THE EFFECTS OF INTERORGANIZATIONAL INFORMATION SYSTEMS INFRASTRUCTURE (IOSI) ON ELECTRONIC COOPERATION: AN INVESTIGATION OF THE "MOVE TO THE MIDDLE"

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Information technology (IT) has increasingly been employed to perform interorganizational business activities. Internet, Electronic Data Exchange (EDI), and interorganizational information systems (IOS) have used for transacting products and services, exchanging information, and doing interactions among organizations.

The use of such information technologies contributes to build a tightly coupled relationship among organizations, which is called electronic cooperation. Based on the recognition of the importance of electronic cooperation, the present study examined the relationship between IT capabilities and electronic cooperation. The information technology examined was interorganizational information systems infrastructure (IOSI). Using an IT infrastructure framework, this study conceptualized IOSI as the shared IT resources among organizations and identified three IOSI dimensions based on its capabilities: technological, structural, and informational dimension. Using transaction costs theory and information-processing theory as theoretical foundations, the three IOSI dimensions were further divided into nine sub-dimensions and a theoretical model relating these IOSI sub-dimensions and electronic cooperation was developed.

The examination of the relationship between IOSI dimensions and electronic cooperation was conducted through structural equation modeling (SEM). A mailed-in survey with a self-administered questionnaire was conducted to collect data. The target

population for data collection was IS managers in the manufacturing and retailing industries, since companies in these industries have used IOSI for the closer relationships with their partners.

The present study finds that IOSI capabilities determine the electronic cooperation between organizations. Especially structural and informational dimensions of IOSI are positively related with the joint decision-making and purchase/sales. However, the impact of technological dimension was found to be statistically insignificant. The findings of this study suggest that the two-step model will better explain the relationship between IOSI and electronic cooperation. In other words, instead of direct effects, the technological dimension will have indirect effects on electronic cooperation through influencing the structural and informational dimensions. In addition, there is a positive relationship between volumes and amount of sales and joint decision-making.

This study makes theoretical as well as empirical contributions to the literature. It addresses significant gaps in the literature and provides empirical evidence to support the solutions suggested in this study. Other contributions of the study are expected to provide guidelines for future research in both IS and supply chain management area, which examine the impacts of IT on interorganizational relationships.

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CHAPTER 1

INTRODUCTION

As information technology (IT) has made advances in its capabilities in information processing and networking, organizations have sought to utilize these capabilities for the creation and maintenance of interfirm relationships (Bakos, 1991; Cash and Konsynski, 1985; Venkatraman, 1991). Through client-sever computing, hub-and-spoke, and distributed computing environments, organizations have increasingly exchanged information and facilitated the flows of resources such as products, services, money, and equipment. Especially, organizations extend their utilization of IT capabilities for information exchange beyond their organizational boundaries. They use the IT capabilities in order to gather, exchange, and process information that is scattered among multiple information holders (Arrow, 1974). These technological forces enable organizations to create new forms of interorganizational relationships that were not possible in the past. They build virtually vertical integration with other firms without ownership and they increasingly outsource their important resources to the markets.

Well-cited examples of information technologies used for interfirm relationships include interorganizational information systems (IOSs) such as American Hospital Supply Corporation's ASAP and American Airlines' reservation system SABRE, Internet, and Electronic data exchange (EDI). The use of Internet and EDI is now becoming an increasingly common way of doing business among organizations. Moreover, there are increasing numbers of studies that view these technologies as an IT infrastructure used across organizations (Broadbent, et al., 1999; Duncan, 1995; Keen, 1991; Weill, 1993). Since they are used across organizations, they are called as interorganizational information

systems infrastructure (IOSI) (Bensaou and Venkatraman, 1995). IOSI is a collection of information technology resources, which include communication networks, hardware, IT applications, standards for data transmission, and human IT skills and experiences.

IOSI helps organizations to establish and maintain interfirm relationships such as alliances, partnerships, and buyer-supplier relationships, to cope with the competitive business environment. Its role is to provide the IT foundation for interorganizational businesses and processes (Ross, 1997). It provides organizations shared IT services that enables them to exchange information necessary for building relationships with their partners (Broadbent, et al., 1999; Keen, 1991). Therefore, the basic question remains: how does IOSI influence the formation of interfirm relationships?

There have been efforts to investigate the impact of IT on the interfirm relationships. Most studies in this area were based on Malone, et al.'s (1987) argument of electronic markets and electronic hierarchies. They argued that because IT reduces costs in coordinating the relationships between organizations, it leads interfirm relationships into electronic markets. The relationships between organizations in electronic markets are temporary, like those in spot markets and stock markets, and mediated principally through market pricing (Clemons and Row, 1992). Researchers, especially economic theorists (e.g., Hess and Kemerer, 1994), have empirically tested the Malone, et al.'s (1987) "electronic markets" hypothesis, using economic models. However, their studies resulted in inconclusive findings. That is, they found that IT did not lead organizations to electronic markets. Rather, IT helps organizations to establish a hierarchies-like form of relationships that is in the middle between hierarchies and markets. This form of interfirm relationship is termed as cooperation (Clemons and Row, 1992).

Studies in both organization and information systems (IS) areas found that there has recently been a move to cooperation between organizations and IT has been a significant driving force behind this trend (Bakos and Brynjofsson, 1993; Clemons, et al., 1993; Bakos and Nault, 1997). In practice, many organizations have maintained tightly coupled relationships with a small, limited number of suppliers through the help of IT. Ford and GM in the automobile industry, for example, have obtained their necessary automobile parts from a limited number of suppliers. This IT-guided tightly coupled interorganizational relationship is called as electronic cooperation (Bensaou, 1997; Konsynski and McFarlan, 1990; Son, et al., 1999; Zaheer and Venkatraman, 1994).

The formation of cooperative relationships enables firms to access specialized resources of other firms without the need to acquire and manage these resources within the firm. Cooperation leverages a firm's capabilities by exploiting complementary resources external to the firm. Cooperation often occurs within business networks of firms that comprise a focal firm and its key suppliers and customers (Gomez-Casseres, 1994). It provides the context for the creation of specialized capabilities (Dyer, 1996; 1997) that can be leveraged by participants. The benefits and feasibility of cooperative relationships, even among competitors, have been found in many areas such as automobile, semiconductor, and other high technology industries (Contractor and Lorange, 1988; Smith, et al., 1995; Dyer, 1997). The cooperation between firms offers many potential benefits such as sharing costs, sharing capabilities and resources, and expanding into new product and geographic markets and lines.

Problem Statement

There are several studies explaining the phenomenon of electronic cooperation. Using an economic approach or the combination of economic and socio-political approaches, the studies have identified organizational/interorganizational contextual factors or behavioral/cultural factors and their consequences on electronic cooperation. (Bensaou, 1997; Hart and Sunders, 1998; Massetti, 1991; Son, et al., 1999; Zaheer and Venkatraman, 1994). The basic premise of the studies is that organizations usually require a large amount of IT investment to build electronic cooperation, and these investments are exposed to the partners' opportunistic behavior. To provide safeguards on negative behaviors and establish effective electronic cooperation, organizations need to establish organizational, behavioral, and/or cultural understandings with their partnering firms. In addition, IT adoption or IT use has been the surrogate measurement for electronic cooperation, and has been measured on a dichotomous scale (e.g., Hart and Saunders, 1998; O'Callaghan, et al., 1992). The problem of the measurement is: a simple IT link that merely automates the transmission of orders from the buyer to the seller is not an adequate measure of electronic cooperation (Choudhury, 1997).

Another stream is the studies done by Vijaysarathy and Robey (1997), Bensaou (1997), and Zaheer and Venkatraman (1994). Instead of organizational and/or cultural factors, they investigated the role of IT on electronic cooperation by including IT use. They assumed when there is the greater IT use between organizations, they develop the higher electronic cooperation. The intensity and scope of IT use between organizations, for example, will increase the degree of electronic cooperation. While these studies give us a better understanding on electronic cooperation, they still do not consider the role of IT

capabilities. The present study argues that there should be more detailed investigation into the role of IT capabilities on electronic cooperation.

The characteristics of IT can be described with such capabilities as information processing capability, network connectivity, and sharedness of data and applications (Ahituv, et al., 1989; Fiedler, et al., 1996; Leifer, 1988). IT capabilities support faster and more efficient transmission of information between the linked firms; reduce a firm's search costs and therefore increase a firm's chances of finding the optimal source or outlet for a product it is trying to buy or sell; and increase the efficiency of interorganizational relationship by creating electronic linkages beyond the simple transaction between the firms (Malone, et al., 1987). Likewise, the contribution of IOSI on electronic cooperation can be determined based on its capabilities. In other words, IOSI capabilities determine the information processing capabilities and interactions between organizations and consequently the electronic cooperation. In addition, electronic cooperation could be measured with the degree of an organization's dedication to partnering firms, instead of IT use.

Research Questions

The current theme in the literature is a shift from the impact of IT within organization to a focus of IT impact on blurring organizational boundaries. This extension of IT study from organizational to interorganizational level is considered timely and important (Bensaou and Venkatraman, 1995). The interorganizational level of analysis has become attractive to organizational and IS scholars (Mohr and Nevin, 1990; Hart and Saunders, 1998). In addition, the management of interorganizational relationships is

directly related to effective functioning of the organization. Building and nurturing cooperative relationships will be the yardstick that measures a firm's effectiveness to survive in the networked world of business environment. In order to respond to the trend, this study examines the effects of IOSI on electronic cooperation.

More specifically, this study will answer the following research questions:

1. What are the dimensions of IOSI in terms of its capability?
2. What consequences do IOSI dimensions have on the electronic cooperation?

As indicated in the research questions, this research limits its attention to study of IOSI capabilities; it does not include organizational and other factors that are considered to influence electronic cooperation. The incorporation of IOSI capabilities is intended to provide a better understanding of the role of IT features across organization boundaries. As organizations have increased their use of IT for managing interactions with other firms, the identification of the IOSI capabilities that help these interactions is needed and critical for emerging electronic business environments. Further, the investigation of the relationships between IOSI dimensions and electronic cooperation, would help in understanding the role of IT on the formation of interorganizational relationships.

Outline of Dissertation

The content of this document is organized into seven chapters. Chapter Two contains a significant literature review presenting the previous research pertaining to information technology and interorganizational relationships. Chapter Three develops the theoretical model to be explored and a discussion of the constructs and hypotheses that

have been derived by the researcher using the model. Chapter Four operationalizes the constructs and explains the methodology for data collection and data analysis. Chapter Five provides details regarding the data analysis. It contains the statistical assessment of measurement properties for each study variable and the results of structural equation models designed to capture the relationships between IOSI and electronic cooperation. Chapter Six discusses the results. The final chapter contains concluding remarks including limitations, contributions to academics and practitioners, and directions for future research.

CHAPTER 2

PREVIOUS IMPORTANT LITERATURE

This chapter provides a review of the literature concerning the impacts of information technology on interfirm relationships. This chapter also presents a discussion of interorganizational information systems infrastructure (IOSI) and its capabilities. As the present study will be centering on the interorganizational impacts of IT, this discussion helps lay a foundation for the theoretical hypotheses that are discussed in chapter 3.

Information Technology and Inter-organizational Relationships

One of the most important business environment conditions that organizations face is the formation of relationships with their partners. Formation of interorganizational relationships, however, involves various degrees of complexity, uncertainty, and change (Schoderbeck, et al., 1990). Complexity is related to the number of interorganizational relationship components with which an organization must interact. Uncertainty is related to the information about interorganizational relationship components held by an organization. Change is related to the dynamics between an organization and its components. Among them, the establishment and maintenance of interorganizational relationships require dealing with increasing degrees of complexity and uncertainty to manage the coordination requirements of interfirm relationships (Tushman and Nadler, 1978).

Coordinating requirements of interfirm relationships deals with processing, sharing, and communicating information within and across organizations. It also involves the monitoring and evaluating performance required to deal with the agency problem

arising from incentive conflicts in a delegated decision setting (Gurbaxani and Whang, 1991). Through facilitating the coordination of these activities, information technology (IT) changes interaction patterns and impacts efficiency and power/domination relationships between interacting organizations (Cash and Konsyski, 1985; Malone, et al., 1987; Pfeffer and Salancik, 1978).

As information becomes a key ingredient in interfirm transactions and IT provides the ability to alter the nature of information exchanges involved in transactions, IT has the potential to change efficiency in interfirm relationships. Moreover, as IT can make organizations more information available and provide a means for better use of the information through analysis and interpretation, interfirm efficiency has the potential to be increased. The use of electronic reservation systems in the airline industry, for example, has afforded travel agents to offer an increased number of alternative bookings, an increased level of quality in the alternative booking eventually selected, and a decrease in the time and money spent in the entire selection process for travelers (Malone, et al., 1987). In addition to improving efficiency, IT changes interaction patterns and thereby initiates the change in power/domination relationships between organizations. IT is seen as a mechanism by which organizations can alter the balance of power in buyer-seller relationships. A buying firm applying IT to scan its primary suppliers for the lowest priced product could easily change its bargaining power as vendor rivalry is in an expected result (Cash and Konsynski, 1985).

The changes due to IT use in interaction patterns introduce further impacts on interfirm relationships. As IT enables organizations to accrue benefits such as reduced coordination costs, increased information exchange, and improved decision-making

abilities, relationship shifts in buyer, supplier, and intra-industry rivalries occur. These shifts help the emergence of new forms of interfirm relationships by changing the structure and behavior of existing relationships. For instance, organizations within a competitive industry may use IT to unite under common set of standards and protocols. These standards may then be used to establish entry or exit barriers and create a more oligopolistic market structure (Cash and Konsynski, 1985; Malone, et al., 1987). As such IT alters the efficiency, interaction patterns, and power/domination relationships, its influences have been considered to be profound in the formation of interorganizational relationships.

Research Streams in IT impacts on Interorganizational Relationships

This section describes the theoretical perspectives in impacts of IT interfirm relationships. Generally, there are two common perspectives: technical-economic and socio-political perspective.

Technical-Economic Perspective

Traditionally, the IT literature relies on the concept of economic rationality to explain the emergence, structure, and behavior of IT in interorganizational settings. One premise underlying technical-economic perspective is that organizations and individuals are economically rational actors whose primary purpose is to minimize costs or maximize benefits from the use of IT in the interorganizational settings. In this perspective, there are three common theoretical approaches: competitive advantage theory, transaction costs theory, and incomplete contracts theory.

Competitive Advantage Perspective.

The concept of competitive advantage (Porter, 1980) frequently is used to explain the impacts of IT across organizations. It emphasizes the importance of gaining power over the firm's suppliers and customers while attempting to constrain the power of competitors (e.g., Bakos and Treacy, 1986; Johnston and Vitale, 1988), or the impacts of IT on market structure (e.g., Cash and Konsynski, 1985). The premise of this concept is that IT can have an impact on competition by transforming industry structure, providing companies with strategic advantages in relations to their competitors and opening avenues for new markets and business ventures. By performing the information processing activities within the value chain more efficiently and effectively, IT changes established rules of competition and allows organizations to lower costs and gain economics of production. Moreover, IT offers the potential for establishing tighter links with outside organizations including suppliers, customers, and distributors. This can be instrumental in providing competitive advantage by altering the bargaining power of suppliers and customers.

Johnston and Vitale (1988) present a framework to look for IT opportunities on competitive advantage. The framework postulates that competitive advantage is a function of bargaining power and comparative efficiency. Bargaining power, which allows a firm to resolve bargaining situations with its customers and suppliers to its own advantage, is influenced by unique product features, switching costs, and search-related costs. Comparative efficiency, which allows an organization to produce its goods or services more cheaply than its competitors, is affected by internal and interorganizational efficiency. Competitive advantage can be realized by capitalizing the capabilities of IT to influence both the bargaining power and comparative efficiency of an organization.

However, the predominant view of IT as provider of strategic advantage has been challenged. Clemons and Kimbrough (1986) and Clemons and Row (1988) cautioned that the strategic impacts of IT investments are rare and the benefits accrue only to companies who are pioneers in developing and using IT, i.e., first-movers. They suggested that most IT investments are likely to become "strategic necessities" over time. Sustaining the competitive edge over a long period of time will depend on how rapidly customers adopt the system relative to the time taken by competitors to copy the system.

Transaction costs Perspective.

Researchers have used transaction costs approach to explain the emergence and structure of interfirm relationships. Transaction costs theory (Williamson, 1985; 1991) concerned with the minimization of a cost function consisting of transaction costs and production costs, and the containment of risks that arise due to the opportunistic behavior of the parties to the relationship. Many studies in this perspective focus on whether IT promotes hierarchical governance mechanisms based on intrafirm control, or market mediated mechanisms based on interfirm relationships (e.g., Bakos and Nault, 1997; Gurbaxani and Whang, 1991; Malone, et al., 1987). Economic theorists have developed economic models to assess the impacts of IT (Bakos, 1987; Bakos and Brynjofsson, 1993; Clemons, et al., 1993; Whang and Seidman, 1995). The most representative study in this perspective is the "electronic markets" argument by Malone, et al. (1987). IT is said to reduce more coordination costs than production costs, by decreasing the search costs for potential suppliers and partners and by providing information-based mechanisms to reduce uncertainty and information asymmetry, thereby reducing the costs of drafting and

monitoring the implementation of transaction contracts. As a result, IT, by reducing the incentives for vertical integration, influences organizations to move toward market arrangements.

Gurbaxani and Whang (1991) examined the impacts of IT on hierarchies and markets. IT can lower both production and transaction costs as well as both information and monitoring costs, reducing the costs of both markets and hierarchies, with the overall impact on organizational governance mechanisms inconclusive. Choudhury, et al. (1998) empirically tested the impact of Inventory Locator Service (ILS) in the aircraft parts industry. They found that the study of ILS does not adequately support the electronic markets arguments. For instance, while ILS sometimes helps buyers find a better price, in other cases it can help suppliers extract an extra premium by providing more accurate information on parts availability. Hess and Kemerer (1994) also found the inconclusive results about the electronic markets hypothesis from their study of Computerized Loan Origination (CLO) systems of the home mortgage industry. Despite the availability of the technology and mortgages' seemingly favorable characteristics as an electronically mediated market product, the industry has not been fundamentally changed by the introduction of CLO systems, despite more than a decade of experience with them. In their study, of the two case studies that could be characterized as electronic markets, neither continues to exist in that form today. The system with the largest dollar volume of mortgages of the companies has been best characterized as an electronic hierarchy.

Incomplete Contracts Perspective.

Since the studies using transaction costs theory and agency theory do not provide

clear conclusions about the impacts of IT on interorganizational governance mechanisms, researchers have adopted other perspectives in order to explain the phenomena. One of the alternative approaches is the theory of incomplete contracts that combines the insights of transaction costs theory regarding the importance of bounded rationality and contacting costs with the rigor of agency theory (Brynjofsson, 1994). The theory of incomplete contracts examines the relationship between ownership of assets and the resulting incentives for investment in electronic networks such as Internet and interorganizational information systems (Bakos and Nault, 1997).

In contrast to the assumption of complete contracts in transaction costs theory, this approach emphasizes the existence of incomplete contracts between partners in contracting, enforcing the contracts, and dealing with unforeseen contingencies. According to Hart and Moore (1990), contracts may be incomplete because certain variables are nonverifiable by a third party such as an arbitrator or a court, even though they are observable by the parties entering into a relationship. Because of this inability to enter into complete contracts, the crucial difference between governance structures lies in their implied residual decision of rights (Grossman and Hart, 1986). Thus, different governance structures assign property rights to resolve the issues that arise when contracts are incomplete. This provides a basis for defining different interorganizational structures by the ownership and control of key assets (Brynjofsson, 1994). Using the incomplete contracts perspective, Bakos and Brynjolfsson (1993) argued that IT influences interorganizational structure by providing the advantages that partners enjoy in noncontractible characteristics such as innovation, adoption of new technology, quality, information exchange, trust, flexibility, and responsiveness, rather than by simply driving

changes in coordination costs, economies of scale, or monitoring.

Socio-Political Perspective

Moss-Kanter (1994) mentions that economic perspective coupled with technical feasibility is not sufficient to explain the interorganizational relationship. He argues that socio-political issues, such as personal chemistry and interaction between corporate leaders, and compatibility between the organizations on broad culture, philosophical, and strategic grounds, determine if the relationship will come into existence and mature. Like his argument, the socio-political perspective focuses on the behaviors of participants in examining the formation of interorganizational relationships. This perspective suggests that the resultant outcome of a participant's behavior is dependent upon the responsive behavior by the other participant(s) within the exchange relationship (Anderson and Narus, 1990).

Factors such as dependence, power, commitment, trust and conflict derived from the theory, has been widely examined in empirical studies analyzing the impacts of IT on interorganizational relationships. Among them, the trust and power are said to influence the adoption and use of IT in the interorganizational relationships. Power is a firm's capacity to influence activities of another firm that is dependent upon the resources of that firm (Anderson and Weitz, 1989). In buyer-supplier relationships, suppliers are typically dependent upon buyers that provide them with a large proportion of sales revenue. In this situation, the buyer frequently exerts power over suppliers to influence them to adopt and use IT. Trust is a firm's belief that its partner will perform actions that will result in positive outcomes for the firm, as well as not take unexpected actions that would result in

negative outcomes for the firm (Anderson and Narus, 1990). It is frequently viewed as a behavioral intention or behavior that relies on a partner and involves vulnerability and uncertainty on the part of the trusting party (Moorman, et al., 1993). Once IT is adopted, expanded use is determined by the extent of trust between firms (Hart and Saunders, 1997; 1998). Greater use of IT means that operations between trading partners will be more integrated and partners will have closer relationships.

As such, the socio-political stream argues that a firm forms interfirm linkages primarily to gain control over critical resources and thereby reduce uncertainty in their acquisition. Firms use various forms of power to control such linkage. While economy oriented researchers ignore the role of power and trust in their analysis, socio-political oriented researchers contend that interfirm relationships could exist even if they are not cost-effective because of other social and political forces (Pfeffer, 1982). The socio-political research stream has contributed to significant findings in the marketing area, but has been used a few in IS research (e.g., Hart and Saunders, 1997; 1998; Son, et al, 1999). The strong research base of this stream is the potential for unearthing important elements of interfirm relationships in the adoption and use decision for IT (Premkumar and Ramamurthy, 1995). Premkumar and Ramamurthy (1995) stated that this research stream helps explaining interfirm relationships in terms of exercise of power and dependence between channel members reflecting the socio-political structure, and the transaction climate reflecting the socio-political processes.

Studies in Governance Structure of Interorganizational Information Systems

There have been efforts to empirically and theoretically investigate the impact of IT

on interfirm relationships using the theoretical foundations described in section 2.2. These studies expanded their focus into more diversified types of interfirm relationships, in addition to Malone, et al.'s (1987) dichotomous markets and hierarchies; as well as they focus on narrower nature of IT, i.e., IT that are used for interorganizational business activities only. This IT is called interorganizational information systems (IOS) and defined as information and communication-based systems that are shared among organizations (Bakos, 1991; Cash and Konsynski, 1985). Since IOS is viewed as planned and managed ventures between independent organizations (Kumar and Dissel, 1996) and as a representation of the patterns of interorganizational relationships, it is considered that the IOS structure is equivalent to the structure of interfirm relationships. In other words, the IOSI governance determines the governance of interfirm relationships.

The typology studies focus on configuring and assessing IOS structure and identifying the determinant factors so that organizations should implement and use appropriate IOS structure fitted to their needs for interorganizational relationships. In determining IOSI typology, several criteria are used. One of them is the level of participant's involvement in developing IOS. Barrett and Konsynski (1982) and Cash and Konsynski (1985) determine the IOS structure in terms of the possible level of technical involvement. Barrett and Konsynski (1982) developed a five-level IOS typology based on the intensity of a firm's participation in an IOS. Cash and Konsynski (1985) present a modified version of Barrett and Konsynski's (1982) framework. Their scheme also is based on the level of participation and the IOS structure is distinguished by the amount of resources committed, the responsibility assumed, and the degree of control exercised by the participating organization.

Some studies have focused on the interactions between participants. For example, Bakos (1987) have classified IOS structure based on the number of suppliers and customers, the existence of intermediaries in the relationships, and the interactions between these participants. Johnston and Vitale (1988) classify IOS contingent on the business function of the system (i.e., leveraging present business or seeking new information driven business), the information function performed by the IOS (i.e., performing boundary transactions, retrieving and analyzing shared information, or assisting internal processing of information), and relationship between the IOS and their sponsors including customers, dealers, suppliers, or competitors. These classification schemes are intended primarily to assist potential IOS developers and users to understand and evaluate the costs and benefits involved, and to assess the managerial and strategic implications of participating in the different types of IOS.

Other studies about IOS governance structure are based on the transaction costs economics (TCE). Malone, et al. (1987) identify two IOS governance structure based on the transaction costs theory: electronic markets, through which multiple buyers and sellers do business; and electronic hierarchies, which integrate tasks and functions across a predefined set of organizational boundaries. TCE studies assume that the degree of relation-specific investment devoted to maintain the interorganizational relationships, determines the different governance structures. Benjamin, et al. (1990) identify four types of IOS based on electronic markets vs. electronic hierarchies, as Malone, et al. (1987) did, and whether the IOS supports only routine transaction processing or also provides task support.

In addition to the above factors, some studies employed various factors that

influence the IOS governance. Bensaou and Venkatraman (1995), for example, configure five types of IOS based on the information processing needs and capabilities in the relationships. Each IOS configuration represents different information needs and capabilities. Remote IOS, for example, represents low information needs and capabilities, while electronic interdependence represents high information processing needs and capabilities. In general, their configurations represent that the IOSI structures supporting high information processing needs show the higher performance than the ones supporting low information processing needs. However, the dimensions of information processing needs by themselves do not predict performance. They found that high performing (i.e., electronic interdependence) as well as low performing IOS (i.e., remote relationship) operates under low and high information processing requirements. This result strongly reinforces the information processing view (Galbraith, 1977; Tushman and Nadler, 1978) that the fit between information processing needs and capabilities is more important than either one alone.

Seidmann and Sundararajan (1997), on the other hand, identify four IOS types based on the information sharing across the supply chain: ordering information, operational information, strategic information, and strategic and competitive information sharing. Their study treats the level of information shared not based on what its exact content or volume is, but based on the impact it has on the operations, sales, marketing, and production strategies of the parties. As the sharing goes up to strategic and competitive information, the level of information sharing increases. They view that the task characteristics are major determinants of the level of information sharing and thus level of IOS governance.

