and low performers in utilizing IS strategic orientations is obvious in that high performers and low performers have different operations strategy needs to cope with the EC environment.

5.6.3 Impact of IS Strategic Orientation on Business Performance

The path model (Figure 5.10) of high performing EC companies shows that two information systems' strategic orientations have direct impact on business performance. More specifically, IS quality strategy positively influences all three dimensions of perceived business performance (i.e., market growth, financial performance, and innovation/reputation). The model also implies that IS flexibility strategy has a positive causal relationship with two dimensions of business performance (i.e., financial performance and innovation/reputation). These finding are consistent with some IS strategy research (Sabherwal and Chan, 2001; Chan *et al.*, 1997). However, IS cost and IS delivery strategies are not shown to influence the perceived business performance.

The path model also suggests that some of the impact of IS strategic orientations of low performers on business performance are in exactly the same direction as high performers: (1) the impact of IS quality strategy on market growth; and (2) the impact of IS flexibility strategy on financial performance.

However, the path model suggests that all dimensions of IS strategic orientation have positive impact on market growth. In other words, IS strategic orientation was employed by low performers mainly to enhance the market growth dimension of the business performance. The rational for this result needs to be explored in future research.

5.6.4 Strategic Alignments on Business Performance

As mentioned in hypotheses 2, 4, 5, and 6, the findings of this research indicate that EC companies with good strategic alignments (fits) perform better than companies with poor strategic alignments. More specifically, the hypotheses test results indicate the following: (1) the fit between the business environment and operations strategy influences business performance (H2); (2) the fit between the information systems strategic orientation and operations strategy influences business performance (H4); and (3) high performers conform to the conceptual model to a greater extent than low performers.

The findings also suggest that systems models of alignment provide more information than do bivariate models (Chan *et al.*, 1997). The bivariate research model (Figure 3.5) involved the examination of numerous "fine-grained" relationships. The bivariate findings could be somewhat unstable as suggested by (Venkatraman, 1989). This lends support to the view that examining isolated components of strategy and performance could be misleading (Chan *et al.*, 1998). As a result, alignment can be a better predictor of perceived performance.

In conclusion, all six proposed hypotheses in the research were empirically supported. Managerial implications of these results will be discussed in the next chapter along with a summary and conclusions of this research.

CHAPTER 6

SUMMARY, CONTRIBUTIONS, LIMITATIONS, AND FUTURE RESEARCH

Chapter 6 consists of the following four sections: (1) summary of the research; (2) contributions of the study; (3) managerial implications; (4) limitations of the research; and (5) recommendations for future research.

6.1 Summary of the Research

Information technologies, especially Internet technologies, are transforming the entire economy into an information-based system because of the greater efficiencies those technologies can help businesses to attain. The rate of technological change is so rapid that the newly emerged electronic commerce is already making fundamental changes in the economic landscape, affecting every aspect of how and what business is, and how future business will be conducted. Electronic commerce is creating opportunities to rethink business models, processes and relationships along the entire length of the supply chain in pursuit of unprecedented levels of productivity, improved customer propositions and new streams of businesses. A leading electronic commerce research firm estimated that business-to-business electronic commerce alone would rise to $2.7 trillion by 2004 from $196 billion in 1998 (Forrester Research Institute, 2000). Electronic commerce is a dynamic, quickly changing phenomenon. Most corporate executives are convinced that the scale and pervasiveness of today's electronic commerce require a fundamental review of business strategy (De Figueiredo, 2000). Operations management researchers also call for substantiating operations strategy research to an electronic commerce environment (St. John *et al.*, 2001; Feeny, 2001; Venkatraman, 2000). However, a thorough review of operations strategy literature revealed that there existed only a few conceptual research studies addressing the electronic commerce environment from the operations strategy perspective (Feeny, 2001; Afuah and Tucci, 2001; Strader and Shaw, 1997). More surprisingly no empirical research has been found to explore electronic commerce strategic issues using the operations strategy theory. To date, the conceptual models for electronic commerce research have remained largely unsubstantiated because they have not been adequately tested (St. John *et al.*, 2000).