Table 2-1

Review of Previous IOS Frameworks

Authors	Dimensions	Typology
Barrett and Konsynski (1982)	• Intensity of involvement of participants in developing IOS	• Remote input/output node • Application processing node • Multi-participant exchange node • Network control node • Integrating network node
Cash and Konsynski (1985)	• The amount of resources committed • The responsibility assumed • The degree of control exercised by the participating organization	• Information entry and receipt • Software development and maintenance • Network process management
Bensaou and Venkatraman (1995)	• The fit between information processing needs and capabilities	• Remote relationship • Electronic control • Electronic interdependence • Structural relationship • Mutual adjustment
Malone, et al. (1987)	• Transaction costs • Production costs	• Electronic markets • Electronic Hierarchies
Benjamin, et al. (1990)	• Electronic hierarchies vs. electronic markets • Transaction Processing vs. task support	• Transaction processing/electronic hierarchies • Transaction processing/electronic markets • Task support/electronic hierarchies • Task support/electronic markets
Seidmann and Sundararajan (1997)	• The degree of information sharing	• Ordering information • Operational information • Strategic information • Strategic and competitive information
Choudhury (1997)	• Demand uncertainty • Market variability	• Electronic dyads • Electronic monopolies • Multilateral IOS
Kumar and Dissel (1996)	• The degree of interdependence	• Pooled information resource IOS • Value/supply-chain IOS • Networked IOS

Kumar and Dissel (1996) classify three IOS structures based on the association between

technology and interdependence: pooled information resource IOS, value/supply-chain IOS, and networked IOS. Choudhury (1997) identifies three IOS configurations based on the demand uncertainty and market variability: electronic dyads, electronic monopolies, and multilateral IOS. Table 2-1 shows the summary of studies on IOS governance structures.

Information technology and Cooperation

The studies mentioned in previous sections ('2.2.1 and '2.3) found that IT and especially, IOS supports organizations in establishing and maintaining various form of interorganizational relationships. Among interorganizational relationships, cooperation with other firms is considered as critical means for survival of an organization and IT is treated as major factor for cooperation. This section describes the conceptual basis and empirical studies in IT impacts on cooperation.

Move to the Middle Hypothesis: The Cooperative Interorganizational Relationships

Traditionally, the studies with an economic perspective have examined IT impacts on interorganizational relationships based on efficiency considerations, i.e., hierarchical structures governed by vertical coordination, or market-based structures governed by pricing mechanisms. However, we are still far from a complete understanding of the interorganizational impact of IT from this dichotomous distinction (Bakos and Brynjolfsson, 1993). Some authors have developed that IT has engendered new forms of organizations (Johnston and Lawrence, 1988). The new interfirm relationship that lies between markets and hierarchies is described as cooperation (Clemons and Row, 1992;

Clemons, et al., 1993).

The most widely accepted study about the impacts of IT on cooperative interorganizational relationships is the "move to the middle" hypothesis presented by Clemons, et al. (1993). According to them, IT does not simply influence the creation of markets or hierarchies structures in the interfirm relationships, rather it promotes the creation of interorganizational governance that lies in the "middle" between markets and hierarchies. Like other economic theorists, they explained the phenomena using the transaction costs theory. They divided the transaction costs into coordination costs and transaction risks and argued that the impact of IT on organization cannot be understood without explicitly considering transaction risk. Transaction risk is the possibility of opportunistic behavior by another party, leading to uncertainty to the relationship. This risk induces costs for cooperation.

The transaction risk is usually derived from the risks from transaction-specific capital, information asymmetries, and loss of resource control in the closely coupled relationships. An investment is considered relationship-specific if its use is particular to one relationship and it has a little value outside the relationship. Asymmetries in information can create problems in monitoring partner's performance. In many situations, due to the nature of production processes or limitations in information, it is difficult to measure accurately the partner's performance and this creates the opportunity for performance shrinking by one party at the expense of the other. Loss of control occurs when resources are transferred as part of the relationship, if these resources cannot be returned or controlled in the termination of relationship. These are major sources for increasing the transaction risk and thus increase the transaction costs in the relationships

(Clemons and Row, 1992; Clemons, et al., 1993).

IT has dramatically reduced the unit cost of computing and communications and has increased economies of scales. IT enables organizations to increase information availability and processing capacity. With these capabilities, IT decouples an investment's beneficial impact on coordination costs from its damaging impact on transaction risk. Thus, Clemons and Row (1992) suggest that although firms will increase market transactions, they will not rely solely on the use of transaction-oriented spot markets, but will move toward long-term, stable partnerships to increase resource utilization through greater cooperation. Firms now outsource their supplies of goods and services and establish vertical quasi-integration with their partnering firms (e.g., the high level of cooperation between Wal-Mart and Proctor & Gamble). IT's ability to reduce the costs of cooperation without increasing transaction risk also makes it possible to create new interactions to exploit economies of scale (e.g., Rosenbluth's Rosenbluth International Alliance, a cooperative organization offering integrated travel management services across the world) and scope (Merrill Lynch's Cash Management Account, the combination of the function of a brokerage account with the functions of a bank demand deposit account).

Empirical Studies about Cooperation

Inspired by Clemons, et al.'s (1992; 1993) the "move to middle" hypothesis, studies have empirically examined the impacts of IT on interfirm cooperation. These studies have identified factors that influence cooperation using several perspectives including transaction costs theory, information processing theory, and socio-political approach.

Studies in the information processing approach view that uncertainty and information processing are the most important issues in explaining cooperation. According to this approach, cooperation between organizations involves a certain level of interdependence (Ouchi, 1980) and the interdependence brings problems of uncertainty (Schoderbeck, et al., 1990). As uncertainty increases, the information processing requirements of the relationships increase (Tushman and Nadler, 1978). To solve the uncertainty problems in the interfirm relationships, the increases in information processing capabilities between organizations are considered as a major solution. Increased information processing capabilities indicate that the partnering firms share more information about transactions, monitoring the performance, and controlling resources. Galbraith (1973) views organizations as information processing systems, and appropriate organizational structures are those that best match an organization's information requirements with its information processing capabilities. More important, in IS area, IT has viewed as tool for increasing information processing capability and thus decreases uncertainty. IT is one of the major factors that determine information processing capabilities in the interorganizational relationships.

Bensaou and Venkatraman (1995) suggest that cooperation clearly is a configuration for high-uncertainty contingencies that require important and rich information processing capabilities. A cooperative interfirm relationship is dependent upon the ways that organizations cope with the uncertainty they face, and with the information processing capabilities they have. They identify three types of uncertainty recognized in the interfirm relationships: environmental uncertainty (i.e., arising from the general environmental conditions underlying the interorganizational business

relationships); partnership uncertainty (i.e., arising due to one firm's perceived uncertainty about its specific partner's behavior in the future); and task uncertainty (i.e., arising due to the specific set of tasks carried out by the organizational agent responsible for the interorganizational relationship). They describe three mechanisms that effect information processing capabilities: structural mechanisms, process mechanisms, and information technology mechanisms. Cooperation is influenced by the fit between these uncertainties and three mechanisms.

Traditional studies in transaction costs theory view that asset specificity is considered as a primary source of uncertainty since it represents investments highly specific to the relationship and hence increases the potential risk and damage if the supplier behaves opportunistically. However, since the value of a firm's capital asset is idiosyncratic to the relationship with the other firm (Son, et al., 1999), the value of transaction-specific assets is significantly lower when employed in alternative uses. Due to these characteristics of asset specificity, an organization may hold the other firm hostage (Anderson and Narus, 1990; Hiede and John, 1992) and the partnering firm is locked into the transaction with its current customer to a great degree (Bensaou and Venkatraman, 1995; Dyer, 1997; Son, et al., 1999). Thus, asset specificity is identified as a major factor that determines cooperation in many studies (e.g., Bakos, 1991; Bensaou, 1997; Bensaou and Venkatraman, 1995; Dyer, 1997; Son, et al., 1999; Zaheer and Venkatraman, 1994). In addition to the uncertainty and asset specificity, power and trust (Hart and Saunders, 1997; 1998; Lee and Kim, 1999; Son, et al., 1999; Zaheer and Venkatraman, 1994), and other partnership characteristics such as behavior and climate of the relationships (Bensaou, 1997) and product characteristics (Lee and Kim, 1999) are also examined intensively as

important factors for cooperation.

Position of The Study

The studies on the impacts of IT on cooperation, described in the previous sections, have mainly focused on transaction costs, organizational context, and behavioral/cultural factors, based on several theoretical backgrounds such as transaction costs theory, information processing theory, and socio-political theory. As summarized in Table 2-2, these factors include asset specificity, uncertainty, trust, behavioral climate, and power. Even though these studies contribute to IS research, they have ignored the role of IT capability itself on cooperation. IT, as a coordination technology, has various features that facilitate communication, information sharing and exchange, and interactions among organizations, and thus contributes to developing closer transactions between organizations. These IT features provide capabilities for processing, communicating, and storing information. Likewise, in an interorganizational context, organizations can benefit such IT capabilities through network connections and data and applications sharing (Ahituv, et al., 1989; Fiedler, et al., 1996; Leifer, 1988). Malone, et al. (1987) described the contribution of IT capabilities in the formation of interfirm relationships. IT provides capabilities that support faster and more efficient transmission of information between the linked firms, increase a firm's chances of finding optimal partners, and increase the efficiency of interorganizational relationship by creating electronic linkage.

There are a few studies that explore IT capabilities on interfirm cooperation. Some studies incorporate the "IT use" construct in the study of cooperation. Bensaou (1997) and Bensaou and Venkatraman (1995) considered the intensity and scope of IT use on

cooperation. Vijasarathy and Robey (1997) investigated how the EDI use influences the structural dimensions of interorganizational relations which, in turn, shapes behavioral dimensions of relationship such as cooperation and conflict.

Table 2-2

Studies about Cooperation

Author	Dimension	Theory
Bensaou and Venkatraman (1995)	• Uncertainty • Information processing capability	• Transaction costs theory • Resource dependency theory • Political economy
Dyer (1997)	• Asset specificity	• Transaction costs theory
Bakos (1991)	• Asset specificity	• Transaction costs theory
Bensaou (1997)	• Behavioral climate of relationship • Governance structure (switching costs) • Scope of IT use	• Transaction costs theory • Resource dependency theory • Political economy
Hart and Saunders (1997; 1998)	• Power • Trust	• Political economy
Kim, et al.(1999)	• Demand Uncertainty • Channel Interdependence • Product characteristics	• Information processing theory
Lee and Kim (1999)	• Trust • Business understanding • Benefit and risk sharing • Commitment	• Power-political theory • Social-exchange theory
Son, et al. (1999)	• Uncertainty • Asset specificity • Reciprocal Investments • Power • Trust	• Transaction cost theory • Socio-political theory
Zaheer and Venkatraman (1994)	• Asset specificity • Trust • Reciprocal Investments	• Transaction costs theory

The EDI use was conceptualized based on its capabilities such as increasing sales, increasing customer services, and reducing inventory level. Other studies have explored the degree and the amount of IT investments to determine IT capabilities and measured how IT capabilities reduce transaction risks that are considered as a barrier to cooperation (Clemons and Row, 1992; Clemons, et al., 1993; Kim and Umanath, 1999).

However, the present study argues that the construct "IT use" alone could not provide enough explanatory power for the formation of cooperative interfirm relationships. There should be more detailed investigation into the nature of IT which influences cooperation. Thus, the present study will focus on the other IT capabilities, neither IT use nor organizational factors. More specifically, this study will investigate the capabilities of a set of IT resources that are used across organizations, which is called interorganizational information systems infrastructure (IOSI).

The following sub-sections describe what is IOSI and role of IOSI in providing a better understanding of IOSI and the theoretical background that guide the rest of research.

Interorganizational Information Systems Infrastructure (IOSI)

What is Interorganizational Information Systems Infrastructure (IOSI)?

Before describing IOSI, it is better to explain the difference between IOSI and IT investments and applications. Weill (1993) and Grossman and Packer (1989) provide an excellent view of what distinguishes IOSI from other IT investments and applications. What distinguishes IOSI is that it is IT shared across organizations and provides an IT platform for performing base business processes of the organizations and several linked processes among business units (e.g., network services, databases services for business

units), while IT investments and applications directly perform or support a particular business process, product, or function (e.g., managing inventory). Infrastructure investment is long-term in nature, often takes advantage of economies of scale of centralized investment, and supports a shared interfirm-wide vision. EDI, for example, is not an IT application, but an IOSI that is an IT platform rooted in a set of standards for informational exchange among participants in a marketplace. EDI consists of a communications standard defining how one computer is to talk to another computer over a network and a message standard defining the sequence and format of data which is to be exchanged (Callahan, 1987). Many IT applications are built on EDI standards to design and deploy different functionality that interconnects multiple organizations (Venkatraman and Zaheer, 1990). In addition to EDI, other examples of IOSI include Internet and interorganizational information systems (e.g., American Hospital Supply Corporation's ASAP, Formost-McKesson's ECONOMOST, and American Airlines' reservation system SABRE).

In this study, IOSI is defined as a set of IT resources shared among organizations, which provides shared IT services and supports information processing and communication across organizations (Broadbent, et al, 1999; Duncan, 1995; Weill, 1993; Keen, 1991). IOSI is IT base that organizations share in order to facilitate information exchange and sharing and thus support interactions between them (Bakos and Nault, 1997). IOSI is used as building blocks for business applications (Keen, 1991) and upon which interorganizational systems and processes are built (Ross, 1997). The definition of IOSI is similar to that of interorganizational information systems (IOS). As mentioned earlier, the distinction between them lies that IOSI provides IT base for IT applications,

while IOS is an application that performs specific business functions.

IOSI comprises of three elements: technical IT infrastructure, human IT infrastructure, and IT standards (McKay and Broakway, 1989; Kayworth, 1996; Keen, 1991). Technical IOSI consists of platform technology (e.g., hardware and operating systems), general purpose databases, productivity tools such as CASE, and network and telecommunication technologies that are commodities and readily available in the marketplace. Human IOSI includes human knowledge, skills, and experience relative to IT. IT standards include common handling mechanisms for different data types and methods, standards, and tools (Turnbull, 1991; Darnton and Giacollette, 1992).

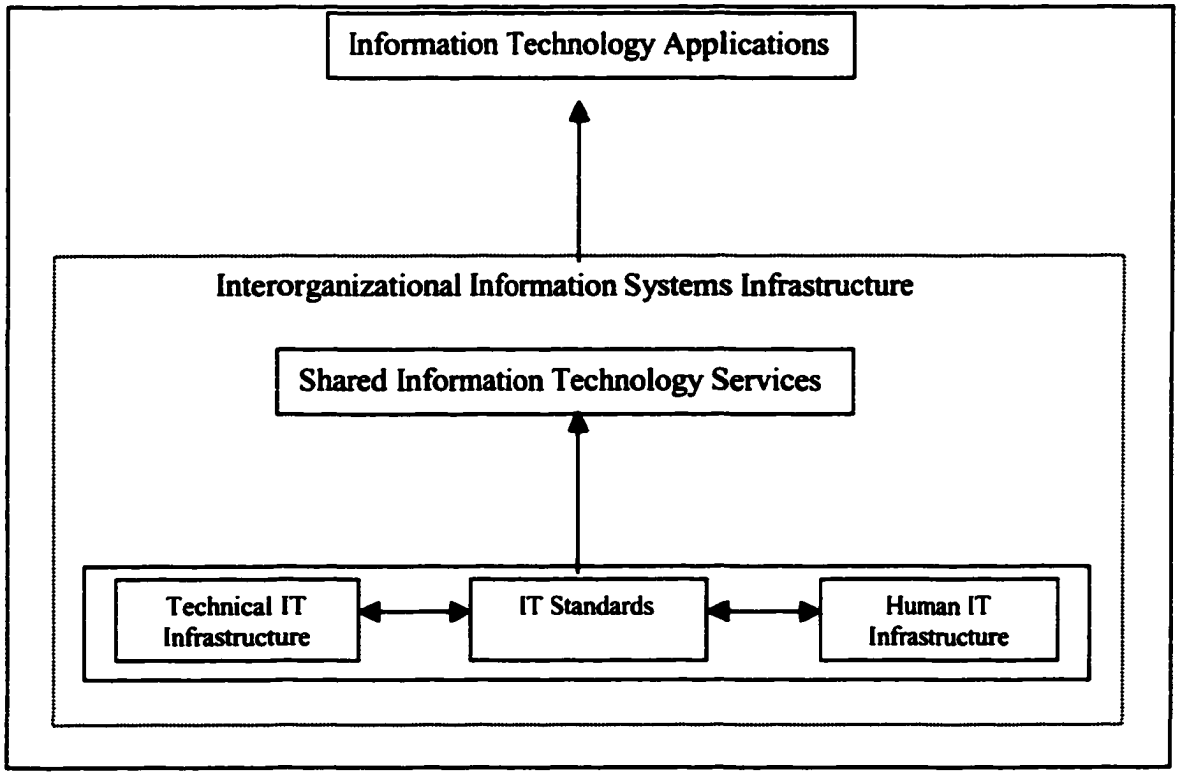


Figure 2-1. IOSI Elements

The combination of the three components delivers a reliable set of shared IT

services, such as the management of large scale data processing capability, management of interfirm-wide databases, security, Internet and Intranet access, and implementation of common system that enable organizations effective long-term use of IT. Figure 2-1 presents the elements of IOSI.

The Role and Benefits of IOSI.

The primary role of IOSI is to support the commonality between different IT applications or IT use (CSC Index, 1992) facilitating information sharing across organizations and cross-functional integration (Darnton and Giacollette, 1992) and to obtain economies of scales. IOSI facilitates interorganizational communications, provides ready access to data, integrates business processes, and establishes electronic linkages that enable IT applications to do business (Ross, 1997). As a result, IOSI improves interfirm relationships by supporting greater automated information processing and providing the opportunity for making information available to trading partners that was previously not accessible, and making information accessible in a more timely way.

Through IOSI, organizations combine information from separate applications in order to create services and products, use the same delivery base for a growing range of services, facilitate cross-organizational information flows, and link a firm's systems with those of customers and supplier (Keen, 1991). Applegate (1999) identifies IOSI-enabled business opportunities in three areas. First, IOSI enables firms to do commerce (transaction). IOSI enables suppliers and customers to complete business transaction. A firm can use IOSI to streamline, integrate, and synchronize key operating processes such as procurement, order fulfillment, and customer service. Then it can increase the efficiency

and effectiveness of existing supply and distribution channels. It can also create new channels to new or existing markets. Second, IOSI enables firms to improve competitive position. IOSI helps firms to create and distribute information-based products and services. Through IOSI, firms can exploit the economic value of information by adding value to existing products and services or by creating new ones. By harnessing information and knowledge and by exchanging information among partnering firms, IOSI helps people to work smart and to use the exchanged information and knowledge to create new products and services or to add value to existing ones, thus improving a company's competitive advantage. IOSI also enables firms to implement "information arbitrage" strategies by serving as an information broker uniting suppliers and buyers within inefficient information markets. Finally, IOSI enables firms to establish and maintain the relationships required for doing business within and outside the industry. A firm can use IOSI to link suppliers, consumers, and business partners. Through IOSI, a firm can establish a position at the center of an electronic market. Recently many firms such as Yahoo.com, Amazon.com and AOL, use IOSI (e.g., Internet) to establish this relationship.

Theoretical Backgrounds

Gray and Wood (1991) identify six major theoretical perspectives used to explain interorganizational cooperation. Among these perspectives, both transaction costs economics and information processing theory are most widely used in IS area. This study adopted these two theories to explain how IOSI contributes to the establishment of interfirm cooperation.

The transaction costs economics (TCE) perspective suggests that, under ceteris

paribus conditions, a firm will adopt a transaction cost minimal arrangement that would not only involve the choice between markets and hierarchies but also various forms of hybrid arrangements (Williamson, 1985; 1991). Interfirm cooperation represents one of these various interorganizational forms. Important factors that affect the choice between these various governance options are uncertainty and asset specificity. Zaheer and Venkatraman (1994) argue that transaction costs perspective has served as a dominant theoretical anchor in understanding the nature of interfirm cooperation.

On the other hand, Galbraith (1977) and Tushman and Nadler (1978) suggest that an organization is an information processing system, and that appropriate organizational structures are those that best match an organization's information requirements with its information processing capabilities. This view of organizations sees information exchange (i.e., communication) as a central phenomenon in organizations, and has contributed greatly to the understanding of information exchange behaviors that affect the development and quality of interorganizational relationships (Mohr and Sohi, 1996). In general, cooperation is related to higher level of information processing capabilities among organizations. Since IOSI supports information processing capability among organizations and the uncertainty and asset specificity are directly influenced by IOSI (Bakos and Treacy, 1986; Clemons and Row, 1993), there is a compelling logic to assess the impact of IOSI on the modes of interorganizational governance, especially interfirm cooperation (Malone, et al., 1987; Gurbaxani and Whang, 1991).

Even though the two theories have greater contribution in explaining interfirm cooperation individually, scholars have found it necessary to apply information processing and transaction cost approaches jointly in order to understand the full range of

interorganizational IT impacts (Argyres, 1999). Information processing approach focuses on the ways in which IT increases the quantity of interactions between organizations per unit of time. This approach, however, generally abstracts from the problem of motivating actors to interact in a qualitative way. On the other hand, contributions applying the transaction costs approach emphasize that IT may play a role in providing incentives for actors to ensure the quality of interactions (e.g., Malone, et al., 1987; Gurbaxani and Whang, 1991; Clemons, et al., 1993). According to this view, IT helps to create and support a set of governance arrangements by binding organizations together with transaction-specific assets. This view also sees that the transaction costs arise from misalignments and potential opportunism by partners, conditions that are absent from information processing approach. As a result, the combination of these two approaches makes us better understand the effects of IT on interfirm cooperation in terms of both the means (i.e., information processing approach) and incentives (i.e., transaction costs approach).

CHAPTER 3

RESEARCH MODEL AND HYPOTHESES

This chapter provides a detailed description of research constructs and their proposed relationships. This chapter identifies three IOSI dimensions that determine interactions between organizations. The three dimensions are then categorized into more detailed constructs. Definition for each construct is presented and descriptions of the theoretical relationships between them are being proposed.

The Basic Research Model

This section describes the basic components of IOSI and the relationships between IOSI components and electronic cooperation. The basic research model is also presented in the last section.

IOSI Capabilities

As the combination of IOSI components, such as technological and human infrastructure and IT standards, provides shared IT services that affect interorganizational IT capabilities and information processing capabilities, the availability of appropriate IOSI capability is a key factor for successful interorganizational relationships (Caron, et al., 1994). Broadbent, et al. (1996; 1999) and Weill and Broadbent (1998) identify the capabilities of IOSI as consisting of three dimensions: IOSI services, reach, and range. IOSI services refer to IT functionality provided IOSI. They amplify the capability of IT applications that are implemented on IOSI and used to directly perform business functions. Reach and range refer to the business functionality of IOSI, while IOSI services do IT

functionality of IOSI. Reach is described as the locations an organization can link through IOSI. IOSI may support organizations to link their functional areas and link suppliers, customers, or even competitors domestically and internationally. The ideal reach is to link to anyone, anywhere (Keen, 1991). Finally, IOSI capabilities are determined by the range or richness (Evans and Wurster, 1997) of information that can be shared at each level of reach. Generally, low range limits the IT-based information sharing, for example, to simple data transfer; the ideal range would allow any IT-generated transaction, document, file, or message to be used on any information systems (Keen, 1991).

Through these capabilities, IOSI supports organizations' ability to business transactions with their partners. For example, a firm that is selling hospital products may wish to offer electronic purchasing facilities to customers so that they can order directly and determine stock availability. When the required IOSI services such as communications network and security services, are not in place, the firm could not introduce the new business functions. IOSI also supports the degree of business scope that a firm can connect to and exchange information with its partners through its reach and range capabilities. A firm can send messages, access information (e.g., checking credit ratings), and handle simple transactions (e.g., order taking), and complex transactions on multiple applications (e.g., order processing) with customers and suppliers regardless of their IT bases. Put together, the IOSI capabilities attribute to the information processing capability of the interfirm relationships by supporting the intensity of interactions and the intensity of information exchange among participants, which is a major factor determining interorganizational relationship (Barrett and Konsynski, 1982; Johnston and Vitale, 1988).

As a part of IOSI, EDI, for example, provides greater information processing

capabilities that allow for interorganizational electronic cooperation. EDI links between organizations support the exchange of explicit, operational and well-structured information (e.g., electronic exchange of quotes, orders, production, and delivery schedule, EFT-electronic fund transfer) and provide each firm with faster, more accurate, and less time and space dependent data exchange. In addition, using EDI, engineers based in one firm can look at and manipulate the same CAD/CAM drawings as their counterparts in another firm can, forming a virtual cross-company cooperative design team.

IOSI Dimensions

As described in Chapter Two, IOSI helps organizations to increase information processing capabilities and decrease uncertainty, which are considered as critical factors for cooperative interorganizational relationships. From IT infrastructure framework, IOSI consists of three capabilities: IOSI services, reach, and range. Literature in interorganizational impacts of IT were also identified several antecedent factors that are likely to influence information processing capabilities of interorganizational relationships. Based on information processing theory, Bensaou and Venkatraman (1995) developed a comprehensive framework for information processing capabilities. According to them, information processing capabilities of relationships are derived from a number of mechanisms for interorganizational coordination, such as structural mechanisms, technological mechanisms, and process mechanisms. Van de Ven and Ferry's (1980) framework presents the situational, structural, process, and outcome dimensions of an interorganizational relationship. Combining their frameworks with IT infrastructure framework, this study identifies three IOSI dimensions: technological, structural, and

informational dimensions.

Technological dimension represents the provision of IT functionality on which IT applications are implemented and used. With the provision of networking connectivity, standards for information exchange, and other supportive functionalities, IOSI could increase the use of IT in business activities of interorganizational relationships. The intensity and scope of IT use between organizations improves interactions and facilitates interorganizational coordination (Bensaou and Venkatraman, 1995).

The structural dimension determines the interaction patterns or structures that characterize an interorganizational relationship. Interaction structures involve rules and procedures, direct contacts, liaison roles, integral roles, and task forces and teams (Daft and Lengel, 1986). These structures have different capacity for interorganizational coordination (Galbraith, 1977; Tushman and Nadler, 1978; Van de Ven, et al., 1976), especially due to their contributions to the nature and scope of linkages established between organizations. Likewise, the information processing capabilities of a relationship will increase when IOSI provides interaction structures that support greater intensity and scope of electronic linkage between organizations (Bensaou and Venkatraman, 1995). In the study based on Van de Ven and Ferry's (1980) framework, Vijayasarathy and Robey (1997) suggest that the information flows in different interorganizational relationships are distinguished by their structural components.

While the technological and structural dimensions help to define the IT functionality and structure for interactions, it is also necessary to capture the nature of information flow of interactions. Although, it is not explicitly included in their framework, Van de Ven and Ferry (1980) emphasize that information flow is an important dimension

in the study of interorganizational relationship. Based on their recommendation, Mohr and Nevin (1990) and Vijayasarathy and Robey (1997) incorporate informational dimensions as a third characteristic of interorganizational relationships. Since the "range" component of IOS capabilities also deals with the information flow of interactions, information dimension is added as the third component of IOSI dimensions.

IOSI and Electronic Cooperation

One of the major topics in IS studies is how the adoption of IT improves interorganizational relationships. A variety of studies have applied transaction costs economics and information processing perspective to explain the phenomena (e.g., Malone, et al., 1987; Zaheer and Venkatraman, 1994). Although there are contradictory results, studies have argued and found that IT has greater contributions on establishing cooperative interorganizational relationships (Clemons and Row, 1992; Clemons, et al., 1993).

Cooperation, by definition, requires joint efforts or actions taken by independent firms to achieve mutual outcomes or singular outcomes (Anderson and Narus, 1990). Cooperative structure is enabled by highly customized components or integrated subsystems and thus requires high levels of interdependence between organizations. The high interdependence contingencies of cooperation are characterized by high uncertainty. Therefore, the reduction of high uncertainty existed was major attention in literature. It requires rich information processing capabilities between organizations (Bensaou and Venkatraman, 1995) and technological and financial hostage so that organizations have difficulties in switching partners. Marrett (1971) proposes that the extent to which the

parties are involved in a cooperative relationship depends upon the invested resources for interactions among themselves. These resources are termed co-specialized assets or asset specificity (Dyer, 1996). Van de Ven, et al., (1976) and Van de Ven and Ferry (1980) view intensity of cooperation as being related to the resources invested and information exchanged among the participants.

IOSI is viewed as contributing to cooperation by posing asset specificity and increasing interactions and information processing capabilities between organizations. Structural and informational dimensions determine the information processing capabilities of the interorganizational relationships (Bensaou and Venkatraman, 1995; Mohr and Levin, 1990). In their studies, Vijayasarathy and Robey (1997) support this argument by identifying the factors that influence information processing capabilities of the relationships as channel structure and channel information quality. In addition to structural and information dimensions, the technological dimension of IOSI is considered as important factor for the formation of cooperative interorganizational relationships. Technological dimension provides organizations technological and financial hostages. They become formal safeguards that enforce organizations to do interactions with their current partners to a great degree (Bensaou, 1997; Son, et al., 1999; Zaheer and Venkatraman, 1994).

Cooperation in interorganizational relationships has been generally explained as a function of IOSI dimensions and IS literature has called this IOSI-induced cooperation in interorganizational relationships as electronic integration (Kambil and Short, 1994; Malone and Crowston, 1994; Venkatraman and Zaheer, 1990; Zaheer and Venkatraman, 1994), electronic interdependence (Benasou and Venkatraman, 1995), or information

partnership (Konsynski and McFarlan, 1990). This study identifies three dimensions of IOSI- technological, structural, and informational dimensions- as important factors that influence electronic cooperation. Figure 3-1 presents the relationships between three IOSI dimensions and electronic cooperation.

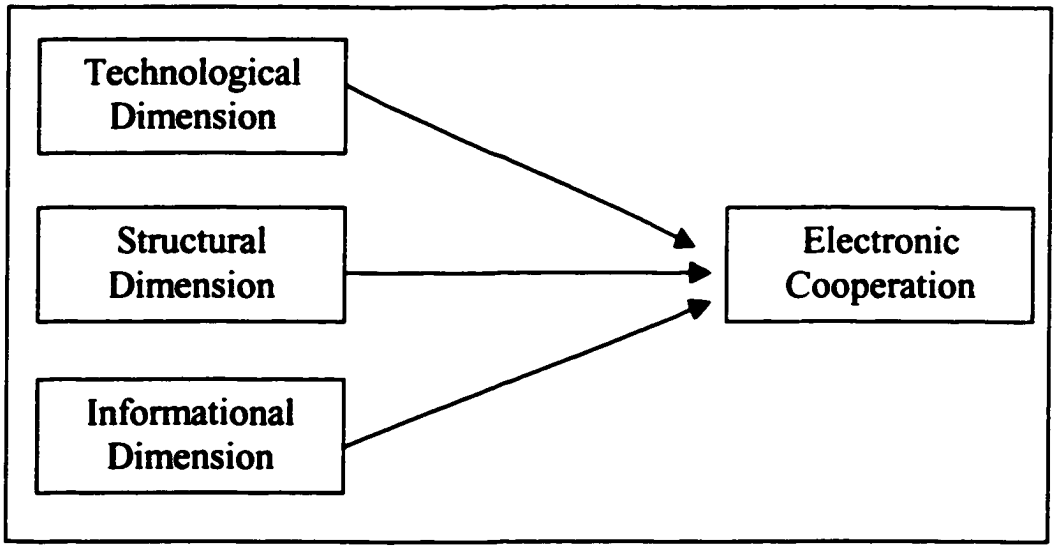


Figure 3-1. The Basic Research Model

Construct Development

This section describes the constructs to be examined in this study. There are total ten constructs: nine constructs for IOSI dimensions and one construct for electronic cooperation. The brief description of each construct establishes a basis to build propositions about how IOSI affects the electronic cooperation in interfirm relationships.

Technological Dimension

Organizations share various IT functionality provided by IOSI with their partners to exploit IT applications for their relationships. For example, when a retailer wishes to

offer EDI-based ordering systems to buyers so that they can order directly, the retailer needs the shared IT functionality for EDI connections such as network protocols, transaction sets for document exchange, and standards for IT applications for processing transactions data (Ferguson and Hill, 1988; Riggins, et al., 1994). However, every IOSI does not provide the same level of IT functionality. For example, when companies use Value Added Network (VAN; i.e., common IOSI) or Private Proprietary Network (PPN; i.e., proprietary IOSI) for EDI applications, these two types of IOSI provide different degrees of IT functionality for EDI applications through different protocols, standards, transaction sets, etc. As such, technological dimension reflects the degree of shared IT functionality supported by IOSI. In the IT infrastructure framework, Weill and Broadbent (1998) suggest that IOSI provides extensive or selective IT functionality. Zaheer and Venkatraman (1994) identified the provision of customized IT functionality as an important element of IOSI. Combining the two studies, technological dimension is assessed by IOSI extensiveness and IOSI customization.

IOSI Extensiveness.

Organizations use IOSI for transactions with their partners. The IOSI they use would be either a common or third-party IOSI such as Internet and an industry IOSI, or proprietary IOSI that the organizations or their partners initiate. Whether organizations use either IOSI to make connections with their partners, each IOSI provides different degrees of IT functionality. There are several IT functionalities identified; they are communication networks, standards for the definition and transmission of data, and security (Broadbent, et al., 1996; 1999). The nature and number of IT functionality is described as IOSI

extensiveness ((Broadbent, et al., 1999). More extensive IOSI consists of a higher number of distinctive IT functionality. A proprietary IOSI, for example, may provide a limited number of IT functionality with a high depth of IT functionality. It may support full fledge of bandwidth for communication networks but enforce the strict application of standards for transmission of data. Such a selective level of IT functionality may limit business transactions between organizations whose business activities require a large amount of data transferring in a broad range of data variations. In an IOSI with only a basic level of IT functionality, its service may not be available to all partners. Thus, this paper defines IOSI extensiveness as the degree of IT functionality provided by IOSI.

IOSI Customization.

With the IOSI extensiveness, the business functionality of IOSI is determined by the degree of specialization in its shared IT functionality (Dyer, 1997). IOSI often provides IT functionality that supports organization-specific workflows and processes and that are specific to a personnel's skills, knowledge, and experience. More specialized IT functionality enables organizations and their employees in a relationship to have distinctive IT functionality for their business activities. The distinctive IT functionality creates relation-specific IT capabilities that have little use outside the relationship and hold organizations to the relationship (Zaheer and Venkatraman, 1994). The ASAP system of Baxter, for example, embodies features built into the system to customize a particular hospital's needs and consequently, there are highly coupled relationships between Baxter and the hospitals (Malone, et al., 1987). Therefore, IOSI customization refers to the extent to which the deployed IT functionality of IOSI is specific to the relationships' business

processes and human skills.

Customization has been used to refer to the ability to deploy standard resources in a context, often using advanced technologies without having to specialize the underlying resources themselves as in descriptions of mass customization (Kotha, 1995). However, I use IOSI customization more restrictively to refer the uniqueness or specialization of IT functionality provided by IOSI to business process and human expertise. In this sense, customization and specialization are synonymous.

Structural Dimension

Daft and Lengel (1986) state that structural design can provide information of suitable richness to reduce equivocality as well as provide sufficient data to reduce uncertainty. Structural design such as task forces and liaison personnel supports information exchange between divisions and provides greater information processing capabilities (Tushman and Nadler, 1978; Nadler and Tushman, 1988) to reduce uncertainty. In this sense, structural dimension involves the IOSI ability to support interaction structures or patterns, enabling organizations to establish various electronic connections for information exchange and transactions. The structural dimension of IOSI provides guidance in determining the patterns of interactions which carry out organizational duties (Rapert and Wren, 1998), through directing the flow of information, managing the depth and breadth of interaction, and capturing the complex and dynamic interchange between partners (Mohr and Speckman, 1994).

In organization studies, the structures of interorganizational interactions have been widely studied as important factors for interorganizational relationships (Marrett, 1971;

Van de Van and Ferry, 1980; Vijayasarathy and Robey, 1997) and are deemed to be a key indicant of partnership vitality (Mohr and Speckman, 1994). Moreover, there is a direct correspondence between interaction structure and the nature of cooperation since the effective interactions between partners are essential to achieve the benefits of cooperation (Choudhury, 1997; Cummings, 1984). Organization and IS studies identify several components of structural mechanisms which facilitate interorganizational interactions, such as frequency, multiplicity, formalization, centralization, and direction of interaction (Mohr and Speckman, 1994; Van de Van and Ferry, 1980; Vijayasarathy and Robey, 1997); and breadth, depth, intensity, scope of IT use (Bensaou and Venkatraman, 1995; Hart and Saunders, 1998; Massetti and Zmud, 1996). Based on these studies, five structural factors that are important for electronic cooperation, are identified: IOSI breadth, IOSI multiplicity, IOSI depth, IOSI formality, and IOSI centrality.

IOSI Breadth.

IOSI breadth refers to the IOSI ability to support an organization to connect with and reach to a variety of its partners. The "variety" here means the nature of suppliers (not the number of suppliers) such as the suppliers in the same or different value chain, the suppliers in the same IT bases or regardless of IT bases, and national or international suppliers. When a firm wants to establish electronic connections with its partners, the firm may have limits due to the capabilities of the IOSI it is using. For example, when a person uses a department LAN, he/she is able to reach people in that department, while the Internet allows the person to connect to anyone in the world. Likewise, the IOSI breadth determines the ability of a firm to establish electronic connections with its various

suppliers (Massetti and Zmud, 1996) and with those who participate in the relationship (Johnston and Vitale, 1988). A firm may need transactions through IOSI with a number of trading partners such as customers, suppliers, customers' customers, suppliers' suppliers, and even competitors (Bergeron and Raymond, 1992). A firm may need to establish electronic connections with the suppliers in the same value chain and/or in several value chains. When an IOSI provides high degree of IOSI breadth, a firm will reach more organizations and consequently, it may have better interfirm interactions with its partners (Iacovou, et al., 1995; Massetti and Zmud, 1996) and be more successful in adapting and competing within the emerging electronic world.

IOSI Multiplicity.

IOSI multiplicity refers to the IOSI ability to support several interaction channels with its trading partners. When a firm interacts with its partners, there is more than one interaction channel to which all the information flows between the two companies. A purchasing department of a firm, for example, may communicate with its partner's manufacturing and design department for designing and producing their products. Multiple interaction channels will increase the functional integration that knits the various business functions together between two companies (Iacovou, et al., 1995).

IOSI multiplicity and IOSI breadth together explain the IOSI's ability to support a variety of electronic connections among organizations (Bensaou and Venkatraman, 1995; Massetti and Zmud, 1996). IOSI breadth presents the variety of electronic connections at the organizational level, while IOSI multiplicity measures them at functional level. By tracking both functional-level and organizational-level electronic connections, an enriched

understanding of a firm's coordination capabilities is obtained (Massetti and Zmud, 1996).

IOSI Depth.

Connecting multiple suppliers and business functions does not necessarily mean that the interaction structure of an organization with its partners are sophisticated enough to satisfy their information exchange needs. IOSI depth is another structural dimension and determines the mode of interactions. In organization studies, a variety of information exchange modes exist, such as face-to-face, telephone, personal documents such as letters or memos, impersonal documents, and electronic mail (Daft and Lengel, 1986; Markus, 1994). Each mode provides a different level of capacity to process information based on its capacity for immediate feedback, the number of cues and channels utilized, personalization, and language variety (Daft and Wiginto, 1979). Likewise, Massetti and Zmud (1996) and Johnston and Vitale (1988) identified information exchange modes that IOSI supports: file-to-file connections, application-to-application connections, and coupled network environments. In this paper, IOSI depth is defined as the IOSI ability to support the degree of sophistication in information exchange modes (Emmelhainz, 1986; Jackson, 1994).

IOSI Formality.

In addition to breadth, multiplicity, and depth that measure the degree of separate interactions between organizations, there are constructs that govern the overall interaction behaviors in the interorganizational relationships. Two of the most common structural constructs are formality and centrality in the organization theory (Rapert and Wren, 1998).

These constructs are directly related to interorganizational relationships since they direct and control the communication processes (Jablin, et al., 1987). As noted, communication processes are the critical components for the formation of the relationships between organizations since they determine the degree of information exchange and thus the uncertainty.

In organization study, formality is described as the degree to which decisions and working relationships are governed by formal rules, standard policies, and procedures (Mohr and Nevin, 1990). The rules, policies and procedures coordinate boundary-spanning activities between the participants in the relationships (Marret, 1971; Van de Ven, et al., 1976). In the IOSI context, for information exchange, organizations adopt common standards for messages and communications (Stern and Kaufmann, 1985) and the establishment of protocols related to the timing and frequency (Vijayasarathy and Robey, 1997). In this paper, IOSI formality is defined as the extent to which IOSI directs interactions between organizations in structured and routinized manner.

IOSI Centrality.

In organization studies, centrality is described as the locus of authority and control of an organization (Tavakolian, 1989). In other words, centrality points out the extent to which decision-making power is concentrated at an organization (Fry and Slocum 1984; Miller, 1988). Centrality and decentrality lie at opposite ends; organizations could fall anywhere on this continuum. In IOSI context, centrality indicates that the degree of interactions controlled by the use of IOSI. Kandathil (1994) describes that the type of electronic linkages between organizations is determined by IT capability to control the

coordination activities. Choudhury (1997) presents the patterns of interactions supported by IOSI; IOSI enables a buyer (seller) to establish individual logical links with each of a selected number of partners, a single logical interorganizational link with a potentially unlimited number of partners, or a single link with a sole partner. These studies underline that IOSI determines the route of information exchange between organizations. Interorganizational relationships, especially cooperative relationships, reflect the realization of relevant knowledge and resources that are dispersed across organizations (Clemons, et al., 1993). Thus, centrality emphasizes the IOSI ability to integrate the dispersed knowledge and resources. In this paper, IOSI centrality is defined as the IOSI ability to support concentrated interactions.

Informational Dimension

The information dimension of IOSI is related to richness of interactions in that it determines the diversity of information exchanged and the quality of information exchange between organizations. IOSI enables organizations to handle a number of distinctive information types (Massetti and Zmud, 1996). In general, interorganizational relationships loose efficiency when transactions involve highly embedded organizational and technical resources and capabilities, conditions which require high quality of information exchange (Nohria and Eccles, 1992). In such conditions, organizations need to use IOSI that is able to transfer a variety of data types and business transaction sets (Hart and Saunders, 1997). In the interorganizational relationship studies, informational dimension is measured by the diversity of information exchanged (Fisher, et al., 1997; Massetti and Zmud, 1996; Mohr and Levin, 1990; Mohr, et al., 1996) and the quality of information exchange (Mohr and

Sohi, 1995; Mohr and Spekman, 1994; Vijayasarathy and Robey, 1997).

Information Diversity.

Information diversity is defined as the IOSI ability to support various data types and data formats in interactions. Information consists of the distinct document types and the data formats of a given document being electronically exchanged (Massetti and Zmud, 1996). Through IOSI, organizations can transmit and receive a variety of data types such as text, picture, voice, as well as request for quotes, purchase orders, paper drawings, or three-dimensional wireframes (Bensaou and Venkatraman, 1995). In addition to the data types, IOSI should be able to support a variety of data formats to be exchanged. Because different organizations, industries, and countries initiate their own electronic data formats, no single standard for the data exchange process does, or will likely, exist. In EDI area, for example, there are many different data exchange formats, including the American National Standards Institute (ANSI) transaction sets established for different industry grouping (Bass, 1989), international standards of EDI for Administration, Commerce, and Transport (EDIFACT), developed under the direction of the United Nations (Warner, 1989), and many proprietary standards which do not directly form established document standards. Due to the existence of various data types and data exchange formats, lack of information diversity in IOSI is often considered as one of the major barriers to successful interorganizational relationships (Emmmelhainz, 1990).

Information Exchange Quality.

Another factor that determines the informational dimension of IOSI is information

exchange quality. Effective information exchange between partners is essential in order to achieve the intended outcomes (Anderson and Narus, 1984). Quality of information exchange leads to better informed parties, which in turn makes each party more confident in the relationship and more willing to satisfy it. In the interorganizational area which information is a vital commodity, the quality of information exchange process is often a prerequisite for functioning and survival of the relationships and thus is a key aspect of successful interorganizational relationships (Mohr and Levin, 1990; Lee and Kim, 1999; Monczka, et al., 1998; Vijayasarathy and Robey, 1997). Quality includes such aspects as the accuracy, timeliness, adequacy, and credibility of information exchange activities (Daft and Lengel, 1986; Huber and Daft, 1987; Iacovou, et al., 1995). For the purpose of the study, information exchange quality is defined as the extent to which IOSI supports the accuracy, timeliness, reliability, completeness, and relevance of information exchange activities between the participants in the relationships.

Electronic Cooperation

Electronic cooperation is defined as a tightly coupled, integrated interorganizational relationships achieved through the deployment of IOSI (Zaheer and Venkatraman, 1994). It lays the middle between the electronic markets (transaction-oriented markets such as stock exchanges) and electronic hierarchies (centrally directed interactions within a single firm) (Clemons and Row, 1992). According to Clemons and Row (1992), in electronic cooperation, partnering firms increase resource utilization and add value to the relationships. Electronic cooperation also involves explicit coordination through high relation-specific investment and information processing

capabilities (Bensaou, 1997; Dyer, 1996; Son, et al., 1999; Zaheer and Venkatraman, 1994).

Electronic cooperation is measured as the level of an organization's dedication to its partners (Zaheer and Venkatraman, 1994). That is, the percentage of business transactions is directed through electronically. The number of partners involved in the transaction (Brynjolfsson, et al., 1994; Johnston and Lawrence, 1988) and the transaction volume (Zaheer and Venkatraman, 1994) is most frequently used as the measures of an organization's dedication in the studies based on the "move to the middle" hypothesis. In strategic management area, cooperation is measured by sales volume flowing between dyadic partners as an objective indicator (Mohr and Spekman, 1994). In the studies of buyer-supplier relationships, economic theorists found that many companies have actually reduced their supplier base after implementing IOSI, despite a significant reduction in their market transaction costs (e.g., Whang and Seidmann, 1995; Bakos and Brynjolfsson, 1993). Partners are also able to increase electronic cooperation as they increase the volume of transaction between the partners (Dyer and Singh, 1998). Automobile manufacturers like General Motors, Ford, and especially Chrysler, for example, have substantially reduced the number of suppliers from whom they purchase components, while simultaneously dramatically increasing the value of parts they procure (Clemons, et al., 1993).

Electronic cooperation is also measured by the frequency of interaction and the degree of working jointly in business activities such as production planning and designing (Bensaou, 1997). Therefore, this study measures electronic cooperation as the degree of joint decision-making and the purchase/sales (volume of transactions) between

organizations.

Research Model and Hypotheses

While there appears to be a common consensus among IS and organization researches that IT supports better cooperative relationships between buyers and suppliers, there have been few attempts at theoretical modeling or empirical testing of this assertion. Based on the constructs derived from relevant reference disciplines, the detailed research model is presented in Figure 3-2.

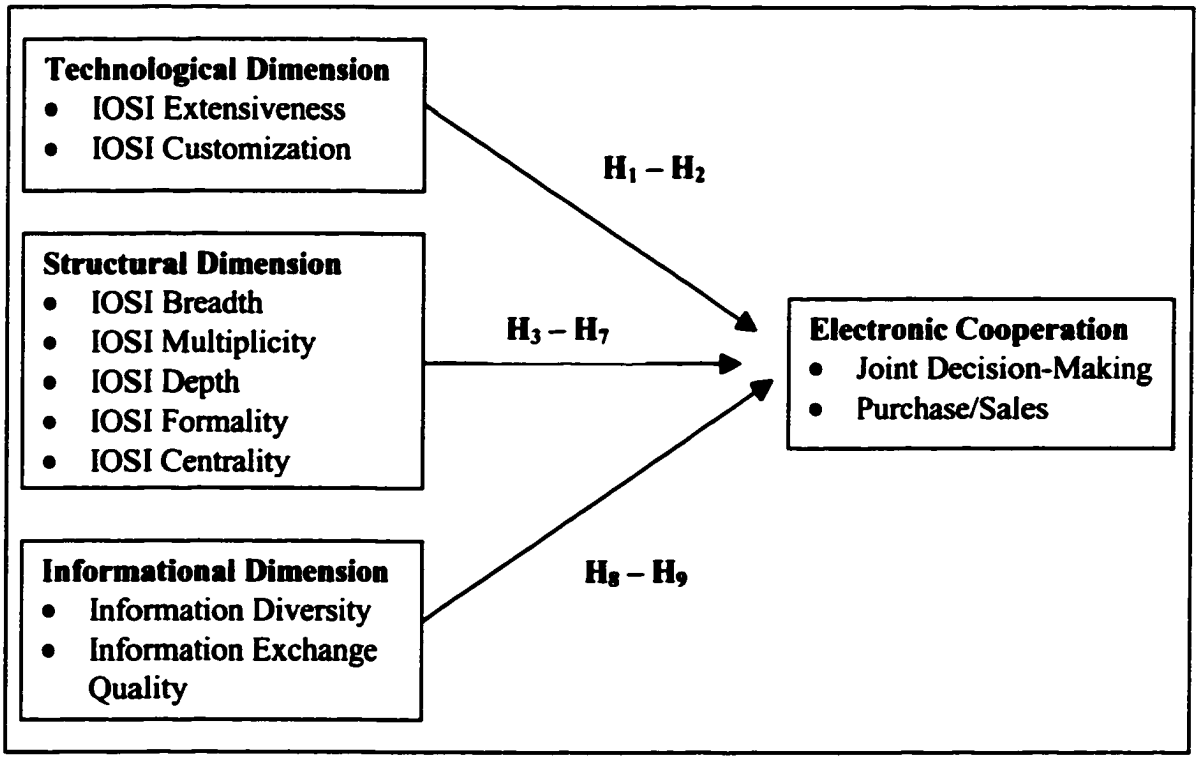


Figure 3-2. The Research Model

The premise of the research model is that cooperative relationship between organization are better explained by incorporating relevant dimensions of IOSI that

support their information processing capabilities and relation-specific assets. The research hypotheses denoted by the model are discussed in the next subsections.

Technological Dimension

IOSI Extensiveness.

When IOSI provides extensive IT functionality, organizations can share a wider range of IT services with their partnering firms, such as an integrated telecommunication network or a united customer database. More extensive IT functionality also supports the integration of organizations' IT activities such as task/team support technologies (e.g., groupware and discussion databases), high bandwidth telecommunications, and information-rich media (such as color graphics and full motion video), so that organizations can exchange a variety of information at a high speed and more accurately. Therefore, the IOSI with higher extensiveness provides organizations a technological platform for greater information access and information processing capabilities (Kumar and Dissel, 1996), and allows easier IT integration between organizations. The increase information processing capabilities between organizations help them to reduce uncertainty about the partner, its inclination of opportunistic behaviors (Benasou, 1997) and hence invite electronic cooperation.

Moreover, the use of extensive IT functionality for interorganizational relationships requires larger fixed investments (Bakos and Brynjolfsson, 1993). Set-up costs are incurred to utilize the IT functionality for transactions (Dyer, 1997). The investments cost more up front and form relation-specific investments that are considerably of less value outside the relationship (Weill and Broadbent, 1998). Since

these specific investments make it costlier and more difficult for organizations to switch their partners, it is expected that organizations to preserve their current relationship more closely and therefore, higher electronic cooperation with their partners.

H_1: *IOSI extensiveness is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.*

IOSI Customization.

IOSI customization is related to the integration of business processes between organizations. When an IOSI provides IT functionality specific to a relationship's business processes, the IOSI is customized one to the relationship. To use customized IOSI, organizations are required to customize their personnel's skills, knowledge, and experience specific to IOSI-mediated business processes. Zaheer and Venkatraman (1994) argued that the relation-specific IT functionality and human skills create procedural and human asset specificity for the relationship. For example, a proprietary IOSI that an individual firm commits resources to implement, provides it IT functionality customized to its business processes or to its relationship's business processes. Its partners also are required to customize their business processes or their employees' skills to the IT functionality. Such IT functionality creates firm-specific or relation-specific IT-based capabilities.

The relation-specific IT-based capabilities determine the level of organizational resources that are tied up to support business competencies. The tied-up resources hold organizations as hostage for the relationship. Thus, organizations try to utilize these resources for better relationships with their partners, instead of revealing opportunistic

behaviors to their partners. The resource utilization between organization brings cooperation (Clemons and Row, 1992) As a result, through the creation of relation-specific IT-based capabilities, IOSI customization provides organizations enhanced opportunities for restructuring their relationships with the chosen business partner (Zaheer and Venkatraman, 1994) and consequently increases electronic cooperation.

H_2: *IOSI customization is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.*

Structural Dimension

The structural dimension of IOSI influences the electronic cooperation by determining the pattern and behavior of interactions and information processing capabilities between organizations (Mohr and Speckman, 1994; Monczka, et al., 1998). The increased interactions and information processing capabilities between organizations reduce the uncertainty and equivocality of the relationships and increase electronic cooperation.

IOSI Breadth.