Drawing on both operations strategy and information systems strategy literature, this research proposed a conceptual framework integrating both operations strategy and information systems strategy models, and then applied the proposed framework to an electronic commerce setting. This research not only provides a conceptual framework to systematically explore electronic commerce strategic issues, but also provides empirical evidence on the relationships between various constructs. More specifically the following relationships were tested using the path analysis approach: (1) the relationship between the business environment and operations strategy; (2) the relationship between the operations strategy and information systems strategic orientation; and (3) the relationship between the information systems strategic orientation and business performance. Moreover, this research examined the impact of alignments between various constructs on business performance, which were often neglected by operations strategy research (Ward *et al.*, 2000). More specifically the following influences of alignments on business performance were empirically tested using structural equation modeling: (1) the impact of alignment between the business environment and operations strategy on business performance; (2) the impact of alignment between the information systems strategic orientation and operations strategy on business performance; and (3) the impact of alignment among the business environment, the information systems strategic orientation, and operations strategy on business performance.

The testing results rendered were all statistically significant. In other words, all six hypotheses proposed in this research were empirically supported. The managerial implications of these results will be discussed in the next section.

6.2. Contributions of the Study

This research has built on the work of others, most notably Sabherwal and Chan (2001), Ward *et al.* (2000), Badri *et al.* (2000), Chan *et al.* (1998), Chan *et al.* (1997), Ward *et al.* (1995), and Swamidass and Newell (1987), in expanding the operations strategy theory by adding the information systems strategic orientation construct to the operations strategy model to be examined in an electronic commerce setting.

This research established the existence of important links between operations strategy and a number of business environment dimensions in an electronic commerce setting. In other words, the business environment appeared to have substantial impact on operations strategy, and successful firms (high performers) adopted different operations strategies in response to environment stimuli than did poor performers. This research also confirmed the notion that the fit between the environment and operations strategy was seen as a central tenet of each of the major strategic management streams (Ward *et al.*, 1995).

The existence of important links between operations strategy and a number of information systems strategic orientation dimensions was also established. That is, operations strategy appeared to have significant impact on information systems strategic orientation, and high performing companies utilized different information systems strategies to support their operations strategy than did low performing companies in an electronic commerce setting. This was in line with the assertion that companies that appeared to perform better were companies in which there was better alignment between operations strategy and the information systems strategic orientation (Chan *et al.*, 1997).

This research also established the existence of important links among the business environment, the information systems strategic orientation, and operations strategy. The findings suggested that high performers conformed to the overall conceptual model to a greater extent than low performers. Similar results were also found in a previous operations strategy study (Ward *et al.*, 2000).

There were several major findings in this research. The first major finding was that operations strategy researchers should build into virtually all research design explicit considerations regarding environment factors. The business environment appeared to have a tangible impact on strategic choices in operations. It also appeared that a link between the business environment and operations strategy helped determine business performance. The second major finding of this research was that the information systems strategic orientation should be considered in conducting operations strategy research in an electronic commerce environment. An information systems strategic orientation appeared to have a direct support in implementing various operations strategy dimensions. It also appeared that an alignment between the information systems strategic orientation and operations strategy influenced business performance. The third major finding suggested that both the business environment and information systems strategic orientation appeared to have direct impact on operations strategy simultaneously. It also appeared that an alignment among the business environment, the information systems strategic orientation, and operations strategy helped determine business performance.

6.3 Managerial implications

The managerial implications of this study are quite evident. First, the correct environmental considerations should be identified and should be a part of any operations strategy framework in an electronic commerce setting. Second, the information systems strategic orientation should be also identified and should be a part of the operations strategy theory when applied to an electronic commerce environment. Third, successful electronic commerce firms were more likely to emphasize flexibility, quality, and delivery rather than emphasizing cost reduction strategies when dealing with the business environment. Fourth, low performing EC firms primarily adopted a cost reduction strategy when coping with the business environment. Fifth, the information systems strategy orientation appeared to support the strategic choices in operations. Finally, high performing EC firms, in general, had a better strategic fit than low performers. A number of authors suggested the consequences of not adhering to a strategic fit (Hill, 1999; Skinner, 1969). The poor model fit found for low performers in this research was consistent with the admonitions of these and other influential thinkers in the operations management field. The findings also suggested practical advice for empirical researchers in the operations management field - separate consideration of high and low performers.