IOSI breadth refers to the IOSI ability to support an organization to make electronic connection with a variety of partners. When a firm establishes electronic linkages with various types of suppliers, the firm can achieve participation externalities that support interfirm relationships (Kumar and Dissel, 1996). In the airline industry, the SABRE system enables an airline company to make connections with its agents, customers,

competing airline companies, as well as companies in other industries. They exchange information about flight schedules, ticketing, hotel reservations, car rentals, and entertainment reservations. As such, IOSI breadth determines the degree to which electronic linkages are established between organizations (Massetti and Zmud, 1996). With higher IOSI breadth, organizations can make electronic connection with their partners regardless the value chain, IT base, and geographic proximity. IOSI breadth makes it easy for a firm to establish interaction structure with the partners to exchange information about their transaction requirements such as products specifications, price, and products delivery. As a result, IOSI breadth facilitates electronic cooperation that involves joint decision-making and consequently increases the volume and dollar amount of transactions.

H_3: *IOSI breadth is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.*

IOSI Multiplicity.

IOSI multiplicity is related to the interdepartmental relationships among organizations. The interdepartmental relationships can be characterized by the degree to which functional relationships are differentiated (Frazier, 1999; Shrivastava and Mitroff, 1984). Each business function develops its own functional specialization, time horizon, goals, a frame of reference and jargon. Interdependence between business functions increases uncertainty because action by one department can unexpectedly force adaptation to other departments in the value chain. Bridging differences between departments reduces

uncertainty and equivocality. IOSI multiplicity helps organizations bridge these differences between business functions by supporting the development of multiple interaction channels.

IOSI multiplicity to support multiple inter-functional interfaces is related to the functional integration and supply chain integration (Narasimhan and Jayaram, 1998). In supply chain integration studies, the functional integration connotes the knitting together of the various departments across the supply chain and is important for successful interfirm cooperation (Narasimhan and Jayaram, 1998). The high interdependence between business functions requires the multiple functional interfaces that more information must be processed in order to resolve needed frequent adjustments (Van de Ven, et al., 1976). For example, a supplier's design engineers must be coordinated with a buyer's design engineer to ensure flawless products. The IOSI-enabled multiple inter-functional interfaces allow the partnering firms to form frequent contacts necessary for confronting and resolving disagreement and misunderstanding that can be arise between their business functions. Therefore, their goals become tightly intertwined through creating interfirm information-sharing routines that transfer know-how and technology. As a result, the multiple functional interfaces mean that organizational boundaries between organizations begin to blur (Dyer, et al., 1998).

As such, IOSI multiplicity determines the strength of interfirm cooperation by influencing the degree of information processing between business functions (Daft and Lengel, 1986). IOSI multiplicity enables organizations to frequently contact and coordinate various business functions of partners (Daft and Lengel, 1986). This IOSI-enabled functional integration allows different business functions to reach a common

frame of reference (Soborero and Schrader, 1998) by facilitating interfirm information-sharing routines to effectively coordinate activities and optimize interfirm cooperation.

H_4: *IOSI multiplicity is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.*

IOSI Depth.

Researchers drawing on information processing theory develop several interaction modes (e.g., face-to-face, telephone, e-mail, and so on) that determine the degree of organizational information processing capability (e.g., Daft and Lengel, 1986). Each mode reveals different level of capability to exchange information and to support the quality of information exchanged and information participation (Huber and Daft, 1987). Firms use various interaction modes to manage their information processing requirements for the relationships (Kambil and Short, 1994).

IOSI depth influences the level of interaction modes by determining the interfirm IT use (i.e., intensity and scope of IT use) (Bensaou and Venkatraman, 1995). IOSI supports basic or shallow linkages where IT use is largely confined to being the conduit for passing massages between parties, or deeper linkages where IT is used to feed information directly into organization's business applications (Massetti and Zmud, 1996). Shallow linkages can be carried out as a standalone, modular activity with minimal integration with related firm processes. In a study in the automobile industry, Bensaou and Venkatraman (1995) report that several suppliers who had such linkages re-keyed the purchase orders

received electronically into their internal information systems. In the deeper linkage, organizations eliminate these redundancies of information processing activities and streamline boundary-crossing business processes (Subramani, 1997).

In addition, IOSI depth influences internal IT integration. IOSI depth enables organizations to interconnect a variety of internal IT applications for such interfirm transaction tasks as order entry, invoicing, billing, and payment transfer. Hart and Saunders (1997) state that higher IOSI depth supports tightly coupled IT integration among partners. The data generated within a specific business function of an organization can be processed seamlessly between the business functions internal and external to the organization. This IT integration allows partners operations integration and more direct access to information. Such IT integration offers direct benefits as well as indirect benefits, such as increased operational efficiency and improved interfirm cooperation, and reduced transaction costs (Iacovou, et al., 1995). There is also increasing recognition that IOSI depth is a key determinant of the nature of interorganizational electronic channels (Venkatraman and Christiaanse, 1996) and corresponding level of information sharing (Massetti and Zmud, 1996). Consequently, IOSI depth influences IT integration and the level of IT use for information exchange that influences significantly interfirm cooperation (Choudhury, 1997; Iacavou, et al., 1995; Mukhopadhyay, 1995).

H_5: *IOSI depth is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.*

IOSI Formality.

In exchanging information, trading partners are required to adopt formal standards for messages and communication, to establish protocols related to the timing and frequency of exchanging information, to reach agreements related to the sharing of transmission and translating costs, and to establish terms of responsibility when errors occur in transmission process (Vijayasarathy and Robey, 1997). When the use of IOSI requires the strict applications of such constraints, the interaction behaviors are more structured and routinized and there is higher IOSI formality. Such IOSI formality helps organizations build "technical bonds" that interconnect their technical processes (Johnston and Mattson, 1987) and direct individual activities to be routinized. Individuals develop routines to integrate their activities more closely with the organizational technical processes. In addition, the structured and routinized interaction develops relational norm for information sharing in the relationship, i.e., the generalized expectations and shared beliefs about appropriate behaviors in the relationships (Heide and John, 1992). When organizations share a belief that extensive information sharing is appropriate behavior, their actual behaviors are likely to reflect this norm.

By supporting the routinization of processes and the establishment of norm, IOSI formality is positively associated with cooperative communication (Mohr, et al., 1996). Morris et al. (1995) report that environmental turbulence requires more formalization in decision-making and exchange processes. Formalization of various aspects of information exchange processes may be especially critical given the ambiguous nature of the typical cooperative relationships. For instance, Michaels, et al. (1988) find that higher levels of formality are related to lower levels of role ambiguity and role conflict in the case of buyers

and suppliers relationships. By formalizing the communication processes and procedures, IOSI enhances the speed, accuracy, and completeness of interorganizational communication (Stern and Kaufmann, 1985). Therefore, IOSI formality enhances the likelihood of developing and implementing cooperation between organizations.

H_6: *IOSI formality is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.*

IOSI Centrality.

The extent to which IT resources are shared determines IOSI centrality. Organizations may establish dyadic, multilateral, or monopolistic interaction channels (Choudhury, 1997). Monopolistic channel that there is only a single link established between organizations for sharing IT resources creates high IOSI centrality. With pooled IT resources sharing, multilateral channel allows an organization to interact with many suppliers. Their interaction channels are dispersed and IOSI centrality is low.

In many cases, high IOSI centrality is created when one or a few organizations implement a proprietary IOSI. Since the initiating organizations have the authority to manage IT resources in such areas as coordinating IS planning and operational IT activities across relationships, IOSI centrality usually limits the autonomy of participating firms' interactions with firms outside their IOSI and concentrates the interaction channels to the initiating firms. Moreover, the initiating firms tend to utilize the IOSI to create their firm-specific IT capabilities which provide them opportunities for restructuring their relationships with chosen business partners (Zaheer and Venkatraman, 1994). This high

level of control on IT resources and establishment of firm-specific IT capabilities create opportunities for centralized interfirm information sharing which intensifies the frequency and volume of information exchange and thereby induces cooperative interorganizational relationships.

IOSI centrality has been also associated with reduction of uncertainty in the external environment of firms, and such reduced uncertainty tends to facilitate the cooperative business process between organizations (Morris, et al., 1995). IOSI centrality reduces the potential confusion that might occur if organizations are allowed to exchange information independently each other. In the absence of centralized interactions, organizations may transfer conflicting messages. Correspondingly, IOSI centrality enables a firm to tightly control the flow of information to and from its partners and increases the efficiency of interfirm information processing. As information processing requirements increase, especially in cooperative relationships, centralized control of information exchange will be more visible.

H_7: *IOSI centrality is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.*

Informational Dimension

The information dimension concerns information richness that involves the number of cues, personalization and a variety of languages used (Daft and Wiginton, 1979), and the quality of information exchange. Rich information can overcome different frames of references or clarify ambiguous issues in a timely manner. Therefore, information

dimension of IOSI that supports diversity of information and quality of information exchange influences electronic cooperation.

Information Diversity.

An organization may interact with many partners who use different data types and formats to exchange information in transactions. When an organization has problems in managing the diversified information, it would have difficulty in processing transaction information. When an IOSI does not support diversity of information, organizations will confront internal information conversion issues, which can complicate and overwhelm their business transaction processes (Moynihan and Norman, 1994). In reality, some IOSIs frequently prove themselves to be imposing, non-supportive, and costly in coping with these information conversion issues (Jackson, 1994). Organizations with successful relationships have implemented many data types and formats to accommodate all requisites for interfirm information exchange.

When IOSI supports diversity of information, organizations can exchange a greater amount of information regardless data types and formats. In EDI studies, it is found that when an organization is able to exchange a large variety of document types across many of its functions and partners using multiple EDI formats, it is positioned to gain further benefits (Massetti and Zmud, 1996). Since distinctiveness of information is related to the distinctive business processes, the ability to exchange the number of distinctive document types invariably increases the extent of data integration across the organizations. The ability to exchange increased number of information formats also improves the accessibility of an organization's information to external trading partners. Implementing

different transaction sets in the EDI, for example, contributes to tighter coupling business activities between partners (Hart and Saunders, 1998). As such, when IOSI supports information diversity, there will be more electronic cooperation between organizations.

H_8: *The information diversity of IOSI is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.*

Information Exchange Quality.

Quality of information exchange has been emphasized as an antecedent of successful interorganizational relationship (Lee and Kim, 1999; Morh and Sohi, 1995; Vijayasarathy and Robey, 1997). Poor quality of information exchange often causes incomplete and inaccurate interactions and leads to feeling of frustration; in some instance it may even be a source of confusion (Daft and Lengel, 1986). Poor quality of information exchange leads organizations to be reluctant to contact their suppliers. Quality of information exchange allows people to complete tasks more effectively and improve the quality of information transferred and being knowledgeable about each other's business (Devlin and Bleckley, 1988; Mukhopadhyay, et al., 1995). As a result, Information exchange quality enables organizations to maintain the relationship over time and hence, increases electronic cooperation.

H_9: *The information exchange quality of IOSI is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.*

CHAPTER 4

RESEARCH METHODOLOGY

The present chapter describes the methodology developed to examine the impact of IOSI on electronic cooperation between organizations. The following sections describe the research design, unit of analysis, informant, and survey instrument.

Research Design

This study attempts to understand the effects of IOSI on electronic cooperation through expressed relationships between research constructs. A common approach to studying such phenomena is to put forth hypotheses regarding relationships between constructs and test them statistically. A research instrument that attempts to capture the constructs is developed and the data will be collected through a mail-based survey. The survey approach emphasizes quantitative analysis, where data from a large number of organizations is collected. Studying a representative sample of organizations, the survey approach enables the researcher to discover relationships among variables across organizations and provides results that are generalizable across the target population.

The data will be collected through self-administered questionnaires from key informants in manufacturing and retailing industries. The choice of the manufacturing and retail industry as the target population is becoming more common in the EDI and interorganizational information systems (IOS) studies (e.g., Bensaou, 1997; Hart and Saunders, 1998; Nakayama, 1999; Vijayasarathy and Robey, 1997). With the advent of EDI, Internet, and/or other IOSI (e.g., industry-specific IOSI or a firm's own proprietary IOSI), these industries have used more IT for transactions for more than decades. In addition, manufacturing industry has noticed the importance of the relationships between buyers and suppliers since there is increased outsourcing. The selection of and closer relationships with suppliers are critical in the retail industry for company's survival. Furthermore, by limiting the sample to a narrow industry, the questionnaire items could be

developed and worded to be representative of the target sample. This will ensure easy comprehension and help informants to avoid confusion and ambiguity.

Unit of Analysis

There are three different levels of analyses in interorganizational relations research: dyad, organizational-set, and networks. Since this study investigates electronic cooperation between organizations, this study focuses on individual firms or dyads of those firms, who have a trading relationship with each other. That is, the unit of analysis for this study is a dyad, dyadic relationship between several large buyers and their respective suppliers. Choudhury (1997) describes a dyad as a partnership that supports a relational, but not an exclusive, exchange mode; that is, a relationship in which a firm does not wish to commit a sole source contract but, at the same time, does not wish to search the entire market for every transaction.

Some of the previous studies on interorganizational relations adopt a dyad-informant method in examining the relationships between IOSI (e.g., EDI) and buyer-supplier relationship (e.g., Hart and Saunders, 1998; Vijayasarathy and Robey, 1997). Since the dyadic relationship focuses the views from both buyers and suppliers, in order to obtain analyzable interorganizational relations measures, data should be collected from the two firms in a dyad and combined their scores to obtain an overall measure (Van de Ven and Ferry, 1980). However, the dyad-informant method is empirically both risky and can be impractical (Nakayama, 1999). In fact, studies by Reve and Stern (1986) have shown that participants in dyad relationships may have widely different perceptions, which question the validity of combined measures. Moreover, the requirements for collecting matched responses from both participants in a dyad can considerably reduce sample size and intrude the opportunity for conducting stringent data analyses.

In order to solve this problem, studies in interorganizational relationships separate the dyadic relationship into two levels, buyers and suppliers, and focus on buyers only

(e.g., Bensaou, 1997; Vijayasarathy and Robey, 1997), suppliers only (e.g., Hart and Saunders, 1998; Zaheer and Zmud, 1994), or both buyers and suppliers independently (e.g., Nakayama, 1999). Whether focusing on one side only or both sides independently in the relationships, these studies explain the interorganizational relationships based on an organization's assessment. In other words, they measure the relationship based on one firm's assessment on its trading functions and the same firm's evaluation on the outcomes of the relationship.

This study will adopt the method that the previous studies have used. That is, this study will examine the relationship between IOSI and electronic cooperation with a firm's assessment on the IOSI it is currently using and the same firm's evaluation on the outcomes of relationships with its trading partners. In this way, the whole assessment process becomes self-contained in the sense how one organization thinks its achieved outcomes based on its own assessment on the state of the relationship.

Data Collection Procedure

The administration of a survey centers around two key events: (1) the identification of a pool or frame of appropriate respondents and (2) a method of choosing respondents from the sampling frame. This study seeks a convenient sample of respondents or develops a deterministic frame of elements from which responses are solicited. This has been the predominant form of sampling design within IS research (Pinsonneault and Kraemer, 1993). In this method of sampling, the researcher obtains an overall frame of potential respondents and then creates a sub-frame containing respondents with sought-after characteristics.

Within this study, the sampling frame adopted is Internet. In the Internet, there are many companies that are selling mailing lists, especially to marketers. Among them,

Zapdata.com is used to get a sampling frame. The company provides mailing lists by connecting many database marketing companies which sell sales leads, mailing lists, direct marketing business data. Among them, ALC, idEXEC, Harris, HHMI, OneSource, HDML, QED, MDR, and Mal Dunn were used to get mailing lists. The company provides selection criteria for mailing lists such as location, industry, demographics, and job function. In developing desired sub-frame, job function, industry, and demographics were focused. Firms that is in automobile manufacturing and retailing industry and has job tiles: Chief information officer, VP of Information Systems, Director of Information Technology, IT/IS Director, IT/IS Manager, MIS director, and MIS manager were selected. The size of company was limited to greater than 100 employees since smaller companies usually do not use IOSI to do transactions with their partners. Automobile firms were selected based on the index of automobile products provided by Motor & Equipment Manufacturers Association (MEMA). From this frame, 926 firms were chosen.

Statistical Technique for Analysis

A primary means of statistical analyses was structural equation modeling (SEM) using AMOS 4.0 from SPSS, Inc. Like LISREL and EQS, AMOS is covariance-based SEM tool. Covariance-based SEM tests the *a priori* specified model against population estimates derived from the sample. Covariance-based techniques also emphasize the overall fit of the entire observed covariance matrix with the hypothesized covariance model: for this reason, they are best suitable for confirmatory research (Gefen, et al., 2000). Because of deductive nature of present research, the SEM technique is employed. In previous chapters, a theoretical view of IOSI dimensions and electronic cooperation has been developed. Thus, the primary objective of this analysis is to confirm the existence of these hypothetical relationships. Given that these relationships are *a priori* specified,

confirmatory testing approach is appropriate.

According to Gefen, et al. (2000), SEM techniques are second generation data analysis techniques that can be used to test the extent to which IS research meets the recognized standards for high quality statistical analysis. In contrast to first generation statistical tools such as regression and factor analysis, SEM techniques provide a more rigorous analysis of the proposed research model and a better methodological assessment tool (Bollen, 1989; Bullock, et al., 1994). Due to the advantage of SEM techniques against first generation techniques, the use of SEM techniques have steadily increased in IS area and in mid-1990's, 45% of ISR's empirically-based articles used SEM; in MISQ, it was 25% (Gefen, et al., 2000). In studies of interorganizational information systems (IOS) area, we can find more and more studies using SEM techniques (e.g., Nakayama, 1999; Zaheer and Venkatraman, 1994; Mohr and Sethi, 1995).

Survey Instrument

Development of the survey instrument will be done along the lines suggested by Churchill (1979) and used by other researchers in their empirical studies (e.g., Sethi and King, 1991). An instrument has been developed with items designed to measure the constructs. A review of the past literature has been done to derive a set of items for each construct. The items are measured using the seven-point Likert scales: the highest level gets 7 points, the middle level gets 4 points, and the lowest level gets 1 point. This ranking is selected to coincide with the seven-point Likert scales planned for the other survey oriented measures. The development of items for each construct is discussed next.

Technological Dimension

Technological dimensions identified for this study are IOSI extensiveness and IOSI customization.

IOSI Extensiveness: Broadbent, et al., (1996) and Weill and Broadbent (1998)

identify the seven areas of IT services of IOSI. They are communication services, IT applications services, data services, security services, standard services, IT education services, and support services. These services represent IT functionality of IOSI. This construct will be measured by how extensively the seven IT services are used between buyers and suppliers. Total seven items are employed to measure IOSI extensiveness.

IOSI Customization: This construct assesses relation-specific investments derived from the use of IOSI between organizations. This construct is measured by the degree to which skills, knowledge, and experience of employees are specific to exploit IOSI capabilities and the degree of an organization's workflows and processes are customized to exploit IOSI capabilities (Zaheer and Venkatraman, 1994).

Table 4-1

Item Measures of IOSI Extensiveness

The extent of IT services • Network communication services (e.g., full fledge of bandwidth) • IT Applications services (e.g., organization-wide and business-unit-specific applications) • Data services (e.g., data definitions and databases transmission) • Standards services (e.g., standards for hardware, operating systems, and data transmission) • Security services (e.g., security in exchanging important information) • IT education services (e.g., technology advice and training) • Support services (e.g., disaster planning and business recovery services)

The questions are intended to measure the degree of uniqueness or specialization of an organization's resources (i.e., employees' skills, knowledge, and experience and the organization's processes) in order to use IOSI for transactions with its partnering firms. The more these resources are aligned with the IT services provided by IOSI, the more the organizations form co-specialized resources with their suppliers for transactions.

Table 4-2

Item Measures of IOSI Customization

The extent of alignment between IT services and • Employees' skills • Employees' knowledge • Employees' experience • Company's workflows and processes

Structural Dimension

A structural dimension is measured by whether IOSI supports organizations to build broad, multiple, deep, formal, and centralized interactions with their partners.

IOSI Breadth: This construct assesses whether an organization can establish electronic connections with a variety of partnering firms through IOSI. IOSI breadth is measured by asking whether organizations can electronically connect the partnering firms in the same value chain and/or in all value chains, through IOSI they are using (Kumar and Dissel, 1996; Malone, et al., 1987; Massetti and Zmud, 1996). The extent to which organizations can reach their partnering firms regardless their IT bases and their geographical proximity is also used as the measures of IOSI breadth (Broadbent, et al., 1996; 1999; Weill and Broadbent, 1998).

Table 4-3

Item Measures of IOSI Breadth

The extent of the establishment of interaction channels with the firms • In the same value chain • In different value chains • Regardless of IT bases • Regardless geographical proximity

IOSI Multiplicity: The multiplicity measures whether IOSI an organization is using supports a number of interaction channels with its partnering firms. A purchasing department usually communicates with a seller's business functions for products, delivery schedule, payment, and so on. Survey questions are designed to capture the extent to which an organization establishes interaction channels with its partnering firm's business functions through IOSI. The business functions listed in the survey questions are purchasing, quality, production, logistic, and payment (Bensaou and Venkatraman, 1995).

Table 4-4

Item Measures of IOSI Multiplicity

The extent that purchasing/sales department establishes interaction channels with the business functions of its partnering firms
• Purchasing/sales
• Quality
• Production
• Logistics
• Payment/finance

IOSI Depth: This construct measures the sophistication of interactions established through IOSI between buyers and supplier. The survey questions about IOSI depth are intended to find out that IOSI an organization is using supports simple or complex interactions with its partnering firms, by asking whether an organization is able to feed information received from its partnering firms directly into its IT applications; whether an organization can update (enter, store, and manipulate) information in its partnering firms' information systems; and whether an organization can do complex transactions with its partnering firms.

Table 4-5

Item Measures of IOSI Depth

The extent that a company processes information received from its partnering firms through IOSI
• Our company feeds the data received from our partnering firms directly into our business IT applications
• Our company is able to update (enter, store, and manipulate) data in our partnering firms' information systems
• Our company does NOT perform additional steps or procedures to access data from our partnering firms
• Our IOSI provides multiple interfaces or entry points (e.g., Web access) to access our partnering firms
• Our IOSI supports the access to a number of protocol

IOSI Formality: IOSI formality is measured by whether IOSI guides formalized patterns of interactions between organizations.

Table 4-6

Item Measures of IOSI Formality

The extent that your IOSI directs the following activities between firms
• Standard policies and procedures for interactions
• Clear routines for interactions
• Planned interactions
• Specified responsibilities for interactions

Borrowed from the organization and marketing studies, IOSI formality is measured by whether IOSI help organizations establish standard procedures, specified responsibilities, formal channels, clear routines, and specified schedules for interactions and planned interactions (Sohi, et al., 1996; Vijayasarathy and Robey, 1997).

IOSI Centrality: IOSI centrality measures the concentration of information

exchange activities between organizations. An organization may have individual and independent information-exchange channels with each partnering firms. An organization may have common and interdependent information-exchange channels with many partnering firms. Either information-exchange channels represent different degree of centrality of interaction channels between organizations (Kumar and Dissel, 1996; Choudhury, 1997). Borrowed from IS literature, IOSI centrality is measured by the authority and control in IT operations and administrative activities (Tavakolian, 1989).

Table 4-7

Item Measures of IOSI Centrality

The extent that your IOSI supports the following statements
• Our IOSI supports shared and interdependent interactions with our partnering firms
• Our IOSI provides unique interaction channels with our partnering firms
• Our IOSI has a significant control on partnering firms' interaction activities
• Our company has authority in IOSI operations
• Our company has authority in IOSI administration

Informational Dimension

Informational dimension is measured by the diversity of information and the quality of information exchange between partnering organizations.

Information Diversity: This construct is measured by whether IOSI supports organizations to transmit various types and formats of data between them. Information consists of many different data types, including text, picture, voice, HTML, CAD/CAM information, paper drawings, or three-dimensional wireframes. There are also many different formats that present these data types, such as ANSI X.12, ASC X12, EDIFACT, or proprietary formats for the document. These data types and formats represent the diversity of information used in information exchange between organizations. In addition

to the data types and formats, diversity of information is measured by the IOSI's capability to support organizations to communicate through many different database protocols (e.g., SQL, ODBC), to handle variances in our partnering firms' data formats and standards, and to present data in a more concise manner or better format (Byrd and Turner, 2000).

Table 4-8

Item Measures of Information Diversity

The extent to which your IOSI supports the transmission of information **IN**:
• A variety of data types (e.g., text, picture, voice, CAD/CAM information, paper drawings, or three-dimensional wireframes)
• A variety of data formats in each data type (e.g., ANSI X.12, ASC X12, EDIFACT, or proprietary formats for document)
• A variety of database protocols (e.g., SQL, ODBC)

Information Exchange Quality: In measuring this construct, information quality instrument is adopted. In IS studies, information quality is used as a surrogate to IS success and the instrument is developed and tested by several researchers (e.g., Bailey and Pearson, 1983). In the study of the impact of IT (e.g., IOS, EDI) on interorganizational relationships, Lee and Kim (1999) and Vijayasarathy and Robey (1997) borrowed this information quality instrument in order to measure the quality of information exchange between organizations.

Table 4-9

Item Measures of Information Exchange Quality

The extent that IOSI supports the following activities between firms
• Timely information exchange
• Accurate information exchange
• Reliable information exchange
• Complete information exchange
• Relevant information exchange

The measures of information exchange quality are timeliness, accuracy, reliability, completeness, and relevance. Flexible information requests, easy access to information, and fast retrieval or delivery of information are also used as measures for information exchange quality.

Electronic Cooperation

Electronic cooperation represents the degree of cooperation achieved through IOSI (Zaheer and Venkatraman, 1994). Even though there are many measures about cooperation in the literature, the dependence or dedication is considered as a most important measure of cooperation. Dependence is a function of the portion of the dependent organization's need for resources or services that the other organization can provide (Emerson, 1962). The measures of cooperation involve the number of partners involved in the relationship (Brynjolfsson, et al., 1994; Johnston and Lawrence, 1988) and the degree of volume transacted among partners (Zaheer and Venkatraman, 1994). These measures of cooperation are most frequently used in the studies, based on the "move to the middle hypothesis" by Clemons and Row (1992) and Clemons, et al. (1993). In general, when greater percentage of revenue is from a particular partner and a company purchases products or services from the smaller partner's pool, an organization's dependence on the partners is greater (Dyer and Singh, 1998; Hart and Saunders, 1998; O'Callaghan, et al., 1992). Thus, in this paper, transaction volume and number of partners are measured by asking the growth rate in the number of partners and the percent of an organization's purchases from the top partners on a dollar basis, on a volume basis, and within a product category.