In summary, this research contributed to electronic commerce research and operations strategy research in the following ways:

First, this research validated, integrated, and expanded earlier research in the area (Sabherwal and Chan, 2001; Badri *et al.*, 2000; Chan *et al.*, 1997; Ward *et al.*, 1995). Modified instruments were developed based on the electronic commerce environment. The usefulness of the information systems strategic orientation concept was also demonstrated. Second, the study presented and examined systems and bivariate models of the business environment, operations strategy, information systems strategic orientation, alignment, and performance. Third, relationships among the business environment, operations strategy, the information systems strategic orientation, alignment, and performance were examined. Empirical links between the business environment and operations strategy, the information systems strategic orientation and operations strategy, and the information systems strategic orientation and business performance were demonstrated. Fourth, the confidence of the research finings was enhanced by employing a more complete, multifaceted measurement of business performance, which allowed better assessment of the reliability and validity of the construct. A single item measure was commonly employed to assess business performance in most operations strategy studies (Badri, 2000; Berry *et al.*, 1999; Ward *et al.*, 1995). Finally, instrument validity was tested using more rigorous methods (i.e., confirmatory factor analysis instead of exploratory factor analysis to assess unidimensionality). As a result, this research also helped alleviate the inadequacies of construct validation in the theory building process within the operations management discipline (Swink and Way, 1995; Flynn *et al.*, 1990; Anderson *et al.*, 1989; Swamidass and Newell, 1987).

6.3 Limitations of the Study

There are several limitations of this research. First, it must be recognized that this research is based on operations strategy theory, and recent theory in the information systems strategy reference discipline, which is exploratory (Chan et al., 1997). Also, this research is the first to explore the electronic commerce setting from an operations strategy perspective. Thus this research is somewhat exploratory in nature. The research models presented represent only a subset of the possible models that could have been formulated.

Second, this research is based on a cross-sectional design. Data were collected from diverse business types across various electronic commerce industries categorized by (Storey *et al.*, 2000). The rationale for the cross-sectional design as follows: (1) the purpose of the research was to examine the strategic alignment issues across EC industries rather than in a specific industry; and (2) it was necessary to obtain a sample size sufficient for analysis. Because the unit of analysis is a business unit, the potential sample size was small, especially when the questionnaires were distributed within a specific industry. However, the cross-sectional design has difficulties eliminating all the external factors and obtaining industry-specific information (Sabherwal and Chan, 2001).

Third, all the measuring instruments used in this research were based on manager's perceptions, a time-honored and valid operational process of various constructs (Buchko, 1994). Company annual reports and other publicly available corporate data could not be employed meaningfully because the unit of analysis was the business unit. Also, because many of the organizations had different accounting practices, the public data that could be gathered were not readily comparable.

Fourth, the electronic commerce concept is still emerging and there is no "one fits all" definition of electronic commerce. In this research, subjects were selected based on the criteria of electronic commerce proposed by (Bauer and Colgan, 2001). However, these criteria were neither the most restrictive nor the most comprehensive measures for determining whether the subjects surveyed were representative of the electronic commerce setting. In other words, it was not validated as to whether these subjects were from electronic commerce industries. Moreover, caution is required in generalizing the findings beyond the definition of electronic commerce employed in this research.

Finally, a single scale item was used in measuring the information systems strategic orientation. However, good models existed in the literature for collecting the information systems strategic orientation data using multiple scale items (Sabherwal and Chan, 2001; Chan *et al.*, 1998).

6.4 Recommendations for Future Research

As mentioned in the previous section, the research models presented represent only a subset of the possible models that could have been formulated. Should there have been a path included between operations strategy and business performance, for instance? Or, could a link have been established between the business environment and the information systems strategic orientation? These questions can be addressed in the future studies.

This research focused on the content and nature of the relationships among various constructs and strategic alignments between different constructs. The process involved in formulating and achieving alignment were not the subject of this research. Further research may focus on related process issues.

Future research should include the isolation of a single EC industry (i.e., Internet Banking) to eliminate all the external factors, and also to obtain industry-specific information. Future studies in exploring the taxonomy of electronic commerce industries are warranted.

Generalizability is an important issue for future research in that electronic commerce enhances the concept of globalization. Operations strategy, the business environment, and the information systems strategic orientation constructs were developed previously but generally restricted in application to mature economies, most notably the U.S. strategy in general. Thus future empirical studies need to apply the research model to other parts of the world (i.e., countries in the Pacific Rim) to achieve meaningful generalizability.

As mentioned previously, perceptual instruments were employed in this research to measure constructs (i.e., business environment, business performance). In future research, archival measures of the business environment, which do not rely on managers' impressions and are objective, can be more aptly employed as frequently-used alternatives to perceptual measures (Buchko, 1994). For business performance, future studies need to find a way to use meaningful and comparable performance data which are widely available.

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Appendix A

IRB # 2001-020145EX

Dear Research Participant:

The Department of Management at the University of Nebraska – Lincoln is conducting an extensive research on the relationships among environmental factors, operation strategy, information systems strategy, and business performance in an electronic commerce setting. The main purposes of this study are: 1) to propose a viable e-business model by integrating both operation strategy model and information systems strategy model; 2) to identify the impact of the alignment between environment factors and operation strategy on business performance; 3) to determine the impact of the alignment between information systems strategy and operation strategy on business performance; and 4) to identify the overall impact of the e-business model proposed on business performance. The results of this research will help practitioners develop new business models for electronic commerce.

The accompanying questionnaire is designed to obtain information concerning your operation strategy, information systems strategy, and business performance. The survey should take no more than 20 minutes to complete. Most of the questions can be answered very quickly based on your experience in electronic commerce and will not require detailed numbers or records. A self-addressed, post-paid envelop is enclosed for your convenience in returning the questionnaire.

Information obtained from you will be held in strict confidence. No reference will be made to specific organizations in any future reports. The overall results of this research will be shared with you if you so indicate at the end of the form. If you have any questions about your rights as research subject that have not been answered by the investigator, you may contact the University of Nebraska-Lincoln Institutional Review Board, telephone 472-6965. You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with the investigators or the university of Nebraska. Your decision will not result in any loss of benefits to which you are otherwise entitled.

Thank you very much for your time and consideration for this research. If you have any questions or concerns please feel free to contact us.

Sincerely Yours,

Qing Cao
Ph.D. Candidate
Management Department
University of Nebraska

Part 1: General Information

The following information is needed to allow coding of the questionnaire and to aid in data analysis. Please answer each question.

1. Your Position Title: ________________________________

2. Your Business Unit Name: ________________________________

   A *business unit* refers to a single business (e.g., eToys) or to a division or subsidiary of a parent company (e.g., Wells Fargo Branch in Minneapolis).

3. Does your company fit into one of the following criteria for electronic commerce firm? (Please check one or both)

   1. Proprietary strategy – implement your own Internet applications and data interfaces

   2. Open strategy – the user interface is identical, regardless of which company the consumer is doing business with

4. How long have you worked in your business unit? _____ years

5. How many years of experience do you have in electronic commerce? _____ years

   Electronic commerce refers to the process of buying and selling goods and services electronically involving transactions using the Internet, networks, and other digital technologies.

6. What is your functional area of expertise? (Check only one.)

   _____ Information Systems
   _____ Logistics
   _____ Customer Services
   _____ Operations Management
   _____ Accounting & Finance
   _____ Other ______________

7. How many employees are in your business unit? _____

8. How long has your business unit been offering electronic commerce services to the public? _____ years

9. Indicate the type of organization for which you are currently principally employed. (Check only one.)

   _____ Internet Trading
   _____ Internet Insurance
   _____ Internet Retailing
   _____ Internet Banking
   _____ Internet Shipping
   _____ Other

10. Indicate what types of electronic commerce technology are used in this organization. (Check as many as applied.)

_____ Internet
_____ Extranet
_____ Internet-based EDI
_____ Groupware technology
_____ Intranet
_____ Traditional EDI
_____ Virtual organization
_____ Others
____

11. Please select the 5 most important reasons that electronic business is used. (Check only 5.)

_____ Create an easily accessible communication network
_____ Faster access to information
_____ Easier access to information
_____ Reduce printing costs
_____ Efficient connection of organizational resources
_____ Exchange information
_____ Communications between employees
_____ Scheduling
_____ Database integration
_____ Training
_____ Support ISO9000 initiatives
_____ Ease of software replacement
_____ User access control
_____ Cost reduction
_____ Access to more accurate information
_____ Increase productivity
_____ Reduce distribution costs
_____ Reduce geographic distance
_____ Connect computer platforms
_____ Flexibility in time of delivery
_____ Global exchange of information
_____ Advertising
_____ Project management
_____ Reduce administration
_____ Reduce paper flow
_____ Others (specify)
____

12. How competitive is the market in which your organization operates? (Check only one.)

_____ Not at all competitive _____ Stable _____ A little Competitive_____ Moderate Competitive

_____ Very Competitive

13. What is the most important core competence of your service, compared with competitors' services? (Check only one.)

_____ Price _____ Quality _____ Delivery _____ Flexibility _____

Other ____________________

14. How important is the information systems strategy to support operation strategy?

_____ Not at important _____ A little important _____ Moderation important _____ Important

_____ Very important

15. Your best estimation at annual sales of your business unit: ($)

Part 2: Environment Factors

This part contains questions about the environment factors which your business unit is conducting business operations. Circle the number to indicate the degree to which the following are a current immediate concern to your business unit.