In addition to the volume and number of partners, cooperation is also measured by the frequency of contact (Bensaou and Venkatraman, 1995) and the degree of joint decision making and action between organizations (Beanasou, 1997; Nakayama, 1999). The author borrows these measures. They are: the frequency of contact between an

organization and top partners; and the degree of joint decision making or action such areas as wholesale pricing, promotion planning, sales strategy, logistics coordination, payment schemes, production planning, product designing.

Table 4-10

Item Measures of Electronic Cooperation

1. The transaction volume • What percent are our purchases/sales from the top partners on a dollar basis? • What percent are our purchases/sales from the top partners on a volume basis? • What percent are our purchases/sales from the top partners within the product category?
2. The extent of joint action taken between firms • Sales pricing • Promotion planning • Sales strategy • Logistics coordination • Payment scheme • Production planning • Product designing

CHAPTER 5

DATA ANALYSIS

This chapter outlines the results of statistical analyses of the survey data. The first section details the profile of response. The second section reports the results of initial data analyses including demographic information regarding the characteristics of participating firm, and non-response bias. The third and fourth sections outline the assessment of measurement properties such as reliability and validity, followed by the results of SEM analyses. Finally, the chapter presents the summary of these results.

Response Profiles

The research instrument packages contained a cover letter, questionnaire, and postage-paid reply envelopes and were mailed to 926 IS/IT managers. The cover letter explained the importance and the nature of the study and solicited participation. The target respondents were asked to fill out the questionnaire based on their company's IOSI use and the relationship with their partners.

After three weeks of the initial mailing, four follow-ups using postcard and E-mail were sent to non-respondents requesting their participation in the study. Of the 926 questionnaires mailed, 13 questionnaires were not delivered and a total of 106 were returned for a response rate of 11.6 percent. Three of these were incomplete or had a number of missing values for the research constructs and were discarded. Additional seven questionnaires were also dropped since the respondents had answered that they were not using IOSI. As a result, 96 usable responses from 913 mailed remained and the response rate was 10.5 percent.

The response rate of 10.5 percent is consistent with the survey studies of this nature. Survey response rates of interorganizational relationship studies are usually low. Furthermore, IS researchers have seen a declining trend of survey response rates. This trend is particularly salient in cross-organizational, unsolicited mail survey in which only a limited number of qualified individuals in an organization can respond to a survey. Examples include 6% of a CIO survey (Jones, et al., 1995), 6-7% of a field survey data for a IS project management study (Nidumolu, 1996), and 8.5% of a survey where IS managers were asked the impact of IT on interorganizational relationship (Nakayama, 1999).

Initial Data Analyses

Before data analysis, screening data for missing data, outliers, normality, and multicollinearity is recommended (Tabachnick and Fidell, 1989). After data screening, this section presents initial data analysis including demographic information regarding respondents' characteristics, and non-response bias analysis.

Demographic Information

The demographic summary of survey respondents is presented in the following tables (Table 5.1 to Table 5.7). Most of respondents are from manufacturing (94.6%) since most of the target population was the companies in automobile industry. The size profile of the respondent companies is presented in Table 5.2 and Table 5.3. Most companies are middle-sized or large-sized companies in terms of the number of employees and the amount of annual sales. 87.5% of respondent companies have more

than 100 employees and the annual sales in 87.1% of them is greater than $10 million. The firm size information indicates that the use of IOSI for transaction is more prevalent among relatively larger companies and matches to Vijayasarathy and Robey's (1997) findings.

Table 5.1

Response by Industry Category

Industry	Number of Respondents	Percent of Total
Manufacturing	88	94.6%
Retailing	3	3.2%
Other	2	2.2%

Table 5.2

Response by Number of Employees

Number of Employees	Number of Respondents	Percent of Total
100 or less	12	12.5%
101-500	44	45.8%
501-1000	17	17.7%
1001-5000	17	17.7%
More than 5000	6	6.3%

Table 5.3

Response by Sales

Annual Sales	Number of Respondents	Percent of Total
$10 million or less	12	12.9%
$11-$50 million	37	39.8%
$51-$100 million	17	18.3%
$101-$500 million	21	22.6%
More than $500 million	6	6.5%

Table 5.4 shows a profile for IOSI types used by respondent companies. Many of them use more than one type of IOSI. Third-party IOSI, Internet, and combination of these two types are major ones. Some companies revealed that the types of IOSI used depended upon the their partners. In other words, companies use different IOSI types based on the types of transactions. As shown in Table 5.5, the duration of IOSI use for transactions is widely dispersed. Even though 36.5% of respondent companies have used IOSI for 4-5 years, 31.3% of them have used IOSI for less than 4 years and 32.3% of them have used IOSI more than 5 years. This information shows that many companies have used IOSI for a long time, and more and more companies are using IOSI for transactions with their partners.

Table 5.4

Response by IOSI Types

Type	Number of Respondents*	Percent of Total
Own Proprietary IOSI	0	0%
Partner's Proprietary IOSI	4	3.0%
Third-party IOSI	31	23.3%
Internet	55	41.4%
Combination of the above	43	32.3%

* Multiple answers are allowed.

Table 5.5

Response by Duration of IOSI Use

Duration	Number of Respondents	Percent of Total
Less than 1 Year	12	12.5%
1-3 Years	18	18.8%
4-5 Years	35	36.5%
6-10 Years	13	13.5%
More than 10 Years	18	18.8%

Table 5.6 and Table 5.7 show the degree of IOSI use in terms of links and total transactions between companies. In contrast to the duration of IOSI use, the number of partners is linked to IOSI are relatively small and the percentage of total transactions done through IOSI is also relatively low. 80.6% of them show that they are doing transactions with about 20% of their partners using IOSI. 71.9% of them indicate that about 20% of their total transactions are done using IOSI.

Table 5.6

Response by the Partnering Firms Linked

Percent of Partners Linked	Number of Respondents	Percent of Total
10% or less	57	61.3%
11-20%	18	19.3%
21-40%	9	9.7%
41-60%	5	5.4%
More than 60%	4	4.3%

Table 5.7

Response by Total Transactions

Percent of Total Transactions	Number of Respondents	Percent of Total
10% or less	47	49.0%
11-20%	22	22.9%
21-40%	11	11.5%
41-60%	6	6.3%
More than 60%	10	10.4%

Non-Response Bias

To ensure response validity, a test for non-response bias is recommended. Non-response occurs when people cannot or will not co-operate, or cannot be contacted. Non-response can affect the reliability of results and can introduce bias. The magnitude of any

bias depends upon the size of non-response and the extent of the difference between non-respondents' characteristics and those that did respond. The test involves the comparison of data from a pool of non-respondents. However, this data is hard to obtain. Therefore, researchers often evaluate non-response bias by comparing the answer patterns of early and late respondents (Schiltz, 1988).

Within the present analysis, non-response bias was tested by comparing early and late respondents along dimensions of number of employee, sales, IOSI type, duration of IOSI use, and the degree of IOSI linkage. The statistical approach was a chi-square goodness-of-fit test. It used to test if an observed distribution conforms to any other distribution, such one based on some other known distribution (e.g., if the observed distribution is not significantly different from a known national distribution based on Census data). Number of employee to response yielded a χ^2 (df = 4) of 8.65 and was not significant at p = 0.07. Sales to response yielded a χ^2 (df = 4) of 1.33 and was not significant at p = 0.86. IOSI type to response yielded a χ^2 (df = 3) of 3.49 and was not significant at p = 0.18. Duration of IOSI use to response yielded a χ^2 (df = 4) of 4.95 and was not significant at p = 0.29. Degree of IOSI linkage to response yielded a χ^2 (df = 4) of 1.38 and was not significant at p = 0.85. These results imply that no response bias exists in the sample and that the results are generalizable within the boundary of the sample frame.

A Framework for Assessing Measurement Properties

A general procedure for assessing the measurement of scale items in structural equation modeling is suggested by Gerbing and Abderson (1988). Figure 5.1

illustrates the procedure adopted within the present analysis. As shown, the process begins with a pre-determination of items that measure a given construct. Through literature review, these *a priori* measures were developed in Chapter Four. Next, to manage the large number of survey items, the confirmatory factor model for each dimension is estimated. The factor model aggregates the survey items into a parsimonious number of factors. There are many covariance-based structural equation modeling (SEM) packages available for confirmatory factor analysis such as LISREL, EQS, PRELIS, and AMOS. Among them, this paper used SPSS AMOS 4.0 (Arbuckle and Wothke, 1999; Byrne, 2001) for data analysis.

Upon model estimation, a formal assessment of convergent validity and unidimensionality can be performed. Convergent validity refers to internal consistency (reliability) of each indicator in the giving construct. Unidimensionality refers to the existence of a single trait (or construct) underlying the covariances among a set of indicators. Where only one method of data collection like this study is adopted (e.g., a survey with a single informant per unit of analysis), unidimensionality and convergent validity can be assessed simultaneously using the same model (Venkatraman, 1989). Since model fit is a function of both unidimensionality and convergent validity (Gerbing and Anderson, 1988), model fit (especially absolute model fit) was assessed. The assessment of absolute fit is concerned with the ability of the proposed model to fit to the data (Tanaka, 1993).

The absolute fit of hypothesized model is measured by χ^2 goodness-of-fit statistic, reflecting the extent to which the covariance matrix of the observed variables matches the covariance matrix implied by the hypothesized model.

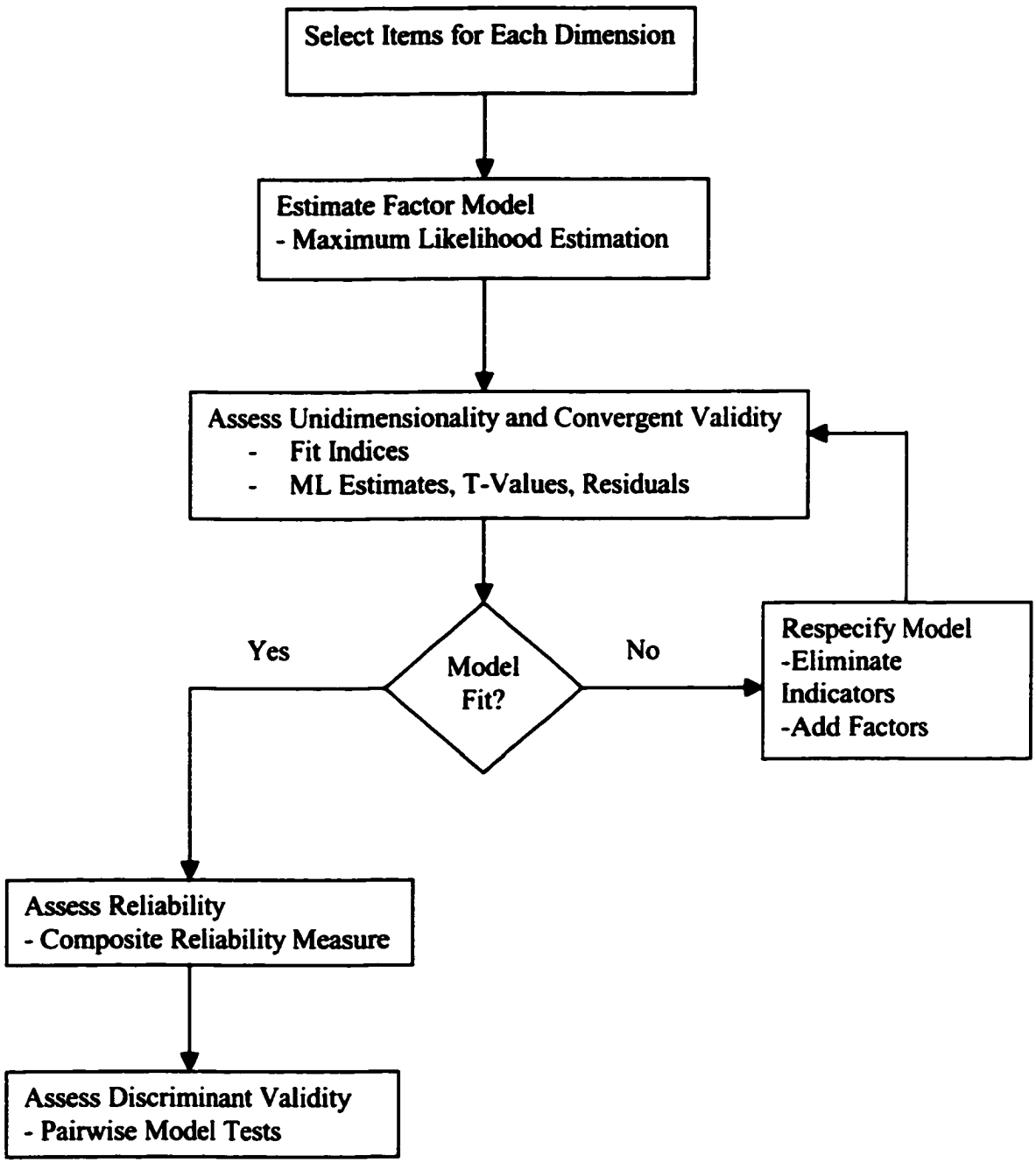


Figure 5.1. Procedure for Assessing Measurement Properties

The null hypothesis for the test is that the two covariance matrices are equal. The probability testing of the goodness of fit statistic is different from conventional probability test; it is aimed at maximizing the probability that the observed goodness of fit is not significantly different from zero. As a consequence, for a good model fit measure, the null hypothesis should be accepted rather than be rejected. Greater p values reflect higher probabilities of observing a better goodness of fit and therefore models with higher p values are preferred. Since χ^2 goodness-of-fit statistic is very sensitive to large sample size and the violations of the assumption of the multivariate normality, the value of χ^2/df ratio is often used in the literature (e.g., Gefen, et al., 2000) and the ration less than 3 is acceptable (Kline, 1998).

In addition to χ^2 goodness-of-fit statistic, there are many model fit indices are used. Among them, use of the following indices are recommended for absolute model fit (Kelloway, 1998): RMR (root mean square residual), GFI (goodness-of-fix index), AGFI (adjusted goodness-of-fit index), and RMSEA (root mean squared error of approximation). CFI(comparative fit index) is also used to assess measurement (factor) model (Byrne, 2001). The value of these measures range from 0 (poor fit) to 1 (perfect fit). Values greater than 0.9 of GFI, AGFI, and CFI indicate good fit of the hypothesized model to the data; values less than 0.1 of RMR and RMSEA are interpretable as good fit.

In addition to absolute model fit, the examination of standardized maximum likelihood (ML) estimates, t-values, and the residual matrix was performed for possible model improvement. Hair, et al. (1992) suggest guidelines for the assessment of ML estimates. When there are offending estimates, it is better to remove the indicators from the model. The offending (undesirable) estimates are the ones: (1) negative error

variances (measurement error) or nonsignificant error variances for any construct (i.e., close to 0), (2) standardized coefficients exceeding or very close to 1.0, and (3) very large standard errors (SE) associated with any estimated coefficient. For the standardized estimate of each indicator, t-value (interpreted using the critical value for the Z test) should be greater than 1.96 at α=0.05 and 2.57 at α=0.01. If statistical significance of estimates is not achieved, the researcher may wish to eliminate the indicator or attempt to transform it for better fit with construct. Residuals are also analogous to Z scores and therefore values greater than 2.58 are considered to be large (Joreskog and Sorbom, 1988).

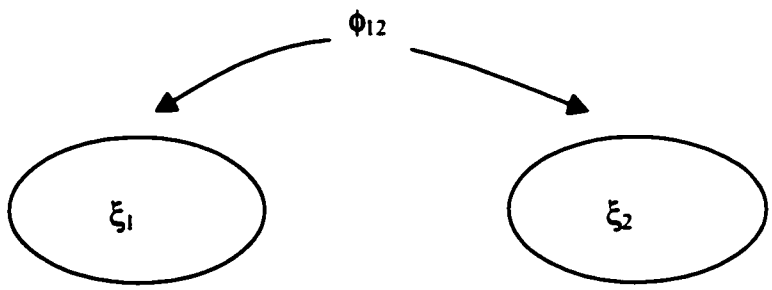
Upon identification of an acceptable model, composite factor reliability and discriminant validity can be assessed. Composite factor reliability is defined by the following formula:

$$\frac{(\Sigma\lambda i)^2}{(\Sigma\lambda i)^2 + (\Sigma(1-\lambda i^2))}$$

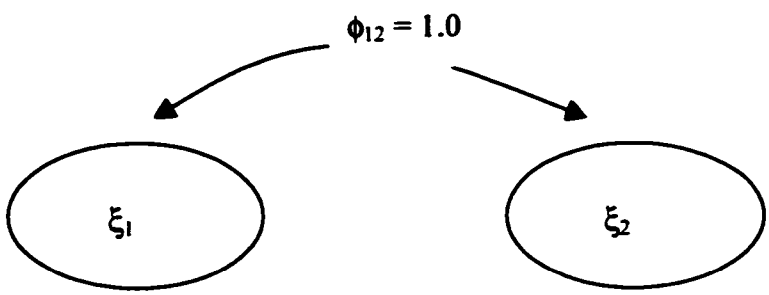
where λi represents the i^{th} estimate of indicator x on a factor. This composite measure assesses whether the specified indictors truly reflect their underlying constructs. Although no exact criteria exist for reliability for confirmatory factor analysis, a value of 0.50 - 0.70 is often recommended (Hair, et al., 1992).

Discriminant validity refers to the degree to which measures of different constructs are unique from each other. Discriminant validity is achieved when the correlations between any two constructs are significant different from unity (Bagozzi, et al., 1991). Empirically, this property can be established through the comparison of models shown in Figure 5.2. As shown the unconstrained model estimates (or "frees") the

correlation (ϕ) between a pair of constructs. The constrained model fixes the value of the construct correlation to unity. The difference in χ^2 between these models is also a χ^2 with degrees of freedom equal to one. A significant χ^2 difference value implies that the unconstrained model is a better fit for the data thereby supporting the existence of discriminant validity. Such tests should be conducted for every pair of constructs within a theoretical system.



(1) Unconstrained Model:
Correlation between constructs freely estimated



(2) Constrained Model:
Correlation between constructs constrained to 1.0

Figure 5-2. Discriminant Validity: Constrained and Unconstrained Models

Assessment of Constructs

Technological Dimension

Technological dimension captures technological aspects of IOSI. As developed in Chapter 3, this dimension includes IOSI extensiveness and IOSI customization. Eleven items are hypothesized to be measures of these two constructs. Seven items are hypothesized to measure IOSI extensiveness and four items to measure IOSI customization. These items were cast on a seven-point likert scale anchored by the phrases "to a greater extent" and "to no extent". Maximum likelihood estimates suggest that this hypothesized structure is not a good fit for the item covariances in the sample. Although χ^2/df ratio, CFI, RMSEA, GFI and AGFI are a relatively strong, 1.63, 0.94, 0.08, 0.90, and 0.84 respectively, the observed χ^2 is 69.96 (df = 43; p = 0.01) suggesting poor model fit. The RMR is a high 0.21, further eroding confidence in the model. In addition, estimated indicator reliability of an item "Standard services" in IOSI extensiveness is relatively low (0.21) and examination of residual matrix suggests that there a significant discrepancy of exists between the item and another item in IOSI customization ("Your company's workflows and processes"). Therefore this item was eliminated and a respecified two-factor model with ten items was estimated.

Observed fit indices as well as maximum likelihood estimates suggest that the respecified model is an adequate representation of the observed covariances. This final measurement model is shown in Figure 5-3. As outlined in Table 5-8, measures indicate that the model is a reasonably good-fitting model. The likelihood χ^2 is 39.94 (df = 32; p = 0.16) and GFI and AGFI are 0.93 and 0.88 respectively. RMSEA is 0.05 and all indicator reliabilities are sufficiently high. The residual matrix contains no values significantly

different from zero, also supporting the adequacy of the reduced model. Finally, the composite reliability of IOSI extensiveness and IOSI customization construct are strong 0.79 and 0.91 respectively.

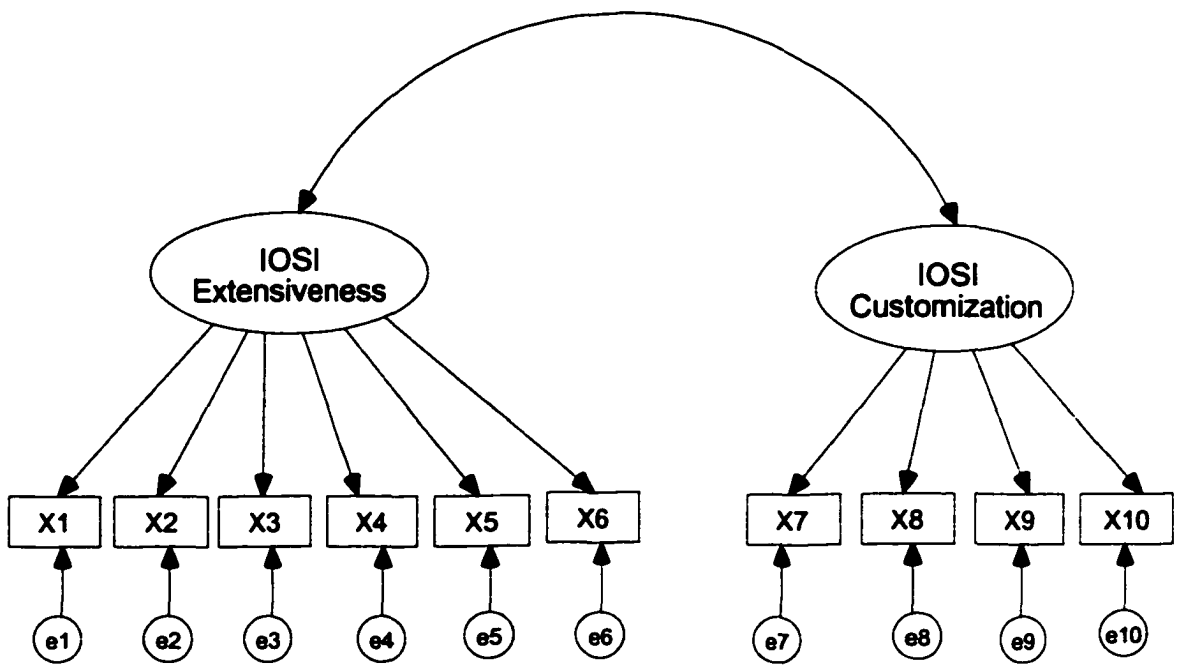


Figure 5-3. Measurement Model of Technological Dimension[a]

[a] The ϕ and λs are omitted for schematic simplicity

X1: Network communication services
X2: IT applications services
X3: Data services
X4: Security services
X5: IT education services
X6: Support services
X7: Your employees' skills
X8: Your employees' knowledge
X9: Your employees' experience
X10: Your company's workflows and processes

Table 5-8

Parameter Estimates, Construct Reliability and Model Fit Statistics of Technological Dimension

Construct	Parameter	ML Estimate	t-Value**	Reliability
IOSI Extensiveness	X1	0.45		0.79
	X2	0.54	3.40	
	X3	0.69	3.71	
	X4	0.63	3.63	
	X5	0.65	3.28	
	X6	0.72	3.82	
IOSI Customization	X7	0.87		0.91
	X8	0.91	11.95	
	X9	0.87	11.17	
	X10	0.71	8.11	
Measures of Model Fit $\chi^2 = 39.93$ (df = 32; p = 0.16); χ^2/df = 1.25 GFI = 0.93; AGFI = 0.89; CFI = 0.98 RMR = 0.22; RMSEA = 0.05				

The first item ML estimate in each construct is fixed at 1.00 and does not have a t-value.
** All t-values are significant at $p < 0.01$.

The Discriminant Validity of Technological Constructs

As noted earlier, the test of discriminant validity involves a comparison of pairs of constructs. Such comparison seeks to determine if any of two constructs are a single construct. A test of discriminant validity was performed for rejecting the hypothesis that the indicators of two technological constructs (i.e., IOSI extensiveness and IOSI customization) together form a single construct and therefore should not be considered as distinct constructs. The results are presented in Table 5-9. The observed χ^2 difference provides strong support for the discriminant validity of the indicators. Although the correlation between two constructs is a little high (0.60), the χ^2 difference is significant at $p < 0.001$ and the χ^2 in unconstrained model is small relative to its degrees of freedom.

Therefore, the results support that the indicators form two distinct constructs- IOSI extensiveness and IOSI customization.

Table 5.9

Results of Discriminant Validity Test: Technological Constructs

Test	Unconstrained Model	Constrained Model
Model χ^2	39.93 (df = 32; p = 0.16)	102.59 (df = 33; p =0.00)
CFI/RMR	0.93/0.22	0.80/0.39
ϕ_{12}	0.60 (t = 3.11; p < 0.001)	
χ^2 Difference	62.63 (df = 1; p < 0.001)	

Structural Dimension

Structural dimension consists of five constructs: IOSI breadth, IOSI multiplicity, IOSI depth, IOSI formality, and IOSI centrality. Among twenty-three indicators, four indicators are highly correlated. The correlation between "Planned interactions" and "Specified responsibilities for interactions" was 0.91 and the correlation between "Our company has authority over IOSI operations" and "Our company has authority over IOSI administration" was 0.90. As a result, the two items were eliminated ("Specified responsibilities for interactions" and "Our company has authority over IOSI operations"). Twenty-one items are hypothesized to measure the five constructs. Like measures of constructs in technological dimension, these items are measured on a seven-point likert scale with "to a greater extent" and "to no extent". Maximum likelihood estimates suggest this hypothesized model is not a good fit to the data. Overall, the fit indices indicate the model misfit. Except RMSEA in a moderate level with 0.19, the rest of indices show relatively low level of model fit with $\chi^2 = 769.49$ (df = 179; p = 0.00), χ^2/df = 4.30, RMR = 0.45, GFI = 0.60,AGFI = 0.48, and CFI = 0.57. The examination of ML

estimates reveals that one item in IOSI breadth construct ("Regardless of IT bases") shows multicollinearity (R^2 = 1.02 and the standardized estimate coefficient >1) and negative variance (-0.05).

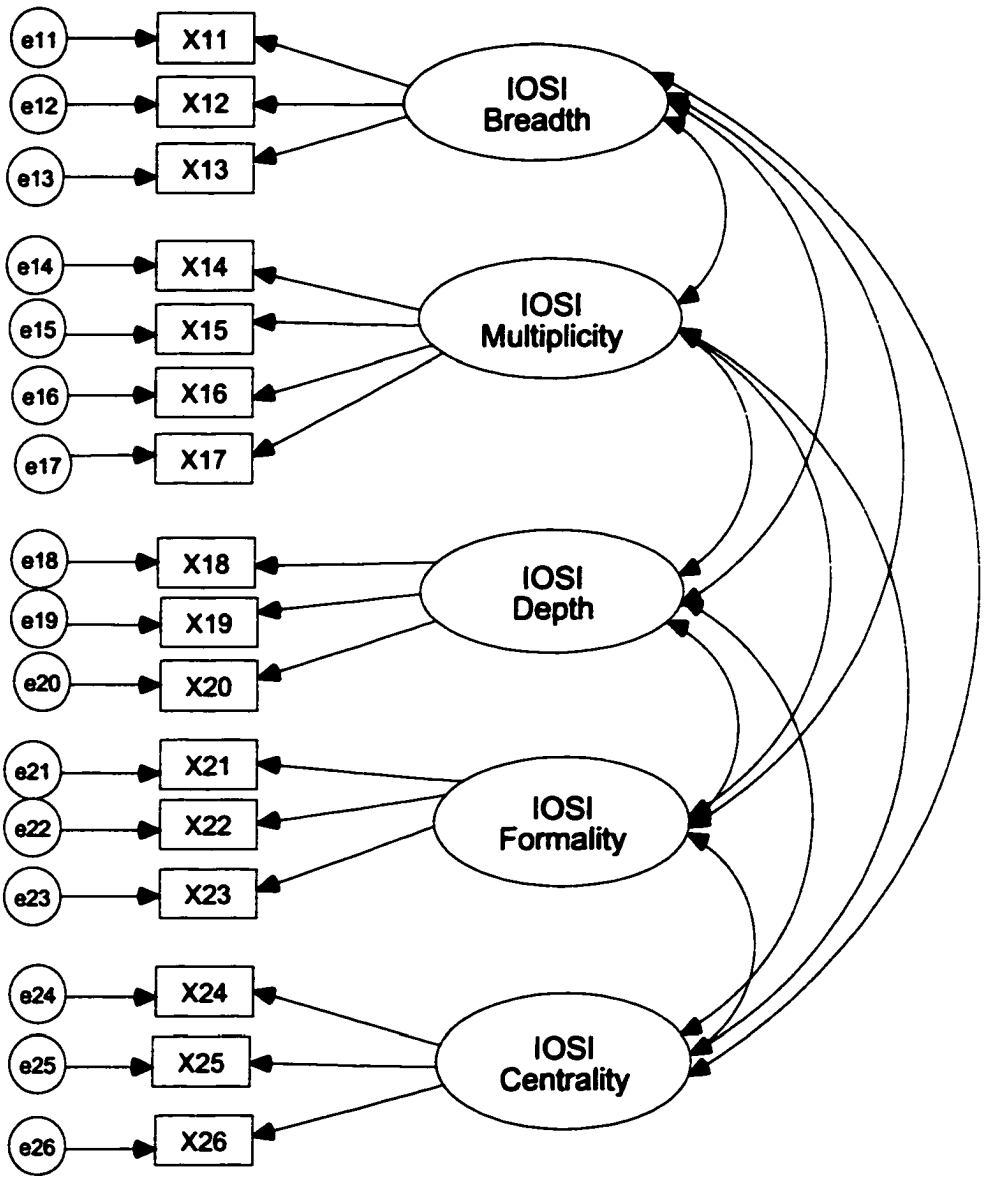


Figure 5-4. Measurement Model of Structural Dimension[a]

[a] The ϕ and λs are omitted for schematic simplicity

X11: In the same value chain
X12: In different value chain

X13: Regardless of geographical proximity
X14: Quality
X15: Production
X16: Logistics
X17: Payment/finance
X18: Our company updates data in our partnering firms' information systems
X19: Our IOSI provides multiple interfaces or entry points to access our partnering firms
X20: Our IOSI supports the access to a number of protocols
X21: Standard policies and procedures for interactions
X22: Clear routines for interactions
X23: Planned interactions
X24: Our IOSI supports shared and interdependent interactions with our partnering firms
X25: Our IOSI has a significant control on partnering firms' interaction activities
X26: Our company has authority over IOSI administration

The two items in IOSI depth construct ("Our company feeds the data received from our partnering firms directly into our business IT applications" and "Our company does not perform additional steps or procedures to access data from our partnering firms") reveals lower t-value (one was fixed to 1; 1.24). The examination of residual matrix suggested the drop of additional two items from the model: one item from IOSI multiplicity and one item from IOSI centrality. The covariances of these items with other items and/or each other are relatively high, ranging from 2.59 to 5.00. The items dropped are: "Purchase/sales" and "Our IOSI provides unique interaction channels with our partnering firms". The model was respecified with sixteen items.

Fit indices and ML estimates suggest that the respecified model is a moderate fit to the data. This final measurement model is shown in Figure 5-4. As outlined in Table 5-10, measures of model fit indicate sufficient congruence between observed and model-implied covariance matrices. Although the likelihood $\chi^2 = 184.89$ (df = 85; p = 0.00) and RMR = 0.25, GFI, AGFI, and CFI are 0.82, 0.71, and 0.88 respectively. The $\chi^2/df = 2.17$

and RMSEA = 0.11, and indicator reliabilities are sufficiently high. The residual matrix contains no values significantly different from zero also supporting the adequacy of the respecified model. Finally, the construct reliabilities are strong- 0.73 for IOSI breadth, 0.84 for IOSI multiplicity, 0.75 for IOSI depth, 0.83 for IOSI formality, and 0.60 for IOSI centrality, substantiating scale reliability.

Table 5-10

Parameter Estimates, Construct Reliability and Model Fit Statistics of Structural Dimension

Construct	Parameter	ML Estimate	t-Value**	Reliability
IOSI Breadth	X11	0.60	5.35	0.73
	X12	0.52	4.70	
	X13	0.91		
IOSI Multiplicity	X14	0.64	7.57	0.84
	X15	0.70	8.64	
	X16	0.79	8.98	
	X17	0.85		
IOSI Depth	X18	0.31	3.03	0.75
	X19	0.84	9.86	
	X20	0.90		
IOSI Formality	X21	0.76		0.83
	X22	0.91	9.78	
	X23	0.67	8.38	
IOSI Centrality	X24	0.43	3.85	0.60
	X25	0.63		
	X26	0.66	5.48	
Measures of Model Fit χ^2 = 184.89 (df = 85; p = 0.00); χ^2/df = 2.17 GFI = 0.82; AGFI = 0.71; CFI = 0.88 RMR = 0.25; RMSEA = 0.11				

The first item ML estimate in each construct is fixed at 1.00 and does not have a t-value.
** All t-values are significant at p < 0.01.

The Discriminant Validity of Structural Constructs

A test of discriminant validity was performed for the indicators of five structural constructs- IOSI breadth, IOSI multiplicity, IOSI depth, IOSI formality, and IOSI

Table 5.11

Results of Discriminant Validity Test: Structural Constructs

Test	Correlation	t-Value	Unconstrained Model χ^2	Constrained Model χ^2	χ^2 Difference
IOSI Breadth with					
IOSI Multiplicity	0.36	2.18*	10.71(9)	55.76(10)	45.05(1)***
IOSI Depth	0.47	2.69**	13.73(7)	51.84(8)	38.11(1)***
IOSI Formality	0.68	3.72***	11.02(8)	30.24(9)	19.22(1)***
IOSI Centrality	0.20	1.39	14.47(8)	58.13(9)	43.66(1)***
IOSI Multiplicity with					
IOSI Depth	0.47	2.86**	21.81(11)	91.71(12)	69.90(1)***
IOSI Formality	0.27	2.00*	31.16(11)	178.10(12)	141.94(1)***
IOSI Centrality	0.25	1.60	25.06(10)	65.70(11)	40.64(1)***
IOSI Depth with					
IOSI Formality	0.82	4.79***	14.00(7)	27.99(8)	13.99(1)***
IOSI Centrality	0.66	3.60***	10.87(6)	38.21(7)	27.34(1)***
IOSI Formality with					
IOSI Centrality	0.72	3.36***	7.37(5)	27.68(6)	20.31(1)***

* significant at $p < 0.05$
** significant at $p < 0.01$
*** significant at $p < 0.001$

centrality. Within the structural dimension, the test of discriminant validity involves the estimation of twenty maximum likelihood models (ten unconstrained and ten constrained), and ten χ^2 difference tests. The results are presented in Table 5-11. The first column

describes the specific test. The second column lists the estimated correlation between constructs. The third column lists the t-value associated with each of these correlations and the level of statistical significance. Columns four and five list the observed χ^2 and associated degrees of freedom for the unconstrained and constrained model. The final column lists the observed χ^2 difference and the associated level of statistical significance.

The observed χ^2 differences provide strong support for the discriminant validity among indicators. All differences are significant at $p < 0.05$. The correlations between constructs are low and moderate (between 0.25 and 0.82) and significant at $p < 0.05$, < 0.01 and < 0.001. The values of χ^2 in the unconstrained models are not significant relative to its degrees of freedom and their model indices are in acceptable levels.

Informational Dimension

Informational dimension consists of two constructs: information diversity and information exchange quality. Total seven items are also hypothesized to measures of these two constructs: three items to information diversity and four items to information exchange quality (one item is removed due to high correlation). These items cast on a seven-point likert scale anchored by the phrases "to a greater extent" and "to no extent". Maximum likelihood estimates suggest that this hypothesized structure is in a low level of fit for the item covariances in the sample. Although the values of CFI, GFI and AGFI are in a relatively moderate level, 0.89, 0.87, and 0.72 respectively, the observed χ^2 is 55.26 ($df = 13$; $p = 0.00$) and $\chi^2/df = 3.48$, suggesting relatively poor model fit. The values of RMR and RMSEA are in high 0.21 and 0.19, further eroding confidence in the model. In addition, residual matrix shows that the covariance score of an item "Reliable

information exchange" with other items in another construct (i.e., information diversity) is high. Therefore, this item was eliminated and a respecified two-factor model with six items was estimated.

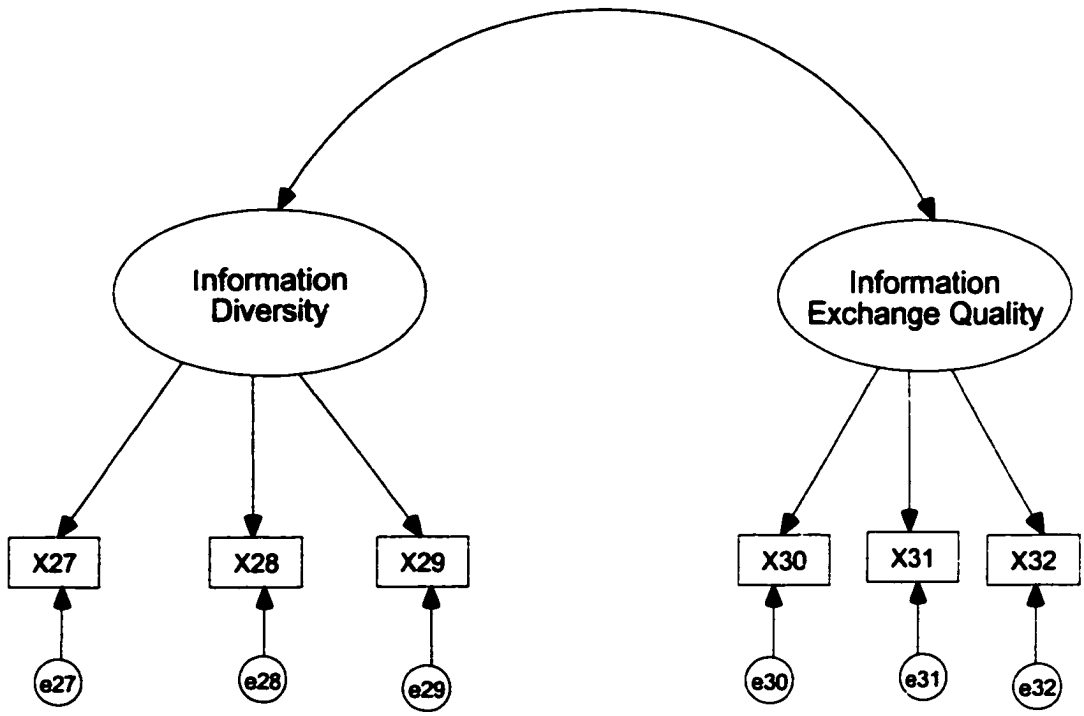


Figure 5-5. Measurement Model of Informational Dimension[a]

[a] The ϕ and λs are omitted for schematic simplicity

X27: A variety of data types
X28: A variety of data formats in each data type
X29: A variety of database protocols
X30: Timely information exchange
X31: Accurate information exchange
X32: Complete information exchange

Observed fit indices as well as maximum likelihood estimates suggest that the respecified model is a good representation of the data in the sample. This final measurement model is shown in Figure 5-5. As outlined in Table 5-12, measures indicate that the model is a good-fitting model. The likelihood χ^2 is 10.35 (df = 7; p = 0.17) and

CFI, GFI and AGFI are 0.99, 0.97 and 0.90 respectively. RMR and RMSEA are 0.11 and 0.07 respectively, indicating very good model fit. All indicator reliabilities are sufficiently high and the residual matrix contains no values significantly different from zero, also supporting the adequacy of the reduced model. Finally, the composite construct reliability of information diversity and information exchange quality construct are a strong 0.88 and 0.85 respectively.

Table 5-12

Parameter Estimates, Construct Reliability and Model Fit Statistics of Informational Dimension

Construct	Parameter	ML Estimate	t-Value**	Reliability
Information Diversity	X27	0.86		0.88
	X28	0.94	9.65	
	X29	0.67	7.21	
Information Exchange Quality	X30	0.83		0.85
	X31	0.95	8.57	
	X32	0.63	6.51	
Measures of Model Fit $\chi^2 = 10.35$ (df = 7; p = 0.17); χ^2/df = 1.48 GFI = 0.97; AGFI = 0.90; CFI = 0.99 RMR = 0.11; RMSEA = 0.07				

The first item ML estimate in each construct is fixed at 1.00 and does not have a t-value.
** All t-values are significant at $p < 0.01$.

The Discriminant Validity of Informational Constructs

A test of discriminant validity was performed for the indicators of two informational constructs- information diversity and information exchange quality. The results are presented in Table 5-13. The observed χ^2 difference is significant at $p < 0.001$. The correlation between two constructs is moderate (0.44) and significant at $p < 0.001$, and the χ^2 in unconstrained model is small relative to its degrees of freedom. Therefore,

the results support the discriminant validity of indicators used to measure information diversity and information exchange quality.

Table 5.13

Results of Discriminant Validity Test: Informational Constructs

Test	Unconstrained Model	Constrained Model
Model χ^2	10.35 (df = 7; p = 0.17)	138.68 (df = 9; p =0.00)
GFI/RMR	0.97/0.11	0.71/0.58
ϕ_{12}	0.44 (t = 3.06; p < 0.001)	
χ^2 Difference	128.33 (df = 1; p < 0.001)	

Electronic Cooperation

Electronic cooperation captures the outcomes of IOSI. As developed in Chapter 3, this construct includes two sub-constructs: joint decision-making and sales/purchase. Nine items are hypothesized to be measures of these two constructs (one item was removed due to high correlation). Seven items are hypothesized to measure joint decision-making and two items to measure sales/purchase. These items were cast on a seven-point Likert scale anchored by the phrases "to a greater extent" and "to no extent". Maximum likelihood estimates suggest that this hypothesized structure is not a good fit for the item covariances in the sample. Although CFI and GFI are relatively moderate, 0.75 and 0.57 respectively, the other values in model indices suggest poor model fit. The observed χ^2 and χ^2/df ration are in poor level, 176.56 (df = 26; p = 0.00) and 6.60 respectively. The RMR and RMSEA are relatively high 0.24 and 0.39, further eroding confidence in the model. In addition, the examination of ML estimates, indicator reliabilities, and residuals matrix reveals that the item "Promotion planning" is problematic. Its t-value is not significant (2.55) at p < 0.01 and its reliability (0.09) is

well below to cut-off value (0.70). This item also has high correlation with an item ("Wholesale pricing") in the same construct. Therefore this item was eliminated and a respecified two-factor model with eight items was estimated.

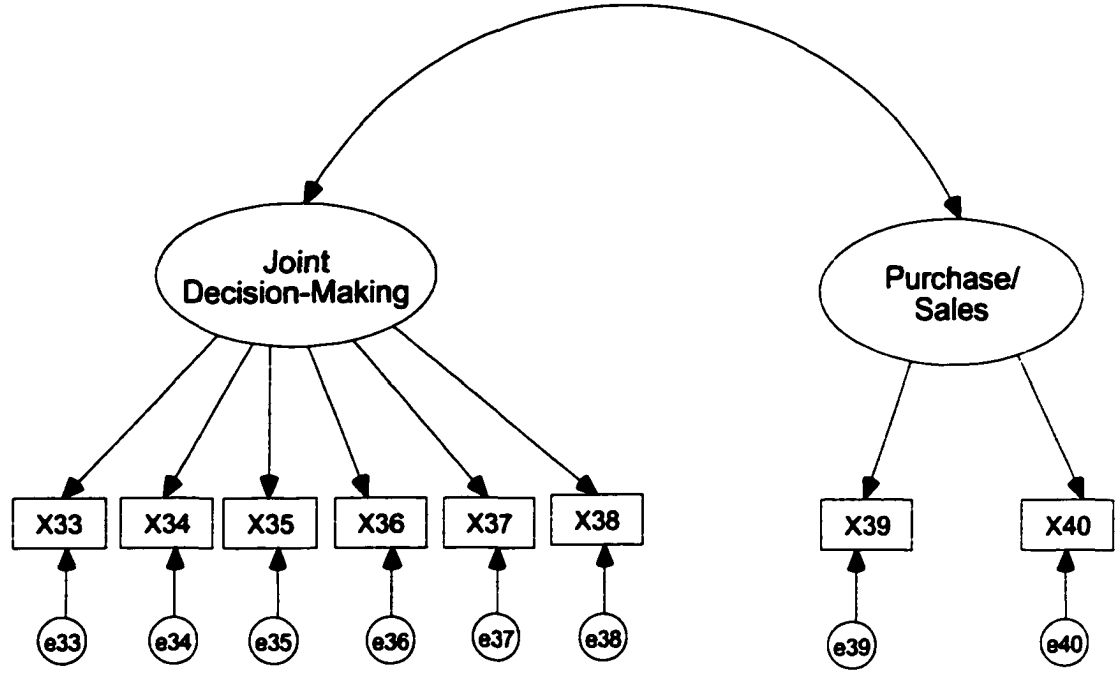


Figure 5-6. Measurement Model of Electronic Cooperation[a]
[a] The ϕ and λs are omitted for schematic simplicity

X33: Wholesale pricing
X34: Sales strategy
X35: Logistics coordination
X36: Payment scheme
X37: Production planning
X38: Product designing
X39: Sales/purchase from the top partners on volume basis
X40: Sales/purchase from the top partners within product category

Observed fit indices as well as maximum likelihood estimates suggest that the respecified model is an adequate representation of the observed covariances. This final measurement model is shown in Figure 5-6. As outlined in Table 5-14, measures indicate

that the model is a good-fitting model. The likelihood χ^2 and χ^2/df ration are 26.93 (df = 15; p = 0.03) and 1.80 respectively. The values GFI, AGFI, and CFI are strong with 0.94, 0.86, and 0.97 respectively. RMR and RMSEA are also strong with 0.21 and 0.09, indication good model-fit. All indicator reliabilities are sufficiently high and the residual matrix contains no values significantly different from zero, also supporting the adequacy of the reduced model. Finally, the composite construct reliability of joint decision-making and sales/purchase constructs is strong 0.84 and 0.90 respectively.

Table 5-14

Parameter Estimates, Construct Reliability and Model Fit Statistics of Electronic Cooperation

Construct	Parameter	ML Estimate	t-Value**	Reliability
Joint Decision-Making	X33	0.44		0.84
	X34	0.35	3.26	
	X35	0.95	4.50	
	X36	0.84	4.43	
	X37	0.77	4.32	
	X38	0.64	3.87	
Sales/ Purchase	X39	0.91		0.90
	X40	0.90	5.48	
Measures of Model Fit χ^2 = 26.93 (df = 15; p = 0.03); χ^2/df = 1.80 GFI = 0.94; AGFI = 0.86; CFI = 0.97 RMR = 0.21; RMSEA = 0.09				

The first item ML estimate in each construct is fixed at 1.00 and does not have a t-value.
** All t-values are significant at p < 0.01.

The Discriminant Validity of Electronic Cooperation

A test of discriminant validity was performed for the indicators of two sub-constructs of electronic cooperation- joint decision-making and sales/purchase. The results are presented in Table 5-15. The observed χ^2 difference is 97.06 and is significant

at $p < 0.001$. The correlation between two constructs is moderate (0.39) and significant at $p < 0.01$, and the χ^2 in unconstrained model is small relative to its degrees of freedom. Therefore, the results support the discriminant validity of indicators used to joint decision-making and sales/purchase.

Table 5.15

Results of Discriminant Validity Test: Electronic Cooperation

Test	Unconstrained Model	Constrained Model
Model χ^2	26.93 (df = 15; p = 0.03)	123.99 (df = 16; p =0.00)
GFI/RMR	0.94/0.21	0.82/0.46
ϕ_{12}	0.39 (t = 2.62; p < 0.01)	
χ^2 Difference	97.06 (df = 1; p < 0.001)	

Results of SEM Analyses

This section reports the results of structural equation modeling designed to empirically test the hypotheses developed in Chapter Three. The SEM analyses were performed to investigate the contribution of IOSI dimensions on electronic cooperation. Based on Anderson and Gerbing's (1988) two-stage modeling approach, the analysis involves comparison of a baseline or first-order model against a second-order model as a basis for accepting or rejecting this study's proposed model. Once the proposed model are accepted, the standardized path coefficients will be evaluated to judge their support on the hypotheses designed Chapter Three.

A Comparison of Baseline and Hypothesized Model

The baseline or first-order model implies that each construct of IOSI dimensions (i.e., IOSI extensiveness, IOSI customization, IOSI breadth, IOSI multiplicity, IOSI

depth, IOSI formality, IOSI centrality, information diversity, and information exchange quality) has a direct causal influence on electronic cooperation (joint decision-making and purchase/sales). The Figure 5-7 shows the first-order model.

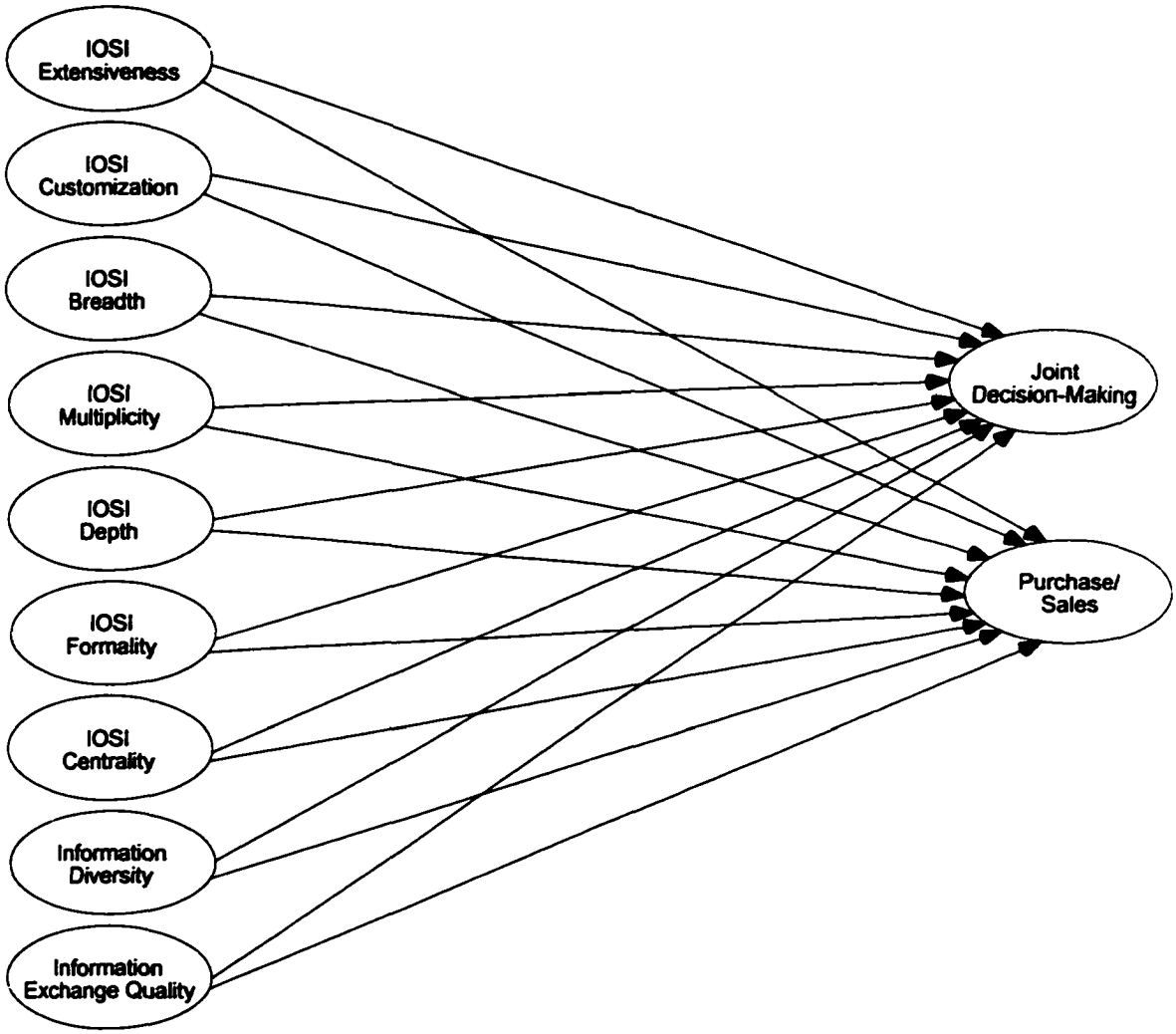


Figure 5-7. First-Order Model[a]

[a] The λs, γs, and δs are omitted for schematic simplicity

As shown in Table 5.16, the observed χ^2 for the first-order model is 2078.02 (df = 715, p = 0.000). The CFI, NFI, RFI, and IFI are relatively weak- 0.62, 0.53, 0.46, and 0.63 respectively. Although, these values are seemed deviant to recommended values,

they must reconcile with the larger degrees of freedom inherent in the model. Nomed χ^2 (χ^2/df), the most commonly used metric in these situations, is 2.91 implying an adequate model fit and no evidence of over-fitting (Joreskog and Sorbom, 1989; Kline, 1998).

Table 5.16

Results of the First-Order Model

Path	Coefficient (β)	t-Value
IOSI Extensiveness – Joint DM	0.11	0.69
IOSI Extensiveness – Purchase/Sales	-0.23	1.14
IOSI Customization – Joint DM	0.20	0.80
IOSI Customization – Purchase/Sales	-0.18	0.77
IOSI Breadth – Joint DM	-0.15	1.11
IOSI Breadth – Purchase/Sales	-0.15	0.82
IOSI Multiplicity – Joint DM	0.53	1.93
IOSI Multiplicity – Purchase/Sales	0.68	3.08**
IOSI Depth – Joint DM	-0.21	0.52
IOSI Depth – Purchase/Sales	-0.44	1.15
IOSI Formality – Joint DM	-0.10	0.19
IOSI Formality – Purchase/Sales	0.51	2.29**
IOSI Centrality – Joint DM	0.21	0.77
IOSI Centrality – Purchase/Sales	-0.17	0.50
Information Diversity – Joint DM	-0.11	0.69
Information Diversity – Purchase/Sales	0.15	1.00
Info. Exchange Quality – Joint DM	0.56	2.29**
Info. Exchange Quality – Purchase/Sales	-0.24	1.18
Measures of Model Fit χ^2 = 2078.02 (df = 715; p = 0.000); χ^2/df = 2.91 CFI = 0.62; NFI = 0.53; RFI = 0.46; IFI = 0.63		

** significant at p < 0.01

Among total eighteen paths, most path coefficients have moderate effects with large effects in four paths (IOSI multiplicity – purchase/sales, IOSI multiplicity – purchase/sales, IOSI formality – purchase/sales, information exchange quality – joint decision-making). The magnitudes of these coefficients are 0.53, 0.68, 0.51, and 0.56

respectively. Like a standardized regression coefficient, path coefficient of IOSI multiplicity (i.e., 0.53) means that IOSI multiplicity is expected to improved by 0.53 standard deviations given a change in purchase/sales of one full standard deviation when other constructs are controlled.

However, only three paths are have associated t-value greater than 1.95, implying significant difference from zero at $p = 0.05$. The coefficient of determination for structural equations, which is analogous to the R^2 of regression analysis, is 0.11 for the first-order model. Overall, these results imply that the majority of constructs in IOSI dimensions have no or little explanatory value with respect to electronic cooperation.

The hypothesized model posits a second-order model. This model indicates that three IOSI dimensions moderate the effects of the first-order IOSI constructs on electronic cooperation. The three second-order constructs are technological, structural, and informational dimensions. The theoretical interpretation of these second-order constructs is an overall trait of the first-order constructs. This second-order model was also estimated using the covariances among the indicators in the first-order constructs. The Figure 5-8 shows the second-order model.

The observed χ^2 for the second-order (hypothesized) model is 2197.17 ($df = 755$, $p = 0.000$). The CFI, NFI, RFI, and IFI are 0.60, 0.50, 0.45, and 0.60 respectively. Adjusting for degrees of freedom, the normed value of χ^2 is 2.91; indicating good model fit and no evidence of over-fitting. As anticipated, the fit of the second-order model was reduced from that of the first-order model, because the second-order model is a nested (hierarchical) model of the first-order model and has more restrictive assumptions. Because the first- and second-order components of the model were fit simultaneously,

misfit could have arisen from either portion of the model. Hence March's target coefficient (TC) was estimated to measure the ability of the second-order model to explain the intercorrelations among the first-order constructs. In other words, Target coefficient evaluates the fit of only the second-order portion of the model (March, 1991). Target coefficient equaled 0.83, indicating that 83% of the covariation among the nine first-order constructs was accounted by the three second-order constructs.

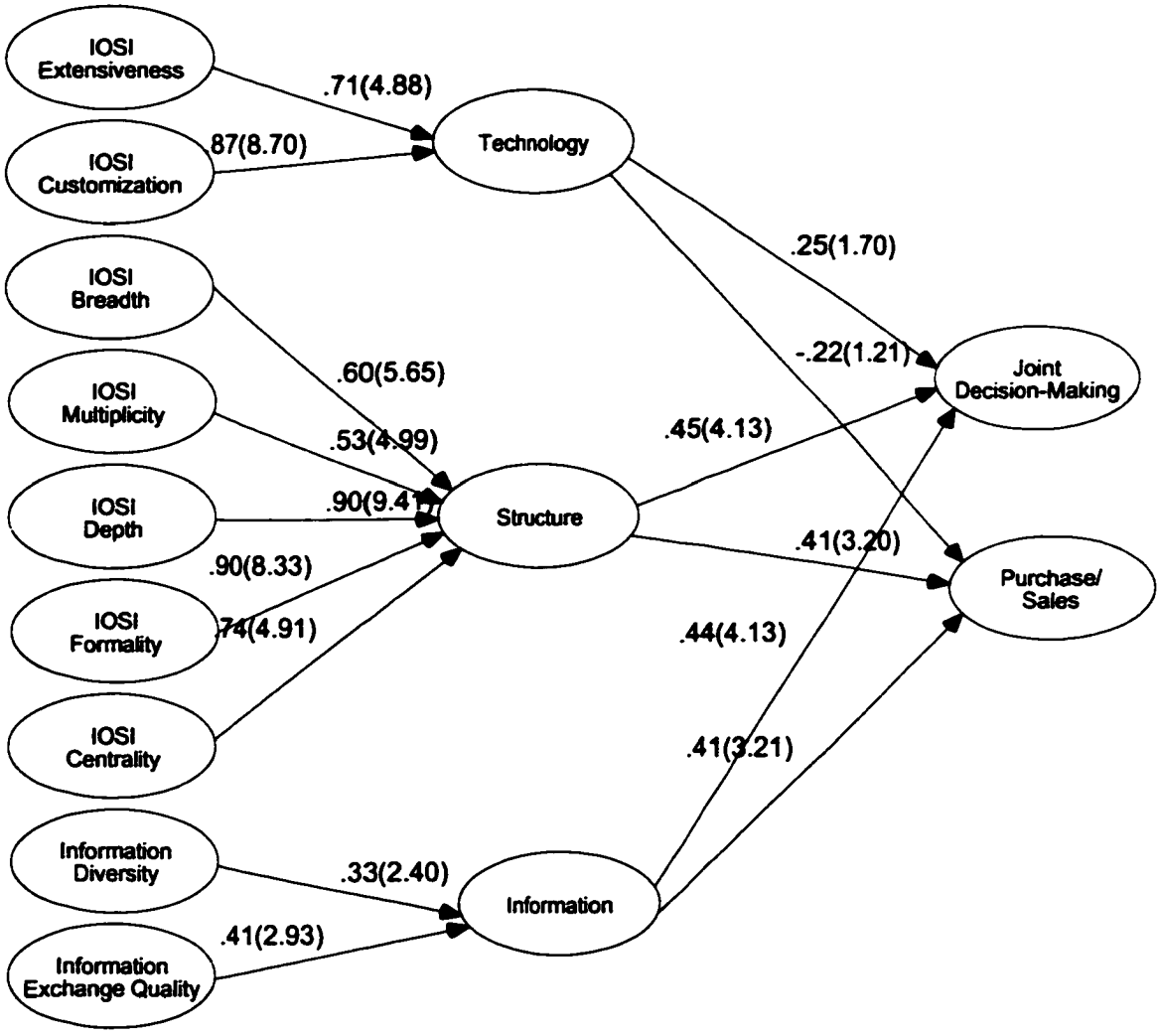


Figure 5-8. Second-Order Model: The Hypothesized Model[a]

[a] The λs and δs are omitted for schematic simplicity

As shown in Figure 5-8, most path coefficients are of high magnitude and exhibit high t-values. These values are much higher than those in the first-order model, ranging 0.22 to 0.90 in absolute value. The t-value indicates that except two paths between technology and electronic cooperation, all path coefficients are significant at $p = 0.05$ and $p = 0.01$. Furthermore, the coefficient of determination for structural equations is 0.86 for the model, indicating that 86% of variance of electronic cooperation is explained by indicators. Therefore, since the second-order model represents a more parsimonious representation of observed covariances, it should be accepted over the first-order model.

Evaluation of the Proposed Model

Based on the acceptance of the proposed model, this section tests the hypotheses developed in Chapter Three. Since the proposed second-order model represents the effects of IOSI constructs on electronic cooperation are mediated by the second-order constructs, indirect effects between IOSI constructs and cooperation should be calculated and their significance also be tested. Indirect effects are the effects from one construct to another construct by a third construct. Direct effects are the path coefficients from one construct to another. In $X_1 \rightarrow Y_1 \rightarrow Y_2$ model, for example, the coefficients in $X_1 \rightarrow Y_1$ and $Y_1 \rightarrow Y_2$ are direct effects and the coefficient in $X_1 \rightarrow Y_2$ is indirect effect. The indirect effects are calculated by multiplying the direct effects. The t-value of indirect effect can be calculated using a formula, ab/SE_{ab}; where ab is the product of coefficient a and b, and SE_{ab} is the standard error of ab. Based on the path coefficient represented in Figure 5-8, Table 5-17 outlines the indirect effects of IOSI constructs and their t-value.

The indirect effects range from 0.16 to 0.41. Cohen (1988) provides recommendations about the effect size interpretation of path coefficient (β) in the social science. Standardized path coefficients with absolute values less than 0.10 may indicate a "small" effect; values around 0.30 a "medium" one; and "large" effects may be suggested by coefficients with absolute values of 0.50 or more. Based on his recommendation, all constructs in structural dimension have the values around 0.30 and their direction is positive. IOSI breadth has positive and moderate association with electronic cooperation, in terms of joint decision-making (β = 0.27) and purchase/sales (β = 0.25).

Table 5-17

Direct Effects, Indirect Effects, and T-Value

Path	Coefficient (β)	t-Value
IOSI Extensiveness – Joint DM	0.18	1.57
IOSI Extensiveness – Purchase/Sales	-0.16	1.45
IOSI Customization – Joint DM	0.39	1.66
IOSI Customization – Purchase/Sales	-0.19	1.19
IOSI Breadth – Joint DM	0.27	3.31**
IOSI Breadth – Purchase/Sales	0.25	2.75**
IOSI Multiplicity – Joint DM	0.23	3.15**
IOSI Multiplicity – Purchase/Sales	0.22	2.66**
IOSI Depth – Joint DM	0.41	3.02**
IOSI Depth – Purchase/Sales	0.37	3.69**
IOSI Formality – Joint DM	0.41	3.77**
IOSI Formality – Purchase/Sales	0.37	3.00**
IOSI Centrality – Joint DM	0.33	3.12**
IOSI Centrality – Purchase/Sales	0.31	2.64**
Information Diversity – Joint DM	0.14	2.04*
Information Diversity – Purchase/Sales	0.13	1.87
Info. Exchange Quality – Joint DM	0.18	2.35*
Info. Exchange Quality – Purchase/Sales	0.16	2.11*

* significant at $p < 0.05$
** significant at $p < 0.01$

Like a standardized regression coefficient, it means that IOSI IOSI breadth is expected to improve by 0.27 and 0.25 standard deviations given the change of one full standard deviation in joint decision-making and purchase/sales respectively when other constructs are controlled.

IOSI multiplicity also impacts the electronic cooperation ($\beta = 0.23$ and $\beta = 0.22$). Other three IOSI constructs also have positive and moderate association with electronic cooperation: IOSI depth to electronic cooperation ($\beta = 0.41$ and $\beta = 0.37$); IOSI formality to electronic cooperation ($\beta = 0.41$ and $\beta = 0.37$); and IOSI centrality to electronic cooperation ($\beta = 0.33$ and $\beta = 0.31$). Furthermore, the t-values of these constructs are significant at $p < 0.01$.

Overall, all IOSI constructs in structural dimension have moderately relationships with the electronic cooperation, in terms of joint decision-making and purchase/sales, and are significant at $p < 0.01$. Therefore, H_3, H_4, H_5, H_6, and H_7 were supported.

The constructs in informational dimension also show positive and mild relationships with electronic cooperation, in terms of joint decision-making and purchase/sales, and they are significant at $p < 0.05$. The path coefficients of information exchange quality to joint decision-making and purchase/sales are 0.18 and 0.16 respectively, indicating positive and moderate relationships with electronic cooperation. Information diversity impacts joint decision-making ($\beta = 0.14$) and statistically significant. It also has positive and moderate relationship with purchase/sales ($\beta = 0.13$) but is not significant at $p = 0.05$ with it's a little low t-value (1.87). Therefore, H_9 was supported, but H_8 was partially supported.

The constructs in technological dimension reveal some problematic features. IOSI extensiveness and IOSI customization have positive and moderate relationships with joint decision-making ($\beta = 0.18$ and $\beta = 0.39$, respectively). However, t-values of these relationships turn out to be insignificant (1.57 and 1.66, respectively). Furthermore, IOSI extensiveness and IOSI customization have negative relationships with electronic cooperation, despite of moderate magnitude of their coefficients ($\beta = -0.16$ and $\beta = -0.19$, respectively). Their t-values also indicate the insignificance of the relationships. As a result, H_1 and H_2 were not supported.

Summary of Results

This chapter provides empirical evidence for the evaluation of the theoretically-derived hypotheses regarding the effects of IOSI on electronic cooperation. Table 5-18 provides a summary of each hypothesis evaluated, the statistical decision (supported vs. not supported), and the strength of empirical evidence supporting the decision. Importantly, the strength of evidence supporting the decision was presented, ranging from strong to marginal. Since within the context of structural equation modeling, many resources of evidences are used in making statements about the validity of structural models, some statement concerning the strength of evidence is necessary (Joreskog and Sorbom, 1989). In the following paragraph, a general overview of findings is presented.

From the SEM analyses, the second-order model combining several IOSI constructs into common traits was strongly supported and the relationships between three IOSI dimensions (technological, structural, and information) and electronic cooperation had moderate effects and were statistically significant. The effects of individual IOSI

constructs on electronic cooperation were also moderate and statistically significant, except IOSI extensiveness and IOSI customization.

Table 5-18

Summary of Hypotheses Testing

Hypothesis	Decision	Empirical Evidence
1. IOSI extensiveness is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.	Not supported.	Path coefficient has moderate effect. But the direction is not in expected direction to purchase/sales. The path is not statistically significant.
2. IOSI customization is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.	Not supported	Path coefficient has moderate effect. But the direction is not in expected direction to purchase/sales. The path is not statistically significant.
3. IOSI breadth is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.	Supported	Path coefficient has moderate effect and expected direction. It is also statistically significant.
4. IOSI multiplicity is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.	Supported	Path coefficient has moderate effect and expected direction. It is also statistically significant.
5. IOSI depth is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.	Supported	Path coefficient has moderate effect and expected direction. It is also statistically significant.
6. IOSI formality is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.	Supported	Path coefficient has moderate effect and expected direction. It is also statistically significant.
7. IOSI centrality is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.	Supported	Path coefficient has moderate effect and expected direction. It is also statistically significant.
8. Information diversity is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.	Partially supported	Path coefficient has marginal effect and expected direction. The path to purchase/sales is statistically significant, but not to joint decision-making.
9. Information exchange quality is positively associated with electronic cooperation, in terms of joint decision-making and purchase/sales.	Supported	Path coefficient has marginal effect and expected direction. It is also statistically significant.

CHAPTER 6

DISCUSSION

This study has focused on two questions: (1) What are the dimensions of IOSI in terms of its capability? and (2) What consequences do IOSI dimensions have on electronic cooperation? The first issue is primarily concerned with definition and measurement while the second issue is concerned with casual relationships among research variables. In the following sections, each of these issues is discussed in terms of existing knowledge and the contribution of this study's results in furthering understanding in this area.

Dimensions of IOSI

To date, a substantial portion of literature within the area of IT impacts on interorganizational relationships has focused on identifying the types of interorganizational information systems (IOS) structure and the factors that influence the formation of electronic cooperation. Both IOS governance and electronic cooperation studies provide meaningful contributions to the understanding of cooperative interorganizational relationship. However, since the formation of interorganizational relationships encompasses the flows of information, the consideration of IOSI capabilities that determine the information processing capabilities among organizations is required.

Researchers in IS and marketing channel have identified IOSI capabilities that influence electronic cooperation. For example, Broadbent, et al. (1996) theoretically derive IOSI dimensions which include IOSI services, reach, and range; Bensaou and

Venkatraman (1995) suggest that the dimensions determining information processing capabilities are structural mechanisms, process mechanisms, and information technology mechanisms; Massetti and Zmud (1996) detail IOSI dimensions into diversity breadth, and depth. While these studies provide general description of IOSI dimensions, they are inconsistent in terms of terminology and range of characteristics considered. Based on fieldwork as well as theoretical literature within IS and marketing channel, this study conceptualizes IOSI as collection of IT resources shared among organizations and identifies IOSI capabilities consisting of three dimensions: technological, structural, and informational dimensions. Rigorous evaluation of measures designed to capture these dimensions of IOSI suggests that the constructs are distinct aspects of IOSI capabilities and that items which measure the constructs are internally consistent and unidimensional. Such results lend credence to the concept of IOSI capabilities within the context of information processing capabilities and confirm theoretical aspects of IT infrastructure and information processing capabilities dimensions developed in previous literature (e.g., Bensaou and Venkatraman, 1995; Broadbent, et al., 1996; Massetti and Zmud, 1996). Therefore, the contribution of this study is a definitional and operational conceptualization of IOSI dimensions that may help structure dialog in the area as well as provide validated measures for future research endeavors.

Discussion of Research Findings

The Effects of Structural Dimension on Electronic Cooperation

This study identified structural dimension as IOSI breadth, IOSI multiplicity, IOSI depth, IOSI formality, and IOSI centrality. The hypothesized relationships between

these five structural components and electronic cooperation are clearly supported by the data. The findings of this research confirm the existence of the relationships between structural dimension and electronic cooperation, and are consistent with the researches on interorganizational relationships (Choudhury, 1997; Mohr and Speckman, 1994; Vijayasarathy and Robey, 1997). For example, Vijayasarathy and Robey (1997) suggest that interaction structure facilitating intensive information exchange and formalizing the interactions reveals positive association to electronic cooperation. Therefore, as structural dimension of IOSI increases the amount of information exchanged between partners, the equivocality and uncertainty accompanied to interorganizational relationships are reduced (Daft and Lengel, 1986) and the opportunity for taking cooperative and coordinated actions in the relationships is also enhanced (Stern and Kaufmann, 1985).

The positive relationships of IOSI breadth, IOSI multiplicity, and IOSI depth with electronic cooperation are conceivable. IOSI with these capabilities make organizations link various partners and their business functions and involve more use of information systems in their business operations. Therefore, they can freely communicate and exchange less limited information exchange information with a variety of their partners and the enhanced information processing capabilities guide their business activities to be more cooperative, accruing the benefits of increased joint decision-making and increased volume and sales of transactions. This finding confirms the theoretical work that suggests that IOSI provides "quick and broad response" systems in interorganizational activities (Swatman and Swatman, 1991). The findings for IOSI breadth, IOSI multiplicity, and IOS depth are also consistent with research on EDI usage (Massetti and Zmud, 1996). The use of IOSI with breadth, multiplicity, and depth supports greater interorganizational

automated information processing and also provides the opportunity for exchanging information with other firms that was not previously available to them, or making information that was available accessible in a more timely manner (Hart and Saunders, 1998).

The findings on IOSI formality and IOSI centrality also reveal the positive relationships with electronic cooperation. As traditional organizational studies have found that formalization and centralization are related to the organizational performance, these two structural components of IOSI positively influence the joint decision-making and purchase/sales between organizations. IOSI formality alleviates organization's concern about uncertainty in interorganizational relationships through the adoption of formal standards for interaction procedures. Van de Ven and Ferry (1980) suggest that IOSI formality fosters trust and confidence between trading partners and enhances their efforts to pursue cooperative activities. The interactions between organizations supported by IOSI formality also can provide favorable atmosphere for establishing a long and stable relationship (Ring and Van de Ven, 1994). As expected and found in this study, this encourages organizations to carry cooperative activities such as joint decision-making in production scheduling, product design, sales strategy, and logistic coordination.

The support of relationship between IOSI centrality and electronic cooperation is widely found in researches in marketing channel area. As IOSI support the concentration of interaction channels between organizations, it removes equivocality and confusion that may occur with various communication channels to perform a specific task. A high level of centrality is the most obvious and simplistic method of coordinating organizational activities. Therefore, with IOSI formality, IOSI centrality reveals relatively high

association with electronic cooperation. In addition, the findings add credence to the notion that concentration of interaction channel boosts the efficacy of information exchange and the coordinating efforts in working partnerships (Anderson and Narus, 1990).

In the findings of this study, high association of IOSI depth and IOSI formality with electronic cooperation, compared to IOSI breadth and IOSI multiplicity, is interesting. It indicates that interactions established through the high formality and depth need to be more emphasized than the interactions covering more wide range of partners and their business functions. The supports of formal standards and procedures for interactions and tightly coupled connectivity among information systems supporting organizations' business functions will hold the promise of a long and stable relationship (Ring and Van de Ven, 1994). This relationship has favorable implications for the design and enactment of enduring cooperative relationship between organizations. In addition, with more formalized and deep interactions, individual firms can form high interfirm specialization such that they engage in a narrow range of activities that are embedded in a complex value-chain of input-output relations with their partners (Dyer, 1996).

The Effects of Informational Dimension on Electronic Cooperation

Informational dimension of IOSI deals with the diversity of information and information exchange quality. The findings of this study support the relationship between information exchange quality and electronic cooperation. Information exchange quality deals with the quality aspects of interaction such as timeliness, accuracy, and completeness. Information exchange quality is expected to reduce or eliminate

misunderstandings that may arise on account of errors in information exchange due to inaccurate, incomplete, and late information transmission of organizations' intentions. Therefore, it reduces the extent of conflicts in organizations (Vijayasarathy and Robey, 1997) and improves joint decision-making and volumes and sales of transactions. The findings for information exchange quality are similar to other findings in information quality studies. Information quality measures are used in many areas in IS fields. Especially in interorganizational relationships area, information quality is considered as critical signal for future intentions and interpreted as an overt manifestation of more subtle phenomena such as trust and commitment (Mohr and Spekman, 1991). As a medium to manifest such intentions, IOSI supporting quality of information exchange is necessary ingredient for the pursuit of cooperative activities. For organizations to carry on coordinated activities in a cooperative manner, quality of information exchange comes into play (Stern and Kaufman, 1985).

The relationship between information diversity and electronic cooperation was partially supported. That is, the information diversity has positive relationship with joint decision-making but not with volume and sales of transactions. The present study views IOSI as another media supporting rich information exchange. Studies in information richness theory emphasize the notion that the ability of information processing media determines the performance of interorganizational relationships (e.g., Daft and Lengel, 1986; Markus, 1994). As mentioned in Chapter 3, when IOSI, as a media for interorganizational coordination, supports to fulfill an organization's requirements for exchanging diverse information with its partners, it removes the conversion problems and processes that an organization have to convert different data formats to its ones.

Therefore, information diversity supports free and frequent communications with the minimum obstacles and consequently facilitates quicker joint decision-making between organizations.

However, the relationship between information diversity and volume and sales of transactions was not significant. One of reasons could be their nature for measurement. The volume and dollar amount of transactions are direct measures of interorganizational performance. Although the information diversity has association to the information exchange and subsequent interactions that improve the processes, procedures, and behaviors of coordination between organizations, the interorganizational financial performance is usually mediated by such direct measures as interaction behaviors and processes. We can see this finding from the differences in the magnitude in path coefficients between joint decision-making and volume and sales of transaction in structural and other dimensions. As mentioned by More and Spekman (1991), the measures for interaction behaviors and processes appear to do a better job of predicting the more qualitative aspects of interorganizational performance. However, they may eventually impact quantitative outcomes such as volumes and sales of transactions in a two-step process in which higher levels of joint decision-making are associated with more efforts on behalf of partnership. Eventually these efforts are associated with increased volumes and sales of transactions (Mohr and Nevin, 1990).

In general, the findings about relationships between information diversity and information exchange quality and electronic cooperation provide additional factors that need to be considered in the cooperative interorganizational relationship studies. Barrowed from marketing channels and IS success literatures, the information dimension

is found to contribute to improving interorganizational relationships. These results are particularly important to and relevant for researchers interested in partnership success, since closer ties results in more frequent and more relevant information exchange between high performing partners (Huber and Daft, 1987).

The Effects of Technological Dimension on Electronic Cooperation

Technological dimension of IOSI have two components: IOSI extensiveness and IOSI customization. Although the two constructs are highly correlated to technological dimension, their relationships with electronic cooperation were not significant. They are moderately and marginally correlated with electronic cooperation, but they are not significantly different from zero. The nonsignificance of this relationship may be due to pre-matured approach to directly connect technological dimension to electronic cooperation. Since coordination of information flow entails complex procedures and processes, the role of technological dimension on cooperation could be supportive instead of direct impact. One possible explanation for this unexpected relationship may bring from IS success studies. In this area, success of IOSI is usually influenced by indirect measures such as IT use. IT capability determines the use of IT and the in turn, IT use effects organizational performance such as individual and organizational performance and financial measures. The same approach can be applied into the technological components of IOSI. In other words, technological dimension has impact on the structural and informational dimensions and they, in turn, influence electronic cooperation. Therefore, the technological dimension has moderating effects on electronic cooperation. This explanation is consistent with the findings of Bensaou and

Venkatraman's (1995) study. In exploring the relationship between IT and information processing capabilities of organizations, they conceptualize technological dimension as the scope and intensity of IT use in the interorganizational relationships. Rather than IOSI capability itself, the interaction patterns, procedures, and behaviors derived from the use of IOSI can be used to measure organizational performance such as joint decision-making and volume of transactions. In addition, the view of indirect effect of technological dimension is consistent to this study's finding on relatively higher correlation of IOS customization than that of IOSI extensiveness with electronic cooperation.

There are mixed finding in IOSI customization in the literature. However, most studies found a positive relationship with electronic cooperation adopt asset specific perspective in the measurements of IOSI customization. This study adopts the same perspective but finds an insignificant relationship. One of explanation could be the difference in the measurement of electronic cooperation, mentioned earlier. The other reason could be the type of IOSI the respondents used. As described in Chapter 5, 97% of respondent companies are using third party or Internet-based IOSI or combination of these two IOSIs. Due to its high degree of openness for the systems and its standards and its lower degree of control over technological compatibility, non-proprietary IOSI provides lower level of customized technological functionality. Therefore, non-proprietary IOSI will not force organizations to invest on relation-specific capital to establish relationships with their partners.

The Move to the Middle

As noted by Clemons, et al. (1993), IT has the impact on emergence of new organizational form established through tightly couple relationship between organizations. Since such cooperative interorganizational relationship lies between electronic markets and electronic hierarchies, this new trend was called the "Move to the Middle". Within existing literature, the "move to the middle" framework is based on the establishment of explicit coordination between organization without ownership and this relationship is achieved by reducing transaction costs. This study adopts IOSI and examines whether IOSI capabilities contribute to the establishment of such cooperative interorganizational relationship. This study focuses on the role of IOSI on increasing information processing capabilities instead of on reducing transaction costs. As described above sections, the findings of this study supports the "move to the middle" hypothesis. IOSI provides organizations technological, structural, and informational capabilities. these capabilities improves the quality, speed, and business values of information exchanges (Mackay, 1993; Mukhopadhyay, et al., 1995). They also support organizations to establish electronic linkages for interactions with their partners. Therefore, IOSI has become a pivotal technology for organizations' movement to the middle in interorganizational relationships.

Two-Step Process Model

Combined with this two-step approach in technological dimension and another two-step process between joint decision-making and purchase/sales mentioned in Section

6.2., the research model can be modified to identify the relationships between IOSI and electronic cooperation. Figure 6-1 presents the two-step approach.

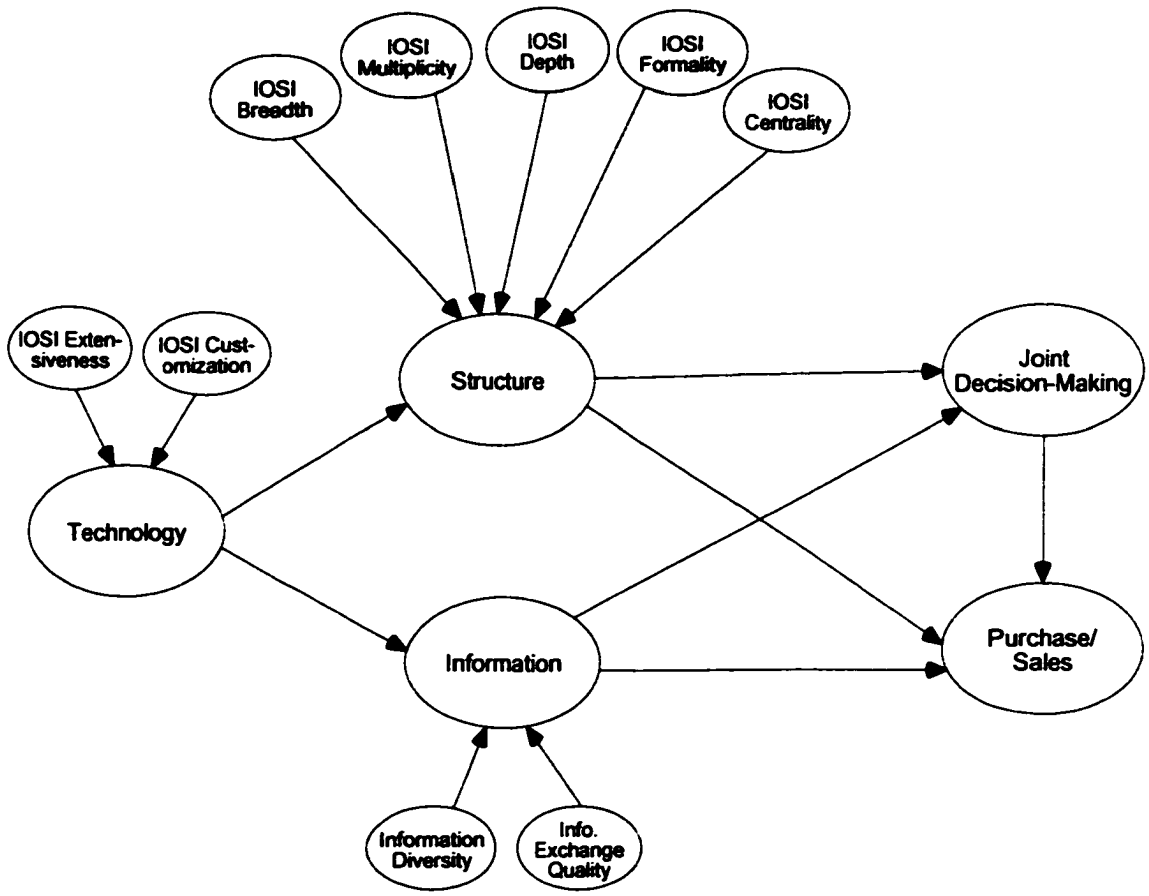


Figure 6-1. Two-Step Process Model

As shown Figure 6-1, the two-step model incorporates the notion that the structural and information dimensions moderate the effects of technological dimension on electronic cooperation. Joint decision-making has also impact on purchase/sales. Thus the structural and information dimensions could have direct impact on joint decision-making

and purchase/sales and their impacts on purchase/sales are also mediated by the joint decision-making.

CHAPTER 7

LIMITATIONS, CONTRIBUTIONS, AND CONCLUSION

This chapter discusses the limitations of this study and contributions to researchers and management. It also provides a basis for recommending future research directions and conclusion remarks.

Limitations of the Study

This study is a modest effort at understanding the consequences of IOSI on interorganizational relationships in manufacturing and retailing industries. In measuring cooperative interorganizational relationships, this study focuses on the IOSI capabilities. However, industries use broadly two types of IOSI: one is proprietary IOSI and the other one is non-proprietary or third party IOSI. These two types of IOSI can be characterized by what protocols, standards, transaction sets, etc. are available for use (Ferguson and Hill, 1988). With third party IOSI, there is a high degree of openness within the system and its standards. With a proprietary IOSI, there is a low degree of openness for the system and its standards. However, with a third party IOSI, there is a much lower degree of control over the system than is available with a proprietary IOSI. Depending on which IOSI used, the degree of capabilities supported by IOSI is expected to differ (Horan, 1988). That is, the type of IOSI determines degree of technological, structural, and informational capabilities. This study did not consider the differences in capabilities in proprietary and third party IOSI. Therefore, it may be the most significant limitation of this study. Especially, due to its openness, third party IOSI may have greater impacts on

the structural capabilities; while proprietary IOSI may provide better technological capabilities due to its equipment compatibility.

Second, the formation of research model is based on the literatures in more than one field. This study combines studies in organizational area and MIS area to bring the research model. Although they share the common topic to interorganizational relationships, their perspectives are quite different. Merging these viewpoints into a research model may miss some important issues. Therefore, the limitation of this study may be the range of developed constructs for both IOSI dimension and electronic cooperation. No claim can be made by this study to have captured every aspect of these rather complex phenomena. What has been accomplished is development of a theoretically-derived set of constructs that seem to behave in a prescribed manner. Therefore, it may sound to suggest that the measures are valid. However, no technique can be adequately address the completeness or breadth of measurement. While the measurements developed in this study are very useful, this study dropped some items from the constructs based on theoretical and statistical criteria. Therefore, similar investigations need to extend and fine-tune the measurements for constructs.

The third limitation of this study comes from the data collection method. The data for the study were collected from manufacturing, especially automobile, and retailing industries since the two industries are most widely used IOSI to keep cooperative relationships with their partners. However, majority of collected data came from manufacturing industry. This relatively biased nature of data may cause generalization problem.

In addition, the present study analyzes the relationships between both sides of the dyad, i.e., buyers and suppliers. However, most data were collected from suppliers. Although the fact that the data were collected from suppliers seemed to adversely affect, there is no question that this study could have been enhanced by collecting data from both sides of the relationship. This would not only provide an understanding the relationships from the perspective of the supplier, but also provides a means for validating the measures obtained from the buyers. As mentioned in Chapter Four, to obtain analyzable interorganizational relationship measures, the data from both sides should be combined with careful management of different perceptions of both sides and validity question. The analysis with the combined data will reveal the perspective of each side well for the relationships. Another limitation of the data collection is the informant problem. The study adopts a single informant approach. The target respondents were IS managers. Although most measures used in this study is about the IT properties, some measures contain organizational processes, behaviors, and performance. Other managers would be better informants to these measures.

The fourth potential limitation concerns the sample size in this analysis. Structural equation modeling was used to analyze data. Compared to conventional statistical methods such as multiple regression analysis, this method requires relatively large sample size. Within SEM, results derived within lager samples have less sampling error and are more likely to be statistically significant than within smaller samples. Although there are no absolute standards in the SEM literature about the sample size, some recommendation are offered. A common guideline for sample size is that more complex models involve larger samples in order for the results to be reasonably stable. Samples sizes less than 100

could be considered "small." Between 100 and 200 subjects could be considered as a "medium" sample size, but this is not an absolute because model complexity must be considered. Sample sizes that exceed 200 cases could be considered "large."

The sample size of this study is 96 cases and therefore, has small samples. Although the results of this study are not untenable, the smaller sample size with some degree of complexity in this study may cause unstable results. However, Breckler (1990) surveyed 72 studies published in personality and social psychology journals that SEM was conducted, to examine the sample sizes. The range of samples sizes reported by Breckler was from 40 to 8,650 cases; 25% of studies had sample sizes greater than 500, but 22% had fewer than 100 subjects, or small sample sizes. Although the results could legitimate the smaller samples size of this study, the sample size problem may still exist.

Theoretical Contributions

Although there were many studies in IS area about the impacts of IT beyond the organizational boundaries, they usually have focused on the economic perspective. They used economic models with financial data to examine the consequences of IT use between organizations. Another study perspective was the identification of organizational variables that are considered to improve interorganizational performance.

The present research focuses on technical perspective of IT role on interorganizational relationships by integrating IS, organization, and marketing researches in the interorganizational area. It identifies IOSI capabilities in several dimensions. It empirically examines how these IOSI dimensions impact interorganizational relationships, especially electronic cooperation in terms of joint

decision-making and purchase/sales. The major theoretical contribution is to integrate various research areas to form IOSI dimensions. IT infrastructure literature conceptualizes the capabilities of IT infrastructure into two categories such as IT infrastructure services and reach and range. Literature in EDI is another one that identifies IOSI dimensions such as EDI volume, EDI depth and EDI breadth. Other organization literature identifies interorganizational factors that influence interorganizational performance such as trust and commitment. Although they provide keen sights to the researchers in diversified perspectives, they may provide separate and unorganized understandings to the emergent phenomena in interorganizational relationships. Combining these perspectives, this study presents a theoretically holistic view to the phenomena existing among organizations. With this regard, it may add a piece to build theoretical foundation on the role of IT beyond organizational boundaries.

Another theoretical contribution of this study is the measures of dependent variable. Previous studies in this area are most conceptual researches. They provide more solid definitions about electronic cooperation (e.g., Zaheer and Venkatraman). Some studies have identified electronic cooperation as EDI volume and diversity (Hart and Saunders, 1998; Son, et al., 1999) based on the measurement of EDI use (Massetti and Zmud, 1996), or as minimization of coordination costs and transaction risk (Kim and Umanath, 1999) based on transaction costs theory. The present study introduces other measures of electronic cooperation: joint decision-making and volume and sales of transactions. Like IOSI dimensions, the measures of electronic cooperation integrate the above perspectives to bring more broad and explainable measures for cooperative interorganizational relationships.

Managerial Contributions

The creation and maintenance of cooperation with partners are critical task for organizations to survive in ever-changing business environments. IT has been recognized as proper media to accomplish this task in both academic and business worlds. This study gives organizational management guidelines for the proper use IT for their emerging task of cooperation. First, this study offers a more detailed explanation for the mostly unsubstantiated direct relationships between IOSI dimensions and electronic cooperation. It will give management understandings that the use of IT, especially IOSI, facilitates the processes and efforts to establish cooperative relationships with their partners. And it also indicates that the electronic cooperation through IOSI make them accrue increased benefits in the areas such as joint decision-making and volume and sales of transactions they made with their partners.

Second, this study also provides broad understanding about the capabilities of IOSI. As described earlier, IOSI provides technological, structural, and informational capabilities to organizations. These capabilities make organization to exchange information and to make interactions with their partners. Through the use of these IOSI capabilities, organizations can establish various types and levels of interaction structures with their partners, which enable them to establish adequate interaction processes and structures for free and frequent information exchange. Organizations can exchange quantity and quality of information and they also build a variety of interaction channels in formalized and focused ways. The consequences of these interactions will end up bringing behavioral assets such as trust and commitment to concrete cooperation relationships between organizations.

Directions for Future Study

While this study has provided further theoretical and operational definitions to IOSI dimensions and their associated measures of electronic cooperation, it has by no means answered all questions concerning this important phenomenon. A potential avenue of future research is replication of this study across broader sampling frame, that is, with more samples from manufacturing and retailing industry and from both sides of dyad. The findings of such work would provide additional validity for these findings as well as provided additional empirical support for theoretical studies in the area.

As mentioned earlier, it is possible that other constructs of both IOSI dimensions and electronic cooperation exist but are not conceptualized in the presented model. This study only explores a small subset of all possible and relevant variables that may have to be considered in arriving at a more complete picture of IOSI and its consequences on interorganizational relationships. It is evident from this study that other literature in organization theory, transaction costs theory, information processing theory, and marketing channel can offer a number of relevant constructs for exploring IOSI phenomenon. One possible avenue for future research could be integrating IOSI capability factors in this study and organizational factors in these literatures.

The third possible direction of future research is to modifying research model in the present study. This study found that IOSI dimensions influence joint decision-making and volume and sales of transactions independently. However, joint decision-making is associated with success in strategic alliances (Mohr and Spekman, 1991). In other words, the successful joint decision-making could mediate the relationships between IOSI capabilities and the measures of financial performance (i.e., volume and sales of

transactions). In IOSI dimensions, the direct relationships between technological components and electronic cooperation can be also converted into the indirect relationships, mediated by structural and informational components. These modifications could result the two-step model suggested in Figure 6-1 in Chapter 6.

The final possible direction of future research is to extending the dimension of electronic cooperation. This study only explores cooperative interorganizational relationships using joint decision-making and volume and sales of transactions. Electronic commerce literature provides insights to seek other measures of organizational performance. In addition to cooperative interorganizational relationships, the minimization of costs and risks (Kim and Umanath, 1999) could be the candidates as dependent variables for future IOSI researches.

Concluding Remarks

As the use of IT for interorganizational activities gains wider acceptance among academics and businesses, research that accurately describes and measures both aspects of IT, especially IOSI, capabilities and dimensions of their success become increasingly important. One of the important consequences of IOSI use is obviously the benefits accrued among organizations. Fortunately, there is no shortage of theoretical works from which these important benefits can be identified. However, there exists a shortage of studies that attempt to empirically test proposed theory and further its definitional aspects through empirical operationalization and formal testing. This study is a step toward assessing one of the popular benefits attributed to IOSI.

Through theoretical conceptualization of IOSI dimensions and their associated consequences, this study provides a theory-driven model to explain the relationships between IOSI and electronic cooperation. The data analysis provided partial support for the model and suggested possible modifications. It is hoped that the lens of this study provides a more accurate view and growing knowledge on the use of IT beyond organizational boundaries.

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APPENDICES

APPENDIX:
Cover Letter and The Survey Questionnaire

A Survey of Interorganizational Information Systems Infrastructure (IOSI) and Electronic Cooperation

A Study Conducted by
The College of Business Administration
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Haiwook Choi
Ph. D. Candidate

Arlyn Melcher
Professor of Management

This study is designed to gain a better understanding of the impacts of interorganizational information systems infrastructure (IOSI) on the cooperation between buyers and suppliers in the manufacturing and retailing industry. The results of this study should provide valuable information for IS executives seeking to develop or improve their understanding about the role of IT in establishing and maintaining closer relationships with their partners.

I am a Ph.D. candidate within the College of Business Administration at the Southern Illinois University and completing the research for my degree program. However, for my research to be successful, I need your help!

The enclosed questionnaire has been developed in conjunction with several IS executives to help me understand the IOSI your firm is using. The survey will take about 20 minutes of your time. Please complete the survey and return it in the postage-paid envelope provided. When the study is completed, I would like to provide you with a summary of the study's findings along with an individualized profile of your firm's IOSI effectiveness. This report will compare your firm's approach to IOSI with all participating firms within your industry. Simply attach a business card to the survey or provide your name and address and I will send you the report by E-mail or mail to repay you for your involvement.

You may pass the survey to someone else who, in your opinion, is in the best position to answer it. Please contact either myself or Dr. Melcher if you have questions about the study or are interested in the further progress of the study.

Your name was selected from a mailing list of senior IS executives specially acquired for this project. Your cooperation is entirely voluntary and your response will be held in strict confidence. Under no circumstance will results specific to your firm be made available to any other individual or organization. Your participation is crucial to the success of the study. Thanks in advance for your cooperation.

Sincerely,

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P.S. You may access the questionnaire and submit it online:
http://www.cba.siu.edu/choi/survey.htm

This project has been reviewed and approved by the SIUC Human Subjects Committee. Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Research Development and Administration, Southern Illinois University, Carbondale, IL 62901-4709. Phone (618) 453-4533.

Instruction:

1. Partnering firms indicates any organizations with which your company is doing transactions:
   - When your company's business is retailing or assembling products for final users, your partnering firms are your suppliers.
   - When your company's business is supplying products to retailers or assembling manufacturers, your partnering firms are your buyers.

2. Interorganizational information systems infrastructure (IOSI):
   - A collection of IT resources that include hardware, communication networks, standards for hardware, data transmission and security, and human skills.
   - IOSI is shared among organizations and provides them an IT platform for their IT activities such as information processing and information exchange (communication), in order to support transactions with their partnering firms.
   - Examples of IOSI are Internet, Electronic Data Interchange (EDI), and interorganizational information systems (IOS) such as SABRE in airline industry.

The following questions relate to the IOSI your company is currently using.

1.What type of IOSI is your company using to exchange information with your partnering firms?

1) Your own proprietary network (the name of IOSI:)

2) Your supplier's proprietary network (the name of IOSI:)

3) Third-party network (the name of IOSI:)

4) Internet

5) Combination of any of the above networks (the name of IOSI:)

2. Which type of information technology applications is your company currently using to do transactions through IOSI with your partnering firms?

1) Your own proprietary applications

2) Your suppliers' proprietary applications

3) Third-party applications

4) Combination of any of the above applications

3. How long has your company been using IOSI?

1) Less than 1 year 2) 1-3 years 3) 4-5 years 4) 6-10 years 5) More than 10 years

4. Approximately, what percent of your company's total partnering firms is linked by IOSI?

1) 10% or less 2) 11-20% 3) 21-40% 4) 41-60% 5) More than 60%

5. Approximately, what percent of your company's total transactions with your partnering firms is done electronically?

1) 10% or less 2) 11-20% 3) 21-40% 4) 41-60% 5) More than 60%

Based on the IOSI your company is currently using, please answer the following questions relating to the functionality that IOSI provides.

1. To what extent does your IOSI provide the following IT services?

	To No Extent				To Some Extent		To a Great Extent
a) Network communication services (e.g., full fledge of bandwidth)	1	2	3	4	5	6	7
b) IT Applications services (e.g., organization-wide and business-unit-specific applications)	1	2	3	4	5	6	7
c) Data services (e.g., data definitions and data transmission)	1	2	3	4	5	6	7
d) Standards services (e.g., standards for hardware, and operating systems)	1	2	3	4	5	6	7
e) Security services (e.g., security in exchanging important information)	1	2	3	4	5	6	7
f) IT education services (e.g., technology advice and training)	1	2	3	4	5	6	7
g) Support services (e.g., disaster planning and business recovery services)	1	2	3	4	5	6	7

2. To what extent are your IOSI services aligned with?

a) Your employees' skills	1	2	3	4	5	6	7
b) Your employees' knowledge	1	2	3	4	5	6	7
c) Your employees' experience	1	2	3	4	5	6	7
d) Your company's workflows and processes	1	2	3	4	5	6	7

3. To what extent has your company established interaction channels with the following partnering firms?

a) In the same value chain	1	2	3	4	5	6	7
b) In different value chains	1	2	3	4	5	6	7
c) Regardless of IT bases	1	2	3	4	5	6	7
d) Regardless of geographical proximity	1	2	3	4	5	6	7

4. To what extent has your purchasing/sales department established interaction channels with the following business functions of your partnering firms?

a) Purchasing/sales	1	2	3	4	5	6	7
b) Quality	1	2	3	4	5	6	7
c) Production	1	2	3	4	5	6	7
d) Logistics	1	2	3	4	5	6	7
e) Payment/finance	1	2	3	4	5	6	7

5. To what extent does your company process information received from your partnering firms through your IOSI.

	To No Extent			To Some Extent			To a Great Extent
a) Our company feeds the data received from our partnering firms directly into our business IT applications	1	2	3	4	5	6	7
b) Our company updates(enters, stores, and manipulates) data in our partnering firms' information systems	1	2	3	4	5	6	7
c) Our company does NOT perform additional steps or procedures to access data from our partnering firms	1	2	3	4	5	6	7
d) Our IOSI provides multiple interfaces or entry points (e.g., Web access) to access our partnering firms	1	2	3	4	5	6	7
e) Our IOSI supports the access to a number of protocols (e.g., Keberos V.5, MIME, PGP, S-HTTP)	1	2	3	4	5	6	7

6. To what extent does your IOSI specify the following activities between your company and your partnering firms?

a) Standard policies and procedures for interactions	1	2	3	4	5	6	7
b) Clear routines for interactions	1	2	3	4	5	6	7
c) Planned interactions	1	2	3	4	5	6	7
d) Specified responsibilities for interactions	1	2	3	4	5	6	7

7. To extent does your IOSI support the following activities.

a) Our IOSI supports shared and interdependent interactions with our partnering firms	1	2	3	4	5	6	7
b) Our IOSI provides unique interaction channels with our partnering firms	1	2	3	4	5	6	7
c) Our IOSI has a significant control on partnering firms' interaction activities	1	2	3	4	5	6	7
d) Our company has authority over IOSI operations	1	2	3	4	5	6	7
e) Our company has authority over IOSI administration	1	2	3	4	5	6	7

8. To what extent does your IOSI support the transmission of information IN:

a) A variety of data types (e.g., text, picture, voice, CAD/CAM information, paper drawings, or three-dimensional wireframes)	1	2	3	4	5	6	7
b) A variety of data formats in each data type (e.g., ANSI X.12, ASC X12, EDIFACT, or proprietary formats for document)	1	2	3	4	5	6	7
c) A variety of database protocols (e.g., SQL, ODBC)	1	2	3	4	5	6	7

9. To what extent does your IOSI support the following activities between your company and your partnering firms?

	To No Extent					To Some Extent	To a Great Extent
a) Timely information exchange	1	2	3	4	5	6	7
b) Accurate information exchange	1	2	3	4	5	6	7
c) Reliable information exchange	1	2	3	4	5	6	7
d) Complete information exchange	1	2	3	4	5	6	7
e) Relevant information exchange	1	2	3	4	5	6	7

The following questions are about the degree of your company's dedication to your partnering firms in doing transactions.

1. To what extent have the joint decisions been made in the following areas between your company and your partnering firms.

a) Wholesale pricing	1	2	3	4	5	6	7
b) Promotion planning	1	2	3	4	5	6	7
c) Sales strategy	1	2	3	4	5	6	7
d) Logistics coordination	1	2	3	4	5	6	7
e) Payment scheme	1	2	3	4	5	6	7
f) Production planning	1	2	3	4	5	6	7
g) Product designing	1	2	3	4	5	6	7

2. What percent are your purchases/sales from the top partners on a dollar basis?

1) 10% or less 2) 11-20% 3) 21-30% 4) 31-40% 5) 41-50% 6) 51-60% 7) more than 60%

3. What percent are tour purchases/sales from the top partners on a volume basis?

1) 10% or less 2) 11-20% 3) 21-30% 4) 31-40% 5) 41-50% 6) 51-60% 7) more than 60%

4. What percent are your purchases/sales from the top partners within the product category?

1) 10% or less 2) 11-20% 3) 21-30% 4) 31-40% 5) 41-50% 6) 51-60% 7) more than 60%

Background Information

1. Please indicate your position in the firm:

2. What industry is your company in?

1) Manufacturing 2) Retailing 3) Other

3. What is annual sales revenue of your firm?

1) $10M or less 2) $11- 50M 3) $51- 100M 4) $100- 500M 5) More than $500M

4. What is the number of full-time employees in your company?

1) 100 or less 2) 101-500 3) 501-1000 4) 1001-5000 5) More than 5000

SIU

SIUC HSC FORM A

REQUEST FOR APPROVAL TO CONDUCT RESEARCH ACTIVITIES INVOLVING HUMAN SUBJECTS

CERTIFICATION STATEMENT

By making this application, I certify that I have read and understand the University's policies and procedures governing research activities involving human subjects. I agree to comply with the letter and spirit of those policies. I acknowledge my obligation to:

1. Accept responsibility for the research described, including work by students under my direction.
2. Obtain written approval from the Human Subjects Committee of any changes from the originally approved protocol **BEFORE** implementing those changes.
3. Retain signed consent forms in a secure location separate from the data for at least three years after the completion of the research.
4. Immediately report any adverse effects of the study on the subjects to the Chairperson of the Human Subjects Committee, SIUC, Carbondale, Illinois - 618-453-4533 and to the Director of the Office of Research Development and Administration, SIUC - 618-453-4531.

Project Title

The Effects of Interorganizational Information Systems Infrastructure (IOSI) on Electronic cooperation: An Investigation of the "[redacted] Move to the Middle" Hypothesis

Haiwook Choi — 1/03/01

Researcher(s) or Project Director(s) — **Date**

Please print or type name below signature.

1/3/01

Researcher's Advisor (required for all student projects) — **Date**

Please print or type name below signature.

The request submitted by the above-named researcher(s) was approved by the SIUC Human Subjects Committee.

This approval is valid for one year from the approval date. Researchers must request an extension to continue the research after that date. This approval form must be included in all Master's theses/research papers and Doctoral dissertations involving human subjects that are submitted to the Graduate School.

Anthony J. Caro — 1/11/01

Chairperson, Southern Illinois University Human Subjects Committee — **Date**

VITAE

Graduate School
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Dissertation Title:
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Conference Publications:

- The Effects of Interorganizational Information Systems Infrastructure (IOSI) on Electronic Cooperation. *Proceedings of the 7th Americas Conference on Information Systems*, Boston, MA, 2001.
- Information Technology Infrastructure as a Moderator of Organization's IT Productivity: An Economic Perspective. *Proceedings of the 4th Americas Conference on Information Systems*, Baltimore, MA, 1998.
- The Effectiveness of Information Systems Planning: A Classification of Planning Systems Structure and the Impact of Organizational Factors. *Proceedings of the 28th Annual Meeting of the Decision Sciences Institute*, San Diego, CA, 1997.
- Classification of IT Investment: A Resource-Based Perspective. *Proceedings of the 3rd Americas Conference on Information Systems*, Indianapolis, IN, 1997.