	Very Unimportant				Very Important
Business costs					
Rising labor cost	1	2	3	4	5
Rising transport cost	1	2	3	4	5
Rising telecommunication cost	1	2	3	4	5
Rising utilities cost	1	2	3	4	5
Rising rental cost	1	2	3	4	5
Rising health care cost	1	2	3	4	5
Labor Availability					
Shortage of managerial and administrative staff	1	2	3	4	5
Shortage of IS technicians	1	2	3	4	5
Shortage of clerical and related workers	1	2	3	4	5
Shortage of service workers	1	2	3	4	5
Inability to operate 24 hours a day	1	2	3	4	5
Competitive hostility					
Keen competition	1	2	3	4	5
Low profit margins	1	2	3	4	5
Declining demand	1	2	3	4	5
Providing services to the required quality standards	1	2	3	4	5
Unreliable vendor quality	1	2	3	4	5
Government regulations					
Complexity of government regulations	1	2	3	4	5
Potential Taxation on electronic commerce	1	2	3	4	5
Limitations on electronic commerce	1	2	3	4	5

Protecting conventional firms	1	2	3	4	5

Environmental Dynamism	Slow				Rapid
The rate at which your services become outdated	1	2	3	4	5
The rate of innovation of your new services	1	2	3	4	5
The rate of innovation of your new operating processes	1	2	3	4	5
The tastes and preferences of customers in your industry	1	2	3	4	5

Part 3: Operations Strategy

This part contains questions about operations strategy that are being used by your business unit. Circle the number to indicate the degree of emphasis which your business unit places on the following activities.

	No emphasis				Extreme emphasis
Flexibility Strategy In Conducting the Business Unit Operations					
Maximize purchasing convenience	1	2	3	4	5
Maximize time flexibility in purchasing	1	2	3	4	5
Provide purchasing convenience	1	2	3	4	5
Minimize effort of shopping	1	2	3	4	5
Maximize ease of finding product/service	1	2	3	4	5
Increase variety of products/services	1	2	3	4	5
Quality Strategy In Conducting the Business Unit Operations					
Maximize product value	1	2	3	4	5
Ensure quality of product	1	2	3	4	5
Minimize Fraud	1	2	3	4	5
Assure System Security	1	2	3	4	5
Maximize Access to Information	1	2	3	4	5
Minimize Misuse of Credit Card	1	2	3	4	5

Minimize Misuse of Personal Information	1	2	3	4	5
Delivery Strategy In Conducting the Business Unit Operations					
Provide reliable delivery	1	2	3	4	5
Assure arrival of purchase	1	2	3	4	5
Minimize delivery time	1	2	3	4	5
Minimize shipping time	1	2	3	4	5
Cost Strategy In Conducting the Business Unit Operations					
Minimize product/service cost	1	2	3	4	5
Minimize tax cost	1	2	3	4	5
Minimize shipping cost	1	2	3	4	5
Reduce inventory	1	2	3	4	5
Increase capacity utilization	1	2	3	4	5

Part 4: Information Systems Strategy

This part contains questions about IS strategies that are being used by your business unit. Circle the number to indicate the degree of emphasis which your business unit places on the following strategic orientation of electronic business.

	Low				High
IS strategy support for cost strategy	1	2	3	4	5
IS strategy support for quality strategy	1	2	3	4	5
IS strategy support for delivery strategy	1	2	3	4	5
IS strategy support for flexibility strategy	1	2	3	4	5

Part 5: Business Performance

This part contains questions about perceived business performance of your organization. Circle the number to indicate your business unit achievement (perceived) on the following dimensions.

	Low				High
Your Market Growth					
Market share gains	1	2	3	4	5
Sales growth	1	2	3	4	5
Revenue growth	1	2	3	4	5
Your Financial Performance					
Return on investment	1	2	3	4	5
Return on sales	1	2	3	4	5
Liquidity	1	2	3	4	5
Cash flow	1	2	3	4	5
Profitability	1	2	3	4	5
Your Product/Service Innovation					
Developments in business operations	1	2	3	4	5
Development in products and services	1	2	3	4	5
Your Company Reputation					
Reputation among major customer segments	1	2	3	4	5

Please also specify real earnings growth of your company for the last three years:

1997________ 1998 ________ 1999 ________

Thank you very much for your time!

If you would like to receive a copy of this study's summary, please provide a name and address or e-mail address below.

Name:

Address:

Email: